# Essays on Contingent Convertible Bonds and Bank Regulation

by

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# Chapter 1

# Introduction

The focus of the present PhD thesis is the analysis of the role of contingent convertible (CoCo) bonds in the context of bank regulation after the 2008 financial crisis. The thesis is composed by three studies that address research questions on the propensity of a bank to issue CoCo bonds; the relations of banks' systemic risk and CoCo issuance; and the a discussion of hybrid securities as a strategy of sequential finance in banking sector.

After the subprime crisis, several regulatory mechanisms were developed in response to criticism about financial deregulation. The pressure for bail-in mechanisms recrudesced and Basel III presented CoCo bonds as an alternative for banks to increase capital requirements. A decade afterward, it is important to assess whether and how the Basel III framework promoted a safer financial system through this new instrument. This thesis aims to update the literature on financial innovation by fostering the discussion between the financial market and academia.

In the second chapter of the thesis, which ihas been published[1], we analyze the determinants

[1]As permitted by FGV EBAPE's MSc  PhD program regulations, chapter 2 of this PhD thesis was published in the form of a scientific article of my authorship in the journal Quantitative Finance, and can be referred to as follows: José Fajardo & Layla Mendes (2020). On the propensity to issue contingent convertible (CoCo) bonds, Quantitative Finance, 20:4, 691-707, DOI: 10.1080/14697688.2019.1685124. Moreover, a preliminary version of the study was presented at the following academic conferences: XVII Encontro Brasileiro de Finanças, held in Brasília in 2017.

of CoCo bond issuance. We find evidence that banks that issue CoCos are typically large. Moreover, in the case of BRICS and other emerging economies, we find evidence that banks are also highly leveraged, aiming to meet the Basel III rules and replace debt with equity funding. Also, we study the strength of the regulatory component in the CoCo issuance through analysis of tax deductibility in the UK, countercyclical capital buffering, subsamples of global systemically important banks and Basel III implementation.

The third chapter[2] purpose to implement an empirical analysis of the impact of CoCo bond issuance on the systemic risk using three systemic risk measures for banks: $SRISK$, $SES$, and $\Delta CoVaR$. Our results show that issuing CoCo bonds the first time decreases systemic risk as a positive response to future crises. However, the second issuance increases the systemic risk, possibly by suggesting a higher risk of financial distress or capital needs. We also perform robustness checks for all the findings and discuss policy implications.

The fourth chapter improves the literature on the issuance of convertible bonds, which has neglected financial institutions. Contrary to firms, banks not only can issue convertible bonds but also, after the subprime crises, contingent convertible (CoCo) bonds emerged as an alternative. Hence, the purpose of this study is threefold: first, we expand the literature on the motivation to issue convertible bonds in the banking sector; second, we introduce a new proxy (Loan-Deposit Flow) to measure the reinvestment in this sector; and third, we analyze the differences in the motivation for issuing CoCo bonds when compared to convertible bonds. Our results show that the theory of sequential financing is not confirmed for CoCo bonds. Additionally, we show evidence that banks issue CoCo bonds for regulatory purposes (to increase their capital), while convertibles are issued to allow banks to expand their investments and loan portfolios. The results are robust to several specifications including a propensity-score matching and a difference-in-difference analysis.

[2]A preliminary version of the chapter 3 was presented at the following academic conferences: XIX Encontro Brasileiro de Finanças, held in Rio de Janeiro in 2019; Fourth International Workshop in Financial Econometrics, held in Maceió in 2019.

Overall, this thesis contributes with our understanding of Coco bonds by showing the determinants of CoCo bonds issuance, the impact of CoCo bonds on systemic risk and also by providing a better understating to what banks do with the money raised from CoCo Bonds when compared to Contingent bonds.

All relevant results are presented in each chapter and all references are presented at the end of the thesis.

CHAPTER 2

# ON THE PROPENSITY TO ISSUE CONTINGENT CONVERTIBLE (COCO) BONDS.

## 2.1 Context and Motivation

The collapse of Lehman Brothers in 2008 triggered the world's biggest financial crisis since the crash in 1929. The years leading up to the 2008 crisis saw a flood of irresponsible mortgage lending in America, excess savings in Asia, and a pattern of European banks borrowing in American money markets and using the funds to buy doubtful securities (The Economist, 2013). Years of low inflation and stable growth - "The Great Moderation" - fostered complacency and risk-taking.

In a globalized economy with the increased presence of transnational corporations, the crisis spread worldwide, affecting mainly the European Union's economy. Many market players suffered huge losses or went bankrupt, and governments were called upon to intervene. Specialists and analysts questioned the external capital input in banks to avoid their bankruptcy (bail-outs), primarily by governments. These specialists suggested bail-in rescue policies, meaning internal mechanisms to solve their financial distress.

In this context, the Basel Committee on Banking Supervision, created in 1975, submitted the Basel III accord - a comprehensive set of reform measures to strengthen the regulation, supervision and risk management of the banking sector (BIS, 2011). The central proposition of Basel III is to increase the bank-level of regulatory capital, which can be decomposed into Tier 1, additional Tier 1 and Tier 2 (see more in Fig. 2.3 in the appendix). Tier 1 capital is high-quality capital that can absorb losses in a going concern context, whereas Tier 2 capital is supposed to absorb losses in a gone concern context (De Spiegeleer and Schoutens, 2011). This regulatory framework classified hybrid instruments, called contingent convertible bonds (CoCo bonds), in the additional Tier 1 or Tier 2 categories, according to trigger levels.

Issuance of CoCo bonds by banks allows them to borrow money whereby the investors have a hybrid bond that can transform this debt into equity if a pre-specified trigger event occurs. In other words, CoCo bonds are debt instruments that can mostly be converted into equity or written down entirely if the issuing bank's capital drops below a pre-agreed threshold.

Another essential suggestion proposed by Basel III was the countercyclical capital buffer concept, which reflects the macroprudential goal of protecting the banking sector from periods of excess aggregate credit growth that have often been associated with the build-up of system-wide risk (BIS, 2010). The idea behind this proposal is that during periods of credit expansion banks will save additional capital, while in periods of credit contraction capital requirements can be loosened. Thus, capital conservation buffers and minimum capital requirements are together designed to enable individual banks to remain solvent through a period of stress.

The first objective of this paper is to comprehend the determinants that affect the propensity of banks to issue CoCo bonds. To this end we use a large sample of banks which issued CoCos or not during the period 2009-2015. In other words, we are the first to explore which kind of bank has a propensity to issue these bonds at the global level. Furthermore, CoCo bonds have rarely been studied in the literature due to the lack of a consistent sample. Most empirical research about the theme is focused on developed countries (see for instance Avdjiev et al. (2015) and

Vallée (2015)). On the other hand, BRICS countries's banks - especially those in China and India - were responsible for the biggest aggregate amount of bonds issued in the period 2009-2015, so they cannot be left out of this analysis. Therefore, we discuss the motivation for BRICS banks to issue CoCo bonds and we compare these banks' determinants to issue these bonds with those of financial institutions in developed and other emerging countries. In this sense we contribute to a global and systemic understanding of decisions by banks to issue CoCo bonds.

We also contribute to the discussion about the impact of regulation on the propensity of banks to issue CoCo bonds. Therefore, we estimate the main model with additional variables that explore the regulatory characteristics implicit in CoCo issuance. The analysis shows the strength of the regulatory component, as well as to what extent regulation is relevant to avoid financial fragility.

On a broad scale, this paper contributes to the discussion on the issuance of CoCo bonds and the related economic and policies implications. Given the results of our analysis, investors can better understand that the incentives for bank issuance the CoCo bond is not homogeneous across the globe. Rather, it allows banks to diversify investments and implement better strategies. The paper indeed supports the view that large banks easily adapt to regulation through the issuance of new financial instruments.

Also, our study supports the importance of heterogeneous regulation of financial institutions as a way to achieve financial stability. Given the inherent idiosyncrasy of the financial sector, regulators have to maintain control over banks' standardized practices in order to avoid economic collapse. Moreover, it can prevent spillovers in other sectors and mitigate systemic contagion. In general, large banks have more resources to meet regulatory requirements. Thus, large banks can make use of financial instruments to reduce default risk. Small banks, though, have more difficulty in making use of these bail-in mechanisms according to our results. If these small banks fail together, the economy will face a too-many-to-fail problem, which can be worse than a too-big-to-fail crisis (Acharya and Yorulmazer, 2007). In this line, a heterogeneous regulation of financial institutions may be optimal for the economy.

Finally, we contribute to the literature on financial innovation. There are no studies in the CoCo literature that contemplate an analysis of the current globalized market, where banks have strong relationships. This work is a pioneer in conducting the comparative analysis of the new financial product in developed and emerging countries.

The paper is organized as follows. Section 2 summarizes the literature about the CoCo bond market. In Section 3 we present and describe our sample. In Section 4 we describe our empirical strategy, and in Section 5 we present the main results. In Section 6 we provide the regulatory explanation, Section 7 analyzes Debt issuing possibilities, and Section 8 concludes.

## 2.2 Related Literature Review

CoCos are instruments similar to corporate bonds where the investor has the right to convert the bond into shares, but in the case of CoCo bonds the conversion is mandatory in the case of a trigger event. (De Spiegeleer et al., 2014). This mechanism permits the firm to continue operating with an adequate level of loss-absorbing capacity (Flannery, 2014). In this line, it is essential to delve more deeply in the concept of this derivative, evaluating its utility, focusing on the kind of situations where it can be implemented, and discussing the advantages and disadvantages. Moreover, it is important to consider data on the CoCo issuance in several countries.

### 2.2.1 CoCo bonds: characteristics and world market

CoCo bonds are designed to provide a source of capital to banks in distress when private investors are reluctant to supply external capital (Avdjiev et al., 2015). That is, they are a kind of bail-in mechanism allowing banks to be safer and diminish the risks of default. Besides that, CoCos are a hybrid type of investment. These hybrid types of investment instruments have at least two components. In the case of CoCo bonds, the components are the liabilities and equity reflected on the balance sheet. CoCos initially act as regular bonds and pay coupons, but they can be converted into shares (not paying coupons, only dividends) when there is a trigger. In some cases, the CoCo can also suffer a write-down.

The CoCo contract is based on trigger events. These events are predetermined contractual values that recapitalize the bank by a haircut (write-down) of the bonds or their conversion into shares. These triggers, in turn, can occur during a general market crisis or a moment of specific financial distress affecting the issuing bank. Thus, depending on the contract, four of these types of triggers can be chosen by banks: market-based, accounting, multivariate and regulatory triggers (De Spiegeleer and Schoutens, 2013). A market-based trigger occurs when the share price decreases to the level defined in the contract. An accounting trigger occurs when the capital ratios of the issuer fall to the level stipulated. The regulatory trigger is an imposition of the bank regulator when it believes the bank has become non-viable. The bank can combine some types in micro and macro triggers, using a multivariate trigger.

As mentioned before, CoCos are convertible bonds developed to help banks to avoid insolvency during an emergency such as a financial crisis. However, the decision of each bank to issue CoCos depends on how advantageous or disadvantageous these issues will be for it.

Regarding the advantages of issuing CoCo bonds, there are explicit guarantees defined in the contract. Since investors take on the risk of receiving bad shares, the bank may offer higher coupons for them. There is a high probability of moderate gains and a low probability of high losses, so the gain is limited, but the losses are unlimited (De Spiegeleer and Schoutens, 2011). Another advantage is that once triggered, the conversion into equity happens fast and gives a clear signal to the market (De Spiegeleer and Schoutens, 2011). This should take the volatility out of the share price, and the credit default swap spreads. That is, the bank has conveyed the message that it is being protected from unforeseen insolvency situations because swaps of debt for shares (CoCos) improve the financial health of the bank. Indeed, if problems occur, the conversion should improve the capital structure of the bank, working to restore market confidence in it.

On the other hand, a critique of CoCos is that instead of giving protection to the market regarding the stress of the bank, it may increase the volatility of the share price. If a trigger event appears to be approaching or the likelihood of conversion is perceived as increasing, investors can dynamically hedge the equity exposure embedded in the CoCo by taking a short position in the underlying shares. An inherent problem with this hedging strategy is that the investors are forced to sell more shares when the share price weakens, possibly creating a self-reinforcing downward spiral of the stock price. This situation is referred to as the death-spiral effect (Corcuera et al., 2014).

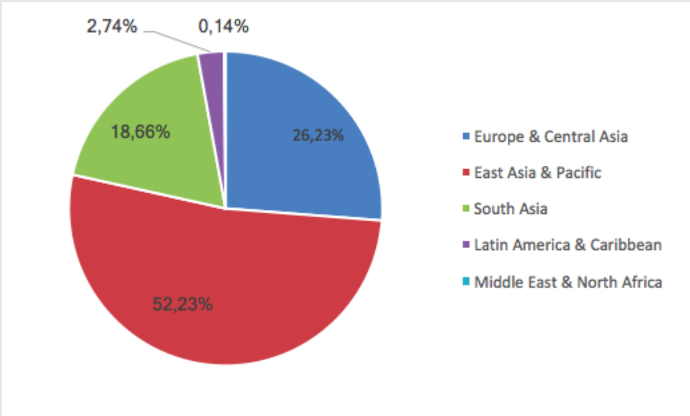
Another concern is that if banks are allowed to invest in CoCos of a financial institution without limitation, there could be a knock-on effect similar to what rocked the banking system in 2008 (De Spiegeleer and Schoutens, 2011). Namely, the trigger activation could create more triggers by a domino effect or contagion effect. In the least, the conversion could induce dilution of the equity stakes of existing shareholders, depending on the conversion mechanism used.

The advantages and disadvantages of issuing CoCo bonds can be evaluated in practice by observing the volume of CoCo issues in the last six years by several banks in the world market. The data were extracted from the Bloomberg database on June 16, 2016. The sample is comprised of 286 bonds from 28 countries.

After the financial crisis of 2008 and the Basel III recommendations, European banks increased their issuance of CoCo bonds. Nevertheless, currently countries of East Asia and the Pacific represent more than 50% by value of the CoCo bonds issued around the world, followed by Europe and Central Asia and South Asia, as shown in Fig. 2.1.

Concerning the volume of CoCo bonds issued broken down by country as shown in Figure 2.2, China is the country with the largest volume of this hybrid instrument. This issuance has been driven by the need to replace previous subordinated debt which is not in line with the current

Figure 2.1: The volume of CoCo bonds issue by regions




The data were extracted from the Bloomberg database from January 21, 2009 until June 16, 2016. The sample is comprised of 286 CoCo bonds from 28 countries.

Basel III rules (Financial Times, 2015).

Following the same pattern, India is in second place in the volume of CoCo ranking, with approximately USD 136 billion. The Reserve Bank of India (RBI) has already recognized CoCo bonds as Additional Tier I instruments in its Basel III Guidelines (RBI, 2014).

Brazil is another emerging country that increased the volume of CoCo issuance in recent years, with approximately USD 9.8 billion. The motivation for this issuance is the need of Brazilian banks to capitalize since they have to reinforce their balance sheets by 2019 when the Basel III rules will be fully implemented in Brazil (CONTRAF, 2014). However, according to Assossiação Brasileira Bancos ABBC (2013), Brazilian banks are not expected to be major players in CoCo bond issuance, due to several reasons. Among these are that Brazilian institutions are in general already well capitalized, even under the stricter rules of Basel III; banks, especially in the private sector, have reduced their lending with the recent (and still ongoing as of this writing) recession; and the Basel rules limit the use of debt securities in the capital composition. It is important to mention that banks in two other BRICS countries - Russia and South Africa – have not issued any CoCo bonds yet.

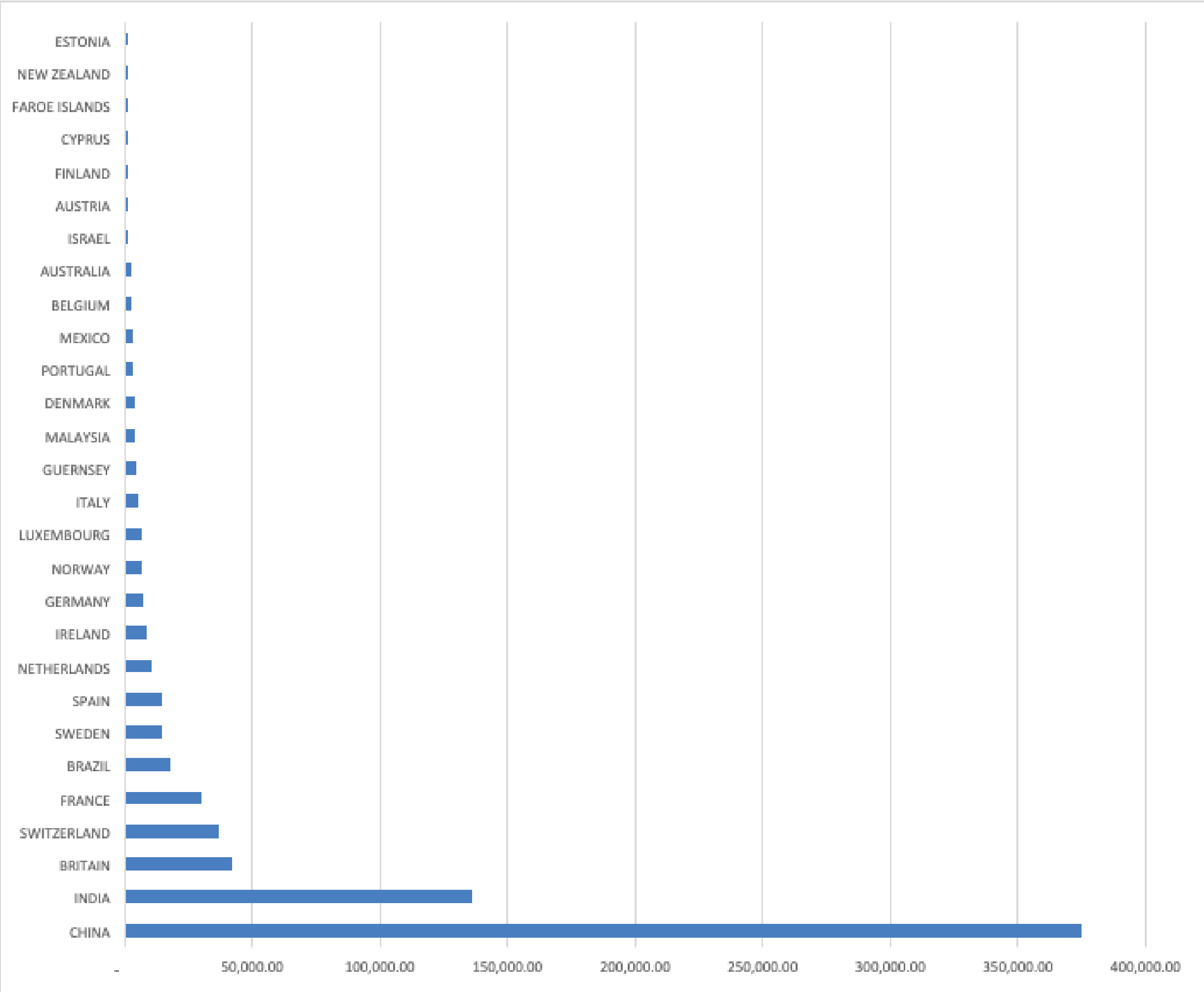



Figure 2.2: The volume of CoCo bonds issue by country

The data were extracted from the Bloomberg database from January 21, 2009 until June 16, 2016. The sample is comprised of 286 CoCo bonds from 28 countries.

From the observation of CoCo bond issuance by year, it is possible to notice that 2014 was the year of highest volume. There was a large increase compared to 2013. In 2015, the total volume issued was the second highest amount in the observed period. A possible explanation for this phenomenon is that Chinese and Indian banks started to issue CoCo bonds for the first time in those years.

Moreover, according to Financial Times (2016), the expectation for the future scenario is that most of the banks will continue to issue AT1 over the coming years, although in 2016 the volume of issuance decrease since these instruments are generally cheaper than equity, have tax advantages and count towards leverage ratio requirements.

### 2.2.2 Related Results

Studies of CoCo issuance are important to obtain a meaningful idea about the propensity of banks to issue these bonds. This topic has only recently been addressed in the baking literature. Avdjiev et al. (2015), for instance, analyzed banks' motives for issuing CoCos as well as the impact of this issuance on bank CDS spreads and equity prices. The dataset consisted entirely of post-crisis CoCos issued between 2009 and 2013. They found that the effect of CoCo issuance on bank funding costs depends crucially on contractual features and bank characteristics. Additionally, their essay shows a negative impact on issuer's CDS spreads, while issuing CoCos with principal write-down has a lesser an impact.

Ammann et al. (2017) showed similar results around the announcement effects of CoCo bonds. They found positive abnormal stock price reactions and negative abnormal CDS spread changes in the immediate period following the announcement date. However, the magnitude of the effects is influenced in part by the structure of the bond.

Alternatively, Vallée (2015) explored the effects of liability management exercises (LMEs) to gain insight into the effects of triggering contingent capital instruments. He analyzed which bank characteristics are associated with implementing LMEs. The results showed that large banks, which are also better positioned for cross-selling, do not seem reluctant to implement these transactions.

It is important to mention that this paper differs the study Avdjiev et al. (2015) significantly in many aspects, Avdjiev et al. (2015) have a sample with 500 banks with the highest total assets in advanced economies, plus the CoCo issuers in our sample from the advanced economies that are not among the top 500, totalizing 523 banks. The sample of this paper contains 2552 banks from 130 countries in advanced and emergent countries. In Tab. 2 of Avdjiev et al. (2015), were the most related results to ours are presented, no emerging markets are considered. Also, Vallée (2015) consider only European Banks.

Moreover, Avdjiev et al. (2015) conclude that Total Assets turns out to be negative and significant, suggesting that larger banks are quicker in jumping on the CoCo bandwagon. The coefficient on Tier 1 might appear counterintuitive. To the extent that CoCo bonds represent a financial innovation to recapitalize troubled banks, one might have expected that banks with inadequate capital are eager to issue. Our paper provides a broad and comparative view of CoCo issuance in the world, evidencing the features of the banks. The results reveal that banks issuing CoCo bonds were mainly larger ones ("too big to fail") and had high leverage, so they were using the issuance of CoCo bonds mainly in an attempt to meet the Basel III rules and reduce indebtedness. Similar results were obtained by Vallée (2015) for European banks.

Finally, in a recent and independent work Avdjiev et al. (2017) extends the sample to a global one, including emerging markets.

In addition, Martynova and Perotti (2015) studied the way the design of bank contingent capital affects risk incentives. In other words, the study explicitly investigated how contingent capital affects the bank risk choices, the necessary feature for its optimal design and, pricing. The main result is that CoCo issuance is superior to subordinated debt, which can be bailed-in upon default, as it actively discourages ex-ante risk choices.

Moreover, if their trigger mechanisms are well designed in the CoCo issuance, it can help banks in times of economic contraction through the countercyclical capital properties that arise through CoCo bonds under these economic conditions (Liebenberg et al., 2017).

However, Chen et al. (2017) identified a phenomenon of debt-induced collapse that occurs when a firm issues CoCos and then takes on excessive additional debt. This means that the added debt burden can induce equity holders to increase their default barrier above the conversion trigger, effectively changing CoCos to junior straight debt and equity value can fall suddenly when this occurs.

Thus, when purchasing a CoCo bond, the investor bets that the probability of bankruptcy of the bank is low. This situation occurs because the bond's conversion after the trigger involves financial losses. In this way, it is necessary to check if the bank is experiencing financial distress. This information helps the investor to understand the probability of conversion.

The concept of financial distress is linked to the idea that individual banks have a high the probability of failing to meet their financial obligations. Thus the stocks of these financially distressed companies tend to move together. In this respect, several measures of financial distress have been developed, such as accounting variables to predict the probability of bank failure (Zmijewski, 1984) and indexes, like Altman's Z-score (Altman et al., 2000).

In this way, CoCo investors could provide meaningful monitoring, as they distinguish between different qualities of CoCo designs and their issuers. Moreover, in the perspective of the investor of CoCo bond, it is important to discuss who buy this bond and their impact in the financial stability of the sector, since that the activation of this bond trigger can generate a contagion effect. Boermans and Van Wijnbergen (2018) shows that in the study of debt instruments (CoCos) issued by European banks that the buyers of European CoCos in the majority are foreign investors from outside the euro area, possible mainly non-European investors (mutual funds, investment banks). This means that the worries of contagion in the continent can be unwarranted through cross-holdings of CoCos by banks.

In the next sections, we analyze, through an exploratory study, the bank characteristics that may affect the propensity of issuing CoCo bonds. Although, some of the results are not surprising, as we mentioned there are few papers in the literature establishing such determinants, and at a global level we are the first.

## 2.3 Sample

The dataset consists of banks in advanced and emerging economies and is taken from Bloomberg. We merged datasets of CoCo bond issuance with equity data of banks. The data indicate the features of CoCos issued[1] and characteristics of the issuing banks. The sample period is between January 2009 and December 2015, with annual frequency.

The sample contains 2552 banks from 130 countries (see more details in Table 2.15 in appendix). There are 93 banks that issued CoCo bonds and 2459 banks that did not issue them. To limit the influence of outliers, we winsorized all variables in the model at the 1st and 99th percentiles. That is, we replaced any observation below the 1st percentile with the 1st percentile and any observation above the 99th percentile with the 99th percentile.

### 2.3.1 Variable Definitions

Table 2.1 presents the definition of the main explanatory variables and Table 4.4 summarizes their main statistics. Group 0 in Table 4.4 describes the average period of independent variables for banks that did not issue CoCo bonds. Group 1 describes a smaller sample of almost 90 banks that issued CoCo bonds in the period after the 2008 crisis.

Table 4.5 shows the correlation between the variables proposed in the model. The explanatory variables have a low pairwise correlation.

## 2.4 Empirical Strategy

The present study is exploratory, so the objective is to analyze if the correlations of banks' propensity to issue CoCo bonds persists across time. For this, we use the following logistic panel data

[1]Table 2.14 in the appendix shows the distribution of CoCo bond issuance across each country and year.

Table 2.1: Variables Definition

| **Variable Name** | **Coding** | **Definition** | **Reference** |
|---|---|---|---|
| CoCo Bond issuance | | | |
| Dummy of CoCo Issue | dummy_CoCO | Binary variable which assumes the value 1 if bank issued any CoCo Bond, and 0 otherwise. | |
| Design of CoCo Issue | dummy_design | Binary variable which assumes the value 1 if the CoCo issue contract after the trigger activated will convertible in equity, and 0 if the conversion will write-down. | Martynova and Perotti (2015) |
| Bank Features | | | |
| Total Assets | ln TOTAL ASSET | The total of all short-term and long-term assets as reported on balance sheet. The variables were scaled by logarithm. | Avdjiev et al. (2015) |
| risk-weight assets | d.RWA | This field returns the risk-weighted assets, as disclosed by the company, which are used in the calculation of a bank's Tier 1 and Total Capital Ratios. Risk-Weighted Assets is calculated by weighting each type of asset relative to its risk. | |
| Capital Tier 1 | d.CAPITAL TIER 1 | The ratio of Tier 1 capital to risk-weighted assets. | Avdjiev et al. (2015) |
| Gross loan | d.GROSS LOAN | Includes direct financing lease receivables, receivable from customers and brokers/dealers in the brokerage industry, mortgage loans, and credit card receivables, automobile loans receivables. | Avdjiev et al. (2015) |
| Financial distress | | | |
| Profitability | NITA | $NetIncome_{it}/TotalAssets_{it}$ | Shumway (2001) |
| | NIMTA | $NetIncome_{it}/(ME_{it}+TotalLiabilities_{it})$ | Campbell et al. (2008) |
| Leverage | TLTA | $TotalLiabilities_{it}/TotalAssets_{it}$ | Shumway (2001) |
| | TLMTA | $TotalLiabilities_{it}/(ME_{it}+TotalLiabilities_{it})$ | Campbell et al. (2008) |
| Liquidity | CASH | $CashandShortTermInvestments_{it}/TotalAssets_{it}$ | Shumway (2001) |
| | CASHMTA | $CashandShortTermInvestments_{it}/(ME_{it}+TotalLiabilities_{it})$ | Campbell et al. (2008) |
| Regulatory | | | |
| Basel III implementation | Basel III | Dummy variable where 1 means that country adopted Basel III rules and 0 is the otherwise. | BIS (2016) |
| Credit-to-GDP gaps | Credit-to-GDP gaps | The credit-to-GDP ratio as published in the BIS database of total credit to the private non-financial sector, capturing total borrowing from all domestic and foreign sources. The gap indicator was adopted as a common reference point under Basel III to guide the construction of countercyclical capital buffers. | BIS (2010) |
| Tax deductibility | Tax deductibility | Dummy variable where 1 means year after 2013 and 0 otherwise. | |

Table 2.2: Summary statistics

| **Variable** | **Mean** | **Std. Dev.** | **Min.** | **Max.** | **N** |
|---|---|---|---|---|---|
| | | Dummy CoCo = 1 | | | |
| ln TOTAL ASSET | 12.605 | 2.316 | 6.45 | 16.916 | 171 |
| d.CAPITAL TIER 1 | 0.064 | 0.021 | 0.001 | 0.113 | 129 |
| d.GROSS LOAN | 0.58 | 0.172 | 0.203 | 0.919 | 161 |
| d.RWA | 0.508 | 0.214 | 0.039 | 1.05 | 150 |
| Profitability (NITA) | 0.004 | 0.007 | -0.03 | 0.025 | 171 |
| Leverage (TLTA) | 0.929 | 0.027 | 0.849 | 1.091 | 171 |
| Liquidity (CASH) | 0.13 | 0.089 | 0.001 | 0.437 | 163 |
| Profitability (NIMTA) | 0.002 | 0.004 | -0.016 | 0.013 | 159 |
| Leverage (TLMTA) | 0.5 | 0.032 | 0.397 | 0.63 | 159 |
| Liquidity (CASHMTA) | 0.117 | 0.07 | 0.005 | 0.31 | 151 |
| | | Dummy CoCo = 0 | | | |
| ln TOTAL ASSET | 10.014 | 3.379 | 4.306 | 19.295 | 10524 |
| d.CAPITAL TIER 1 | 0.109 | 1.194 | 0 | 98.674 | 6835 |
| d.GROSS LOAN | 0.635 | 0.156 | 0 | 1.847 | 9742 |
| d.RWA | 0.846 | 9.791 | 0 | 656.035 | 7586 |
| Profitability (NITA) | 0.006 | 0.12 | -11.667 | 0.782 | 10416 |
| Leverage (TLTA) | 0.889 | 0.205 | 0.015 | 19.265 | 10517 |
| Liquidity (CASH) | 0.125 | 0.108 | 0 | 1 | 10049 |
| Profitability (NIMTA) | 0.004 | 0.012 | -0.315 | 0.276 | 9070 |
| Leverage (TLMTA) | 0.472 | 0.041 | 0.009 | 0.973 | 9107 |
| Liquidity (CASHMTA) | 0.098 | 0.071 | 0 | 0.9 | 8655 |

regression.

The logistic regression model is used for binary outcome focus on the determinants of the probability $p$ of the occurrence of one outcome rather than an alternative outcome that occurs with a probability of $1 - p$ (Cameron and Trivedi, 2009) . The model is specified different functional forms for $p$ as a function of regressors, and the models are fitted by maximum likelihood (ML).

$$P(y_{it} = 1|x_{it}) = \Lambda(\delta BankFeatures_{it} + \gamma FinancialDistress_{it}). \quad (2.1)$$

The dependent variable ($Y_{it}$) is a binary variable which assumes the value 1 if bank $i$ issued any CoCo Bond in year $t$, and 0 otherwise. On the side of the explanatory variables, $\Lambda$ is the cu-

Table 2.3: Cross-correlation table

| Variables | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. ln TOTAL ASSET | 1.000 | | | | | | | | | |
| 2. d.CAPITAL TIER 1 | -0.024 | 1.000 | | | | | | | | |
| 3. d.GROSS LOAN | -0.160 | 0.015 | 1.000 | | | | | | | |
| 4. d.RWA | -0.020 | 0.778 | 0.022 | 1.000 | | | | | | |
| 5. Profitability (NITA) | 0.036 | 0.002 | -0.008 | -0.001 | 1.000 | | | | | |
| 6. Leverage (TLTA) | 0.069 | -0.023 | 0.108 | -0.004 | -0.880 | 1.000 | | | | |
| 7. Liquidity (CASH) | 0.109 | -0.006 | -0.418 | -0.006 | 0.026 | -0.088 | 1.000 | | | |
| 8. Profitability (NIMTA) | 0.096 | 0.002 | -0.033 | -0.003 | 0.432 | -0.342 | 0.079 | 1.000 | | |
| 9. Leverage (TLMTA) | 0.144 | -0.013 | -0.034 | -0.001 | -0.059 | 0.235 | -0.106 | -0.198 | 1.000 | |
| 10. Liquidity (CASHMTA) | 0.169 | -0.010 | -0.406 | -0.004 | 0.024 | -0.059 | 0.947 | 0.085 | 0.082 | 1.000 |

mulative distribution function (CDF) of the logistic distribution. The vector of bank features is $\delta$, which affects the likelihood of issuing a CoCo bond. The variables are total assets, risk-weighted assets, tier 1 capital, and gross loans. Since these variables have a high correlation, the last three variables are all scaled by total assets, expressed as percentages.

The other vector, $\gamma$, is a proxy variable of financial distress, namely the relative likelihood of bankruptcy. The measures are profitability (NITA), leverage (TLTA), and liquidity (CASH), in accordance with Shumway (2001). In addition, Campbell et al. (2008) suggested using the equity component of total assets at market value, adding the book value of liabilities, because market prices more rapidly incorporate new information about the firm's prospects or more accurately reflect intangible assets of the firm.

The set of variables proposed in this model was divided into two groups: bank features and financial distress. The first group is related to the characteristics of banks directly related to the issuance of CoCo bonds according to the literature (Avdjiev et al., 2015; Vallée, 2015). These variables portray the bank regulatory behavior (RWA and Capital Tier 1) and bank size (Total Assets and Gross loan).

The other group takes into account the banks performance. As mention in the literature review, understand the level of financial distress is a possible way for banks to decide the necessity to issue or not CoCo bonds. This is an innovation of this paper by including the set of variables based on Campbell et al. (2008) and Shumway (2001).

## 2.5 Main Results

In this section, we present the results obtained using random effects, clustered standard errors, country fixed effects and year fixed effects. Tables 2.4 and 2.5 show the results[2]. Each column represents the estimation by different criteria, which are: all banks in the sample, only BRICS [3],

[2]We redid the tests using probit estimations, with similar results.

[3]Denomination of five countries among the fastest growing emerging markets: Brazil, Russia, India, China and South Africa

only European countries and only emerging countries [4], respectively. This segmentation is based on the volume of CoCo bonds issued per country.

The sample is composed of banks from different countries, each of which has its particularities regarding regulation, economic model, social policy, etc. In order to minimize these contrasts, we separated the sample into three groups (BRICS, Europe, IBRD) because of the broadly similar economic structures and governmental regulations. Moreover, we ran the model with a dummy variable for each country. Thus, each country had its intercept, increasing the explanatory power of the model and avoiding omitted variable bias.

Table 2.4 shows the regressions with financial distress measures calculated according to Shumway (2001), namely, the index used only book value in its composition. On the other hand, Table 2.5 shows the regressions with financial distress measures calculated at the market value according to Campbell et al. (2008). When we compare estimation by groups in both tables, Table 2.5 present best models by that minimizes AIC and BIC. These penalized likelihood criterion is appealing for model selection because logit and probit models have larger differences of fitted probability may be evident in the tails of the distribution (Cameron and Trivedi, 2009).

The Total Assets variable was positive and significant at 5% level in all models. This means that as the size of the bank increases, the propensity to issue a CoCo bond rises. Interpreting the marginal effect in the first column, for each increase of one unit in logarithm of Total Assets, the probability of issuing a CoCo bond increased by 2.1%, keeping other variables constant. The coefficients of marginal effects are shown in Table 2.6.

For European banks, the results showed that rising value of Risk Weighted Assets decreased the probability of CoCo issuance. The best-capitalized banks and those with high RWA levels were less likely to issue these hybrid instruments. The financial distress measures in both tables

[4]As a proxy for classifying countries as emerging, we used the 189 member countries of the International Bank for Reconstruction and Development (IBRD), according to the World Bank. It works closely with the rest of the World Bank Group to help developing countries reduce poverty, promote economic growth, and build prosperity.

were not significant.

In turn, for BRICS banks, Leverage (TLMTA) was positive and significant, meaning that more indebted banks were more likely to issue CoCo bonds. This corroborates the fact that banks of the BRICS countries are trying to meet the Basel III rules and replacing subordinated debt with additional Tier 1 debt. In addition to bank size and financial distress, the variable Tier 1 Capital was positive and significant, and Total Loans and RWA was negative and significant.

Emerging countries followed the same pattern as the BRICS, with total assets and leverage variables positive and significant. Nevertheless, the other variables (Tier 1 Capital and RWA) were not significant, so no increase in the likelihood of banks in these countries to issue CoCo bonds was noted.

The results illustrate that size and leverage of banks are two of the determinants for issuance of CoCo bonds. This implication has two sides: on one hand it shows the concern of banks to protect themselves from future uncertainties through core capital (Tier 1, Additional Tier 1 and Tier 2), while on the other hand it encourages the discussion of the capability of Cocos to help banks in distress, because if the debt is high, even when substracting the value of CoCos from the liabilities, the financial problems persist.

Table 2.4: Results of estimation using book value in financial distress measures

| | WORLD1A | BRICS1A | EUROPE1A | IBRD1A |
|---|---|---|---|---|
| ln TOTAL ASSET | 0.997*** | 9.372*** | 0.659*** | 0.763* |
| | (0.203) | (1.210) | (0.179) | (0.367) |
| d.CAPITAL TIER 1 | 4.989 | 150.5** | 4.702 | 8.403 |
| | (3.123) | (50.06) | (4.942) | (16.21) |
| d.GROSS LOAN | 2.517 | -27.62* | 1.044 | -12.75** |
| | (1.817) | (12.22) | (1.644) | (4.613) |
| d.RWA | -1.380 | -14.72** | -3.937** | -0.328 |
| | (1.412) | (5.592) | (1.298) | (1.868) |
| Profitability (NITA)_ | -11.93 | -259.1 | -2.370 | -75.27 |
| | (20.80) | (167.0) | (9.653) | (62.48) |
| Leverage (TLTA)_ | -1.463 | 25.52 | 2.218 | 21.48 |
| | (3.915) | (17.73) | (6.082) | (11.26) |
| Liquidity (CASH)_ | 2.354 | -9.237 | 1.567 | -4.436 |
| | (2.384) | (8.826) | (2.630) | (3.838) |
| Constant | -12.90** | -155.7*** | -13.08* | -28.94* |
| | (4.488) | (23.25) | (6.363) | (12.66) |
| Observations | 1125 | 496 | 984 | 1266 |
| Country Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| *AIC* | 656.7 | 189.2 | 438.2 | 231.6 |
| *BIC* | 802.4 | 227.0 | 482.2 | 277.9 |

The dependent binary variable assumes value 1 if the bank issued CoCo bonds in the year, and 0 otherwise. The logistic regression is estimated by maximum likelihood, and standard errors are clustered at the bank level. Since these variables have a high correlation, some variables are all scaled by total assets, expressed as percentages (coding d.). The financial distress measures were calculated by book value in accordance with Shumway (2001). Standard errors in parentheses:* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Bloomberg, authors' calculations.

Table 2.5: Results of estimation using market value in financial distress measures

| | WORLD1B | BRICS1B | EUROPE1B | IBRD1B |
|---|---|---|---|---|
| ln TOTAL ASSET | 0.888*** | 10.19*** | 0.561** | 1.573*** |
| | (0.211) | (1.191) | (0.197) | (0.379) |
| d.CAPITAL TIER 1 | 9.805 | 281.3*** | 6.376 | 29.42 |
| | (5.505) | (69.40) | (6.646) | (25.63) |
| d.GROSS LOAN | 1.388 | -54.57** | 0.436 | -19.61*** |
| | (1.964) | (17.63) | (1.923) | (5.547) |
| d.RWA | -2.750 | -29.00*** | -4.981*** | -2.246 |
| | (1.536) | (7.890) | (1.506) | (3.036) |
| Profitability (NIMTA) | -21.10 | -560.2 | 7.106 | -304.6 |
| | (45.30) | (349.0) | (47.84) | (160.6) |
| Leverage (TLMTA) | -9.874 | 118.5* | -7.214 | 89.08*** |
| | (6.516) | (46.92) | (7.077) | (26.93) |
| Liquidity (CASHMTA) | 4.417 | -22.06 | 4.171 | -12.96 |
| | (3.685) | (15.58) | (4.334) | (8.259) |
| Constant | -7.414 | -186.9*** | -5.810 | -62.97*** |
| | (4.164) | (32.60) | (4.122) | (15.26) |
| Observations | 1006 | 404 | 843 | 1106 |
| Country Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| *AIC* | 613.3 | 155.1 | 402.3 | 213.2 |
| *BIC* | 755.8 | 191.1 | 444.9 | 258.3 |

The dependent variable binary variable which it assumes value 1 if the bank issued CoCo Bonds in the year, and 0 the otherwise. The logistic regressions are estimated by maximum likelihood, and standard errors are clustered at the bank level. Since these variables have a high correlation, some variables are all scaled by total assets, expressed as percentage points (coding d.). The variables of financial distress measures were calculated by book value in accordance with Campbell et al. (2008). Standard errors in parentheses:* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Bloomberg, authors' calculations.

### 2.5.1 Contract design

A robustness test for the issuance of CoCo bonds is to analyze the type of contract that each bank used at the moment of emission. The banks could decided on the type of contract based on their own characteristics and future needs. Thus, the determinants to issue CoCo bonds can change since the contractual strategy might be more or less risky to the investor.

Table 2.6: Marginal effects after logit transformation relative on Table VI and VII

| **Table VI** | **WORLD1A** | **BRICS1A** | **EUROPE1A** | **IBRD1A** |
|---|---|---|---|---|
| ln TOTAL ASSET | .0214833 | 5.54e-11 | .0163783 | 1.96e-11 |
| d.CAPITAL TIER 1 | .1075473 | 8.08e-10 | .0688215 | 2.23e-10 |
| d.GROSS LOAN | .0542441 | -1.12e-10 | .0673122 | -8.12e-11 |
| d.RWA | -.0297471 | -7.37e-11 | -.0313017 | -1.93e-11 |
| Profitability (NITA) | -.257064 | -1.38e-09 | .0627374 | -1.37e-09 |
| Leverage (TLTA) | -.0315339 | 1.85e-10 | -.0824465 | 5.44e-11 |
| Liquidity (CASH) | .0507312 | -8.13e-11 | .1123856 | -3.36e-11 |
| **Table VII** | **WORLD1B** | **BRICS1B** | **EUROPE1B** | **IBRD1B** |
| ln TOTAL ASSET | .0222636 | 1.23e-09 | .0165482 | 8.79e-11 |
| d.CAPITAL TIER 1 | .2459212 | 3.78e-08 | .1298369 | 1.54e-09 |
| d.GROSS LOAN | .0348157 | -6.68e-09 | .0474716 | -4.23e-10 |
| d.RWA | -.0689743 | -3.82e-09 | -.0799792 | -1.46e-10 |
| Profitability (NIMTA) | -.5291166 | -7.71e-08 | .283097 | -1.13e-08 |
| Leverage (TLMTA) | -.2476483 | 2.01e-08 | -.2906795 | 1.50e-09 |
| Liquidity (CASHMTA) | .110779 | -4.27e-09 | .1790441 | -4.12e-10 |

This table shows values of marginal effect after logit transformation of results of estimation in Tables 2.4 and 2.5. In estimation, the probability of a positive outcome assumes that the fixed effect is zero. Source: Bloomberg, authors' calculations.

To test this explanation empirically, we estimated the main models by dividing the sample according to contract design, namely; we used the capital type after CoCo trigger activation. Thus, we formed two subamples: "Equity conversion" and "Write Down" and the estimations are shown in Table 2.7. This division enabled assessing the heterogeneity in the sample. Of course, write-downs are riskier for the investors and demand higher premiums and larger collateral.

The results showed that the size of the bank is important (positive and significant coefficients) only for banks that issued CoCo bonds with a write-down trigger in the contract. Moreover, the risk-weighted asset variable also was significant for this type of trigger, but the higher the RWA, the lower the probability of issuing CoCo. On the other hand, more profitable and liquid banks tended to have lower probability of issuing CoCo bonds with equity conversion triggers.

The last two columns, with estimations using financial distress measures calculate by market value, present best-adjusted models for having lower AIC and BIC values comparatively other columns.

Table 2.7: Results of estimation by contract design

| | Equity | WriteDown | Equity | WriteDown |
|---|---|---|---|---|
| ln TOTAL ASSET | 0.362 | 0.839*** | 0.247 | 0.891*** |
| | (0.190) | (0.241) | (0.255) | (0.261) |
| d.CAPITAL TIER 1 | 53.94** | 90.39*** | 196.1** | 99.27*** |
| | (17.89) | (23.30) | (68.53) | (25.07) |
| d.GROSS LOAN | -2.356 | -0.161 | -0.650 | -1.192 |
| | (2.447) | (2.190) | (3.718) | (2.286) |
| d.RWA | -1.074 | -6.769** | -6.781 | -8.242** |
| | (2.692) | (2.547) | (3.660) | (2.707) |
| Profitability (NITA) | -134.1* | 15.17 | | |
| | (65.44) | (50.10) | | |
| Leverage (TLTA) | 24.03 | 2.751 | | |
| | (14.21) | (6.088) | | |
| Liquidity (CASH) | -14.76** | 6.762* | | |
| | (5.092) | (2.929) | | |
| Profitability (NIMTA) | | | -365.1* | 25.37 |
| | | | (172.4) | (103.4) |
| Leverage (TLMTA) | | | 22.29 | -4.942 |
| | | | (17.02) | (7.641) |
| Liquidity (CASHMTA) | | | -17.18 | 5.707 |
| | | | (9.144) | (4.492) |
| Constant | -27.94 | -16.95* | -20.58* | -11.81* |
| | (14.52) | (6.823) | (10.20) | (5.600) |
| Observations | 177 | 228 | 165 | 221 |
| Country Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| *AIC* | 192.6 | 260.2 | 164.1 | 251.2 |
| *BIC* | 243.4 | 339.1 | 210.7 | 329.3 |

To check the alternative explanation of the main model depicted in Section 4, we divided the sample according to the capital type after CoCo trigger, forming two subsamples "Equity Conversion" and "Write Down". The dependent binary variable assumes value 1 if the bank issued CoCo bond in the year, and 0 otherwise. The logistic regression is estimated by maximum likelihood, and standard errors are clustered at the bank level. Since these variables have a high correlation, some variables are all scaled by total assets, expressed as percentages (coding d.). The variables of financial distress measures were calculated by book value and market value in accordance with Shumway (2001) and Campbell et al. (2008), respectively. Standard errors in parentheses: $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. Source: Bloomberg, authors' calculations.

## 2.6 Regulatory Explanation

This section explores the regulatory impact on the propensity to banks to issue CoCos. We examine four different proxies to exemplify the importance and strength of regulation on the issuance of CoCos: Basel III implementation; global systemically important banks; countercyclical capital buffer and tax incentives.

As an empirical strategy, we estimated the previous model with additional variables that capture the regulatory effect. The next subsections discuss each aspect involving banking regulation. It should be noted that in all the tables presented in this section, estimates using financial distress measures calculated by the market value have the best goodness of fit than financial distress measures calculated by book value since AIC and BIC were minimized.

### 2.6.1 Basel III implementation

The possible explanation for banks to issue CoCo bond is based on whether the country implemented the Basel III suggestions. Once a country adopts Basel III rules, banks need to increase the level of core capital, and for this, they can issue CoCo bonds. The objective of the Committee is to strengthen the regulation, supervision; and practices of banks worldwide with the purpose of enhancing financial stability (BIS, 2016).

In the first analysis, we used the status of Basel III rules implementation [5] to divide the sample into countries that did and did not adopt these rules during the period studied. The dummy variable is based on the report of the Bank for International Settlements BIS (2016). Thus, we estimated the model in equation 1. The results are shown in Table 2.8. For the countries

[5] Basel III Capital: In December 2010, the Committee released Basel III, which set higher levels for capital requirements and introduced a new global liquidity framework. The committee members agreed to implement Basel III from January 1, 2013, subject to transitional and phase-in arrangements (BIS, 2016)

that adopt Basel III rules, the results were the same as in the previous tables, namely the Total Asset variable was positive and significant.

With this approach, it is possible to see the determinants of CoCo issuance in both ways they can be issued. By comparing the differences between both groups, it was also able to draw better conclusions about the mechanisms behind the decision of banks to issue CoCos or not.

In the same way, we performed a complementary analysis that included the dummy for adoption of Basel III requirements in the same estimation of tables 2.4 and 2.5. The information about year and country of Basel III implementation were extracted from reports of Basel Committee on Banking Supervision.

The results showed in Table 2.9, like the previous results, that the size of the bank was the principal determinant for issuing CoCo bonds. However, the dummy for Basel III implementation behavior was a significant and positive determinant to issuance in all models. The high magnitude of these coefficients suggests the power of enforcing regulations to minimize the financial fragility in the future scenario.

### 2.6.2 Global systemically important banks (G-SIBs)

The Financial Stability Board (FSB) is an international institution that monitors and makes recommendations about the global financial system. Like the Basel Committee, the FSB worries about the level of capital requirement.

The FSB proposed that global systemically important banks should add an extra percentage of capital requirement stipulated by regulators. In other words, this group of banks will show the allocations to buckets corresponding to the level of additional loss absorbency they would be required to meet had the requirements been in effect (FSB, 2011). Thus, FSB created a list of banks which are global systemically important, and with the support of the G20 Leaders, these

Table 2.8: Results of estimation by Basel III rules implementation

| BASEL III | YES | NO | YES | NO |
|---|---|---|---|---|
| ln TOTAL ASSET | 1.154*** | 0.528 | 1.017*** | 0.495 |
| | (0.263) | (0.354) | (0.259) | (0.365) |
| d.CAPITAL TIER 1 | 8.502 | 1.310 | 8.235 | 17.87 |
| | (5.670) | (4.501) | (5.784) | (16.77) |
| d.GROSS LOAN | 2.632 | 7.912 | 1.086 | 5.221 |
| | (2.056) | (6.528) | (2.171) | (6.861) |
| d.RWA | -1.418 | -0.878 | -2.867 | -3.461 |
| | (1.784) | (2.236) | (1.951) | (2.953) |
| Profitability (NITA) | -33.24 | 8.617 | | |
| | (30.17) | (29.31) | | |
| Leverage (TLTA) | 1.463 | -1.123 | | |
| | (6.368) | (4.009) | | |
| Liquidity (CASH) | 1.980 | 11.63 | | |
| | (2.691) | (8.935) | | |
| Profitability (NIMTA) | | | -67.45 | 11.36 |
| | | | (65.19) | (71.55) |
| Leverage (TLMTA) | | | -14.58 | 0.246 |
| | | | (8.806) | (10.74) |
| Liquidity (CASHMTA) | | | 4.399 | 7.967 |
| | | | (3.912) | (12.24) |
| Constant | -17.58* | -12.79 | -6.102 | -10.90 |
| | (6.918) | (8.622) | (5.180) | (9.558) |
| Observations | 913 | 212 | 798 | 208 |
| Country Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| *AIC* | 525.8 | 140.7 | 486.4 | 138.6 |
| *BIC* | 631.8 | 191.1 | 589.4 | 188.7 |

To check the alternative explanation of the main model depicted in Section 4, we divided the sample according to BIS (2016) for the status of implementation of Basel III by country. Thus, the countries in the "YES" columns adopted Basel III rules, and those in the "NO" columns did not. The dependent binary variable assumes value 1 if the bank issued CoCo bonds in the year, and 0 otherwise. The logistic regression is estimated by maximum likelihood, and standard errors are clustered at the bank level. Since these variables have a high correlation, some variables are all scaled by total assets, expressed as percentages (coding d.). The variables of financial distress measures were calculated by book value and market value in accordance with Shumway (2001) and Campbell et al. (2008), respectively. Standard errors in parentheses: $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. Source: Bloomberg, BIS, authors' calculations.

Table 2.9: Results of estimation with Basel III implementation variable

| | WORLD | | IBRD | |
|---|---|---|---|---|
| | Book | Market | Book | Market |
| D_COCO | | | | |
| ln TOTAL ASSET | 1.346*** | 1.253*** | 5.355* | 4.894*** |
| | (0.251) | (0.265) | (2.509) | (1.271) |
| d.CAPITAL TIER 1 | 7.092** | 13.13* | 108.3 | 160.0** |
| | (2.711) | (5.177) | (66.31) | (58.14) |
| d.GROSS LOAN | 1.253 | -0.602 | -34.01* | -36.47** |
| | (2.329) | (2.549) | (16.66) | (14.03) |
| d.RWA | -1.644 | -3.440 | -11.16 | -17.29** |
| | (1.829) | (2.264) | (6.918) | (6.346) |
| Basel III implementation (1=Yes) | 4.591*** | 4.534*** | 4.288*** | 4.513* |
| | (0.406) | (0.404) | (1.082) | (2.058) |
| Profitability (NITA) | -15.43 | | -553.5 | |
| | (25.16) | | (348.2) | |
| Leverage (TLTA) | -1.555 | | 29.60* | |
| | (4.167) | | (11.58) | |
| Liquidity (CASH) | 1.000 | | -24.21* | |
| | (3.604) | | (11.64) | |
| Profitability (NIMTA) | | -38.89 | | -458.3 |
| | | (54.13) | | (260.9) |
| Leverage (TLMTA) | | -14.29 | | 50.96 |
| | | (7.367) | | (53.93) |
| Liquidity (CASHMTA) | | 0.176 | | -25.02 |
| | | (5.336) | | (17.02) |
| Constant | 1.855*** | 1.894*** | 3.597** | 4.075*** |
| | (0.320) | (0.335) | (1.156) | (0.488) |
| Observations | 1125 | 1006 | 423 | 370 |
| Country Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |
| *AIC* | 527.7 | 493.6 | 153.8 | 152.9 |
| *BIC* | 678.5 | 641.0 | 210.4 | 203.8 |

To check the alternative explanation of the main model depicted in Section 4 and we included the dummy variable reflecting whether or not the country adopted the Basel III rules. The dependent binary variable assumes value 1 if the bank issued CoCo bonds in the year, and 0 otherwise. The logistic regression is estimated by maximum likelihood, and standard errors are clustered at the bank level. Since these variables have a high correlation, some variables are all scaled by total assets, expressed as percentages (coding d.). The variables of financial distress measures were calculated by book value and market value in accordance with Shumway (2001) and Campbell et al. (2008), respectively. Standard errors in parentheses:* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Bloomberg, BIS, authors' calculations.

banks will implement the higher level of the capital requirement by 2018.

In this line, we analyzed the determinants to issue CoCo bonds for these important banks. The data were extracted from reports about the list of global systemically important banks published in the period between 2011 and 2016. Again, we estimated the model proposed in Section 4 and the results are shown in Table 2.10.

Since the sample contains only large banks, the coefficient of Total Assets was not significant as in other estimations. This means that the size of the bank is an important predictor when the sample is heterogeneous, so the result strengthens the main finding that too-big-to-fail banks have higher propensity to issue CoCo bonds than small banks.

Nonetheless, the increase of one unit in risk-weight asset and profitability imply a lower probability of banks' issuing CoCo bonds, similar to what we found in our main analysis.

### 2.6.3 Countercyclical capital buffer

Basel III uses the gap between the credit-to-GDP ratio and its long-term trend as a guide for setting countercyclical capital buffers. This is also illustrated by Jokivuolle et al. (2015), who argued in favor of Basel III when they estimated a similar setup to motivate the countercyclical capital buffers through banks' credit risks by realized banking sector loan losses, and modeled them with three macroeconomic variables.

In this way, we included the credit-to-GDP gap, which is defined as the difference between the credit-to-GDP ratio and its long-run trend, in the previous estimation be- cause it is a measure of the countercyclical capital buffer. The input data are from the Bank for International Settlements database of total credit to the private non-financial sector, capturing total borrowing from all domestic and foreign sources. Table 2.11 shows the results.

Table 2.10: Results of estimation using only G-SIBs banks

| | Book | Market |
|---|---|---|
| D_COCO | | |
| ln TOTAL ASSET | 2.123 | 1.250 |
| | (3.342) | (2.032) |
| d.CAPITAL TIER 1 | 751.9* | 704.4** |
| | (357.7) | (250.8) |
| d.GROSS LOAN | -22.56 | -23.72 |
| | (19.20) | (17.72) |
| d.RWA | -47.04* | -43.54** |
| | (19.80) | (15.48) |
| Profitability (NITA) | -885.4 | |
| | (466.7) | |
| Leverage (TLTA) | -167.4 | |
| | (222.2) | |
| Liquidity (CASH) | 5.124 | |
| | (17.92) | |
| Profitability (NIMTA) | | -1254.7* |
| | | (531.6) |
| Leverage (TLMTA) | | -11.38 |
| | | (25.52) |
| Liquidity (CASHMTA) | | -3.084 |
| | | (14.32) |
| Constant | 2.382 | 1.456 |
| | (1.854) | (1.412) |
| Observations | 125 | 125 |
| Country Fixed Effects | Yes | Yes |
| Year Fixed Effects | Yes | Yes |
| *AIC* | 102.0 | 103.0 |
| *BIC* | 147.3 | 148.2 |

To check the alternative explanation of the main model depicted in Section 4, we used in the sample only banks that have appeared at least once in the list of global systemically important banks (G-SIBs) from the Financial Stability Board. The dependent binary variable assumes value 1 if the bank issued CoCo bonds in the year, and 0 otherwise. The logistic regression is estimated by maximum likelihood, and standard errors are clustered at the bank level. Since these variables have a high correlation, some variables are all scaled by total assets, expressed as percentages (coding d.). The variables of financial distress measures were calculated by book value and market value in accordance with Shumway (2001) and Campbell et al. (2008), respectively. Standard errors in parentheses:$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. Source: Bloomberg, BIS, authors' calculations.

Table 2.11: Results of estimation by adding Credit-to-GDP gaps

| | Book | Market |
|---|---|---|
| D_COCO | | |
| ln TOTAL ASSET | 1.390*** | 1.246*** |
| | (0.342) | (0.333) |
| d.CAPITAL TIER 1 | 10.70 | 10.39 |
| | (6.351) | (6.271) |
| d.GROSS LOAN | 2.350 | 1.129 |
| | (2.423) | (2.449) |
| d.RWA | -0.721 | -0.988 |
| | (0.938) | (1.103) |
| Credit-to-GDP gaps | -0.0677*** | -0.0627*** |
| | (0.0169) | (0.0167) |
| Profitability (NITA) | -25.45 | |
| | (33.25) | |
| Leverage (TLTA) | -0.175 | |
| | (5.434) | |
| Liquidity (CASH) | 0.901 | |
| | (3.161) | |
| Profitability (NIMTA) | | -21.17 |
| | | (70.63) |
| Leverage (TLMTA) | | -8.609 |
| | | (8.203) |
| Liquidity (CASHMTA) | | 2.861 |
| | | (4.282) |
| Constant | 1.530*** | 1.436** |
| | (0.455) | (0.482) |
| Observations | 1065 | 953 |
| Country Fixed Effects | Yes | Yes |
| Year Fixed Effects | Yes | Yes |
| *AIC* | 560.8 | 525.4 |
| *BIC* | 700.0 | 661.5 |

To check the alternative explanation of the main model depicted in Section 4, but now we added the independent variable Credit-to-GDP. The dependent binary variable assumes value 1 if the bank issued CoCo bonds in the year, and 0 otherwise. The logistic regression is estimated by maximum likelihood, and standard errors are clustered at the bank level. Since these variables have a high correlation, some variables are all scaled by total assets, expressed as percentages (coding d.). The variables of financial distress measures were calculated by book value and market value in accordance with Shumway (2001) and Campbell et al. (2008), respectively. Standard errors in parentheses: $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. Source: Bloomberg, BIS, authors' calculations.

The result of the size of the bank remains positive and significant, corroborating the previous findings. The new variable, Credit-to-GDP gap, was negative and significant, meaning that when a country has a high Credit-to-GDP gap, this decreases the probability of banks' issuing CoCo bonds.

### 2.6.4 Tax incentives to issue the CoCo bond

We included in the main estimation the tax deductibility variable, a dummy that assumes value 1 if the year was after 2013 when the UK gave tax deductibility to banks that issued CoCo bonds. Table 2.12 shows the results.

The coefficients of Tax Incentive variables were positive and significant in all models, which leads us to conclude that the UK government pioneered the granting of tax incentives to banks issuing CoCo bonds and this policy spread to other markets, like Europe and BRICS. This corroborates the findings of Marquardt and Wiedman (2005) suggesting that investors can have a favorable view the tax benefits associated with CoCos but not perceive the contingent conversion feature itself as providing net benefits or costs to the firm.

## 2.7 Debt Issuing Possibilities

Now we include a sample of the junior and senior debt, and we run a multinomial logit regression to see if in the face of other issuing possibilities our result remains robust. The period of the sample is between 2009 and 2015. It has 93 banks that issued CoCo bonds, 214 banks that issued subordinated debt, and 2320 banks that did not issue either of the two bonds. Also, there are 75 banks that issued both debt instruments. We estimated the model using different groups, which are: all banks in the sample, only European countries, and only emerging countries (IBRD).

As can be seen in Table 2.13, when we compare banks that issue subordinated debt and

Table 2.12: Results of estimation with tax deductibility variable

| | WORLD | | EUROPE | | BRICS | |
|---|---|---|---|---|---|---|
| | Book | Market | Book | Market | Book | Market |
| D_COCO | | | | | | |
| ln TOTAL ASSET | 1.353*** | 1.224*** | 1.580** | 1.301** | 2.938*** | 3.198** |
| | (0.273) | (0.284) | (0.493) | (0.487) | (0.815) | (1.215) |
| d.CAPITAL TIER 1 | 7.301 | 5.803 | 6.911 | 5.294 | 82.63* | 106.6* |
| | (6.065) | (6.403) | (6.980) | (6.885) | (36.61) | (53.88) |
| d.GROSS LOAN | -0.246 | -0.519 | 2.087 | 3.685 | -14.26 | -26.37 |
| | (2.472) | (2.710) | (3.386) | (3.891) | (9.267) | (14.39) |
| d.RWA | -1.849 | -3.957* | -1.067 | -4.552 | -8.902* | -11.76* |
| | (1.576) | (1.809) | (1.977) | (2.383) | (4.090) | (5.947) |
| Tax deductibility (1=after 2013) | 5.820*** | 6.070*** | 6.316*** | 6.848*** | 5.723** | 6.051** |
| | (0.610) | (0.668) | (0.897) | (1.078) | (1.798) | (2.263) |
| Profitability (NITA) | -16.88 | | -1.502 | | -125.3 | |
| | (21.02) | | (24.67) | | (94.25) | |
| Leverage (TLTA) | 0.145 | | -3.370 | | 18.03 | |
| | (4.374) | | (4.352) | | (15.25) | |
| Liquidity (CASH) | -0.489 | | 6.737 | | -14.52 | |
| | (4.060) | | (4.686) | | (9.504) | |
| Profitability (NITA) | | -57.08 | | -8.619 | | -482.6 |
| | | (47.29) | | (52.89) | | (324.7) |
| Leverage (TLMTA) | | -6.221 | | 2.774 | | 17.13 |
| | | (7.457) | | (13.34) | | (36.04) |
| Liquidity (CASHMTA) | | 0.393 | | 15.22 | | -18.81 |
| | | (6.068) | | (9.262) | | (15.55) |
| Constant | -20.53*** | -14.87** | -23.04*** | -25.29** | -54.89** | -43.78 |
| | (5.398) | (5.292) | (6.752) | (9.617) | (18.74) | (23.55) |
| Observations | 1125 | 1006 | 658 | 580 | 462 | 370 |
| Country Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| *AIC* | 471.7 | 438.5 | 291.3 | 267.1 | 166.1 | 144.2 |
| *BIC* | 622.5 | 585.9 | 399.1 | 371.8 | 219.9 | 195.1 |

To check the alternative explanation of the main model depicted in Section 4 and we included the dummy variable for tax incentives in the UK after 2013. The dependent binary variable assumes value 1 if the bank issued CoCo bonds in the year, and 0 otherwise. The logistic regression is estimated by maximum likelihood, and standard errors are clustered at the bank level. Since these variables correlate, some variables are all scaled by total assets, expressed as percentages (coding d.). The variables of financial distress measures were calculated by book value and market value in accordance with Shumway (2001) and Campbell et al. (2008), respectively. Standard errors in parentheses:* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Bloomberg, FSB, authors' calculations.

banks that did not debts instruments, we conclude that size (ln TOTAL ASSET) is a determinant of issuing this derivative because the coefficients were positive and significant for all groups. Another relevant determinant for the world and emerging countries is leverage, whose coefficients were positive and significant. Also, only for IBRD were the variables gross loans and liquidity negative and significant.

Moreover, when we compared banks that issued CoCo bonds and banks that did not issue these debt instruments, we found positive significance for size and leverage variables, like in the model with subordinated debt. However, the variable about the level of Tier 1 capital was negative and significant for world and IBRD groups. The higher magnitude of the coefficients illustrates the importance of the regulatory environment for banks' decision to issue CoCo bonds.

These results support the previous findings that the relevant determinants for banks' issuance, in the econometric constraints of a multinomial logit model. In the end, we can conclude that the determinants for banks to issue subordinated debt are size and leverage, whereas the decision to issue CoCo bonds includes the additional determinant of regulatory environment.

## 2.8 Conclusion

The issuance of CoCo bonds spread throughout the world after the crisis in 2008 and the announcement of the Basel III framework. Following this phenomena, research emerged about CoCo bonds issue mainly by European banks. Our paper provides a broad and comparative view of CoCo issuance in the world, evidencing the features of the banks.

The results reveal that banks issuing CoCo bonds were mainly larger ones ("too big to fail") and had high leverage, so they were using the issuance of CoCo bonds mainly in an attempt to meet the Basel III rules and reduce indebtedness.

Table 2.13: Multinomial Logit

| | WORLD | EUROPE | IBRD |
|---|---|---|---|
| **Alternative: No Issue vs. CoCo bonds** | | | |
| ln TOTAL ASSET | 0.153** | 0.267* | 0.223* |
| | (2.91) | (2.13) | (1.92) |
| d.CAPITAL TIER 1 | -15.74* | -19.83 | -49.91** |
| | (-1.98) | (-1.54) | (-3.14) |
| d.GROSS LOAN | 1.795 | -1.962 | -5.290 |
| | (1.47) | (-1.12) | (-1.66) |
| d.RWA | -1.296 | -1.824 | 0.322 |
| | (-1.18) | (-1.21) | (0.56) |
| Profitability (NIMTA) | 27.81 | 34.56 | 20.41 |
| | (0.90) | (0.88) | (0.17) |
| Leverage (TLMTA) | 30.91*** | 8.884 | 44.25** |
| | (4.90) | (1.00) | (2.61) |
| Liquidity (CASHMTA) | 8.078** | -10.14* | -1.101 |
| | (2.99) | (-2.08) | (-0.21) |
| **Alternative: No Issue vs. Subordinated Debts** | | | |
| ln TOTAL ASSET | 0.213*** | 0.227* | 0.150* |
| | (6.83) | (2.07) | (2.29) |
| d.CAPITAL TIER 1 | -5.437 | -13.49 | -12.42 |
| | (-1.50) | (-1.48) | (-1.87) |
| d.GROSS LOAN | 1.040 | -1.409 | -3.890* |
| | (1.31) | (-0.92) | (-2.46) |
| d.RWA | -0.00632 | -1.430 | 0.311 |
| | (-0.10) | (-1.17) | (0.94) |
| Profitability (NIMTA) | -8.100 | -1.898 | -38.34 |
| | (-0.44) | (-0.07) | (-1.41) |
| Leverage (TLMTA) | 10.94* | 3.465 | 18.35* |
| | (2.30) | (0.48) | (2.41) |
| Liquidity (CASHMTA) | 2.395 | -15.07** | -7.084* |
| | (1.28) | (-3.17) | (-1.98) |
| *N* | 3675 | 531 | 705 |

To check the alternative explanation of the main model depicted in Section 7 and we estimated the model using multinomial logit regressions. The choices of dependent variable are the issuance of the subordinated debt, CoCo bonds, and not issuing these debt instruments. We used the mean of independent variables in the period between 2009 and 2015. Since explanatory variables of bank features are correlated, we scaled all variables by total assets, expressed as percentages (coding d.). The variables of financial distress measures were calculated by market value in accordance with Campbell et al. (2008). We ran the model with financial distress measure calculated by book value, and the results were similar to those this table. Standard errors in parentheses:* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: Bloomberg, authors' calculations.

Additionally, our results show that countries that adopted Basel III rules increased the probability of banks to issue CoCo bonds. Also, the increasing amount of CoCo bond issuance might be derived from the incentives of tax deductibility for banks to issue these bonds in the United Kingdom after 2013. On the other hand, in countries with high credit-to-GDP gaps, banks had less probability of issuing CoCo bonds because they adopted the countercyclical capital buffer. Finally, we ran a multinomial logit including subordinated debt and the results confirmed our main results above.

Other important issues are related to the management of CoCo bond risks and the relation of the Coco bond issuance with systemic risk. The latter aspect is addressed in (Fajardo and Mendes, 2018) while the former is a topic of current research.

## 2.9 Appendix

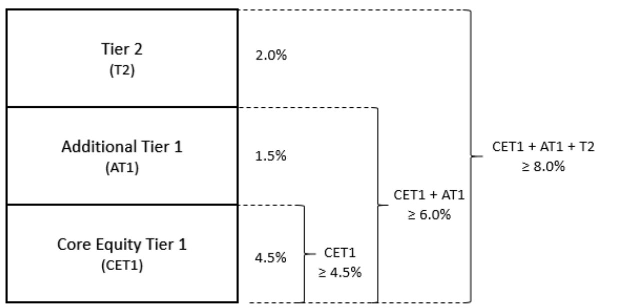



Figure 2.3: Basel III capital requirements

The figure illustrates the percentage capital requirement, which represents risk weighted assets, as proposed in BIS (2011). To compose the 8% of liquidity capital proposed by regulators, banks institutions can have 4.5% of RWA in Core Equity Tier 1, 1.5% in Additional Tier 1, and 2% in Tier 2. CoCo instruments are classified as Additional Tier 1 or Tier 2 according to trigger levels in the bond contract.

Table 2.14: The distribution of CoCo bond issuance across each country and year

| COUNTRY | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|
| AUSTRALIA | - | - | - | 1 | - | - | - | 1 |
| AUSTRIA | - | - | - | - | - | 1 | 2 | 3 |
| BELGIUM | - | - | - | - | 1 | 2 | - | 3 |
| BRAZIL | - | - | - | 2 | 2 | 7 | - | 11 |
| BRITAIN | - | 1 | - | 1 | 3 | 17 | 9 | 31 |
| CHINA | - | - | - | - | - | 11 | 10 | 21 |
| CYPRUS | - | - | - | - | 2 | - | - | 2 |
| DENMARK | - | - | - | 1 | - | 4 | 5 | 10 |
| ESTONIA | - | - | - | - | - | 1 | - | 1 |
| FAROE ISLANDS | - | - | 1 | - | - | - | - | 1 |
| FINLAND | - | - | - | - | - | - | 1 | 1 |
| FRANCE | - | - | - | - | 5 | 9 | 5 | 19 |
| GERMANY | - | - | - | - | - | 6 | 8 | 14 |
| GUERNSEY | - | - | 1 | 2 | - | - | - | 3 |
| INDIA | - | - | - | - | 1 | 3 | 9 | 13 |
| IRELAND | - | - | 1 | 1 | 6 | 3 | 3 | 14 |
| ISRAEL | - | - | - | - | - | - | - | - |
| ITALY | - | 1 | - | - | - | 2 | 2 | 5 |
| LUXEMBOURG | - | - | - | - | 6 | 7 | 1 | 14 |
| MALAYSIA | - | - | - | - | - | 1 | - | 1 |
| MEXICO | - | - | - | - | 2 | - | - | 2 |
| NETHERLANDS | - | - | 2 | - | 3 | - | 4 | 9 |
| NEW ZEALAND | - | - | - | - | - | - | 1 | 1 |
| NORWAY | - | - | - | 2 | 4 | 6 | 13 | 25 |
| PORTUGAL | - | - | - | 1 | - | - | - | 1 |
| SPAIN | - | - | - | 1 | 2 | 4 | 2 | 9 |
| SWEDEN | - | - | - | - | - | 6 | 8 | 14 |
| SWITZERLAND | - | - | - | 5 | 8 | 6 | 11 | 30 |

Table 2.15: Frequency of banks by country

| COUNTRY | Freq. | COUNTRY | Freq. | COUNTRY | Freq. |
|---|---|---|---|---|---|
| ARGENTINA | 7 | GRENADA | 1 | PAPUA N.GUINEA | 1 |
| ARMENIA | 3 | GUAM | 1 | PARAGUAY | 8 |
| AUSTRALIA | 31 | HONDURAS | 1 | PERU | 22 |
| AUSTRIA | 6 | HONG KONG | 6 | PHILIPPINES | 19 |
| AZERBAIJAN | 33 | HUNGARY | 1 | POLAND | 15 |
| BAHAMAS | 4 | INDIA | 43 | PORTUGAL | 2 |
| BAHRAIN | 13 | INDONESIA | 42 | PUERTO RICO | 3 |
| BANGLADESH | 32 | IRAQ | 22 | QATAR | 8 |
| BARBADOS | 2 | IRELAND | 3 | ROMANIA | 3 |
| BELGIUM | 6 | ISRAEL | 10 | RUSSIA | 50 |
| BELIZE | 1 | ITALY | 27 | RWANDA | 1 |
| BENIN | 1 | IVORY COAST | 3 | SAUDI ARABIA | 12 |
| BERMUDA | 1 | JAMAICA | 5 | SENEGAL | 1 |
| BOLIVIA | 9 | JAPAN | 95 | SIERRA LEONE | 1 |
| BOSNIA-HERZE. | 21 | JORDAN | 11 | SINGAPORE | 3 |
| BOTSWANA | 3 | KAZAKHSTAN | 14 | SLOVAKIA | 6 |
| BRAZIL | 22 | KENYA | 9 | SOUTH AFRICA | 7 |
| BRITAIN | 12 | KUWAIT | 10 | SOUTH KOREA | 13 |
| BULGARIA | 5 | KYRGYZSTAN | 4 | SPAIN | 10 |
| BURKINA FASO | 1 | LAOS | 1 | SRI LANKA | 18 |
| CANADA | 16 | LEBANON | 6 | ST. KITTS & NEV | 2 |
| CAPE VERDE | 2 | LIECHTENSTEIN | 2 | SUDAN | 1 |
| CAYMAN ISLANDS | 3 | LITHUANIA | 1 | SWAZILAND | 1 |
| CHILE | 8 | MACEDONIA | 14 | SWEDEN | 6 |
| CHINA | 26 | MALAWI | 4 | SWITZERLAND | 48 |
| COLOMBIA | 7 | MALAYSIA | 9 | SYRIA | 11 |
| COSTA RICA | 1 | MALTA | 4 | SERBIA | 7 |
| CROATIA | 13 | MAURITIUS | 3 | TAIWAN | 19 |
| CYPRUS | 3 | MEXICO | 7 | TANZANIA | 5 |
| CZECH | 3 | MOLDOVA | 12 | THAILAND | 11 |
| DEM.REP. CONGO | 1 | MONACO | 1 | TOGO | 1 |
| DENMARK | 22 | MONGOLIA | 2 | TRINIDAD AND TO | 2 |
| ECUADOR | 8 | MOROCCO | 6 | TUNISIA | 11 |
| EGYPT | 12 | MONTENEGRO | 13 | TURKEY | 15 |
| EL SALVADOR | 9 | NAMIBIA | 2 | UAE | 19 |
| FAROE ISLANDS | 1 | NEPAL | 94 | UGANDA | 2 |
| FINLAND | 3 | NETHERLANDS | 3 | UKRAINE | 84 |
| FRANCE | 17 | NIGER REPUBLIC | 1 | UNITED STATES | 1,104 |
| GAMBIA | 1 | NIGERIA | 17 | VENEZUELA | 7 |
| GEORGIA | 4 | NORWAY | 26 | VIETNAM | 9 |
| GERMANY | 8 | OMAN | 7 | ZIMBABWE | 3 |
| GHANA | 6 | PAKISTAN | 22 | ZAMBIA | 5 |
| GREECE | 8 | PALESTINE | 7 | Total | 2,552 |
| GREENLAND | 1 | PANAMA | 8 | | |

CHAPTER 3

# Do Contingent Convertible Bonds Reduce Systemic Risk?

## 3.1 Context and Motivation

In the past century, the world has experienced successive financial crises preceded or followed by banking panics and economic adjustments. From the Great Depression of 1929 to the subprime mortgage crisis of 2008, including many others, such as the oil price shock in 1973 and Asian financial crisis in 1997, economists have struggled to dissect, conceptualize and prevent the system from suffering new crises. Policymakers and academics are always looking for solutions that minimize the losses in crises and maintain the financial stability of the system. There is still no consolidated model that has proved able to forecasting financial crisis and allow banks to avoid distress.

After the 2008 financial crisis, regulators focused on a countercyclical capital buffer and capital requirement framework (BIS, 2011, 2010). Moreover, the Basel III framework suggested a hybrid loss-absorption instrument: the contingent convertible (CoCo) bond. The CoCo functions as a bail-in mechanism that can help banks in distress, offering to investors an investment instrument that pays a coupon return with another component that is automatically converted into equity at a predetermined trigger level (De Spiegeleer and Schoutens, 2011). This instrument emerged as an alternative to the much-criticized government bail-outs. According to Fajardo and Mendes (2019), banks that issued CoCo bonds were mainly larger ones ("too big to fail") and had high leverage, so they were using the issuance of CoCo bonds mainly in an attempt to meet the Basel III rules and reduce indebtedness. From that standpoint, CoCos can act as the first line of defense and public bail-in may be a complementary tool for banks that will likely remain distressed after the conversion of CoCos (Oster, 2019).

However, it remains unclear whether CoCo bonds will be effective in practice for loss absorption of issuers in the event of another financial crisis. This is an important point considering there are varying amounts of regulatory discretion built into triggers and the equity conversion or write-down mechanisms that can influence the results. There are still open questions to answer in the financial literature: Will CoCo bonds avoid bankruptcy in a future crisis? How much capital would be necessary to bail-in banks after a crisis? How does the CoCo bond issuance impact the financial market's systemic risk?

Systemic risk has been prevalent throughout history but has become more important in recent years. In particular, it is crucial for regulators to understand and address systemic risk. In practice, financial firms can fail per se, but in the context of firms' overall contribution to system-wide failure, this becomes systemic risk. Thus, a crisis can be interpreted here as undercapitalization of the financial sector (Acharya et al., 2012), where each bank is responsible for a portion of the market risk. In this way, Allen and Tang (2016) proposed a dual trigger mechanism for CoCos that focuses on systemic risk exposure, thus a banks with a large contributions to overall systemic risk – as measured by $\Delta CoVaR$ – experience automatic contingent capital conversion during periods of high aggregate systemic risk.

Regulatory agencies should encourage the use of financial instruments that can minimize the impacts of economic and systemic risks, ex-ante of stress events. In a crisis scenario where the CoCo trigger can be activated, the question arises of whether the bond will be able to absorb the losses given the volume that was issued. In light of this situation, there is a need to understand whether CoCo bonds are an effective bail-in mechanism, especially by satisfying liquidity or regulatory adequacy requirements. In an attempt to bring insights in this respect, we empirically analyze the impact of CoCo bond issuance on the decrease of systemic risk of commercial banks.

In the first exercise, we find, through the regressions with panel data, that issuing CoCo bonds may decrease the expected capital shortfall that a bank keeps for bail-in a future financial crisis. For accurate analysis, we use the approach of MacKinlay (1997), where the event day is the announcement of the first CoCo issuance by each bank. The results show that when banks issue their first CoCo, the expected capital shortfall decreases, implying that the market sees the first issue as adequate to Basel standards. However, some banks issue CoCo bonds more than once. Regarding this, we conduct an event study for the second announcement date of issue and find that the individual systemic risk increases after the new CoCo bond. This opposite result for the first and second issue can already denote possible mismanagement of resources and raise doubts regarding the dynamics of bank financial distress, thus increasing systemic risk.

It is important to mention that De Spiegeleer et al. (2016) studied previously the price performance of outstanding CoCos after announcement of a new CoCo issue by the same issuer. They compared average differences in cumulative returns with those of global CoCo bond indexes. They found a negative effect of about 20–40 bps on average in between the announcement date and the issue date.

The contribution of this study is the pioneering effort to assess whether and how the CoCo bonds can affect systemic risk in empirical terms. We conduct an event study that allows the assessing whether issuing CoCo bonds is a suitable tool to avoid financial distress and how an individual bank's systemic risk is impacted after the issuing of CoCo bonds. In the literature about systemic risk measures, there is no consensus about the most adequate systemic risk measure. For that reason, we choose three measures ($SRISK$, $SES$, and $\Delta CoVaR$), previously used and very well accepted in the literature to explain these measures clearly. Moreover, there is much criticism that studies of systemic risk "use different sources of systemic risk in isolation" (Benoit et al., 2017). Hence, this study employs these three measures to show not only the robustness of the results, but also to increase the credibility of this effect.

Additionally, although the method for assessing systemic risk used by both the Basel Committee on Banking Supervision (BCBS) and the Financial Stability Board (FSB) are simple and intuitive, we decided not to employ them because they have faced criticism recently (Benoit et al., 2019; Loffler and Raupach, 2018). Rather, we use the three different measures ($SRISK$, $SES$, and $\Delta CoVaR$) that avoid the pitfalls of the BCBS/FSB ones.

We employ a series of different statistical and methodological approaches, including a regression, event study, propensity score matching and difference-in-differences in order to reduce possible endogeneity problems, and results remain consistent.

It is also important to mention that Fajardo and Mendes (2019), using a global sample, found that bank characteristics affect the propensity to issue CoCo Bonds. In this study, we go a step further by analyzing the relationship between CoCo bond issues and systemic risk measures, in a clear and satisfyingly robust way.

Finally, Koziol and Lawrenz (2012) showed that, under certain modeling assumptions, if CoCos are part of the capital structure of a company, equity holders can adopt more risky strategies, trying to maximize the value of their shares. On the other hand, Dewatripont and Tirole (2012) argued that CoCo issuance is an appropriate solution that does not lead to moral hazard, provided that conversion is tied to exogenous macroeconomic shocks. In that sense, our research brings empirical evidence to complement those important theoretical contributions.

The study is organized as follows. Section 2 reviews the related literature on systemic risk. In Section 3, we develop the hypothesis. Sections 3 and 4 discuss the impact of CoCo bond issuance on systemic risk through a regression and event study estimation, respectively. The last sections presents the policy implications and conclusions.

## 3.2 Related Literature Review

Despite being widely used in the finance literature, the expression "systemic risk" remains difficult to define and quantify, mainly due to its complexity and scope across institutions, markets and countries.

Acharya and Richardson (2009) proposed that a combination of widespread failures of financial institutions and the freezing of capital markets leads to a severe financial crisis. In this way, systemic risk can be described as a severe credit and liquidity crisis where the entire financial system, including several markets and institutions, is simultaneously distressed (Patro et al., 2013). Thus, the spread of distress gives rise to systemic risk; which means that the intermediation capacity of the entire financial system is impaired, with potentially adverse consequences for the supply of credit to the real economy (Adrian and Brunnermeier, 2016).

According to Abdymomunov (2013), systemic risk can be defined as the risk of a severely negative shock affecting the entire financial system and the real economy, such as a macroeconomic shock, contagion effect due to a failure of an individual market and its interconnections with other banks in the system, or a shock caused by information disruption in financial markets.

Extrapolating the impact of negative shocks, Glasserman and Young (2015) estimated the extent to which interconnections increase expected losses and defaults under a wide range of shock distributions. They used three metrics about each node – net worth, outside leverage, and financial connectivity – and combined these variables in a simple contagion index for each node. They showed that this contagion index determines the relative likelihood that the node will cause other nodes to fail through contagion.

Another relevant aspect that can multiply negative shocks is the higher level of securitization that banks assume, in other words, banks use credit derivatives (i.e., CDS) to trade credit risks of a variety of exposures. Consequently, they transfer pools of loans from their balance sheet to third-party investors. Battaglia and Gallo (2013) showed, through an Italian database, that securitizing banks have, on average, higher expected losses in case of extreme events.

Aiming to find solutions that minimize losses in moments of financial distress, Anginer et al. (2014) showed the existence of a negative relationship between bank competition and systemic risk. Increased competition encourages banks to diversify risk, indirectly making the system less vulnerable to shocks. Following the same rationale, Vallascas and Keasey (2012) focused on identifying which bank characteristics offer shelter from systemic shocks and compared the relative effects of several hypothetical prudential rules on banks' risk exposure. They found that the size of the bank, the share of non-interest income, and asset growth are key determinants of the risk exposure of a bank. However, these elements were not taken into consideration during the development of new regulations.

The regulatory process used risk models that are directly embedded within the Basel regulations and are therefore employed to determine bank capital. Hence, according to Danielsson et al. (2016), the output of these models has a real economic impact. So it is important to understand to what extent decision-makers can rely on risk models and when their use is not advisable. In this line, Acharya and Richardson (2009) explained that the bankruptcy of the financial sector in the 2008 crisis occurred due to methods by which banks had circumvented regulatory capital requirements.

The discussion of banking regulation pervades the debate about the impact of too-big-to-fail banks on financial stability. The FSB (2011) already had proposed that global systemically important banks (GSIB) should have an extra percentage of capital requirement stipulated by regulators. This corroborates the claim of Arinaminpathy et al. (2012) that increasing the level of capital requirements of big banks can improve the resilience of the system, and these effects should be more pronounced in less diluted systems.

However, Zhou (2013) examined why imposing capital requirements may not reduce systemic risk or maintain the stability of a banking system. He showed through a static model the tradeoff of imposing capital requirements, finding that while it effectively reduces individual risks, it also can aggravate systemic linkage.

CoCos have since been put forward as a way to reduce systemic risk, as a bail-in strategy as proposed in the Basel III framework. However, U.S. regulators continue to regard CoCos with skepticism, given the uncertainty inherent in CoCo design and implementation. Policy analyses have examined how effective CoCos have been at resolving the challenges they were designed to address and whether an alternative policy measure would better fulfill the same ends. This perception is reflected in a particular metric of Basel III implementation, where the U.S. has grade 1 (adoption not started, the lowest grade possible): Capital requirements for equity investments in funds, including the CoCo implementation.

Having briefly described the broad concept and the implications of systemic risk, in the next section we discuss measures of systemic risk as required by the IMF (2009) after the 2008 crisis, which emphasize the need for tools to detect systemic risk.

### 3.2.1 Measures

Some researchers have proposed metrics to estimate systemic risk, but there is no consensus about which measure is the best to support for decision-making by regulators. Thus, in this section we present some systemic risk measures already discussed in the literature.

Lehar (2005) proposed a method to monitor the risk of a regulator's portfolio using stock market information. For this, the author estimated the joint dynamics of banks' asset portfolios for a sample of international banks, allowing comparing the risk over time as well as between countries. In the logic of a simple indicator, Patro et al. (2013) contributed to the literature by pointing out that stock return correlations are a useful indicator of systemic risk. Hence, the pattern of correlation movements, such as spikes, can be used with other measures to determine the likelihood of systemic failure.

To account for potential losses in future stress scenarios, Acharya et al. (2016) employed stressed capital shortfall measures. The first measure is book capital shortfall, based on book value of equity and assets, while the least stringent benchmark is the leverage ratio (book equity/assets) of 4% and the strictest benchmark is 7%. The authors suggested an alternative measure, replacing book value by market value. In the same line, Acharya et al. (2012); Richardson (2017), also developed a model in which a group of banks set leverage levels and choose asset positions in a broader economic environment with systemic risk emerging when aggregate bank capital drops below a given threshold.

On the other hand, Avramidis and Pasiouras (2015) introduced a systemic risk capital attribution procedure using $t$-factor and the double $t$-factor models that are well suited to cases of extreme event dependence. They calculated systemic risk as the expect credit losses and the contribution of each participant in the financial system.

There are three main recent measures to calculate the systemic risk as the capital shortfall that firms face in distress scenarios. The first measure is $\Delta CoVaR$, defined as the change in the value at risk of the financial system conditional on an institution being under distress relative to its median state (Adrian and Brunnermeier, 2016). The estimation of $\Delta CoVaR_q^i$ is based on quantile regressions that consider the value of financial sector losses $X_q^{system}$ on the loss of a particular institution $i$ for the $q\%-quantile$, given by:

$$\hat{X}_q^{system|X^i} = \hat{\alpha}_q^i + \hat{\beta}_q^i X^i. \tag{3.1}$$

Thus, the predicted value of the quantile regression of system return losses on the losses of institution $i$ gives the value at risk (VaR) of the financial system conditional on $X^i$. In this way, $\Delta CoVaR$ can be expressed as a percentage loss rate, (3.2) $$\Delta CoVaR_q^i = \widehat{\beta}_q^i (VaR_q^i - VaR_{50}^i),$$

or in dollar terms,

(3.3) $$\Delta^{\$} CoVaR_q^{j|i} = Size^i . \Delta CoVaR_q^{j|i}.$$

The second model of systemic risk was proposed by Richardson (2017), called systemic expected shortfall (SES). SES is defined as the expected amount by which a bank will be undercapitalized in a future systemic event in which the overall financial system is undercapitalized. The model takes into account a linear combination of financial firms' marginal expected shortfall ($MES$) and the leverage of each bank ($LVG$). The first component can be estimated by:

(3.4) $$MES_{5\%}^i = \frac{1}{\#days} \sum R_t^i,$$

where $MES$ is estimated at a standard risk level of the worst 5% of days of market returns ($R$) in a given period and the equally weighted average return of any given firm ($R^i$) for those days. The second component is the standard approximation of leverage, denoted by:

(3.5) $$LVG^i = \frac{\text{book assets} - \text{book equity} + \text{market equity}}{\text{market value of equity}}.$$

The last measure is SRISK proposed by Brownlees and Engle (2017a), whose definition is the expected capital shortfall of a financial entity conditional on a systemic event. In other words, SRISK is a function of the size of the firm, its degree of leverage, and its expected equity loss conditional on the market, which can be defined for firm $i$ on days $t$ as

$$
\begin{aligned}
(3.6) \qquad SRISK_{it} &= E_t(CS_{it+h} | R_{mt+1:t+h} < C), \\
&= kE_t(D_{it+h} | R_{mt+1:t+h} < C) - (1-k)E_t(W_{it+h} | R_{mt+1:t+h} < C), \\
&= w_{it}[kLVG_{it} + (1-k)LRMES_{it} - 1],
\end{aligned}
$$

where $D_{it}$ is the book value of debt, $W_{it}$ is the market value of equity, $E_{it}$ is the book value of equity, and $k$ is a prudential management measure restricting each institution's equity as a fraction of its assets (the authors adopted 8%). The expected loss of market value is the long-run marginal expected shortfall (LRMES), which was constructed from predictions using a GARCH-DCC model. The model assumes that, in case of a systemic event, the debt cannot be renegotiated.

## 3.3 Hypothesis Development

The discussion of the concept of systemic risk and its measures is relevant, mainly in the post-crisis period, for both academics and practitioners, although there is no consensus about which method is more theoretically valid. A crisis can be understood as undercapitalization of the financial system or lack of liquidity.

In this context, CoCo bonds are a new instrument to relieve financial distress, and hence reduce possible systemic dissemination of distress, as a mechanism of bail-in protection against bankruptcy in the short term. In recent study, Fiordelisi et al. (2019) developed a theoretical model and empirical tests to show the investors' expectation of whether or not the CoCo bond will be converted or written down. They found that CoCo issuance leads to a reduction in stock return variance and several other measures of downside risk.

In light of these concepts, and taking into consideration the discussion presented in the literature review, we hypothesize that:

*$H_1$: The first issuance of CoCo bonds reduces the systemic risk of the issuing bank.*

Since CoCo bond issuance is a preventive instrument for future losses in financial distress scenarios and systemic risk calculation accounts for future losses, it is logical to expect CoCo issuance to reduce systemic risk. Nevertheless, it is important to consider that some banks issue CoCos more than once. This could signal that the bank needs to increase its capital at tiers 1 and 2. In those cases, previous explanation about the ability of issuing CoCo bonds to reduce systemic risk would not be adequate. Therefore, we also hypothesize that:

*$H_2$: The second issuance of CoCo bonds also reduces the systemic risk of the issuing bank.*

To test these hypotheses, we conduct two main sets of empirical exercises. First, we estimate a regression model in order to investigate the impact of CoCo issuance on systemic risk of the bank. Second, we design an event study that determines how the announcement and issuance of CoCo bonds influence the systemic risk. Also, we discuss the behavior of banks' systemic risk in case of multiple CoCos issuuance.

## 3.4 Regression Approach

This section describes the model employed to test the relationship between a systemic risk and CoCo bond issuance. This allows us to check the main hypothesis ($H_1$), according to which issuing CoCo bonds can decrease the systemic risk in the short term. Therefore, we estimate the following model:

$$SR_{i,t} = \beta_0 + \beta_1 DummyCoCo + \sum_{j=1}^{J} \beta_j X_{i,t}^{j} + \lambda_t + \eta_i + \varepsilon_{i,t}. \tag{3.7}$$

The dependent variable $\mathrm{SR}_{i,t}$ is the systemic risk for each bank $i$ at time $t$, with $i = 1,...,N$, $t = 1,...,T$ . As proxies of systemic risk, we use three different measures: $SRISK$ (Brownlees and Engle, 2017a,b), $SES$ (Richardson, 2017), and $\Delta CoVaR$ (Adrian and Brunnermeier, 2016).

$\beta_0$ is a constant term and DummyCoCo is the explanatory variable of interest of the model, which assumes value 1 when the bank issues the CoCo bonds, and 0 otherwise.

The $X_{i,t}$'s are the bank control variables. The bank size (Size) is measured as the natural logarithm of total assets; profitability (ROE) of the bank is calculated by the return on equity; capital structure (Debt) is calculated by dividing total debt by total assets; price-to-book (P/B) is a proxy for the bank's charter value, which is calculated by the bank's market capitalization of equity divided by the book value of equity; and finally capital tier 1 (Tier 1) and tier 2 (Tier 2) refer to the capital adequacy requirement according to the relevant regulation.

Furthermore, $\varepsilon_{i,t}$ is the disturbance, with $\nu_i$ the unobserved bank-specific effect and $u_{i,t}$ the idiosyncratic error. The parameter $\lambda_t$ is a time dummy variable that changes in time but is equal for all banks in each of the time periods considered. This parameter is designed to capture the influence of economic factors that may also affect banks' systemic risk but which they cannot control. Finally, $\eta_i$ is the bank's unobserved heterogeneity and captures the particular characteristics of each bank.

### 3.4.1 Sample

We obtained data on CoCo bond issuance from Bloomberg (478 bonds issued) and control variables – the data about each bank's financial structure – were extracted from the Capital IQ/Compstat database (3460 banks). With regard to systematic risk measures, we obtained $SRISK$ from V-LAB (1320 firms); and we calculated $SES$ and $\delta CoVAR$ from the Bloomberg database (1320 firms). After merging datasets, our sample is an unbalanced panel dataset of 382 banks from 65 countries. It consists of 14,478 quarterly observations over the years from 2009 to 2018 (2nd quarter).

In order to further limit the influence of outliers, we winsorized all variables in the model at the 1st and 99th percentiles. That is, we replaced any observation below the 1st percentile with the 1st percentile and any observation above the 99th percentile with the 99th percentile. Table 4.4 reports some descriptive statistics for systemic risk measures, CoCo bond issuance, and the control variables. We also verified that the correlations between variables are between -0.5 and 0.5.

Table 3.1: Summary statistics

| Variable | Mean | Std. Dev. | Min. | Max. | N |
|---|---|---|---|---|---|
| SRISK | 485.799 | 4374.681 | -9382.99 | 9557.42 | 13334 |
| SES | 0.623 | 0.649 | 0.046 | 4.119 | 13352 |
| ΔCoVaR | 112.217 | 348.94 | -0.505 | 2161.518 | 10580 |
| CoCo bond | 0.071 | 0.257 | 0 | 1 | 14478 |
| DEBT | 0.182 | 0.511 | 0 | 27.043 | 12136 |
| ROE | 9.919 | 9.833 | -40.7 | 33 | 12115 |
| P/B | 1.653 | 2.105 | -6.989 | 57.401 | 9523 |
| TIER 1 | 13.004 | 4.199 | 6.72 | 35 | 8509 |
| TIER 2 | 2.604 | 1.484 | 0 | 6.73 | 5513 |

We also calculated the variance inflation factor (VIF) for each independent variable in our models. The largest VIF value is 1.24, which confirms there is no multicollinearity problem in our sample because it is far from 5 (Studenmund and Cassidy, 1997).

### 3.4.2 Results

Initially, we applied the Breusch and Pagan Lagrangian multiplier test for the three different dependent variables for random effects and rejected the null hypothesis that variances across entities are zero, so the random effect model can deal with heterogeneity better than pooled OLS[1]. Then, we used the Hausman test to select the appropriate estimation method between fixed and random effects. Rejection of the null hypothesis in all estimations indicates the correct method is fixed effects. The results obtained from Eq. (4.4) appear in Table 2, which summarizes the empirical results for systemic risk measures – $SRISK$ (columns 1), $SES$ (columns 2), and $\Delta CoVaR$ (columns 3).

In all estimations, the variable of CoCo bond issuance was negative and significant, that is, the fact that the bank issued the CoCo bond decreased on average the amount of expected capital shortfall that bank needs for future distress scenarios. These findings support and confirm our $H_1$, according to which CoCo bond issuance reduces the systemic risk of the issuing bank due to a positive signal that it adopted the regulatory recommendations, and is protecting against possible future losses by building a counter-cyclical capital.

[1]By running a panel-consistent estimator, we obtained similar results to those presented by OLS. Hence we used the latter approach.

Table 3.2: Results of estimations

| | (1)<br>SRISK | (2)<br>SES | (3)<br>ΔCoVaR |
|---|---|---|---|
| CoCo bond issue | -605.0* | -2.097** | -65.00*** |
| | (298.1) | (0.657) | (8.544) |
| SIZE | 837.6*** | 10.19*** | 91.28*** |
| | (164.8) | (0.858) | (11.23) |
| DEBT | 2757.4** | 23.31*** | -66.77 |
| | (1058.4) | (3.020) | (39.29) |
| ROE | -4.827 | -0.127*** | -0.229 |
| | (7.344) | (0.0208) | (0.285) |
| P/B | 91.41 | -0.162 | -0.709 |
| | (57.14) | (0.169) | (2.180) |
| TIER 1 | -71.42 | 0.377*** | 1.691 |
| | (40.54) | (0.0942) | (1.270) |
| TIER 2 | 260.0** | 0.0656 | -7.034** |
| | (79.42) | (0.175) | (2.433) |
| Constant | -1259.1*** | 114.7*** | -896.2*** |
| | (319.6) | (10.59) | (140.2) |
| Observations | 3993 | 4219 | 3552 |
| $R^2$ | 0.072 | 0.070 | 0.127 |
| Bank FE | Yes | Yes | Yes |
| Quarterly FE | Yes | Yes | Yes |

Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regarding the controls, the effect of Size was positive and significant, showing that the relevance of large banks to systemic risk than that of small banks. DEBT was positive and significant for model estimations with $SRISK$ and $SES$ since that capital structure is a parameter to calculate these dependent variables. The other control variables had a theoretical impact on the outcome, although they are not relevant to the objective of this study.

### 3.4.3 Robustness check

#### 3.4.3.1 Subsample analysis

As a robustness check, we divided the sample into three groups (GSIB, European countries, and emerging countries) according to country economic similarities, because our sample is composed of banks with different features and in different countries. The first group is composed of "Global Systemically Important Banks" (GSIB), which are composed of too-big-to-fail banks – according to the list of the Financial Stability Board (FSB) – that have special regulation (FSB, 2011). The second group consists of banks in the European Union, which adopted the recommendations of Basel III and encouraged the issuance of CoCo bonds. The last group is composed of banks in emerging countries, which typically deal with challenges such as global economic slowdown, rising interest rates, trade protectionism, and geopolitical tensions. Table 3.3 presents the results of estimation by subsamples and systemic risk measures.

Analyzing the results for the group of European Union banks (columns 2, 5 and 8), we can conclude that the coefficient of the CoCo issuance variable was negative and significant for three measures of systemic risk. Thus, these findings corroborate the previous results and confirm hypotheses 1. However, the results of our main independent variable (CoCo bond issuance) for the emerging country subsample (columns 3, 6, and 9) were negative and significant only when the model was estimated with SRISK as the outcome. Moreover, in the estimations of the GSIB group (columns 1, 4, and 7), the coefficients of CoCo bond issuance were negative and significant in the models with $SES$ and $\Delta CoVaR$ as the dependent variables. The majority of these results confirm hypothesis 1, since they were not significant in all models and groups.

#### 3.4.3.2 Matching

As a robustness check to minimize the endogeneity problem, we implemented a matching analysis for banks that issued CoCo bonds or not. The matching is used to estimate the counterfactual outcomes of subjects by using the results from a subsample with similar behavior or features as the other group.

First, we estimated the propensity score (Rosenbaum and Rubin, 1983), which is a scalar func-

Table 3.3: Robustness check: subsamples analysis

| | SRISK | | | SES | | | Δ CoVaR | | |
|---|---|---|---|---|---|---|---|---|---|
| | GSIB | Europe | Emergent | GSIB | Europe | Emergent | GSIB | Europe | Emergent |
| CoCo bond issue | -267.2 | -739.8* | -701.3* | -15.41*** | -4.565** | -0.0487 | -217.5*** | -82.61*** | -2.73 |
| | (587.4) | (287.4) | (363.3) | (4.461) | (1.648) | (0.0484) | (39.18) | (14.47) | (15.82) |
| SIZE | 2269.2** | 1479.2** | 285.3 | -55.25*** | -31.18*** | 0.0254 | 36.16 | -3.968 | 121.4*** |
| | (807.8) | (468.3) | (463.8) | (6.137) | (2.687) | (0.0619) | (54.06) | (24.54) | (19.92) |
| DEBT | 2293.7 | 1352.6 | 2653.8 | 163.3*** | 45.70*** | 2.580*** | -27.29 | -97.86 | -265.4** |
| | (2936.5) | (1241.9) | (2097.7) | (22.33) | (7.115) | (0.28) | (193.6) | (62.25) | (93.88) |
| ROE | -4.838 | -1.16 | -12.24 | -0.574*** | -0.191*** | -0.00121 | 0.592 | 0.0948 | -0.486 |
| | (17.65) | (8.484) | (11.87) | (0.134) | (0.0487) | (0.00158) | (1.169) | (0.431) | (0.568) |
| P/B | 23.25 | 66.41 | 90.72 | -0.976 | 1.422 | 0.0271** | -3.178 | 0.731 | 0.932 |
| | (288.6) | (163.6) | (68.19) | (2.197) | (0.939) | (0.0091) | (19.24) | (8.34) | (2.851) |
| TIER 1 | 17.39 | 123.5** | -229.8*** | 5.511*** | 1.050*** | -0.0328*** | 6.261 | 4.684* | 1.516 |
| | (135.9) | (41.34) | (56.29) | (1.035) | (0.237) | (0.007) | (9.022) | (2.126) | (2.527) |
| TIER 2 | 1030.6*** | 187.1* | 262.3** | -6.013** | 0.405 | -0.0246* | 5.203 | -6.713 | -1.697 |
| | (274.4) | (84.04) | (90.23) | (2.09) | (0.482) | (0.012) | (18.25) | (4.498) | (4.156) |
| Constant | -36015.3** | -18803.1** | -224.1 | 748.6*** | 367.5*** | 0.464 | 105.2 | 328.4 | -1187.1*** |
| | (12498.8) | (5888.7) | (5551.8) | (94.94) | (33.8) | (0.741) | (835.8) | (310.8) | (240.6) |
| Observations | 482 | 1386 | 1902 | 486 | 1390 | 1903 | 475 | 1226 | 1437 |
| $R^2$ | 0.149 | 0.051 | 0.1 | 0.412 | 0.168 | 0.141 | 0.327 | 0.233 | 0.155 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Quarterly FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

tion of a set of covariates that determines the probability of a bank issuing a CoCo bonds, through logistic regression. Then, we balanced the sample by a one-to-one matching with replacement, as shown in Table 3.4.

Table 3.4: Robustness check: balanced matching

| | Treat | Control | Difference | T-statistics | % bias reduction |
|---|---|---|---|---|---|
| SRISK | | | | | |
| SIZE | 13.693 | 13.775 | -0.082 | -0.86 | 94.2 |
| DEBT | 0.261 | 0.283 | -0.023 | -2.08* | 63.2 |
| ROE | 9.036 | 8.021 | 1.015 | 1.98* | 28.5 |
| P/B | 0.821 | 0.882 | -0.061 | -1.34 | 89.8 |
| TIER 1 | 13.878 | 13.757 | 0.121 | 0.59 | 89 |
| TIER 2 | 2.771 | 2.503 | 0.267 | 3.69*** | -2.7 |
| SES | | | | | |
| SIZE | 13.863 | 13.838 | 0.025 | 0.28 | 98.4 |
| DEBT | 0.267 | 0.285 | -0.018 | -1.57 | 73.6 |
| ROE | 9.103 | 7.580 | 1.522 | 2.89*** | -10 |
| P/B | 0.771 | 0.720 | 0.050 | 1.96 | 92.2 |
| TIER 1 | 13.952 | 13.888 | 0.064 | 0.31 | 94.5 |
| TIER 2 | 2.829 | 2.441 | 0.388 | 5.33*** | -18 |
| $\Delta CoVaR$ | | | | | |
| SIZE | 13.788 | 13.926 | -0.138 | -1.38 | 90.2 |
| DEBT | 0.266 | 0.248 | 0.018 | 1.89 | 63.1 |
| ROE | 9.091 | 8.423 | 0.668 | 1.35 | 24.1 |
| P/B | 0.821 | 0.838 | -0.016 | -0.34 | 97.3 |
| TIER 1 | 13.944 | 13.645 | 0.299 | 1.38 | 76 |
| TIER 2 | 2.785 | 2.624 | 0.161 | 2.21* | 33.8 |

T-statistics: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Since the differences between the treatment and control groups after matching were not significant for the most covariates, we concluded that the balance was reached and the groups did not differ. Since CoCo bonds are a type of Tier 2 capital, it is expected that only issuing banks had accounts this variable. So, the significant difference between the groups is also expected for Tier 2.

Alternatively, we performed a propensity score analysis using the nearest neighbor matching estimator (Abadie et al., 2004). We matched the observations using control variables as covariates, and we exactly matched the bank's country. Hence, the control group for a bank with CoCo bond issuance equal to 1 is an observation of another bank from the same country, with similar size, capital structure, regulatory capital level, and price-to-book ratio.

The average treatment effect on the treated for both methods is shown in Table 4.8.

Table 3.5: Robustness check: Matching

| | SRISK | SES | CoVaR |
|---|---|---|---|
| Propensity-Score Matching | | | |
| ATT | -838.14*** | -0.198*** | -442.727*** |
| | (335.552) | (0.065) | (44.252) |
| Nearest-Neighbor Match | | | |
| ATT (exact match) | -802.435*** | -0.136*** | -42.451 |
| | (325.005) | (0.061) | (52.312) |

Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In the first estimation, using propensity-score matching, ATT was negative and significant at 5%, indicating significant differences in the average of systemic risk measures between groups that issued CoCo bonds or not. In the second estimation, the results were consistent with the previous findings, except for the model with $\Delta CoVaR$ as dependent variable. In conclusion, the results indicate that the confirmation of hypothesis 1 is robust, since after the matching of the groups, the result of the independent variable persists.

## 3.5 Event Study

An event study aims to measure short-term reactions to corporate events, such as earnings announcements, IPOs, etc. Therefore, using financial market data, an event study measures the impact of a specific event on the value of a firm (MacKinlay, 1997). The usefulness of such study comes from the fact that, given rational behavior in the marketplace, the effects of an event will be reflected immediately in security prices.

In this study, we replace security prices with capital shortfall measures ($SRISK$, $SES$, and $\Delta CoVaR$), because the objective is to analyze the impact of CoCo issuance on systemic risk, and consequently the regulatory effect. As mentioned by Schwert (1981), firms will seek regulation that increases security prices and try to avoid regulation that decreases security prices. Thus security price behavior cannot measure all regulatory effects.

We adopt the approach of MacKinlay (1997). This model seeks to identify whether there is a statistically significant abnormality in the systemic risk performance that can be specifically attributed to CoCo issuance, such that:

$$AR_{i\tau} = R_{i\tau} - \hat{\alpha_i} - \hat{\beta_i} R_{m\tau}, \tag{3.8}$$

where $\hat{\alpha_i}$ and  are the ordinary least square (OLS) parameters estimated from the regressions of SRISK ($R_{we\tau}$) on Market Index ($R_{m\tau}$). The abnormal return ($AR_{i\tau}$) is the disturbance term of the market model, calculated with an out-of-sample bias, which is the excess return caused by the event. The abnormal return observations must be aggregated, in time and bank dimensions, in order to draw overall inferences about the CoCo issuance event. $CAR_i(\tau_1, \tau_2)$ is defined as the sample of cumulative abnormal returns:

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau} \tag{3.9}$$

In this way, we can test the null hypothesis that the abnormal return is zero using the $T$ statistics ($\theta_1 = \overline{CAR}(\tau_1, \tau_2)/var(\overline{CAR}(\tau_1, \tau_2))$.

### 3.5.1 Event window

The event day is defined as the announcement date of the CoCo issuance for each bank, available in the Bloomberg database. Assuming that the market is semi-strong efficient (Malkiel and Fama, 1970; Fama, 1991), this date captures the reactions of the market in general when hearing the news that a bank will issue CoCo bonds. Thus, this is considered as time zero. Alternatively, we also use the issue date of CoCo bonds as the event day.

The event window is composed of 11 days: 5 pre-event days, the event day, and 5 post-event days. As a disclaimer, the average period between the announcement and the issuance is the 8.1 days in the sample. For each announcement/issuance, the 180-trading-day period before the event window is used as the estimation window. Figure 3.1 illustrates the timeline of the event study.

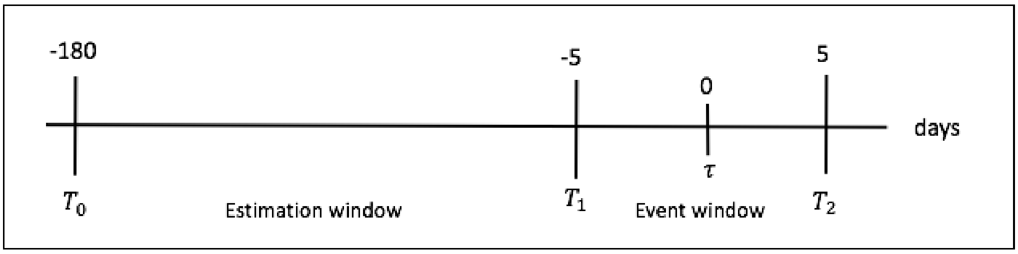



Figure 3.1: Timeline of the event study

### 3.5.2 Sample

From V-LAB[2] and Bloomberg, we extracted and calculated the daily $SRISK$, $SES$, and $\Delta CoVaR$ metrics from January 1, 2008 to May 31, 2018. As a benchmark of these systemic risk measures, we used the market index for each country (see the index in Table 3.6), extracted from Bloomberg. The CoCo bond attributes, such as issue date, announcement date, maturity, volume, and other information, were obtained from Bloomberg also. After merging both databases and excluded missing data, the final sample had 96 banks[3] (see Table 3.6) .

Additionally, we tested the unit root for $SRISK$, $SES$, and $\Delta CoVaR$ time series because the estimation model used in the method must be estimated in first differences. The test implemented was from Harris-Tsavalis, where the null hypothesis – panels contain unit roots – was rejected

[2]The Volatility Laboratory (V-Lab) of New York University, provides real time measurement, modeling and forecasting of financial volatility and correlations for a wide spectrum of assets. V-Lab blends together both classic models as well as some of the latest advances proposed in the financial econometrics literature.

[3]The sample did not contain the U.S. banks because the country's regulators of the country should continue to regard these securities with skepticism and caution given the deficiencies inherent in CoCo design and implementation. From them, the policy analysis examines how effective CoCos have been at resolving the challenges they were designed to address and whether an alternative policy measure would better fulfill the same ends. These perceptions are reflected in metrics of Basel III implementation, when the country has grade 1 (adoption not started) in the variable of Capital requirements for equity investments in funds BIS (2020).

Table 3.6: Number of banks by country

| Country | Banks | Codes | Market Index |
|---|---|---|---|
| Australia | 3 | AS51 Index | S&P/ASX 200 |
| Austria | 3 | ATX Index | Vienna Stock Exchange Austrian Traded Index |
| Belgium | 1 | BEL20 Index | BEL 20 Index |
| Brazil | 3 | IBOV Index | Ibovespa Brasil Sao Paulo Stock Exchange Index |
| China | 19 | SHCOMP Index | Shanghai Stock Exchange Composite Index |
| Colombia | 1 | IGBC Index | Indice General de la Bolsa de Valores de Colombia 30 Index |
| Cyprus | 1 | CYSMFTSE Index | FTSE/CySE20 |
| Denmark | 3 | OMXC25 Index | OMX Copenhagen 25 Index |
| Finland | 1 | HEX25 Index | OMX Helsinki 25 Index |
| France | 3 | CAC Index | CAC 40 Index |
| Germany | 3 | DAX Index | Deutsche Boerse AG German Stock Index DAX |
| India | 13 | BSE500 Index | S&P BSE 500 Index |
| Ireland | 1 | ISEQ Index | Irish Stock Exchange Overall Index |
| Israel | 3 | TA-125 Index | Tel Aviv Stock Exchange 125 Index |
| Italy | 2 | IT8300 Index | FTSE IT ALL-SHARE BANKS INDEX |
| Malaysia | 5 | FBMKLCI Index | FTSE Bursa Malaysia KLCI Index - Kuala Lumpur Composite Index |
| Mexico | 1 | MEXBOL Index | S&P/BMV IPC |
| Netherlands | 1 | AEX Index | Amsterdam Exchange index |
| Norway | 5 | OBX Index | Oslo Stock Exchange 25 Index |
| Spain | 6 | IBEX Index | IBEX 35 Index |
| Sweden | 4 | OMX Index | OMX Stockholm 30 Index |
| Switzerland | 8 | SMI Index | Swiss Market Index |
| UK | 6 | UKX Index | FTSE 100 Index |

(p-value < 0.001). The series were already stationary, so in first differences, serial autocorrelation of errors in the model were added.

### 3.5.3 Results

Table 3.7 summarizes the $T$ statistics for each event study (announcement and issue dates) by each systemic risk measure ($SRISK$, $SES$, and $\Delta CoVaR$).

Table 3.7: Event Study

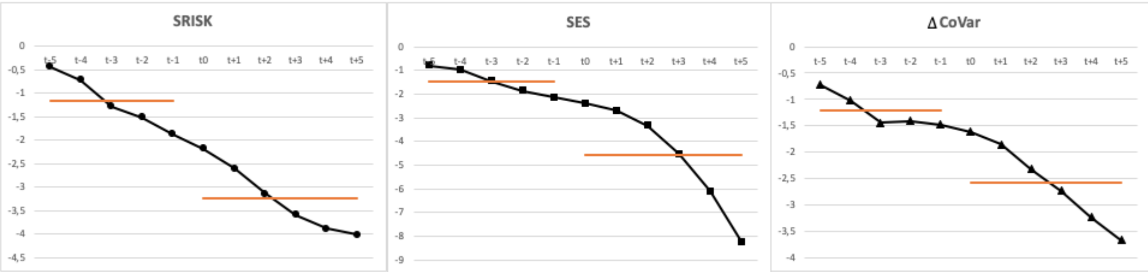
| | SRISK | SES | ΔCoVaR |
|---|---|---|---|
| Panel A: First CoCo Issue | | | |
| Number of banks | 96 | 96 | 96 |
| Announcement date | -4.016*** | -8.254*** | -3.672*** |
| Issue date | -4.538*** | -7.378*** | -6.005*** |
| | | | |
| Panel B: Second CoCo Issue | | | |
| Number of banks | 48 | 48 | 48 |
| Announcement date | 5.451*** | 2.992*** | 2.283*** |
| Issue date | 4.767*** | 1.604 | 2.342*** |

The t-statistcs are based on a two-tailed test,* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In panel A, analyzing the impact of first CoCo announcement/issue on systemic risk ($H_1$), the value of $\theta$ is negative and significant at 5%, indicating that the announcement date and issue date are events, and strongly rejecting the null hypothesis that the event has no impact. Thus, when a bank announces the issuance of CoCo bonds, the bank's capital shortfall decreases. This CoCo announcement/issue can be interpreted as a good sign to the market that banks are adhering to regulatory recommendations. Figure 3.2 illustrates the results of the $T$-statistics across the event window.

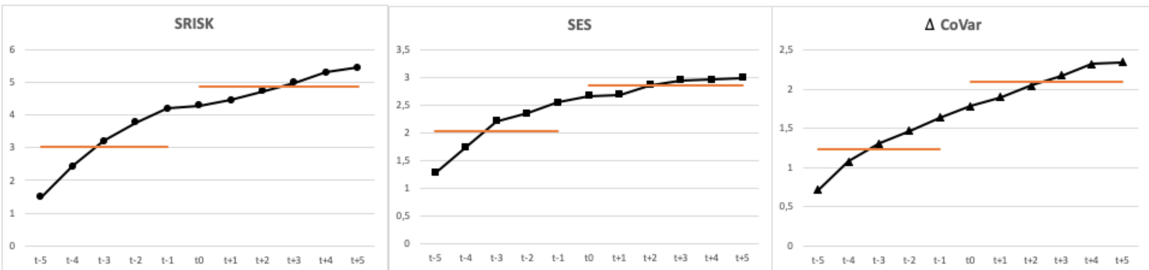
On the other hand, since banks can issue CoCo bonds whenever desired according to their strategy, we also analyzed 48 banks that issued CoCo bonds a second time ($H_2$). Using the previous approach, we performed an event study where the event window was five days before and after the announcement date and issue date of the second CoCo bonds by each bank in the sample.

Figure 3.2: Plot of cumulative abnormal return for the first announcement of CoCo bond issuance from event day -5 to event day 5.




In panel B in Table 3.7, the announcement date and issue date had positive and significant $\theta$ value – except for the $SES$ measure on the issue date. This means that systemic risk increased in the event window and $H_2$ is rejected. In other words, the second issuance can be interpreted as a negative signal to the market, indicating financial fragility of the bank for needing a greater counter-cyclical capital buffer. Figure 3.3 illustrates the results of the $T$ statistics across the event window.

Figure 3.3: Plot of cumulative abnormal return for the second announcement of CoCo bond issuance from event day -5 to event day 5.




These results are in line with De Spiegeleer et al. (2016), who studied the impact on the price performance of outstanding CoCos after a announcement of a new CoCo issue by the same issuer. The authors compared averaged differences in cumulative returns with those of global CoCo bond indexes: Credit Suisse index and Merrill Lynch index. They found a moderate negative effect on outstanding CoCo bonds of about 20–40 bps on average between the announcement date and issue date.[4]

[4] One critique to this approach is the fact that these indexes cannot reflect the true behavior of the market.

We interpret this puzzling effect through signaling theory. We theorize that by issuing the CoCo bonds for the first time, the bank is signaling a prudential decision, and decreasing its risk in the market's perception. However, the second issue signals to the market that the bank may be distressed, and exposed to more risk than the market has priced, and causing the systemic risk metrics to increase.

### 3.5.4 Robustness check

#### 3.5.4.1 Different event window estimation

In the estimation of the event window, we adopted five days surrounding the announcement/issue date of the of CoCo bonds. However, as a robustness check, we estimated the event study with alternative event windows – surrounding three, ten and twenty days – leading to similar results. Table 3.8 presents the $T$-statistics for estimation of the $SRISK$, $SES$, and $\Delta CoVaR$ measures of systemic risk.

The results of the first issue of CoCo bonds, in all event windows, had negative CAR and was significant at 1%, like the previous findings. However, the same did not occur for the second issue because CAR was not significant for $\Delta CoVaR$ estimation in bandwidths of three and twenty days, emphasizing the effect is stronger some days after the announcement/issue. In this sense, these results confirms our hypothesis and corroborate the findings in the main estimation of the event study.

#### 3.5.4.2 Subsample analysis

As in testing the robustness of the previous section, we divided the banks into subsamples – GSIB, European Union, and emerging countries – and performed the same event study approach. Table 3.9 summarizes the $T$-statistics for each event study (announcement and issue dates) according to each systemic risk measure ($SRISK$, $SES$, and $\Delta CoVaR$).

Table 3.8: Robustness check of event study: different event window estimations

| | First issue | | Second issue | |
|---|---|---|---|---|
| Event Window | Announce date | Issue date | Announce date | Issue date |
| t-1 to t+1 | | | | |
| SRISK | -2.227*** | -1.809* | 2.447*** | 3.594*** |
| SES | -5.135*** | -1.505* | 4.680*** | 1.131 |
| ΔCoVaR | -1.203 | -4.822*** | 1.037 | 1.205 |
| t-3 to t+3 | | | | |
| SRISK | -3.574*** | -3.335*** | 4.199*** | 4.470*** |
| SES | -4.432*** | -3.732*** | 2.251*** | 1.170*** |
| ΔCoVaR | -2.505*** | -4.822*** | 1.832 | 1.906 |
| t-10 to t+10 | | | | |
| SRISK | -4.217*** | -7.714*** | 6.000*** | 5.323*** |
| SES | -13.657*** | -12.688*** | 5.905*** | 3.300*** |
| ΔCoVaR | -5.928*** | -8.427*** | 2.586*** | 2.243*** |
| t-20 to t+20 | | | | |
| SRISK | -6.907*** | -12.637*** | 7.551*** | 7.960*** |
| SES | 21.405*** | 19.556*** | 14.029*** | 9.705*** |
| ΔCoVaR | -9.761*** | -15.007*** | 2.996*** | 1.075 |

The t-statistics are based on a two-tailed test,* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In the analysis of first and second issues, the same results were obtained for emerging countries and GSIB. However, for European banks, the value of $\theta$ on the announcement/issue dates was significant only for the model with the $SES$ variable.

These results can be explained by the fact that banks in the GSIB and emerging countries have more severe macroprudential policies for capital requirement than the group of European countries, since European banks' systemic risk did not increase or decrease after the event.

Finally, these results corroborate our main results, emphasizing the validity and robustness of the findings in the tests of hypotheses 1 and 2.

Table 3.9: Robustness check of event study: subsample analysis

| | SRISK | | | SES | | | ΔCoVaR | | |
|---|---|---|---|---|---|---|---|---|---|
| | GSIB | IBRD | Europe | GSIB | IBRD | Europe | GSIB | IBRD | Europe |
| Panel A: First CoCo Issue | | | | | | | | | |
| Number of banks | 18 | 42 | 50 | 18 | 42 | 50 | 18 | 42 | 50 |
| Announce date | -2.127*** | -1.882 | -0.478 | -7.998*** | -10.223*** | -10.123*** | -5.458*** | -1.061 | -0.549 |
| Issue date | -5.510*** | -2.750*** | -2.495*** | -8.390*** | -11.249*** | -11.283*** | -4.260*** | -8.332*** | -1.008 |
| Panel B: Second CoCo Issue | | | | | | | | | |
| Number of banks | 18 | 14 | 34 | 18 | 14 | 34 | 18 | 14 | 34 |
| Announce date | 2.980*** | 6.491*** | 0.476 | 7.685*** | 5.576*** | 8.835*** | 2.739*** | -1.374 | -0.71 |
| Issue date | 2.179*** | 6.045*** | 0.064 | 7.988*** | 6.172*** | 8.707*** | 2.505*** | -0.692 | 0.047 |

The t-statistcs are based on a two-tailed test,* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

## 3.6 Policy Implications

A decade after the last financial crisis, policymakers still worry about their main objective of protecting financial stability by reducing systemic risk. Some macroprudential policies were implemented using capital and liquidity regulation to reduce the likelihood that individual institutions would fail (Cecchetti, 2016). CoCo bonds are financial instruments that respect this regulation and can reduce the systemic risk, as shown in this study. This result corroborates that of Berg and Kaserer (2015), who ascertained a conversion price that induces some wealth transfer from equity holders to CoCo bondholders, helping to mitigate risk-shifting incentives already present in the current capital structure of banks. In this way, regulators can look favorably on CoCo issuance as well as suggest mechanisms to encourage their issuance. In other words, our results suggest that issuing CoCo bonds by banks is good, so policymakers can encourage it in situations of necessity.

However, it is of the utmost importance for policymakers to be aware of the need to monitor such issuance, since excessive issues may not lead to a reduction in systemic risk. As argued by (Cecchetti, 2016), given the current state of knowledge, stress tests are the best tools to ensure crises will be rare and not ruinous.

From the perspective of banks, issuing CoCos can help avoid debt overhang in the short term in future distress scenarios because it can anticipate the future loss effects. Moreover, the issuance might positively influence the perception of shareholder value, since equity owners seem to interpret the issuance of CoCo bonds as a positive signal that the bank is adopting the recommended regulation and minimizing systemic risk.

## 3.7 Conclusion

The present study examines the relationship between systemic risk and CoCo bond issuance.

In the regression approach, we found that banks that issued CoCos decreased the amount of capital shortfall. We showed the robustness of our results using matching and stratification analyses (GSIB, European Union, and emerging countries). Hence, although we cannot claim strict causality, we argue there is a very strong association between a bank issuing CoCo bonds and reduced capital shortfall.

We then conducted an event study of both first and second announcement dates and also on the issue date of the bond. The results showed that the first issue can be interpreted by the market as a positive signal, since the measures of systemic risk decreased. On the other hand, the systemic risk increased when banks issued bonds again. This may reflect investors' fear of seeing the bank taking more capital or it could be interpreted as a bad signal by the market. We replicated the analysis for different event windows and found similar results. Also, we estimated the event study for subsamples and found the same results for GSIB and emerging countries.

The results confirmed our hypothesis 1 and rejected hypothesis 2, so issuing CoCos once may be a way to reduce systemic risk, but issuing CoCo excessively may not be adequate to face the problem of future losses and allay the market's perception of bankruptcy risk. Moreover, the robustness checks of our results mainly used measures of systemic risk ($SRISK$, $SES$, and $\Delta CoVaR$) in all the analyses, thus avoiding problems associated with the limitations of calculating each measure individually.

An important limitation of this study is not differentiating between Global Banks, Systemically Important Financial Institutions, and smaller banks. Further research might be able to disentangle the effects for these groups of banks and address policy implications for the regulation for these groups of banks.

# Chapter 4

## Hybrid Securities as a Strategy of Sequential Finance in the Banking Sector.

### 4.1 Context and Motivation

Hybrid securities are located at the crossroads between debt and equity (De Spiegeleer et al., 2014). These financial instruments initially act as regular bonds and pay coupons, but they can be converted into equity in the issuing firm. Also, these bonds have many special features, including call and put provisions, mandatory conversion, and restrictions on conversions (Ho and Pfeffer, 1996). In a nutshell, a convertible bond offers the market a blend of the defensive qualities of bonds with the higher returns typically associated with riskier investments, such as equities.

The popularity of these asset classes in the financial market since the 1970s has encouraged extensive literature to explain the phenomenon. The motivations for why firms issue these instruments are based on: the risk-shifting (Green, 1984), the risk uncertainty (Brennan and Schwartz, 1988), asymmetric information (Stein, 1992), and sequential financing (Mayers, 1998).

Focus on an idea of sequential financing that predicts convertible bonds enable companies to control overinvestment. It is noteworthy that this explanation of issuance may not be associated with a particular class of convertible bonds, denominated contingent convertible (CoCo) bond. In essence, a CoCo bonds is a standard corporate bond issued exclusivity by banks that can absorb losses without triggering a default for the issuing bank. Fajardo and Mendes (2020) showed, through an empirical study, the strength of the regulatory component pertaining to bank that issue a CoCo bonds as soon as proposed by regulators in the Basel III[1]. The CoCo issuance is linked to creating a countercyclical capital buffer; that is, bank replenish their financial reserves in optimistic market scenarios to survive in uncertain and distressing moments. In such a case, bank choose to assume debt through the CoCo bond to increase liquidity and capital requirement compared to other bonds that are focusing on increasing capital expenditures.

Thus, this study's main objective is to generalize these results to other types of convertible bonds, such as CoCo bonds. Therefore, we proceed with a set of analyses to investigate how banks allocate the capital raised by issuing CoCo bonds and convertible bonds. The results show that the regulatory convertible bonds (CoCo bonds) are different from those previously discussed in the literature. Using a mixture of models (Poisson and GLS regressions, propensity-score matching, and a difference-in-differences approach), we show that the amounts raised by CoCo bonds are used to increase banks' adequacy regarding capital requirements, and banks with timing problems tend to issue CoCo bonds with longer call provision periods, but these relationships are largely absent for convertible bonds. Hence, we fill this literature gap, showing that not all types of convertible bonds are created equally.

Moreover, we discuss whether the funds raised through the CoCo issuance are used to increase capital expenditures as suggested by the literature, or to improve the bank's liquidity in response to regulators. It is important to consider the relevance of the call provision feature in convertible bonds as a strategic measure that permits to evaluate firm's real intentions in the bond issuance as soon as proposed by Korkeamaki and Moore (2004).

[1] Basel III is a framework established to reduce the need for government bail-outs in the subprime crisis (2008) through the strong regulatory liquidity component in the bank balance sheets (BIS, 2011)

As previously mentioned, this study shines a new light on the already analyzed (and much-discussed) relationship of convertible bonds and call provisions literature, emphasizing that the sequential financial theory cannot fully accommodate for CoCo bonds. Thus, the first contribution is that not all types of convertible bonds are created equally. CoCo Bonds are mainly being used for regulatory purposes, while convertibles bonds are used to leverage the banks and increase loan offers.

In addition, the second contribution of the present study is to extend the discussion of convertible bond issuance and call provisions into the banking sector, which has two types of bonds the usual convertible ones and the contingent convertibles, which have been overlooked in the previous studies.

Finally, we develop a new measure to analyze reinvestment in the banking sector, which we call "Loans-Deposits Flow," in which a larger positive value shows that the bank has received more flows from deposits than it has directed to loans, and a negative value shows otherwise. This allows us to assess if banks are increasing their loans proportionally to the deposit flows.

The next section presents a discussion of related literature review. Then we proceed to define our empirical strategy and sample, followed by the main results and robustness checks. The last section concludes.

## 4.2 Related Literature Review

Convertible bonds provide the market with hybrid-financing tool that combines the features of bonds and stocks in one instrument, giving holders the right to convert their bonds into a predetermined number of shares (Olivier et al., 2018). Some companies may use convertible bonds to boost the equity in their capital structures in situations where information asymmetries make common equity issues unattractive (Stein, 1992). In other words, convertible bonds may represent an indirect mechanism for implementing equity financing that mitigates the adverse-selection costs associated with direct equity sales.

In general, the call provision is a prominent feature of convertible bonds, which allows an issuer to pay off the bond before its maturity date. It is of particular interest in convertibles' case because of the holder's right to convert into common stock. The critical point is that a callable bond gives the issuing firm an option to reduce its debt obligation if it finds that the future project has negative NPV (Chen et al., 2010). A callable bond essentially enables the bondholders to influence the firms into making an efficient investment decisions.

The explanations why firms issue these instruments instead of standard non-hybrid financing instruments has been synthesized in four theories (Dutordoir et al., 2014). First, Green (1984) focused on models and characterized investment incentive problems associated with debt financing. He concluded that, under certain conditions, such claims can be constructed to restore net present value-maximizing incentives and simultaneously meet the firm's financing requirements. On the other hand, Brennan and Schwartz (1988) showed that the most plausible rationale for the continuing popularity of convertibles is their insensitivity to company risk. Companies issuing convertible bonds tend to have higher market value and earnings volatility, higher business and/or financial uncertainty, stronger growth-orientation, and shorter corporate histories than their straight debt counterparts. Thus, the theory suggests that management should force conversion of convertibles soon after the value of the security rises above the call price. Still, companies tend to delay calling their convertibles well beyond this point.

From another point of view, Stein (1992) argued that companies might find convertible bonds an attractive middle ground between the negative informational consequences associated with an equity issue and the potential for costly financial distress related to a debt issue. Therefore, a convertible can serve as a risky indirect mechanism for implementing equity financing that entails less of an adverse price impact than an offering of common stock when used with a call provision that enables early forced conversion. The last theory was proposed by Mayers (1998), that corporations use convertible debt to solve sequential financing problems, which means the portion of the convertible bond provides a hedge against incurring the costs associated with raising capital in the future while helping to control the overinvestment incentive. Thus, the call provision has the role of allowing the firm to proceed with its financing plan unencumbered by the debt issue when the overinvestment problem is favorably resolved.

In sum, the view adopted by Stein (1992) is based on asymmetric information about assets in place. In contrast, the sequential financing hypothesis is based on uncertainty about the value of future investment options.

An essential part of this literature focuses on the importance of the design of call provisions in the investment decision and debt structure. Other studies, such as Lewis et al. (1998), provide empirical evidence regarding the design of convertible bonds, concluding that managers of firms with ample growth opportunities also set relatively short periods of call protection to overcome the adverse selection costs associated with common stock issues.

In the same way, Korkeamaki and Moore (2004) focused on this narrow but important security design feature involving convertible bonds. They showed that firms design call provisions largely consistent with the need for short-term financing flexibility. Moreover, they found that the call protection period's length is shorter for firms with higher capital investment levels shortly after issuance. Following the empirical studies of the sequential-financing hypothesis, Chang et al. (2004), by analyzing convertible debt offerings by Taiwanese firms, found support for the sequential-financing theory that convertible debt financing is motivated by a desire to minimize security issue costs and agency costs of overinvestment of firms with promising growth opportunities, allowing them to finance a sequence of major corporate investments of uncertain value and timing.

Complementary, Chen et al. (2010) corroborated these findings, showing that the firms use a callable bonds to reduce the risk-shifting problem in case their investment opportunities become poor. By way of explanation, a firm facing poorer future investment opportunities is more likely to issue a callable bond than a firm facing better investment opportunities. Also, Alderson et al. (2006) examined whether changes in the rate of investment relate to changes in the rate of financing activity around convertible calls. Similar to Mayers' results, conversion-forcing firms exhibited an increase in capital expenditures and debt financing around the year of the convertible bond call.

King and Mauer (2014) developed another approach. They investigated the call policy determinants and concluded that the risk of a failed call over the call notice period helps explain why firms call only after the conversion value exceeds the call price by a substantial safety margin (premium). They found that a significant portion of calls is associated with restructuring and merger activity and bond rating upgrades and downgrades.

However, these studies portray findings exclusively for convertible bonds, excluding other types of hybrid bonds and also firms in the financial sector. It should be noted that after the 2008 crisis, a new class of convertible bonds was created by the Basel III framework (BIS, 2011). The so-called CoCo bonds work as bail-in mechanisms that permit banks to recapitalize in the short term during financial distress moments. Thus, regulators have advocated that CoCos are designed to be truly loss-absorbing, in contrast to other regulatory instruments such as the hybrid Tier 1 bonds, which failed during the near-collapse of the financial system just after the subprime crisis (Jan De Spiegeleer, 2014). However, in the U.S. the adoption of CoCos has not been allowed by regulators, due to the uncertainty inherent in CoCo design and implementation.

Like convertible bonds, CoCos have the feature of a call provision. According to Pennacchi and Tchistyi (2019), giving shareholders a call option can increase the value of the candidate stock price relative to that of a noncallable CoCo, thereby making it more likely the candidate stock price will organically grow in the bank's assets. On the other hand, Martynova and Perotti (2018) showed that the design of bank contingent capital affects risk-taking incentives if the bank takes an inefficient risk that involves a choice for speculative assets purely for risk-shifting reasons, highlighting the nature of bonds anchored to the capital requirement. On the side of investors, Fiordelisi et al. (2019) analyzed the investors‘ expectations and concluded that CoCos tend to reduce stock returns volatility and other tail risk measures. From these premises, we can affirm that CoCo issuance aims to reduce the gap between loan supply and deposits in order to maximize the bank’s liquidity.

Regarding the market timing ability in bond markets, results show this to be of a relatively neutral impact (Chen et al., 2010). Hence, we regard market timing as a factor of the banks’ choice between issuing CoCos or Convertibles’ as less important compared to the main regulatory or internal investment factors.

Most of the papers in the literature use capex to assess the reinvestment made by non-financial firms. However, this poses a problem for the application of this theory to financial firms since “unlike manufacturing firms that invest in plant, equipment, and other fixed assets, financial service firms invest primarily in intangible assets such as brand name and human capital" (Damodaran, 2009). Although capex is clearly defined for firms, this is not the case for banks. Nevertheless, we adopt capex as a proxy for reinvestment in order to compare our results to those of the cited literature. Notwithstanding, we developed a new variable to assess banks’ reinvestment flow, called Loans-Deposits Flow. We did so our results apply better fit to the financial sector, in which “firms invest primarily in intangible assets such as brand name and human capital" and “consequently, their investments for future growth often are categorized as operating expenses in accounting statements” (Damodaran, 2009). We explore this metric in the next section.

## 4.3 Methods and Data

To answer the question proposed in this study, we adopted insights based on theoretical and empirical research by Mayers (1998); Korkeamaki and Moore (2004).

We estimate the model in Equation 4.1 using Poisson regressions. We must use a Poisson regression approach in our estimations, since the dependent variable is a time counting variable that refers to the interval in years of first call protection specified in each contract, rounded to an integer. Hence, the Poisson regression is necessary for estimating a time period between two events (from issue to first call protection specified in each contract), which can only be a natural number. Table 4.1 describes all variables present in the model.

$$log(E(Length \mid x)) = \alpha + \beta' x \tag{4.1}$$

On the right side, $x$ is a vector of independent variables that portray the primary variable of Timing, which is the number of years following issuance in which cumulative annual expenditures or Loans-Deposits Flow first meet or exceed proceeds from convertible issuance. Hence, this variable can be perceived as the break-even point in the bond issuance time, from the bank's perspective.

Other variables in the vector are relevant controls of issuer and bond contract design: issuer leverage, measured by the debt/asset ratio (Lev) as of the year-end before issuance; the issue size measured as the amount raised divided by total asset value (Proceeds); binary variable of perpetual maturity (Mature); binary variable of the private bond placement (Private); and a geographic and economic dummy variable for European bond issuance (Euro).

The variable Loans-Deposits Flow is calculated as the first difference of year $t$ to year $t-1$ between the differences in the stock of deposits minus the stock of loans, which is now a measure of flow of the incoming assets: a positive value means a larger flow of assets to deposits than to loans in year $t$, and a negative value means a larger flow of assets to loans. Hence, we construct the variable Loans-Deposits Flow (LDF) as follows (with D representing the $Deposits$ and L the $TotalLoans$):

$$LDF_{i,t} = (D_{i,t} - L_{i,t}) - (D_{i,t-1} - L_{i,t-1}) = (D_{i,t} - D_{i,t-1}) - (L_{i,t} - L_{i,t-1}). \tag{4.2}$$

It is important to notice that we have to calculate Loans-Deposits Flow as a first difference since both deposits and loans are balance sheet accounts, and hence they represent stocks and not flows. This metric now becomes a flow metric by analyzing the first difference, just like capex is a measure of cash flow.

Table 4.1: Definition of variables

| Variables | Coding | Definition |
|---|---|---|
| CoCo bond dummy | CoCo | Binary variable which assumes the value 1 if a bond is a Contingent Convertible Bond, and 0 if the bond is only a Convertible Bond. |
| Issue to Call | Length | Call protection period in years |
| Timing Capex | Timing Capex | Measure of capital expenditure timing |
| Timing Loans-Deposits | Timing_LDF | Measure of difference between loan and deposits timing |
| Proceeds | Proceeds | bond issuance size relative to total assets |
| Levarage | Lev | total debt/total assets ratio |
| Euro market | Euro | Binary variable which assumes the value 1 if bond is a Eurobond and zero otherwise |
| Private Placement | Private | Binary variable which assumes the value 1 if bonds are placed privately and zero otherwise |
| Maturity | Mature | Binary variable which assumes the value 1 if bonds have perpetual maturity and zero otherwise |
| Amount Issue | Amount | Bond issuance size in dollars |
| Capital Expenditures | CAPEX | Capital expenditure by bank |
| Loans-Deposits Flow | LDF | Total Deposits - Total Loans |
| Cash ratio | Cash | Cash and Equivalents/Total Assets |

### 4.3.1 Sample

Our sample comprises convertible bonds and contingent convertible (CoCo) bonds issued by financial firms between 2009 and 2019, available from the Bloomberg database. See the distribution of issuance by years and countries in Tables 4.2 and 4.3, respectively. In this dataset, we obtain data about the bond issuance, such as: bond classification, issuer, amount raised, issuance date, the market at issue, maturity, coupon, call provision information, and others. To improve the sample composition, we extract data about financial firms' capital structure from the Capital IQ/Compustat database. After merging both datasets, our sample is an unbalanced panel dataset of 776 convertible bonds and 548 contingent convertible (CoCo) bonds issued by financial firms from 42 countries.

Table 4.2: Frequency of bond issuance by year

| Year | CoCo Bonds | Convertible Bonds | Total |
|---|---|---|---|
| 2009 | 2 | 330 | 332 |
| 2010 | 3 | 28 | 31 |
| 2011 | 1 | 16 | 17 |
| 2012 | 13 | 13 | 26 |
| 2013 | 30 | 50 | 80 |
| 2014 | 78 | 35 | 113 |
| 2015 | 73 | 23 | 96 |
| 2016 | 75 | 28 | 103 |
| 2017 | 88 | 44 | 132 |
| 2018 | 75 | 45 | 120 |
| 2019 | 110 | 164 | 274 |
| Total | 548 | 776 | 1324 |

### 4.3.2 Summary statistics

Table 4.4 provides descriptive statistics for all variables divided into CoCo and convertible bonds. The dependent variable Issue to Call is, on average, 6.068 years for CoCo bonds and 1.722 years for convertible bonds. For the main independent variables, Capex Timing and LDF Timing, the averages are 3.305 and 0.614 for CoCo bonds, and 1.53 and 0.383 for convertible bonds, respectively.

Table 4.5 displays correlations among variables used in the subsequent analyses. The explanatory variables have low pairwise correlation. In addition, we used a formal test to ensure absence of multicollinearity problem. We calculated the variance inflation factor (VIF) for each independent variable in our model. The largest VIF value is 1.11, which confirms that there is no multicollinearity problem because it is far from 5 (Studenmund and Cassidy, 1997).

Table 4.3: Frequency of bond issuance by country

| Country | CoCo Bonds | Convertible Bonds | Total |
|---|---|---|---|
| Australia | 7 | 3 | 10 |
| Austria | 10 | 4 | 14 |
| Bahrain | 0 | 1 | 1 |
| Belgium | 4 | 0 | 4 |
| Bermuda | 0 | 17 | 17 |
| Brazil | 18 | 0 | 18 |
| Britain | 56 | 303 | 359 |
| British virgin | 0 | 2 | 2 |
| Canada | 0 | 39 | 39 |
| Cayman islands | 0 | 16 | 16 |
| China | 58 | 8 | 66 |
| Colombia | 2 | 0 | 2 |
| Cyprus | 2 | 1 | 3 |
| Denmark | 24 | 0 | 24 |
| Faroe islands | 2 | 0 | 2 |
| Finland | 12 | 0 | 12 |
| France | 42 | 3 | 45 |
| Georgia | 3 | 0 | 3 |
| Germany | 13 | 8 | 21 |
| Hong kong | 0 | 2 | 2 |
| India | 22 | 0 | 22 |
| Ireland | 12 | 0 | 12 |
| Israel | 11 | 1 | 12 |
| Italy | 18 | 6 | 24 |
| Japan | 26 | 14 | 40 |
| Luxembourg | 5 | 5 | 10 |
| Malaysia | 18 | 1 | 19 |
| Mexico | 5 | 0 | 5 |
| Mult | 0 | 2 | 2 |
| Netherlands | 4 | 17 | 21 |
| Norway | 77 | 0 | 77 |
| Portugal | 2 | 0 | 2 |
| Singapore | 0 | 2 | 2 |
| Slovakia | 1 | 0 | 1 |
| South korea | 0 | 2 | 2 |
| Spain | 24 | 0 | 24 |
| Sweden | 12 | 0 | 12 |
| Switzerland | 56 | 265 | 321 |
| Taiwan | 0 | 2 | 2 |
| Turkey | 2 | 0 | 2 |
| Uae | 0 | 3 | 3 |
| United states | 0 | 49 | 49 |
| Total | 548 | 776 | 1324 |

Table 4.4: Summary statistics

| | CoCo Bonds | | | | Convertible Bonds | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | Mean | Std. Dev. | Min. | Max. | Mean | Std. Dev. | Min. | Max. |
| Issue to Call | 6.068 | 2.862 | 0 | 15 | 1.722 | 1.963 | 0 | 11 |
| Timing Capex | 3.305 | 1.743 | 1 | 7 | 1.53 | 1.462 | 1 | 11 |
| Timing Loans-Deposits | 0.673 | 0.835 | 0 | 8 | 0.519 | 0.604 | 0 | 5 |
| Proceeds | 0.017 | 0.237 | 0 | 5.272 | 0.017 | 0.141 | 0 | 3.715 |
| Leverage | 0.272 | 0.147 | 0.014 | 0.925 | 0.307 | 0.176 | 0.006 | 3.141 |
| Euro market | 0.266 | 0.442 | 0 | 1 | 0.68 | 0.467 | 0 | 1 |
| Private | 0.102 | 0.303 | 0 | 1 | 0.019 | 0.138 | 0 | 1 |
| Amount Issue | 1119.036 | 1515.071 | 1.764 | 12038.635 | 70.839 | 371.932 | 0 | 5857.4 |
| Capital Expenditure | 1164.006 | 2010.988 | -67.2 | 12280.7 | 1308.948 | 1285.487 | -0.232 | 7912.1 |
| Loans-Deposits | 92884.13 | 216162.1 | -307042.7 | 1071292 | 60703.8 | 115269.6 | -190757.5 | 730934.9 |
| Cash ratio | 0.074 | 0.077 | 1.48e-06 | 0.595 | 0.106 | 0.046 | 0.0013 | 0.501 |

Table 4.5: Cross-correlation table

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.CoCo | | | | | | | | | | | |
| 2.Issue to call | 0.643 | | | | | | | | | | |
| 3.Timing Capex | 0.482 | 0.252 | | | | | | | | | |
| 4.Timing Balance | 0.099 | 0.214 | -0.021 | | | | | | | | |
| 5.Proceeds | -0.001 | -0.008 | 0.152 | 0.076 | | | | | | | |
| 6.Leverage | -0.102 | -0.117 | 0.051 | -0.285 | 0.487 | | | | | | |
| 7.Euro market | -0.408 | -0.286 | -0.475 | -0.237 | -0.084 | -0.010 | | | | | |
| 8.Private | 0.181 | 0.198 | 0.169 | 0.052 | -0.002 | 0.108 | -0.242 | | | | |
| 9.Amount Issue | 0.454 | 0.269 | 0.242 | 0.198 | -0.007 | -0.109 | -0.265 | 0.131 | | | |
| 10.Capex | -0.044 | 0.188 | -0.403 | 0.242 | -0.073 | -0.175 | 0.078 | 0.049 | 0.243 | | |
| 11.Loans-Deposits | 0.085 | 0.132 | -0.091 | 0.302 | -0.145 | -0.390 | -0.199 | -0.001 | 0.549 | 0.521 | |
| 12.Cash ratio | -0.252 | -0.227 | -0.294 | 0.063 | 0.188 | -0.089 | 0.150 | -0.051 | -0.189 | -0.084 | 0.056 |

## 4.4 Results

### 4.4.1 Capex

The results appear in Table 4.6, which summarizes the empirical results by the groups CoCo bonds (columns 1.a, 1.b, 1.c) and convertible bonds(columns 2.a, 2.b, 2.c). In order to identify the stability of the coefficients and their significance, we first include only the Capex Timing in the model (columns 1.a and 2.a). Next, we report the estimates of the full model with controls. In the last columns (1.c and 2.c), we include a country fixed effect.

Table 4.6: Poisson regression estimation results for the model using Capex

| | CoCo Bonds | | | Convertible Bonds | | |
|---|---|---|---|---|---|---|
| | 1.a | 1.b | 1.c | 2.a | 2.b | 2.c |
| Timing Capex | -0.0439*** | -0.0372*** | -0.0345** | 0.210*** | 0.135*** | 0.0765* |
| | (0.0104) | (0.0105) | (0.0125) | (0.0287) | (0.0336) | (0.0359) |
| Proceeds | | -0.132 | 0.0748 | | -0.241 | -0.222 |
| | | (0.129) | (0.146) | | (0.307) | (0.197) |
| Leverage | | 0.273* | 0.0320 | | 0.409 | 0.269 |
| | | (0.122) | (0.159) | | (0.395) | (0.261) |
| Euro | | 0.110* | 0.00242 | | -0.619*** | -0.718*** |
| | | (0.0435) | (0.0558) | | (0.160) | (0.217) |
| Private | | 0.210*** | 0.0796 | | 0.584*** | -0.0669 |
| | | (0.0546) | (0.0633) | | (0.167) | (0.149) |
| Perpetual | | 0.0284 | 0.0553 | | 0.216 | 0.724* |
| | | (0.0672) | (0.0959) | | (0.245) | (0.316) |
| Constant | 1.962*** | 1.777*** | 2.154*** | -0.168 | 0.212 | -0.405 |
| | (0.0379) | (0.0796) | (0.248) | (0.0889) | (0.230) | (0.540) |
| Observations | 435 | 435 | 435 | 309 | 309 | 309 |
| Country FE | No | No | Yes | No | No | Yes |
| Pseudo $R^2$ | 0.008 | 0.019 | 0.037 | 0.097 | 0.129 | 0.304 |
| *AIC* | 2019.0 | 2006.7 | 2018.7 | 938.6 | 915.2 | 771.9 |
| *BIC* | 2027.1 | 2035.2 | 2145.0 | 946.0 | 941.3 | 869.0 |

Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For the convertible bond, the main variable Capex Timing was positive and significant ($p < 0.001$) for all model models since estimation 1.c the best models that minimize AIC and BIC. It means that the length of the call protection period is shorter for banks that experience higher levels of capital investment shortly after issuance, corroborating the findings of Korkeamaki and Moore (2004) and Mayers (1998).

In contrast, these results are negative and significant ($p < 0.001$) for the CoCo bonds group. This opposite result may be explained by the regulatory approach by which the bond was issued, which focuses on creating a countercyclical capital buffer instead of investing capital in new projects. Also, we redid the tests using negative binomial estimations and found similar results.

### 4.4.2 Loans-Deposits Flow

As a complementary approach, we estimated the main independent variable based on bank liquidity after the bond issuance. We adopted the Loans-Deposits Flow as a proxy measure of liquidity, as previously discussed, and created the variable LDF Timing. Following the previous results, we estimated the model by replacing the main independent variable by Timing LDF. Table 4.7 presents the results according to the groups CoCo bonds (columns 3.a, 3.b, 3.c) and convertible bonds(columns 4.a, 4.b, 4.c).

LDF Timing was positive and significant for CoCo bonds and not significant for convertible bonds. This result confirms that banks choose to assume debt to recompose the capital requirement since it predicts that banks having incremental liquidity distributed over longer periods following convertible issuance tent to have longer call protection periods. In a nutshell, CoCos can help to discourage high risk-taking initiatives by management that are at odds with the shareholders' interests. This result corroborates the findings of Martynova and Perotti (2018) ] by considering the relevance of the contractual characteristics, impacting the banks' decision regarding risks. Also, we redid the tests using negative binomial estimations and found similar results.

Table 4.7: Poisson regression estimation results for the model using Loans-Deposits Flow

| | CoCo Bonds | | | Convertible Bonds | | |
|---|---|---|---|---|---|---|
| | 3.a | 3.b | 3.c | 4.a | 4.b | 4.c |
| Timing LDF | 0.0599*** | 0.0755*** | 0.0685*** | 0.271* | 0.0553 | -0.0262 |
| | (0.0165) | (0.0120) | (0.0153) | (0.113) | (0.103) | (0.0865) |
| Proceeds | | -7.337 | -3.419 | | 11.72 | 0.0334 |
| | | (4.734) | (5.173) | | (14.64) | (18.85) |
| Leverage | | 0.374** | 0.340* | | 0.137 | -0.279 |
| | | (0.129) | (0.165) | | (0.702) | (0.704) |
| Euro | | 0.125** | 0.0625 | | -0.939*** | -0.778** |
| | | (0.0434) | (0.0548) | | (0.163) | (0.257) |
| Private | | 0.185*** | 0.0904 | | 0.215 | -0.397** |
| | | (0.0544) | (0.0617) | | (0.149) | (0.128) |
| Perpetual | | -0.00393 | -0.0114 | | 0.809* | 1.213 |
| | | (0.0724) | (0.0887) | | (0.336) | (0.637) |
| Constant | 1.791*** | 1.652*** | 2.072*** | 0.0575 | 0.778** | 0.456 |
| | (0.0240) | (0.0795) | (0.210) | (0.0781) | (0.295) | (0.272) |
| Observations | 471 | 466 | 466 | 237 | 237 | 237 |
| Country FE | No | No | Yes | No | No | Yes |
| Pseudo $R^2$ | 0.004 | 0.018 | 0.044 | 0.017 | 0.106 | 0.202 |
| *AIC* | 2247.1 | 2203.8 | 2201.2 | 676.8 | 624.0 | 572.1 |
| *BIC* | 2255.4 | 2232.8 | 2342.1 | 683.8 | 644.8 | 617.2 |

Standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

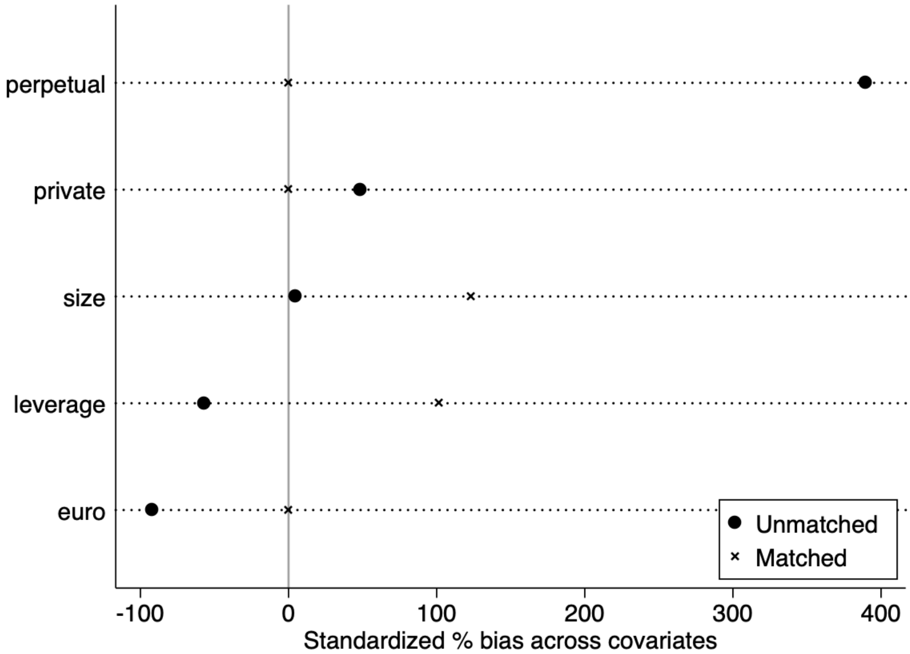
## 4.5 Robustness check

### 4.5.1 Matching

We conducted Epanechnikov kernel weighted propensity score matching of our data in order to reduce endogeneity concerns. We used as covariates the bank size, leverage ratio, a perpetual maturity dummy, the Euro market dummy, and the private placement dummy. The fitness of the matching procedure can be seen in Figure 4.1. Results are presented in Table 4.8.

The results are similar to our main results. Using the LDF Timing variable, we have a positive coefficient for CoCo bonds and a non-significant effect for the c onvertible Bonds. For capex, the results are reversed, again corroborating our main findings.

Figure 4.1: Robustness check: matched vs unmatched sample




### 4.5.2 Difference in differences

We exploit the issuance of the bond as a shock and because the bond and be either convertible or CoCo this enables the employment of a difference-in-differences approach. This approach enables us to assess the within-bank incremental impact of the CoCo issuance compared to the issuance of convertibles. We then, proceed to estimate the following model:

$$Y_{i,t} = \beta_0 + \beta_1 CoCo_{i,t} + \beta_2 Post_{i,t} + \beta_3 CoCo_{i,t} \times Post_{i,t} + \sum_{j=1}^{J} \beta_j X_{i,t}^{j} + \lambda_t + \eta_c + \varepsilon_{i,t}, \tag{4.3}$$

where $Y_{i,t}$ is our dependent variable, either Loans-Deposits Flow or the capex, $CoCo_{i,t}$ is a dummy variable which assumes a value 1 if the bond is a CoCo or 0 if it is a convertible, and the $Post_{i,t}$ is also a dummy variable assuming a value of 1 after the issue of the bond, and 0 beforehand. Finally, $\sum_{j=1}^{J} \beta_j X_{i,t}^{j}$ denotes the controls, $\lambda_t$ and $\eta_c$ are the year and country fixed effects (respectively), and $\varepsilon_{i,t}$ is the error term.

Table 4.8: Robustness check: Poisson regression estimation results for matching sample

| | CoCo Bonds | | Convertible Bonds | |
|---|---|---|---|---|
| | 5.a | 5.b | 6.c | 6.d |
| Estimation A: | | | | |
| Timing Capex | -0.0629*** | -0.0472** | 0.241*** | -0.0239 |
| | (0.0153) | (0.0173) | (0.0657) | (0.107) |
| Constant | 1.998*** | 2.539*** | -0.222* | 0.501 |
| | (0.0543) | (0.0867) | (0.109) | (0.489) |
| Observations | 203 | 203 | 223 | 223 |
| Pseudo $R^2$ | 0.015 | 0.061 | 0.029 | 0.155 |
| *AIC* | 927.0 | 920.1 | 582.3 | 519.0 |
| *BIC* | 933.6 | 986.4 | 589.1 | 546.3 |
| Estimation B: | | | | |
| Timing LDF | 0.0520* | 0.0672** | 0.221 | -0.0289 |
| | (0.0262) | (0.0245) | (0.120) | (0.112) |
| Constant | 1.799*** | 2.457*** | 0.0180 | 0.405 |
| | (0.0385) | (0.117) | (0.0789) | (0.236) |
| Observations | 235 | 235 | 231 | 231 |
| Pseudo $R^2$ | 0.003 | 0.069 | 0.011 | 0.143 |
| *AIC* | 1132.2 | 1095.4 | 630.5 | 560.5 |
| *BIC* | 1139.1 | 1168.1 | 637.4 | 591.4 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.9 reports the results.

We replicate our main result, in which we have a positive interaction for CoCo bonds, which shows that banks issuing CoCos tend to direct a smaller flow of assets towards loans when compared to banks issuing convertible bonds. Hence, we show that the CoCos are being used according to their regulatory intention: reducing banks' risk exposure and increasing their capital. We found no results in the capex regression, which is also in line with our main results and with our argument that capex is not a good measure for assessing investments in banks.

Table 4.9: Robustness check: differences-in-differences estimation

| | Loans-Deposits Flow | | Capex | |
|---|---|---|---|---|
| | 7.a | 7.b | 8.a | 8.b |
| coco=1 | 0.0303 | 0.145 | -0.521*** | -0.116 |
| | (0.169) | (0.169) | (0.0946) | (0.117) |
| post=1 | 0.0285 | -0.135** | -0.0232 | 0.0509 |
| | (0.0483) | (0.0484) | (0.0663) | (0.0713) |
| coco=1 × post=1 | 0.218*** | 0.220*** | -0.0865 | -0.0961 |
| | (0.0580) | (0.0566) | (0.0734) | (0.0766) |
| Leverage | -2.419*** | -2.025*** | -0.438 | -0.174 |
| | (0.248) | (0.273) | (0.255) | (0.254) |
| Size | 0.491*** | 0.498*** | 0.943*** | 0.938*** |
| | (0.0562) | (0.0628) | (0.0274) | (0.0355) |
| Cash ratio | 0.784*** | 0.690** | 1.219*** | 1.438*** |
| | (0.225) | (0.230) | (0.354) | (0.388) |
| Constant | -4.781*** | -5.939*** | -5.709*** | -6.018*** |
| | (0.737) | (0.912) | (0.366) | (0.486) |
| Observations | 3825 | 3825 | 4226 | 4226 |
| $R^2$ | 0.29 | 0.62 | 0.84 | 0.89 |
| Country FE | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

### 4.5.3 Cash Holdings

If our metric of Loans-Deposits Flow is indeed related to banks' prudence level, then this metric should be correlated with the banks' cash holdings (i.e., its reserves). Moreover, suppose our theory postulated in the previous subsection holds. In that case, this metric should be more strongly correlated with cash holdings for banks that issued CoCos than in banks that issued convertible bonds because the excess in assets over deposits should be used to increase their level of Core Tier 1 capital instead of other financial assets. Hence, we estimated the following GLS model:

$$Cash_{i,t} = \beta_0 + \beta_1 Cash_{i,t-1} + \beta_2 LDF_{i,t} + \beta_3 Size_{i,t} + \beta_4 Leverage_{i,t} + \lambda_k + \varepsilon_{i,t}, \quad (4.4)$$

where $Cash_{i,t}$ is the value of the cash and equivalents normalized by total assets, $LDF_{i,t}$ is the Loans-Deposits Flow metric, $Size_{i,t}$ is the natural logarithm of total assets, $Leverage_{i,t}$ is the ratio of total debts over total assets and $\lambda_k$ is the fixed effects for each issuance. We use the lag of $Cash_{i,t}$ in order to avoid problems of autocorrelation in our estimation, following the approach of Fernandes et al. (2020). Results are provided in Table 4.10.

Table 4.10: Robustness check: GLS estimation results

| | CoCo Bonds | Convertible Bonds |
|---|---|---|
| L.cashratio | 0.691*** | 0.608*** |
| | (0.0180) | (0.0144) |
| Loans-Deposits | 0.00307*** | -0.00141** |
| | (0.000652) | (0.000498) |
| Leverage | 0.0144 | -0.0158 |
| | (0.00997) | (0.0133) |
| Size | 0.000126 | 0.0505*** |
| | (0.00312) | (0.00812) |
| Constant | 0.0142 | -0.616*** |
| | (0.0400) | (0.103) |
| Observations | 4942 | 7162 |
| Issuance FE | Yes | Yes |
| $R^2$ | 0.518 | 0.479 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results corroborate with our reasoning. For CoCo issuance, we find that our metric is positively correlated to the cash holdings, meaning that the extra flow of assets from deposits is being used to increase banks' reserves. Still, this is reversed in the case of convertible bonds, meaning no prudential reasoning is involved in the bank decision-making process. Thus, CoCo bond funds are being used for their regulatory purpose, i.e., to increase the adequacy of capital requirements.

## 4.6 Conclusion

This study has examined the literature on motivation for banks to issue the new type of convertible bond known as CoCo bonds.

Our results show that the theory of sequential financing for convertible bonds (Mayers, 1998; Korkeamaki and Moore, 2004) was not confirmed for CoCo bonds. We also estimated the same model with a new variable (Loans-Deposits Flow) that measures the effectiveness of the regulatory approach and finality of this special asset class of convertible bonds. Additionally, we show evidence that banks issue CoCo bonds for regulatory purposes (increase their capital), while convertibles are issued to allow banks to increase their investments and loan portfolios.

Robustness estimations (propensity-score matching and difference-in-differences analysis) indeed confirmed our results, according to which banks issue CoCo bonds in a more precautionary way, so that banks with greater timing (i.e., taking longer for the flow of deposits to reach the level of the amount raised by issuing the bond) issue CoCo bonds with longer call periods.

Moreover, the above results are either absent or reversed using capex as a proxy, which shows that our proxy "Loans-Deposits Flow" is indeed capturing banks' behavior compared to our new proxy, the LDF.

A final important result is that our proxy is positively correlated with banks that issue CoCo bonds but is negatively correlated with banks that issue convertibles. This provides evidence that banks that issuing CoCos are using the excess flow from deposits that issued CoCos in order to increase their capital, which is in line with the theory that we put forward in our main results.

For future research, we recognize the need to increase the causality claim by using an exogenous shock, since the shock used in our difference-in-differences approach is not exogenous. An additional avenue for research is implementing the proposed Loans-Deposits Flow to analyze reinvestment in banks in other settings, not only following the issuance of bonds, which is the research setting of this study.

# Chapter 5

## General Conclusion

This thesis offers a new perspective on contingent convertible bonds and their place in banking regulation. This is a very important and current topic, which emerged after the 2008 financial crisis. Moreover, this topic is also noteworthy due to the recent COVID crises, which has affected the market and banking liquidity.

In the next paragraphs we provide a general conclusion to the present thesis, highlighting the contribution, results and main takeaways of each chapter.

The second chapter provides evidence of what determinants drive the propensity to issue CoCo bonds. The results reveal that banks issuing these bonds have mainly been larger ones ("too big to fail") and institutions with high leverage, so they have been using CoCo bond issuance mainly in an attempt to meet the Basel III rules and reduce indebtedness.

The results in the second chapter support the findings in the previous literature which show the relevant determinants of banks' issuance of bonds. In the end, we conclude that the main determinants for banks to issue subordinated debt are size and leverage, whereas the decision to issue CoCo bonds includes the additional determinant of regulatory environment.

The third chapter deals with CoCo bond issuance and its impact on systemic risk. We provide evidence that the first issuance is perceived positively by the market, reducing the systemic risk, but this results reverses in the second issuance, increasing systemic risk. Thus, this chapter highlights the importance of CoCo issuance as a signal to the market.

The results show that the first issuance can be interpreted by the market as a positive signal, since the measures of systemic risk decreased in the period studied. On the other hand, the systemic risk increased when banks issued bonds again. This may reflect investors' fear of seeing the bank taking more capital or it could be interpreted as a bad sign by the market. We replicated the analysis for different event windows and found similar results. Also, we estimated the event study for subsamples, and found the same results for GSIB and emerging countries.

The fourth chapter deals with the difference between CoCo and convertible bond issues. In this chapter, we also introduce a new proxy to measure the self-investment of a financial firm, the "Loans-Deposits Flow". Our results show that the theory of sequential financing for convertible bonds (Mayers, 1998; Korkeamaki and Moore, 2004) was not confirmed for CoCo bonds. Additionally, we show evidence that banks issue CoCo bonds for regulatory purposes (increase their capital), while convertibles are issued to allow banks to increase their investments and loan portfolios.

Overall, we also believe that the individual chapters in this thesis also address important gaps in the literature and are also of theoretical and practical relevance for both academics and practitioners regarding contingent convertible bonds and banking regulation.

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