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JEL Classification: G01, G11, G21, G32

Keywords: Contingent Convertible Bonds, Risk Taking, Bank Capital Structure

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March 24, 2020

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1 Introduction and related literature

The capital ratios of major banks were too low to withstand the great financial crisis, forcing governments in many countries to bail-out banks. Contingent convertible bonds (CoCo bonds), first suggested by Flannery (2002), seemed an attractive way to involve creditors into a recap before the public sector would have to come in. These bonds convert into equity shares, or have their principal written-down, when a certain capitalisation trigger is hit. The focus of regulators was on the automatic recapitalization feature of Cocos; little thought was paid to the risk taking incentives CoCos themselves would lead to, or how they should be designed to minimize that risk taking effect. European regulators permit banks to cover up to 25% of their minimum (risk-based) capital requirements CoCo bonds [1]. In this paper we show that Cocos as they are commonly structured substantially increase risk taking incentives and the more so the less the original equity holders are diluted upon conversion. This works at cross-purposes of the tighter recapitalization requirements they were allowed to be used for.

The structure of CoCos is determined by three components: (i) trigger type - is the trigger level evaluated at market or book-based indicators [2]; (ii) trigger level - the pre-specified level of the trigger indicator, at which the conversion/write-down is triggered. Under Basel III capital requirements the trigger level has to be specified as a ratio of Core equity Tier 1 capital to Risk Weighted Assets and has to be 5.125 % or higher for CoCos to be admissible as CET1 capital; and (iii) type of conversion, which is the loss-absorption mechanism and defines the CoCo bond transformation upon conversion. The type of conversion is either principal write-down (PWD), where the entire CoCo debt is erased (temporarily or permanently) from a bank's balance sheet, or conversion to equity (CE), where the bonds are converted into equity at a pre-specified price which may or may not depend on market indicators.

Empirically, the debate on whether these securities have an impact on bank risk-taking behavior, and to what extent this behavior is dependent on the conversion type selected by issuing banks is still going on. If CoCo bonds distort risk-taking incentives, then the benefits that they bring from a societal perspective might be out-weighted by the costs associated with an increase in the risk profile of the banks issuing CoCos. The loss-absorbing mechanism of CoCo bonds induces wealth transfers between CoCo holders and the existing shareholders, depending on the conversion price. This leads to potential unintended (?) impact on the risk-taking incentive of existing shareholders of the issuing bank. A number of papers (Koziol and Lawrenz,

[1]But they need to meet certain conditions; Article 52 of the European Capital Requirements Regulation (CRR) states that, to qualify as AT1 capital, CoCo bonds have to be perpetual, have a predetermined trigger not below 5.125% of Common Equity Tier 1 (CET1) capital, and have cancelable coupon payments at the full discretion of the issuer, where cancellation is not subject to any restriction on the institution and cannot bring it into default. There are no requirements in terms of the conversion type. Hence, banks can freely choose the loss absorption mechanism.

[2]All CoCos issued to this date trigger at book-based indicators.

2012; Hilscher and Raviv, 2014; Berg and Kaserer, 2015; Albul et al., 2015; Chen et al., 2017; Chan and van Wijnbergen, 2017; Fatouh and McCunn, 2019) have focused on the impact of CoCos on risk taking but with mixed, incomplete and sometimes contradictory results. The empirical literature has not yet addressed the impact of the degree (and sign...) of dilution of existing shareholders implied by the conversion parameters on risk taking, a key focal point of our paper. Hilscher and Raviv (2014), Song and Yang (2016) and Chan and van Wijnbergen (2017) argue that CoCo bonds that do dilute the wealth of current shareholders upon conversion reduce risk taking incentives [3]. They point out that therefore the risk-shifting problem can be addressed through a proper design of CoCo bonds contracts: a low enough conversion price would eliminate this problem. Somewhat illogically, the Basel III requirements and their EU implementation (CRR) stipulate the presence of a minimum conversion price rather than requiring a cap, setting a maximum price to guarantee sufficient dilution.

In the empirical literature so far authors have assumed that accounting values are to be used to determine the conversion price, or simply distinguished PWD Cocos and CE CoCos without paying any attention to the heterogeneity within the second class in terms of implied dilution. Nonetheless, theoretical papers classify CoCo bonds in terms of their impact on risktaking incentives based on dilution size and sign, where they link the conversion price to market values. The theoretical literature generally argues that CoCo bonds increase risk-taking incentives if their loss-absorption mechanism implies a wealth transfer from bondholders to the existing shareholders and reduce risk-taking incentives when the weaslth transfer goes from existing shareholders to the CoCo bond holders. One of this paper's contributions is that we proxy what market prices would be in a crisis environment, which we can plausibly assume to be necessary to trigger conversion. This allows us to assess the implied wealth transfer and subsequent dilution embedded in the particular design of a given CoCo. This in turn allows our econometric tests of risk taking incentives to test the theory predictions much more accurately than a simple distinction between PWD and equity converter CoCos allows.

This paper focuses on the potential effects of CoCo bonds on banks' risk-taking profile. The research aims are three-fold. Like others before us, we want to empirically test whether having CoCo bonds on a bank's balance sheet changes that bank's risk-taking behaviour. But if banks that have issued CoCos do so because of other characteristics driving risk-taking, a simple regression linking risk-taking to the presence of CoCos could suffer from sample selection bias. For example Chan and van Wijnbergen (2017) suggested a regulatory arbitrage hypothesis, according to which banks issue certain types of CoCo bonds structured to increase their risk-taking incentives in an attempt to offset the impact on risk taking that regulators had when

[3] Martynova and Perotti (2018) argue that the principal write-down CoCo bonds (which imply wealth transfers from CoCo bond holders to the existing shareholders) reduce risk incentives, but they did not take into account the endogeneity of conversion; doing so would have reversed their results (cf Chan and van Wijnbergen (2017)).

stipulating higher capital requirements. This potentially introduces a selection bias in regressions tracing the impact of CoCos on risk taking by the issuing bank. This issue has to the best of our knowledge not received attention in the empirical literature, but we do test for such a bias explicitly.

Second, we study the ex-ante impact on risk taking of the conversion price and its impact on the expected wealth transfer conditional on conversion from CoCo bond holders to existing shareholders (note that that transfer can be negative if the conversion price is low enough). We use in our empirical analysis a proxy for market-based conversion prices. The assumption of basing the conversion on market prices is in line with the conditions embedded in most CoCos issued so far. The stipulated conversion price of CoCo bonds, combined with the market price of equity at time of conversion determines the wealth transfer. This allows us to classify CoCo bonds based on their dilutive nature, which is a first in the empirical literature. Finally we add control variables for the degree of banking competition and the extent of macroeconomic uncertainty in our analysis of the impact of the presence and structure of CoCo bonds on bank risk-taking.

A third novelty of this paper is that we explicitly compare results based market based risk measures of risk taking with the results derived from analyzing an accounting based proxy and find that the market based measures conform to the theory predictions but the results based on the accounting based measure do not.

To sum up, new in this paper is that we explicitly test for sample selection bias (are banks with a greater risk appetite more inclined to issue Coco bonds?), that we include the extent to which CoCo bonds will dilute shareholders upon conversion and assess its impact on risk taking, and that we explicitly distinguish between market- and accounting based measures of riskiness.

We focus on the UK, the largest CoCo market in Europe, with 35% of all going-concern (Additional Tier 1) CoCo issuances [4]. The UK market has also the largest share of conversion-to-equity CoCo bond issuances. Almost 60% out of all conversion-to-equity CoCo bonds in Europe were issued in the UK. Moreover, 42 out of the 46 CoCo bonds issues in the UK are conversion-to-equity.

When analysing our results, we do not find enough evidence to support the regulatory arbitrage hypothesis. When we compare the Heckman selection model with the pooled OLS results, we find no significant difference. Our tests for sample selection bias thus come out negative: as a consequence we do not need to control for the endogenous decision to issue when assessing the risk-taking impact of CoCo bonds. But we do find that the issuance of CoCo bonds have a positive and significant impact on asset risk of the issuing banks. As predicted, the direction and the size of wealth transfer affect the magnitude of this impact. An increase in the wealth transfer from the CoCo holders to shareholders leads to an increase in asset risk. We find that based on our measures of price at conversion, all conversion to equity

[4] In the end of 2018, UK banks had CoCo bonds worth EUR54.208 billion, out of EUR158.2 billion in total in Europe.

CoCo bonds are non-dilutive for existing shareholders. The impact of the wealth transfer on risk-taking is only robust across market measures of risk, and not for book-based measures. The results also show that macroeconomic uncertainty and banking competition increases asset risk chosen by CoCo issuing banks.

Our findings have obvious policy implications. We show that the risk-taking implications of CoCo bonds are affected by the size and the direction of the wealth transfer between CoCo bond holders and the existing shareholders, a wealth transfer that is controlled by the conversion price. Hence, regulators should arguably limit the risk-shifting incentives of CoCo issuing banks either by imposing some restrictions on the contractual features that determine the size of the wealth transfer, such as the conversion price or by not counting them one-for-one as capital (cf Chan and van Wijnbergen (2017) for such a proposal). Additionally, since certain types of banks tend to issue certain types of CoCo bonds, the type of CoCo bonds issued by a bank could be used as a warning indicator for its future risk profile.

The reminder of the paper is organised as follows. In the remainder of Section 1 we discuss the related literature. Section 2 describes our methodological choices for the empirical analysis and describes the data. Section 3 focuses on descriptive statistics and discusses the estimation results, whereas Section 4 has concluding remarks.

Related literature

Since CoCos are a relatively recent phenomenon, the CoCo bonds literature has initially largely been dominated by theoretical analyses. However, due to increasing data availability, empirical CoCo papers have emerged. Our paper contributes to this growing empirical CoCo bonds literature.

Several authors focus on the relation between risk-shifting incentives and CoCo bond issuance. As we already discussed, this impact depends on the direction of the wealth transfer between CoCo bond holders and existing shareholders conditional on conversion (Berg and Kaserer, 2015; Chan and van Wijnbergen, 2017; Fatouh and McCunn, 2019). That is, if shareholders are expected to gain from a CoCo conversion they have reasons to increase their risk-taking since that will increase the chance that a conversion will in fact take place. Obviously if shareholders stand to lose from a conversion, the impact on risk taking is actually negative (cf Chan and van Wijnbergen (2017)). To test this prediction, we construct a measure which takes into account the number of shares issued at the time of a CoCo conversion (or, equivalently, the expected market share price at conversion, and the probability of conversion. This classification of CoCo bonds has received little attention in the empirical literature, which relies mainly on the classification into conversion to equity and principal write-down bonds without distinguishing within the class of CE CoCos between high and low price conversion contracts. The only empirical paper to classify CoCo bonds into dilutive and non-dilutive at time of issuance is Berg and Kaserer (2015), who, based on a sample size of 24 CoCo issuances, find that the majority of

CoCo bonds considered are non-dilutive.

Other empirical work deals with the market response/market perception of CoCo bonds, such as market reactions to increased risk-taking incentives (Hesse, 2018), fear of conversion (Fiordelisi et al., 2018) or announcement effects of CoCo issuance (Ammann et al., 2017), simply distinguishing PWD CoCos and CE COCos without recognizing heterogeneity within the class of CE CoCos. But PWD CoCos are just a limiting case of CE conversion, where the CoCo holder gets zero shares (equivalently has to pay an infinite share price) upon conversion. From a risk taking incentive point of view this is not a meaningful distinction, the distinction should be between dilutive and non-dilutive CoCos. To the best of our knowledge we are the first to measure the conditional wealth transfer for a large number of CoCo bond issuances; this allows us to assess the impact of the size and sign of that variable on risk-taking and verify whether that impact is in line with what theory has predicted or not .

Additionally, for robustness sake we use four different measures for the level risk-taking (three market-based and one book-based). The benchmark measure is asset risk measured by asset beta. The other two market-based indicators are market risk (equity beta), and bankruptcy risk (CDS spreads on 5 year subordinated debt). The book-based measure of risk is the z-score, a measure of insolvency risk widely used in the literature.

Despite the extensive body of theoretical literature on the impact of CoCo bonds on ex-post risk-taking incentives, there is as yet little empirical investigation of this issue. Previous papers (Avdijev et al., 2017; Goncharenko et al., 2019) concentrate more on ex-ante determinants of CoCo issuance. They analyse the choice of issuance from a debt overhang perspective, where the bank's ex-ante risk profile (Goncharenko et al., 2019) or capital structure characteristics (Avdijev et al., 2017) determine whether it will issue CoCo bonds. Goncharenko et al. (2019) argue that banks with less risky profiles are more likely to issue CoCo bonds, while riskier banks prefer to issue equity instead. See also Derksen et al. (2018) for a discussion of the link between debt overhang and the decision to choose CoCo bonds to meet capital requirements. We also analyse this issue, although for a different reason: we want to test for sample selection bias. Sample selection bias might result if ex ante risk characteristics influence the decision to issue CoCo bonds rather than equity in response to higher capital requirements. A subsequent test for the impact of CoCos on risk taking behavior would then suffer from sample selection bias. A similar theory of regulatory arbitrage has been tested using trust preferred securities (TPS) (Boyson et al., 2016), who found that more financially constrained banks are more likely to issue TPS. We test for selection bias, using the Heckman Mills ratio.

Finally, the past decade, during which all existing CoCo bonds have been issued, has also seen increasing market volatility and reduced competition in the banking sector. To avoid finding spurious correlations, a comprehensive analysis of the effects of CoCo bonds on risk-taking incentive should account for these trends. We do so by including proxies for market volatility and the degree of banking comnpetition as controls.

The interaction between market uncertainty and risk-taking preferences has received much attention since beginning of the 1990s. Authors try to explain the implication of uncertainty for optimal portfolio choice (Dow and da Costa Werlang, 1992), and the interaction between uncertainty and risk in the context of monetary policy (Greenspan, 2004; Bekaert et al., 2013). More recent papers attempt to quantify the impact of different sources of uncertainty (economic, political, etc.) on the riskiness of banks' assets (Francis et al., 2014). The consensus is that higher levels of uncertainty lead to higher bank operating costs, and as a consequence more risk taking (see Brock and Suarez (2000) for an example).

A number of authors point out to an overall reduction in the level of competition in the banking system in the UK (de Ramon and Straughan, 2016), and in Europe in general (Maudos and Vives, 2019). The literature on risk-taking bases its analysis of the impact of the degree of competition on risk taking mostly on the franchise value theory: the argument is that an increase in competition increases the insolvency probability of banks which in itself can lead to more risk taking in an attempt to increase the value of downside risk insurance provided by limited liability (the so called Merton put (Merton (1974)). Moreover, more competition diminishes franchise value, and since the latter act as a break on risk taking, competition and more risky bank asset portfolio's tend to go together. A low franchise value has been identified as a predictor for regulatory arbitrage and risk taking by Boyson et al. (2016). We use an aggregate index of banking competition to test the franchise value argument.

2 Data and empirical methodology

In this section we introduce the data which we use for our analysis. We further discuss model specifications, variable descriptions and the methods used to construct the key variables in our study.

2.1 Data

Our focus is on U.K. banks. We have a sample of 15 banks of which 10 are CoCo issuers[5]. This sample represents approximately 84% of the entire UK banking industry in terms of total assets [6] . We use data on a semi-annual basis, from 2000 to 2018. The maximum numbers of observations per bank for each variable is 38, but it can

[5]The 10 CoCo issuing banks are: HSBC Holdings PLC, Barclays PLC, Santander UK Group Holding PLC, Standard Chartered PLC, OneSavings Bank PLC, CYBG PLC, RBS PLC, Lloyds Banking group PLC, Nationwide Building Society.

[6]At the end of June 2018, the total assets of our sample were £6,097,642 million out of a total reported value of £7,336,381 million for all UK banks – `https://bit.ly/2QFWmxs`

Table 1: Data sources

Variable	Nr of banks	Frequency	Timespan	Source
Adjusted close stock price	10	Daily	2000-2018	Yahoo Finance
CDS spreads	9	Daily	2000-2018	Eikon Thomson One
Market capitalisation/ share numbers	10	Semi-annual	2006-2018	Factset
FX rates	-	Daily	2000-2018	Bank of England Exchange rate statistics Database
AT1 CoCo issuance data	10	-	2013-2018	Bloomberg
Bank balance sheet	15	Semi-annual	2000-2018	SNL + + directly from annual reports
Banking competition level	-	Semi-annual	2000-2018	Bank of England internal measurement
Macro-economic uncertainty	-	Semi-annual	2000-2018	Bank of England internal measurement

vary per bank[7]. We combine proprietary data from Bank of England with publicly available data. A summary of the data collection is in Table 1.

The daily adjusted close stock prices for the listed banks in our sample size at London Stock Exchange are from Yahoo Finance. The data is from H12000 until H22018. FTSE100 is our benchmark for market returns, and the 10Y UK guilt rate is the risk free measure. Daily values of CDS spreads on 5 year subordinated debt of 9 banks are retrieved from Eikon Thomson One, from which we derive semi-annual CDS averages per bank.

Data on market capitalisation and total number of shares on a half annual basis are retrieved from Factset, with the earliest value from 2006. The CoCo issuance data (conversion price, date of issuance, call date, etc.) is from Bloomberg. We transform all non-GBP data in GBP by using the average exchange rate against the sterling on a half yearly basis. We obtain daily FX rates against the pound from the Bank of England exchange rate statistics Database, and then we average them on a half yearly basis.

Bank specific characteristics for our 15 banks are retrieved from SNL, and when data was not available we retrieved them directly from the annual bank reports. All book based measures are reported end period. The banking competition level, and the measure for macro-economic uncertainty in the U.K. are sourced from internal Bank of England measurements.

[7] We have the least amount of observations for Metro bank which only started operating in 2010.

2.2 Concepts and Variables

We use standard bank control variables, such as size (natural log of book value total assets), debt ratio (total liabilities to total assets) and bank type (deposits to liabilities). By bank type we mean a bank classification in commercial banks, mixed or investment banks. Commercial banks take on more deposits, thus the ratio of deposits to liabilities is very high. In contrast, the ratio is very low for investment banks. We control for GDP growth as well, which we de-trend. We further augment the analysis to incorporate competition level and macro economic uncertainty in both the dynamic and static specifications. A full list of variables names and description can be found in the appendix.

Bank risk measures

We use four different measures measures for bank risk-taking, three market-based and one book-based measure. The most common ones in the literature are the ratio of non-performing loans and z-score. Both of them are book-based. The credit risk (NPL ratio) only captures past risk-taking behaviour, while we want to capture changes in risk-tasking post CoCo issuance. We think that market-based measures would better (more rapidly) reflect the level of risk-taking. The market-base measures are asset beta (asset risk), equity beta (market risk), and CDS spreads on 5 year subordinated debt (bankruptcy risk). The book-based measure is the z-score, defined as the ratio between ROA (returns on assets) plus the fraction of equity to total assets, and the volatility of ROA (accounting based insolvency risk).

To derive our benchmark measure of asset risk, the asset beta, we first calculate the equity beta on a semi-annual basis. We use the standard CAPM methodology, where $\beta_{X,equity} = \frac{COV(r_X - r_f, r_m - r_f)}{VAR(r_m - r_f)}$. Cov denotes the variance, and r_X are returns on asset, r_f is the risk free rate, and r_m is the market return. To calculate it, we derive the returns for each listed bank (r_X) and FTSE1000 (r_m), and we calculate a daily measure for equity beta based on a rolling window, which we aggregate on a semi-annual basis. Equity beta is only possible to calculate for listed banks, and so our sample restricts to 10 banks, out of the initial 15 we had in our sample.

We derive the asset beta from the equity beta by taking into account leverage. Specifically we estimate β_{asset} per bank by regressing $\frac{\text{debt}}{\text{core equity}}$ on equity beta : $\beta_{\text{equity}} = \frac{Liab}{TotEquity}\beta_{\text{asset}}$, where L are total liabilities and TE total core equity. We estimate it using a 24 month rolling window, where the value for the first half year is computed using the past 2 years including the current half[8].

We retrieve daily CDS spreads for five year subordinated debt, and we use the semi-annual average for our analysis. This covers 9 of our 15 banks. The advantage

[8] e.g. The asset beta for first half of 2000 (H1- 2000) uses values from H2-1998 up to and including H1 - 2000.

of this measure compared to the previous two market based ones is that it includes some financial institutions (Building Societies) which are not listed at the London Stock Exchange.

We calculate the z-score from 2006 onwards, following the methodology used by the Federal Reserve[9]:

$$\text{z-score}_{i,t} = \frac{\text{ROA}_{i,t} + \frac{TE_{i,t}}{TA_{i,t}}}{\sigma_{ROA}}$$

where $TE_{i,t}$ represents the total amount of equity of bank i at time t, and $TA_{i,t}$ denotes the total amount of assets on banks' i balance sheet at time t. We use bank balance sheet values for ROA, total assets and total equity. We compute the standard deviation of return on assets (ROA) using the past three semi-annual observations up to and including the current half-year.

CoCo variables

Let $CoCo_{i,t}$ be the total amount outstanding in pounds of CoCo bonds on a semi-annual basis at time t for bank i, and $P_{c,i}$ be the conversion price per CoCo bond of bank i (sold initially at price P_0). Notice that the conversion price does not have a time dimension - in the U.K. all CoCo bonds have a fixed pre-specified conversion price. In the rest of Europe, conversion prices can depend on various market indicators at the time of conversion. Moreover, we denote by $P^m_{i,t}$ the expected market price at conversion per share of bank i at time t. We compute the number of shares received for each CoCo bond (with initial price 100), and convert the amount outstanding and prices in pounds.

The wealth transfer measure

The wealth transfer measure is a key contribution to the CoCo bond literature. We define $TotalWTCoCos_{i,t}$ as the total expected wealth transfer in case of conversion at time t for bank i, multiplied with the probability of a CoCo conversion for bank i at time t. This is our key measure of wealth transfer in the empirical analysis.

A measure which incorporates the degree of share dilution qfter conversion comes from the wealth transfer measure developed in Chan and van Wijnbergen (2017). This paper mimics a CoCo by stting up an equivalent pair of call options. The resulting measure for the wealth transfer at conversion is:

$$MarginalWT_{i,t} = \frac{C[R, D_d]}{1 + N \cdot D_s} - C[R, D_d + D_s] \tag{1}$$

where N is the total number of shares per unit of coco (conversion rate), $N = P_0/P_c$: initial price (100 usually)/ conversion price stipulated in the contract.

[9] For more details please see Fred Economic research St. Luis bank z-score.

Based on this method, our simplified measure of wealth transfer is:

$$MarginalWT_{i,t} = \frac{\text{Mrktcap}_{i,t} + CoCo_{i,t}}{a_{i,t} + N \cdot CoCo_{i,t}} - \frac{\text{Mrktcap}_{i,t}}{a_{i,t}} \tag{2}$$

where $a_{i,t}$ is the total number of ordinary shares of bank i at time t, $\text{Mrktcap}_{i,t}$ is the market capitalisation and $CoCo_{i,t}$ is the total CoCo amount converted. The first term denotes the value per share in case the CoCo bonds get converted - the new number of shares is $a_{i,t} + N \cdot CoCo_{i,t}$, and the total wealth is the CoCo debt which is converted $CoCo_{i,t}$ and the market capitalisation pre-conversion. The second term denotes the share price in case of non-conversion. If $MarginalWT_{i,t} > 0$, then the wealth transfer from CoCo holders to shareholders is positive, so CoCo bonds are non-dilutive for existent shareholders, and shareholders have to gain from conversion. The total impact on wealth transfer to existing shareholders in case of conversion is $WT_{i,t} = MarginalWT_{i,t}a_{i,t}$. We calculate the total amount outstanding of CoCo bonds on a semi-annual basis, by aggregating the CoCo issuance per bank at time t.

$Mrktcap_{i,t}$ is the market capitalisation in case of conversion. We calculate it as the number of existing shares multiplied with the estimated price of a share at conversion.

We use two different estimates for the price at conversion. The first one is inspired by Baron et al. (2019). They study the relationship between equity prices and banking crises between 1870 to 2016 in 46 countries, and find that bank equity prices decline on average by 30% nine months before a panic. One month before, the decline is estimated at 35% compared to the previous peak. The difference between nine and one month before the crisis is not substantial in terms of price decline. Hence, to simulate price levels in times of crisis, we define the estimated share price at conversion as a 30% drop in the share price at the end of each half year, and we refer to the corresponding measure of wealth transfer as *wealth transfer 30%*. In robustness checks we vary the price drop from 5% to 25%.

Our second proxy for the estimated price per share at conversion is based on a stress testing approach. We derive the maximum observed price drop per bank since 2006 using semi-annual prices, using SNL data on semi-annual reported values of market capitalisation. The maximum drop varies from 20% for HSBC to close to 50% for Lloyds and RBS. Thus, the expected price at conversion is the maximum historical decline (fixed per bank), multiplied with the current share price at each half-year end. We further denote this price estimate as *empirical wealth transfer*. Under both the empirical wealth transfer based, and the 30% drop, all CoCos turn out to be non-dilutive for existing shareholders.

Distance to conversion / Probability of conversion

We define the expected wealth transfer as probability of conversion multiplied with the wealth transfer in case of conversion. To derive the probability of conversion, we first compute the distance to conversion. The distance to conversion is similar to the distance to default from the Kealhofer Merton Vasicek model (Vasicek, 1977), where instead of considering default as the threshold conversion point, we use the CoCo conversion trigger requirement stipulated in the prospectus. Whether a conversion is likely to take place or notThe conversion depends on the capitalisation level of the issuing bank and on the CoCo trigger level.

Using the Black-Scholes formula for an European call option, we derive numerically the asset value and asset volatility for each bank i from the equity value and the equity return volatility [10]. That allows us to calculate the distance to conversion and probability of conversion using the asset value and asset volatility. More precisely, the distance to conversion is the distance between the expected value of the asset and the conversion point. Thus,

$$DC(t) = \frac{log(\frac{V_A}{\lambda D}) + (r - \frac{1}{2}\sigma_A^2)(T - t)}{\sigma_A \sqrt{T - t}} \tag{3}$$

where V_A is the asset value, σ_A is the asset volatility, and $\lambda = \frac{1}{1-TRC}$ and TRC is the stipulated trigger level for each CoCo. In the U.K. all banks issue at the minimum regulatory requirement of 7% , and so TRC is 7% throughout the sample. We numerically solve for distance to conversion and probability of conversion for a one year horizon $T = 1$.

Combining the wealth transfer measure and the distance to conversion indicator: the expected wealth transfer

The probability of conversion is derived based on the distance to conversion measure defined above. This is the final measure that we use in our estimation. Thus,

$$TotalWTCoCo_{i,t} = Pr(conversion_{i,t}) \cdot MarginalWT_{i,t} \cdot a_{i,t}$$

$$TotalWTCoCo_{i,t} = \phi(-DC_{i,t}) \cdot MarginalWT_{i,t} \cdot a_{i,t} \tag{4}$$

The degree of competition, the measure of general uncertainty and other variables

The level of competition (Comp) is measured using the Boone indicator calculated by de Ramon and Straughan (2016). Introduced by Boone (2008) and increasingly popular, this indicator only uses easily available firm-level data and does not

[10] See Appendix for the derivation.

require observations for all firms. Originally, the Boone indicator is negative, and higher values (movement towards zero) represent a reduction in competition. To avoid misinterpretation of the coefficients, we multiply the values of the indicator by -1. Hence, smaller values of our competition variable indicate lower levels of competition. We expect higher competition to increase risk taking.

The level of uncertainty (Uncty) is measured using the quarterly uncertainty indicator produced by the Bank of England's Monetary Analysis Division. This indicator is computed as the principal component of a set of indicators. The uncertainty indicators they use combine information from the whole economy, such as the option implied volatility of FTSE and of the Pound Sterling, with firm and household information. The Bank of England indicator incorporates the standard deviation of observed dispersion of company earning forecasts, and of annual growth forecasts based on financial market or survey information. On the firm side, they use survey data from the Confederation of British Industry (CBI) in the score of 'demand uncertainty limiting investment'. The measure also incorporates information such as unemployment expectations from the household perspective, and the number of newspaper articles that mention 'economic uncertainty'. Haddow et al. (2013) in a Bank of England Quarterly bulletin present more detailed information on this measure.

For the reasons discussed earlier, we add a set of industry-level and bank-level control variables. These industry-level variables include determinants of risk-taking common to all banks. We use GDP growth to proxy fluctuations in economic activity (Agoraki et al., 2011). The bank-level variables are used to control for the differences in size, technical efficiency and business models across banks. They include debt ratio (total liabilities divided by total capital), ratio of deposits to liabilities, and the natural logarithm of total assets. Given that higher debt levels (debt ratio) imply higher bankruptcy risks, we would expect a negative impact of the debt ratio on the dependent variable.

2.3 Estimation and testing

We test for sample selection bias using three different approaches. We set up the basic model in line with the well known Heckman setup by formulating a selection equation and a response equation, with potentially correlated error terms. The selection equation assesses the likelihood of banks selecting CoCo's as part of their capital structure. And the response equation tests our hypothesis of the impact of CoCos and their design on risk taking behavior. In the first approach we use a FIML estimator and test explicitly whether the relevant correlation parameter is different from zero. But FIML estimators may lead to misspecification in one equation biasing the other equation. We therefore also try in our second approach a single equation estimator, the well known Heckman estimator relying on the inverse Mills ratio.

In our third approach We use a dynamic GMM model specification and the Arrellano-Bond estimator with robust standard errors (Arellano and Bond, 1991), because of evidence in the literature (cf Agoraki et al. (2011); Delis and Kouretas (2011); Jiménez et al. (2013)) that risk-taking behaviour is time-persistent. Use of the Arellano-Bond estimator is then called for because persistence is captured by including a lagged endogenous variable. Comparing results of a specification that includes respectively excludes the inverse Mills ratio allows us to test for sample selection bias using a Hausman test.

2.3.1 Testing for selection bias

If banks that want to increase their risk profile are the ones most likely to issue CoCo bonds, a test of the hypothesis that having issued CoCos leads to additional risk taking incentives is likely to suffer from sample selection bias. We can test this hypothesis by using a Heckman correction model (Wooldridge, 2010). We construct a selection equation based on known bank characteristics which are expected to predict CoCo issuance, such as asset size and capitalisation level (Goncharenko et al., 2019; Avdijev et al., 2017). Thus, the selection equation and the response equation under the Heckman selection model become:

$$\text{CoCobank}_i = \beta_0 + \beta_1 Size_{i,t} + \beta_2 Debt_{i,t} + \beta_3 \text{DepLiab}_{i,t} \tag{5}$$

Bank specific variables are- $Size$ - natural log asset size, $Debt$ -debt to total capital ratio, DepLiab - ratio of deposits to liabilities, and the macro variables are GDPgrowth – GDP growth and . The dependent variable captures bank risk-taking, and is computed using one one the four bank risk-taking measures discussed above. CoCoDummy is a dummy variable indicating whether the bank has CoCo bonds in the capital structure, and TotalWTCoCo measures the expected wealth transfer in case of CoCo conversion to existing shareholders: the total amount of wealth transfer multiplied with the probability of conversion.

Next we define a selection equation:

$$r_{i,t} = \beta_4 + \beta_5 \text{GDPgrowth}_{t-1} + \beta_6 Size_{i,t-1} + \beta_7 \text{CoCoDummy}_{i,t-1} + \beta_8 \text{TotalWTCoCo}_{i,t}$$

$$+\beta_9 Uncty_{t-1} + \beta_{10} Comp_t + \varepsilon_{i,t} \tag{6}$$

where CoCobank is a time-invariant dummy variable with a value of 1 if the bank ever issued CoCos, and 0 if not,

Based on this set of equations - selection and response equations, the null hypothesis H_0 is no selection bias, or $Var(r|\mathbf{x}, \text{CoCobank} = 1) = Var(r|\mathbf{x})$, where $\mathbf{x}$ is the vector of independent variables and so homoskedasticity holds under H_0. If we reject this hypothesis, we can construct a consistent estimate for the impact of CoCo bonds on risk-taking.

2.3.2 Dynamic model specification and testing for persistence

We first test only for the impact of the presence of CoCo bonds, and then we add the contemporaneous effects of possible wealth transfer in case of conversion. We use contemporaneous instead of lagged effects when we analyse market values as markets react faster compared to book values. When we use the z-score as a measure of risk we incorporate instead only lagged values.

The first test is for the impact of CoCo bonds presence on risk-taking in a dynamic setting:

$$r_{i,t} = \beta_0 + \rho r_{i,t-1} + \beta_1 \text{GDPgrowth}_{t-1} + \beta_2 Size_{i,t-1} + \beta_3 Debt_{i,t-1} +$$

$$\beta_4 \text{Dep/Liab}_{i,t-1} + \beta_5 \text{CoCoDummy}_{i,t-1} + \beta_6 \text{TotalWTCoCo}_{i,t} + \varepsilon_{i,t} \quad (7)$$

We augment the specification to test for the impact of uncertainty and competition:

$$r_{i,t} = \beta_0 + \rho r_{i,t-1} + \beta_1 \text{GDPgrowth}_{t-1} + \beta_2 Size_{i,t-1} + \beta_3 Debt_{i,t-1} + \beta_4 Comp_{t-1} +$$

$$+\beta_5 Uncty_t + \beta_6 \text{DepLiab}_{i,t-1} + \beta_7 \text{CoCoDummy}_{i,t-1} + \beta_8 \text{TotalWTCoCo}_{i,t} + \varepsilon_{i,t} \quad (8)$$

Finally, we augment the model with interaction terms: Inter Uncty = uncertainty $*$ CoCo dummy, Inter Comp = competition $*$ CoCo dummy.

We test for persistence by assessing the significance of the lagged endogenous variable among the explanatory variables. The Arellano-Bond model is designed for such a dynamic panel data structure with a lagged endogenous variable on the right hand side of the equation. We test for auto-correlation of order 1 and 2 (AR(1) and AR(2)) using the Arellano-Bond test (Arellano and Bond, 1991).

2.3.3 Static model specification

Although our estimates confirm the need to use a dynamic specification, for comparability with the literature we also show the results of a pooled OLS. The first variant of the static version is simply the dynamic version but with the lagged endogenous variable left out:

$$r_{i,t} = \beta_0 + \beta_1 \text{GDPgrowth}_{t-1} + \beta_2 Size_{i,t-1} + \beta_3 Debt_{i,t-1} +$$

$$\beta_4 \text{Dep/Liab}_{i,t-1} + \beta_5 \text{CoCoDummy}_{i,t-1} + \beta_6 \text{TotalWTCoCo}_{i,t} + \varepsilon_{i,t} \quad (9)$$

The initial model specification is then also extended to test for CoCo effects in the presence of macroeconomic uncertainty and banking competition, like was done for the dynamic setup:

$$r_{i,t} = \beta_0 + \beta_1 \text{GDPgrowth}_{t-1} + \beta_2 Size_{i,t-1} + \beta_3 Debt_{i,t-1} + \beta_4 Comp_{t-1} +$$

$$+ \beta_5 Uncty_t + \beta_6 \text{DepLiab}_{i,t-1} + \beta_7 \text{CoCoDummy}_{i,t-1} + \beta_8 \text{TotalWTCoCo}_{i,t} + \varepsilon_{i,t} \quad (10)$$

3 Descriptive statistics and empirical results

3.1 Descriptive Statistics

Bank risk measures

We derive equity and asset beta measures for the ten out of the fifteen banks in our sample which are listed at London Stock Exchange. The first reported measure is equity beta, with a mean value of -0.0109, indicating that our sample has almost no correlation with the FTSE100. We find that asset beta, which takes into account bankruptcy risk, has both a smaller mean value and a smaller standard deviation, as expected. We further report the CDS 5 year subordinated debt on 9 banks. The reported values are in basis points, which shows an average CDS spread of 2,015%, with a variation between 0,555% to 5,964%. The accounting measure z-score is reported for all banks in our sample. We find that the z-score has the highest volatility from all measures. Summary statistics for our four measures of bank risk taking are listed in Table 2.

The CoCo market

The total amount of CoCo bonds issued in Europe between Jan 2013 and November 2018 was approximately 158.2 bn EUR. U.K. and Switzerland are by far the largest issuers both in number of issuances and amount outstanding, with U.K. having issued CoCo bonds worth 54.2 bn EUR, so more than a third of the entire market in terms of size.

We analyse the 46 AT1 U.K. CoCo issuances, from which almost all are conversion to equity, with a fixed conversion price. The U.K. has by far the largest European issuance in terms of CE CoCo bonds, both in terms of size and number of issuances. CoCo bonds represent an average of 12.3% relative to total bank capital. The market issues at a constant pace every year, with occasional spikes. A standard feature of CoCo IPO's is that banks can call the CoCo bonds every 5 years. We observe that banks call the CoCo bonds, and they subsequently reissue, leading to a five year cycle. A possible explanation for this behaviour is cheaper financing costs, as CoCo bonds are no longer an exotic instrument to the market, as it was in the early 2010's. Under

Bank of England regulation, AT1 CoCo bonds must have a trigger level of minimum 7%. Very few other countries (Switzerland) impose a higher trigger level compared to the Basel regulation of 5.125%, which leads to a 'cluster' of CoCo issuances at the minimum regulatory requirement of a 5.125% CET1 to RWA trigger. A brief market overview for AT1 U.K. CoCo bonds can be found in Table 10.

We report on the key descriptive statistics of our derived CoCo variables in Table 3 [11]. The probability of CoCo conversion is on average very small, due to the current high level of bank capitalisation in terms of CET1 to RWA ratio. The marginal wealth transfer, under the assumption of a share price drop equal to the historical price drop per bank, implies a gain of 0.329 sterling per share for existing shareholders. We obtain a similar value for the marginal wealth transfer gain when we assume a 30% share drop. Based on our two measures of price at conversion, we find that all conversion to equity UK CoCos are non-dilutive for existing shareholders.

Lastly, in Table 9 we present descriptive statistics for macroeconomic variables and bank control variables which we use. We report all values in GBP, unless otherwise stated.

Table 2: Bank Risk measures

Variable		**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Equity beta	overall	258	-.0109766	.1302362	-.4733327	.4389159
	between	10		.0592895	-.1058798	.050259
	within	25.8		.1211537	-.4293169	.3776803
Asset beta	overall	218	-.0010243	.0072374	-.016214	.0240661
	between	10		.0054054	-.0111882	.0030955
	within	21.8		.0056664	-.0175939	.0199463
CDS	overall	141	201.476	110.1216	55.48713	596.4548
	between	9		48.31686	116.4804	248.1396
	within	15.67		102.1	39.42808	561.3742
Z-score	overall	270	6.74263	11.63534	-5.746688	99.13686
	between	15		5.809552	-.8234839	20.91514
	within	18		9.99202	-12.48019	84.96435

[11] The full table of descriptive statistics can be found in the appendix.

Table 3: CoCo descriptive statistics

Variable		N	Mean	Std. Dev.	Min	Max
CoCo bonds to overall capital ratio	overall	69	.1233856	.089128	.027243	.4310864
	between	10		.077867	.0552798	.309227
	within	6.9		.0387314	.0168818	.245245
Prob of CoCo conversion	overall	69	8.27e-06	.0000417	3.47e-51	.0002638
Total CoCo shares mn	overall	78	19.3876	27.620	0	83.1719
	between	11		25.8804	0	83.171
Marginal wealth transfer per share (empirical decline)	overall	57	.32888	.27027	0	1.1509
Total expected WT at conversion £mn (empirical decline)	overall	57	3979.367	3280.7	0	13272.63

3.2 Empirical results

We are most interested in the impact of CoCo bonds issuance on the asset beta. Asset beta is a measure for asset risk, on the assumption that the bank risk-shifting incentives are reflected in the asset portfolio allocation.

3.2.1 Selection bias

We test for selection bias using three different methods. The first one is a full information maximum likelihood estimation, where we jointly estimate the selection equation for a bank to be a CoCo issuing bank, and the response equation, where we assess the impact on risk taking. This method is ideal if the equations are correctly specified. However if we have a specification error, this will lead to spillover effects and incorrect estimates in the other equation too in a full systems estimator like FIML. To avoid this potential problem, we use the Heckman two step correction model as our second testing method. The first step estimates the probability that a bank is a CoCo issuing bank based on observed capital structure characteristics, and this probability is summarized in the Inverse Mills ratio variable, for which we test its statistical significance in the second step of the response equation. We find strong evidence that the bank risk-taking behaviour is persistent in time, and so the third method incorporates the Arellano-Bond estimation. We perform a Hausman test on the Arellano-Bond specification where we include the Inverse Mills ratio, which is always consistent, but might be inefficient, with the Arellano-Bond specification without the Mills ratio is efficient in the absence of selection bias. We report the results of the first two methodological specifications in Table 4.

Full Information Maximum Likelihood

The first two columns in Table 4 report the full information maximum likelihood estimation results of the selection and response equation simultaneously, where column (1) assumes a static response equation, and column (2) refers to a dynamic model specification with a lagged endogenous variable. In the selection equation we find that asset size is a predictor of CoCo issuance, consistent with previous empirical studies (Goncharenko et al., 2019; Avdijev et al., 2017). We find no statistically significant evidence of selection bias, as the estimate (*athrho*) which captures the correlation in the error terms of the selection and response equation has a t-statistic of -1.26 in the static model specification, and -0.2 in the dynamic one[12]. We report the LR test test of no selection bias ($\rho = 0$) and find that in both model specifications (1) and (2) we cannot reject the null hypothesis that the two equations are independent. The results and corresponding probabilities are reported in the LR test and $Prob > chi2$ in Table 4.

Two step Heckman correction model

In the Heckman two step correction model, he first stage is the selection equation, a probit model which determines the probability that a bank is a CoCo issuing bank based on key capital structure characteristics documented in the literature. The second stage is the response equation, and incorporates other variables that affect asset beta, while taking into account the selection bias of a bank issuing CoCo bonds from the first stage. This selection bias is calculated via the Mills ratio, which captures the probability that a bank issues CoCo bonds given ex-ante characteristics.

Columns (3) and (4) in Table 4 illustrate the results of the two-step Heckman estimator. In step one we estimate the selection equation to determine the Inverse Mills ratio. In step two this ratio is used in the response equation. The selectivity effect is summarised by *lambda*[13]. We find no effect of selection bias, as the inverse Mills ratio is not statistically significant in either static or dynamic case (p-values of 0.149, and 0.595 for the static, and dynamic case respectively).

As an additional test, we incorporate the inverse Mills ratio from the first stage

[12]The correlation between the error terms of the selection and response equation is ρ, and the reported estimate *athrho* denotes the inverse hyperbolic tangent of ρ, or the Fisher z-transform : $atanh\rho = \frac{1}{2}ln(\frac{1+\rho}{1-\rho})$. In this setup, the estimates in the response function do not correct for the Mills ratio, and so the coefficients are different compared to the two step variant. Let σ denote the standard error of the residuals in the response equation. The lnsigma coefficient reports the log transform of σ.

[13]This value captures $\lambda = \rho\sigma$ from the maximum likelihood estimation variant described in the previous footnote

Table 4: Heckman correction model. Bank risk measure: Asset beta

	(1)	(2)	(3)	(4)
	β_{asset}	β_{asset}	β_{asset}	β_{asset}
β_{asset}				
GDP growth (-1)	0.103	-0.0357	0.104	-0.0348
	(1.63)	(-1.10)	(0.79)	(-1.06)
Size (-1)	-0.000546	-0.000186	-0.00425	-0.000537
	(-0.96)	(-0.50)	(-1.35)	(-0.65)
Uncty(-1)	0.00316***	0.000312	0.00330**	0.000344
	(5.08)	(0.92)	(2.57)	(0.99)
CoCoDummy	0.00957***	0.00410***	0.00961***	0.00414***
	(6.46)	(5.04)	(3.18)	(5.07)
Comp	0.00214***	0.000700***	0.00189**	0.000686***
	(5.34)	(3.07)	(2.25)	(2.99)
Asset beta (-1)		0.849***		0.846***
		(23.98)		(23.44)
Const.	-0.00164	0.0000742	0.0524	0.00514
	(-0.20)	(0.01)	(1.15)	(0.43)
CoCo bank				
Size	0.530***	0.531***	0.500***	0.531***
	(6.38)	(6.44)	(6.38)	(6.43)
Dep/Liab	-0.240	-0.577	-0.519	-0.575
	(-0.28)	(-0.69)	(-0.63)	(-0.68)
Debt	-0.0155	-0.102	-0.107	-0.104
	(-0.06)	(-0.37)	(-0.40)	(-0.38)
Const	-5.875***	-5.640***	-5.229***	-5.636***
	(-3.67)	(-3.64)	(-3.53)	(-3.64)
athrho	-0.347	-0.0707		
	(-1.16)	(-0.19)		
lnsigma	-5.110***	-5.833***		
	(-81.24)	(-110.24)		
LR test (rho=0)	chi2(1)=1.11	chi2(1)=0.04		
$Prob > chi2$	0.2912	0.8449		
Inv. Mills ratio				
lambda			-0.0154	-0.00141
			(-1.45)	(-0.52)
N	296	287	296	287

t statistics in parentheses

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

The first two columns use the maximum likelihood estimation. Column (1) assumes a static model specification and column (2) incorporates the first lag of asset beta in the response equation. The variables of interest are *athrho*- correlation in the error terms of selection and response equation, and the *LR chi2* test.

Columns (3) and (4) report the two step Heckman correction, where column (3) uses the static response, and column (4) the dynamic response equation. The selection effect coefficient is captured by the *lambda* in the Inverse Mills ratio.

Table 5: Estimated coefficients for Mills ratio

Dependent variable: Asset beta	Pooled OLS	Arellano-bond
Inv Mills ratio	-.0111517	-.0028405
	(-1.38)	(-1.14)
N	218	199

t statistics in parentheses

First column reports the coefficient of the Inverse Mills ratio in the pooled OLS estimation, with a static model specification. The second column reports the coefficient in the Arellano-Bond estimation for the dynamic model specification. See the full regression estimations in Table 11.

Heckman as an additional variable in the static model estimated via pooled OLS and in the dynamic version of our model estimated via the Arellano-Bond estimator, and we find that the coefficients are statistically insignificant in both cases, providing further indication of no selection bias. We report the coefficients for the Invers Mills ratio in Table 5, and the full estimation results can be found in Table 11.

Hausman test

In a third test, we use the Hausman-Wu test to we compare the model estimation which incorporates the CoCo selection bias with the variant where we do not incorporate it. We denote by $\hat{\theta_1}$ the vector of parameter estimates from the Arellano-Bond estimator which do not incorporate selection bias, and by $\hat{\theta}_{Mills}$ the one which incorporates the Mills ratio. The null hypothesis in this case is:
H_0: *$\hat{\theta_1}$ is efficient and consistent, and $\hat{\theta}_{Mills}$ is inefficient and consistent.*

Alternatively,

H_A: *$\hat{\theta_1}$ is inconsistent, and $\hat{\theta}_{Mills}$ is consistent.*

The Hausman test for the χ^2 test with 8 degrees of freedom is 0.69, and has a corresponding p-value of 0.9996. These results show that the difference in coefficients is not systematic, providing further evidence against the presence of selection bias in our model specification.

Based on the above evidence we reject the regulatory arbitrage hypothesis, and we find no statistically significant selection bias in CoCo issuing banks.

3.2.2 Dynamic specification results

Our main results stem from the dynamic model specification with the asset beta as LHS variable, and are presented in Tables 6, 12. The coefficient of the lagged

Table 6: Dynamic panel data specification with robust std errors. Bank risk measure: Asset beta

	(1) Asset beta	(2) Asset beta	(3) Asset beta	(4) Asset beta	(5) Asset beta	(6) Asset beta	(7) Asset beta
Asset beta (-1)	0.813***	0.816***	0.816***	0.769***	0.771***	0.816***	0.771***
	(23.22)	(22.90)	(23.68)	(21.03)	(20.89)	(22.90)	(20.89)
GDPgrowth	-0.0250*	-0.0245*	-0.0114	0.0439*	0.0523**	-0.0245*	0.0523**
	(-1.76)	(-1.73)	(-0.64)	(1.96)	(2.16)	(-1.73)	(2.16)
Size	-0.00114**	-0.00108**	-0.000493	-0.00168***	-0.00116	-0.00108**	-0.00116
	(-2.36)	(-2.31)	(-0.90)	(-3.10)	(-1.62)	(-2.31)	(-1.62)
Debt	0.000570	0.000610	0.000663	0.000422	0.000482	0.000610	0.000482
	(0.24)	(0.26)	(0.31)	(0.20)	(0.23)	(0.26)	(0.23)
Dep/Liab	-0.00319***	-0.00294***	-0.00378***	-0.00149	-0.00201	-0.00294***	-0.00201
	(-3.81)	(-3.10)	(-6.03)	(-0.79)	(-1.06)	(-3.10)	(-1.06)
CoCoDummy (-1)	0.00294***	0.00279***	0.00334***	0.00347***	0.00388***	0.00279***	0.00388***
	(4.39)	(3.98)	(4.96)	(4.21)	(5.53)	(3.98)	(5.53)
WealthTransfer Emp.		0.00276***	0.00293***	0.00178**	0.00196**		
		(3.36)	(4.02)	(2.05)	(2.32)		
Competition (-1)			0.000326**		0.000262		0.000262
			(2.49)		(1.59)		(1.59)
Uncertainty				0.000934***	0.000903***		0.000903***
				(3.06)	(2.96)		(2.96)
WealthTransfer 30%						0.00276***	0.00196**
						(3.36)	(2.32)
Const.	0.0154**	0.0144**	0.00633	0.0206***	0.0133	0.0144**	0.0133
	(2.07)	(2.00)	(0.74)	(2.75)	(1.25)	(2.00)	(1.25)
N	199	199	199	199	199	199	199

t statistics in parentheses

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

dependent variable is positive and statistically significant at a 1% level for all four risk measures, and so we accept the dynamic model instead of the static specification.

We find that CoCo bonds on the balance sheet have a positive and significant effect on asset risk, and moreover this impact depends on the size of wealth transfer, regardless on whether we measure it via the empirical, or the 30 % price drop. The size of expected dilution for existing shareholders has a lower economic impact than the presence of CoCos. Our results confirm our hypotheses and the results in theoretical literature that less dilutive CoCos have a higher impact on bank risk-taking behaviour. We find that the size of dilution has a positive impact on asset risk. The more equity holders have to gain from a possible CoCo conversion (so higher value of the Wealth Transfer variable), the more risk the bank will take. The coefficients for both the CoCo dummy and the wealth transfer are statistically significant at a 1%, 5% or 10% depending on the model specification. Macroeconomic uncertainty and competition have a very small, but significant positive economic impact on asset risk, and it strengthens the effects of having CoCo bonds on balance sheet, while diminishing the impact of the wealth transfer on asset risk.

In the model specification with interaction terms (Table 12) Inter uncty and Inter Comp measure the relative impact of CoCo bonds on risk-taking in the presence of macroeconomic uncertainty, and competition respectively. Neither interaction of uncertainty or competition in the presence of CoCo bonds has a statistically significant effect on asset risk, so the direct effects of these two variables are not influenced by the presence of CoCo bonds. Under some model specifications with interaction terms the dilution size seems to no longer impact asset risk, while having CoCo bonds on the balance sheet continues to play a positive and statistically significant role.

Our results in a dynamic setting reinforce our hypotheses when looking at the other two market measures of risk, equity beta and CDS spreads respectively. Equity beta, one of our proxies for market risk, is positively affected by CoCo bonds on a banks' balance sheet, but the size of the wealth transfer does not seem to affect it. Past levels of higher inter-bank competition increase market risk, but the interaction effects with the CoCo bonds variable do not seem to play a role.

CDS spreads are a measure of the riskyness of debt (in all cases we use CDS on 5 year subordinated debt). CoCo bonds are an additional capitalisation buffer which protects debt-holders, which in turn makes the subordinated debt less risky. The presence of CoCo bonds on the balance sheet has a negative and significant impact at 5% or 10%, which is what one would expect. In contrast, the wealth transfer has a positive impact on CDS spreads. If gains from conversion are expected, then the bank is expected to take more risk, which in turn will decrease the probability of subordinated debt to be repaid, which leads to higher CDS spreads.

Overall, the results forthe three market based risk measures (the asset beta, the equity beta and CDS spreads) are very similar, but the results based on the accounting based risk measure are very different. In both the dynamic and static panel, CoCo issuance has no effect on the z-score, and the only determinant of it appears to be the banking competition level from the last half year and the uncertainty measure. Again, under all cases for both asset and equity beta we find a positive significant effect of past coco issuance. The dynamic specification gives more robust results, but the accounting based measure of risk (z-score) does not capture the impact of CoCo bonds on risk-taking.

Summing up, our empirical results indicate that banks with CoCos on their balance sheet take more asset risk, both in the static and dynamic model specifications. The expected wealth transfer has a statistically significant effect when we use the asset beta and CDS spread risk measure. If the shareholders expect a negative wealth transfer, they are less likely to increase their asset risk[14]. Banking competition has a positive and statistically significant effect on CDS spreads and equity beta in the dynamic model, while banking competition has no additional effect on CoCo impact on bank risk-taking decisions. Macroeconomic uncertainty matters for both asset risk (asset beta) and bankruptcy risk (CDS spreads).

3.2.3 Model misspecifications and robustness checks

Consider next the Arrelano-Bond estimator results which eliminate potential problems related to the presence of lagged endogenous variables. We test for auto-correlation of order 1 and 2 AR(1), AR(2) in the dynamic panel using the Arellano-Bond test. We reject the null hypothesis of no auto-correlation in error terms for AR(1), and accept it for AR(2). This is further evidence that our dynamic model with one lag is well-specified.

Lastly, we perform additional robustness checks. We re-run the analysis with market price of shares evaluated at assumed drops in the market price at conversion time varying from 5 to 25 percent, and we obtain similar values compared to the empirical and 30% price drop that we considered. Secondly, a change in one or two lags from when the CoCo was issued does not significantly change our main results. Thirdly, we test for a static panel models with fixed, and random effects as well, and results are consistent for CoCo presence, macroeconomic uncertainty and banking competition. The impact of wealth transfer on risk measures is positive, but not significant. Fourthly, we calculate the wealth transfer only using the marginal impact per shareholder in case of conversion. Results are not robust for the wealth transfer when assessing the impact on CDS, as we obtain contradicting results. Moreover, the wealth transfer for the marginal shareholder is no longer statistically significant for asset beta. In light of these results, we argue that the marginal impact is too small to be able to affect the risk measures, and the aggregate is a more economically relevant measure to inspect. The detailed estimation resuklts of all the robustness results are listred in the appendix.

[14]In the static setup this variable is insignificant, but note that the static equation suffers from omitted variable bias. It is included only for comparability with the literature

4 Conclusion

In this paper we add to the empirical literature assessing the impact of CoCos on risk taking. New is that we explicitly test for sample selection bias (are banks with a greater risk appetite more inclined to issue Coco bonds?), that we include the extent to which CoCo bonds will dilute shareholders upon conversion and assess its impact on risk taking, and that we explicitly distinguish between market- and accounting based measures of riskiness.

Further we test the regulatory arbitrage hypothesis in a CoCo setting, which argues that banks' decision to issue is determined by incentives to ex-post increase their risk-taking behaviour, but we find no compelling evidence for this hypothesis. We analyse the impact in the U.K., as the United Kingdom is by far the largest CoCo issuer in Europe, and it accounts for 60% of all conversion to equity CoCo issuances.

We find that the decision to issue CoCo bonds has a positive and significantly significant effect when looking at market-based measures of bank risk-taking, but no effect with respect to book-based measures. Taking into account that risk-taking is persistent, we find that the total amount of expected dilution to current shareholders has a significant effect on asset risk. More precisely, less dilutive CoCo bonds from last period predict an increase in current risk-taking. The impact of wealth transfer on risk is only robust across market measures of risk, and not for the book based measure. Past banking competition has a positive and significant impact on current risk-taking, as expected, but the economic impact seems to be small. Macroeconomic uncertainty has an ambiguous effect on bank risk-taking, depending on whether we analyse it on market or book based measures. Looking at market based measures of risk-taking, we find that higher uncertainty amplifies the positive impact of CoCo bonds on risk taking.

Summing up, our empirical results confirm earlier CoCo theories (Chan and van Wijnbergen, 2017), according to which the size of the dilution matters for risk-taking incentives. More precisely, we obtain evidence to support that less dilutive CoCo bonds increase banks' risk-taking incentives, as existing shareholders can potentially gain from a CoCo conversion.

These results suggest that policymakers would be well advised, when they want to control the risk taking incentives for banks, to not just consider the level of capital requirements or the share which can be met by issuing CoCos; The specific design features of the CoCos should be considered as well if overall risk taking incentives are to be lowered. In particular regulators may well want to insist on a sufficiently high degree of dilution for existing shareholders in the event CoCo triggers are set off and conversion will take place.

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List of Tables

A Probability of conversion

The Merton credit risk model states that equity under limited liability is equivalent to a call option on the assets of the firm with strike price the debt of the firm:

$$E_{t+T} = max(A_{t+T}, 0)$$

We use the Black-Scholes formula for a European call option to value E (note that the exercise time equals the maturity of the debt):

$$E_t = A_t\theta(d) - De^{-r_f T}\theta_t(d - \sigma_a\sqrt{T}) \tag{11}$$

Note also that r_f is the risk free rate. This gives us one equation in two unknowns: we know E_t but we do not know A_t and σ_A. But (11) also implies a relation between the two volatilities, which gives us a second equation for the two unknowns in

$$\frac{dE_t}{E_t} = \frac{\theta dA_t}{E_t} = \theta\frac{A_t}{E_t}\frac{dA_t}{A_t} \tag{12}$$

Combining the two, $E_t\sigma_E = \theta(d)A_t\sigma_A$. Using the standard stochastic process definition for Brownian motion asset price dynamics. So we derive numerically the asset value A and asset volatility σ_A from the equity value E_t and the equity return volatility $sigma_E$ using equations (11) and (12).

B Variable description

C Descriptive statistics

Table 7: Variable description

Variable	Description
$r_{i,t}$	risk measure of bank i at time t
Equity beta	Equity beta of bank i at time t
Asset beta	Asset beta of bank i at time t
CDS	CDS spread in basis points on 5 year subordinated debt
Z-score	Z-score of bank i at time t
$GDPgrowth_t$	GDP growth at time t
$Size_{i,t}$	ln total assets
$Debt_{i,t}$	Total liabilities to capital ratio
$Comp_t$	Banking competition - Boone indicator for UK
$Uncty_t$	UK Macroeconomic Uncertainty indicator
$Dep/Liab_{i,t}$	Deposits to liabilities ratio
$\text{CoCoDummy}_{i,t}$	1 if the bank had CoCo bonds on their balance sheet last
$\text{TotalWTCoCo}_{i,t}$	probability of CoCo conversion times expected WT to shareholders
Wealth transfer 30%	Total wealth transfer for an expected 30% price drop of equity
Wealth transfer emp.	Total wealth transfer for an expected maximum historical price drop of equity
$CoCo_{i,t}$	the total amount of CoCo bonds outstanding at time t for bank i
N_i	total number of shares obtained per unit of CoCo in case of conversion
$TE_{i,t}$	Total amount of Tier 1 capital (equity) of bank i at time t
$TA_{i,t}$	Total assets of bank i at time t
$a_{i,t}$	total number of shares before conversion
$Mrktcap_{i,t}$	Market capitalisation
$MarginalWT_{i,t}$	Marginal wealth transfer (per share) in case of conversion
$WT_{i,t}$	Total wealth transfer to existing shareholders in case of conversion
$P_{c,i}$	Conversion price per coco stipulated in contract
$P_{0,i}$	Price of CoCo bond at issuance
$P^m_{i,t}$	price per share of bank i at time t
v_A	Asset value
σ_A	Asset volatility
$DC(t)$	Distance to conversion at time t
TRC	Stipulated trigger level

Table 8: CoCo descriptive statistics

Variable		N	Mean	Std. Dev.	Min	Max
CoCo bonds to overall capital ratio	overall	69	.1233856	.089128	.027243	.4310864
	between	10		.077867	.0552798	.309227
	within	6.9		.0387314	.0168818	.245245
Prob of CoCo conversion	overall	69	8.27e-06	.0000417	3.47e-51	.0002638
	between	10		.0000184	4.97e-12	.0000496
	within	6.9		.0000382	-.0000413	.0002226
Total CoCo shares mn	overall	78	19.3876	27.620	0	83.1719
	between	11		25.8804	0	83.171
Total CoCo issued £mn	overall	80	3019.308	3154.228	60	13297.87
	between	11		2862.673	60	8434.633
Total expected WT at conversion £mn (30% decline)	overall	57	3890.012	3195.588	0	12997
Total expected WT at conversion £mn (empirical decline)	overall	57	3979.367	3280.7	0	13272.63
Wealth transfer per share (30% decline)	overall	57	.32348	.2675	0	1.1412
	between	10		.2513	0	.778
	within	5.7		.1381	-.0581	.6867
Marginal wealth transfer per share (empirical decline)	overall	57	.32888	.27027	0	1.1509
	between	10		.2536	0	.7839
	within	5.7		.1402	-0.056402	.695906

Table 9: Descriptive statistics

Variable		N	Mean	Std. Dev.	Min	Max
GDP growth	overall	37	.0087806	.0103891	-.0311613	.023159
GDP growth de-trend	overall	37	-8.41e-18	.0060915	-.019686	.0093905
Comp	overall	34	3.561197	1.453176	1.119733	6.361119
Uncty	overall	37	.0775492	1.167255	-1.421495	3.753024
Size (ln assets)	overall	471	11.77222	1.82722	6.647948	14.69167
	between	15		1.960801	8.479973	13.92499
	within	31.4		.531713	9.917609	13.12894
Debt ratio	overall	439	.9877092	.2608556	.4013616	3.820427
	between	15		.0788757	.8753267	1.17426
	within	29.266		.2485091	.4387452	3.633876
Dep Liab (deposits to liab)	overall	439	.6471326	.1752675	.108447	.9907721
	between	15		.1572393	.4207125	.9550327
	within	29.266		.105992	.083895	.9483333

Table 10: CoCo issuance Europe

Year	Amount EUR mn	N (from which CE)	GBP	EUR	USD	SGD	SEK
2013	2753	2 (2)	0	1	1	0	0
2014	15936	15 (15)	8	3	4	0	0
2015	10128	8(7)	3	1	4	0	0
2016	7401	5(5)	1	0	4	0	0
2017	9246	10(7)	6	1	2	1	0
2018	8744	6(6)	1	0	4	1	0
Total UK	**54208**	**46(42)**	**19**	**6**	**19**	**2**	**0**
Total Europe	*158200*	*182(71)*	*21*	*66*	*67*	*5*	*6*

Table 11: Dynamic and static panel specifications with the inverse Mills ratio

	(1)	(2)
	Asset_beta	Asset_beta
GDP growth (-1)	0.0980**	-0.0283
	(1.99)	(-1.63)
Size (-1)	-0.00599***	-0.00206***
	(-2.90)	(-2.62)
Debt (-1)	0.000986	-0.00246
	(0.41)	(-1.31)
Dep/Liab (-1)	0.00599	-0.00673***
	(0.99)	(-5.08)
Uncty (-1)	0.00300***	0.000494***
	(6.00)	(3.39)
CoCodummy	0.00845***	0.00444***
	(6.70)	(5.24)
Comp	0.000712*	0.000544***
	(1.76)	(3.38)
Mills	-0.0112	-0.00284
	(-1.38)	(-1.14)
Asset beta (-1)		0.814***
		(35.92)
_cons	0.0707**	0.0316***
	(2.28)	(2.75)
N	218	199

t statistics in parentheses

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

Table 12: Dynamic panel data specification with interaction terms, and robust std errors. Bank risk measure: Asset beta

	(1)	(2)	(3)	(4)	(5)	(6)
	Asset beta	Asset beta	Asset beta	Asset beta	Asset beta	Asset beta
Asset beta (-1)	0.812***	0.770***	0.766***	0.812***	0.770***	0.766***
	(19.99)	(19.81)	(26.30)	(19.99)	(19.81)	(26.30)
GDPgrowth	-0.0108	0.0298	0.0403	-0.0108	0.0298	0.0403
	(-0.55)	(1.02)	(1.42)	(-0.55)	(1.02)	(1.42)
Size	-0.000471	-0.00146**	-0.000975	-0.000471	-0.00146**	-0.000975
	(-0.70)	(-2.31)	(-1.16)	(-0.70)	(-2.31)	(-1.16)
Debt	0.000701	0.000588	0.000691	0.000701	0.000588	0.000691
	(0.31)	(0.27)	(0.31)	(0.31)	(0.27)	(0.31)
Dep/Liab	-0.00373***	-0.00137	-0.00171	-0.00373***	-0.00137	-0.00171
	(-5.80)	(-0.82)	(-1.01)	(-5.80)	(-0.82)	(-1.01)
Competition (-1)	0.000336**		0.000253	0.000336**		0.000253
	(2.01)		(1.33)	(2.01)		(1.33)
Inter comp (-1)	-0.000333		-0.000500	-0.000333		-0.000500
	(-0.12)		(-0.27)	(-0.12)		(-0.27)
CoCoDummy (-1)	0.00368	0.00352***	0.00441***	0.00368	0.00352***	0.00441***
	(1.45)	(4.85)	(2.67)	(1.45)	(4.85)	(2.67)
WealthTransfer Emp.	0.00295***	0.00135	0.00156*			
	(3.55)	(1.59)	(1.77)			
Uncertainty		0.000709	0.000709*		0.000709	0.000709*
		(1.62)	(1.78)		(1.62)	(1.78)
Inter uncrty		0.00147	0.00138		0.00147	0.00138
		(1.56)	(1.64)		(1.56)	(1.64)
WealthTransfer 30%				0.00295***	0.00135	0.00156*
				(3.55)	(1.59)	(1.77)
Const.	0.00593	0.0178**	0.0108	0.00593	0.0178**	0.0108
	(0.55)	(2.10)	(0.87)	(0.55)	(2.10)	(0.87)
N	199	199	199	199	199	199

t statistics in parentheses

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

D Robustness tables

Table 13: Dynamic panel data specification with robust std errors. Risk measure: Equity beta

	(1) Equity beta	(2) Equity beta	(3) Equity beta	(4) Equity beta	(5) Equity beta	(6) Equity beta	(7) Equity beta
Equity beta (-1)	0.542***	0.542***	0.540***	0.535***	0.536***	0.542***	0.536***
	(11.78)	(11.86)	(11.76)	(10.67)	(10.75)	(11.86)	(10.75)
GDPgrowth	-1.219**	-1.218**	-0.734	-0.947*	-0.548	-1.218**	-0.548
	(-2.33)	(-2.32)	(-1.20)	(-1.70)	(-0.83)	(-2.32)	(-0.83)
Size	-0.0472***	-0.0470***	-0.0228	-0.0489***	-0.0239	-0.0470***	-0.0239
	(-3.35)	(-3.29)	(-1.42)	(-3.17)	(-1.47)	(-3.29)	(-1.47)
Debt	-0.0844**	-0.0842**	-0.0811***	-0.0851**	-0.0820***	-0.0842**	-0.0820***
	(-2.33)	(-2.32)	(-2.68)	(-2.35)	(-2.72)	(-2.32)	(-2.72)
Dep/Liab	-0.146*	-0.145*	-0.165**	-0.141*	-0.158**	-0.145*	-0.158**
	(-1.76)	(-1.73)	(-2.13)	(-1.69)	(-2.07)	(-1.73)	(-2.07)
CoCoDummy (-1)	0.0730***	0.0724***	0.0917***	0.0751***	0.0930***	0.0724***	0.0930***
	(3.46)	(3.30)	(4.21)	(3.09)	(3.98)	(3.30)	(3.98)
WealthTransfer Emp.		0.0110	0.0193	0.00837	0.0177		
		(0.56)	(1.13)	(0.38)	(0.92)		
Competition (-1)			0.0118***		0.0116***		0.0116***
			(2.73)		(2.70)		(2.70)
Uncertainty				0.00370	0.00258		0.00258
				(0.95)	(0.71)		(0.71)
WealthTransfer 30%						0.0110	0.0177
						(0.56)	(0.92)
Const.	0.754***	0.750***	0.413*	0.768***	0.422*	0.750***	0.422*
	(3.23)	(3.18)	(1.71)	(3.15)	(1.76)	(3.18)	(1.76)
N	229	229	229	229	229	229	229

t statistics in parentheses

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

Table 14: Dynamic panel data specification with robust std errors and interaction terms. Risk measure: Equity beta

	(1) Equity beta	(2) Equity beta	(3) Equity beta	(4) Equity beta	(5) Equity beta	(6) Equity beta
Equity beta (-1)	0.538***	0.539***	0.537***	0.538***	0.539***	0.537***
	(13.38)	(11.51)	(12.23)	(13.38)	(11.51)	(12.23)
GDPgrowth	-0.719	-0.818*	-0.360	-0.719	-0.818*	-0.360
	(-1.10)	(-1.83)	(-0.69)	(-1.10)	(-1.83)	(-0.69)
Size	-0.0223	-0.0507***	-0.0249	-0.0223	-0.0507***	-0.0249
	(-1.20)	(-2.91)	(-1.22)	(-1.20)	(-2.91)	(-1.22)
Debt	-0.0808***	-0.0867**	-0.0835***	-0.0808***	-0.0867**	-0.0835***
	(-2.65)	(-2.37)	(-2.71)	(-2.65)	(-2.37)	(-2.71)
Dep/Liab	-0.164**	-0.142*	-0.160**	-0.164**	-0.142*	-0.160**
	(-2.16)	(-1.78)	(-2.30)	(-2.16)	(-1.78)	(-2.30)
Competition (-1)	0.0120**		0.0121**	0.0120**		0.0121**
	(2.21)		(2.47)	(2.21)		(2.47)
Inter comp (-1)	-0.00812		-0.0119	-0.00812		-0.0119
	(-0.15)		(-0.22)	(-0.15)		(-0.22)
CoCoDummy (-1)	0.0998*	0.0740***	0.104*	0.0998*	0.0740***	0.104*
	(1.83)	(3.02)	(1.89)	(1.83)	(3.02)	(1.89)
WealthTransfer Emp.	0.0203	0.0128	0.0243			
	(1.01)	(0.48)	(0.98)			
Uncertainty		0.00570	0.00502		0.00570	0.00502
		(1.07)	(1.18)		(1.07)	(1.18)
Inter uncrty		-0.0145	-0.0167		-0.0145	-0.0167
		(-0.42)	(-0.52)		(-0.42)	(-0.52)
WealthTransfer 30%				0.0203	0.0128	0.0243
				(1.01)	(0.48)	(0.98)
Const.	0.406	0.791***	0.433	0.406	0.791***	0.433
	(1.48)	(3.01)	(1.48)	(1.48)	(3.01)	(1.48)
N	229	229	229	229	229	229

t statistics in parentheses

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

Table 15: Dynamic panel data specification with robust std errors. Risk measure: CDS

	(1) CDS	(2) CDS	(3) CDS	(4) CDS	(5) CDS	(6) CDS	(7) CDS
L.CDS	0.706***	0.706***	0.693***	0.631***	0.622***	0.706***	0.622***
	(18.61)	(18.88)	(17.71)	(21.34)	(21.23)	(18.88)	(21.23)
GDPgrowth	-598.5***	-598.7***	108.6	2159.0***	2695.7***	-598.7***	2695.7***
	(-2.59)	(-2.59)	(0.27)	(4.68)	(4.90)	(-2.59)	(4.90)
Size	1.345	3.508	10.07	-5.380	-2.272	3.508	-2.272
	(0.04)	(0.11)	(0.33)	(-0.28)	(-0.11)	(0.11)	(-0.11)
Debt	54.78***	55.64***	58.86***	49.12***	51.95***	55.64***	51.95***
	(3.08)	(3.25)	(3.36)	(3.64)	(3.15)	(3.25)	(3.15)
Dep/Liab	-365.0***	-356.2***	-335.6***	-263.3***	-237.3***	-356.2***	-237.3***
	(-6.54)	(-6.71)	(-4.99)	(-3.40)	(-2.83)	(-6.71)	(-2.83)
CoCoDummy (-1)	-11.12*	-12.78**	-1.654	2.620	11.72	-12.78**	11.72
	(-1.77)	(-2.21)	(-0.20)	(0.58)	(1.61)	(-2.21)	(1.61)
WealthTransfer Emp.		167.7***	158.7***	198.8***	192.1***		
		(18.12)	(10.57)	(8.87)	(7.98)		
Competition (-1)			10.82**		9.464**		9.464**
			(2.08)		(2.48)		(2.48)
Uncertainty				35.58***	35.27***		35.27***
				(5.33)	(5.27)		(5.27)
WealthTransfer 30%						167.7***	192.1***
						(18.12)	(7.98)
Const.	209.8	175.0	46.27	220.1	138.2	175.0	138.2
	(0.44)	(0.39)	(0.11)	(0.83)	(0.45)	(0.39)	(0.45)
N	124	124	124	124	124	124	124

t statistics in parentheses

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

Table 16: Dynamic panel data specification with robust std errors and interaction terms. Risk measure: CDS

	(1) CDS	(2) CDS	(3) CDS	(4) CDS	(5) CDS	(6) CDS
L.CDS	0.699***	0.639***	0.633***	0.699***	0.639***	0.633***
	(16.91)	(18.59)	(17.69)	(16.91)	(18.59)	(17.69)
GDPgrowth	-252.2	2417.4***	2411.3***	-252.2	2417.4***	2411.3***
	(-0.50)	(4.21)	(3.81)	(-0.50)	(4.21)	(3.81)
Size	10.86	-7.234	-2.971	10.86	-7.234	-2.971
	(0.38)	(-0.37)	(-0.14)	(0.38)	(-0.37)	(-0.14)
Debt	56.73***	50.63***	49.85***	56.73***	50.63***	49.85***
	(3.13)	(3.72)	(2.88)	(3.13)	(3.72)	(2.88)
Dep/Liab	-350.4***	-247.1***	-246.3**	-350.4***	-247.1***	-246.3**
	(-4.96)	(-2.95)	(-2.49)	(-4.96)	(-2.95)	(-2.49)
Competition (-1)	5.612		2.177	5.612		2.177
	(0.85)		(0.35)	(0.85)		(0.35)
Inter comp (-1)	32.48**		38.15***	32.48**		38.15***
	(2.20)		(3.58)	(2.20)		(3.58)
CoCoDummy (-1)	-38.67**	5.197	-31.04*	-38.67**	5.197	-31.04*
	(-2.01)	(1.22)	(-1.86)	(-2.01)	(1.22)	(-1.86)
WealthTransfer Emp.	122.9***	179.9***	139.8***			
	(5.79)	(8.19)	(5.30)			
Uncertainty		40.35***	38.85***		40.35***	38.85***
		(4.92)	(4.67)		(4.92)	(4.67)
Inter uncrty		-16.50	-10.20		-16.50	-10.20
		(-1.23)	(-0.68)		(-1.23)	(-0.68)
WealthTransfer 30%				122.9***	179.9***	139.8***
				(5.79)	(8.19)	(5.30)
Const.	59.16	225.6	167.0	59.16	225.6	167.0
	(0.15)	(0.86)	(0.53)	(0.15)	(0.86)	(0.53)
N	124	124	124	124	124	124

t statistics in parentheses

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

Table 17: Dynamic panel data specification with robust std errors. Risk measure: Z-score

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Z-score	Z-score	Z-score	Z-score	Z-score	Z-score	Z-score
Z-score (-1)	0.768***	0.768***	0.748***	0.766***	0.746***	0.768***	0.746***
	(34.50)	(34.62)	(75.77)	(38.14)	(54.37)	(34.62)	(54.37)
GDP growth (-1)	-9.233	-9.118	-36.15	-42.58	-74.95	-9.118	-74.95
	(-0.25)	(-0.25)	(-1.00)	(-0.65)	(-0.87)	(-0.25)	(-0.87)
Size (-1)	3.154	3.205	0.359	3.603	0.781	3.205	0.781
	(1.46)	(1.45)	(0.20)	(1.12)	(0.33)	(1.45)	(0.33)
Debt (-1)	-0.159	-0.167	-2.790	-0.0887	-2.717	-0.167	-2.717
	(-0.09)	(-0.09)	(-1.11)	(-0.05)	(-1.10)	(-0.09)	(-1.10)
Dep/Liab (-1)	1.943	1.963	-5.871	2.768	-5.075	1.963	-5.075
	(0.32)	(0.32)	(-0.62)	(0.55)	(-0.62)	(0.32)	(-0.62)
CoCoDummy (-1)	0.701	0.649	-1.216	0.297	-1.629	0.649	-1.629
	(1.20)	(1.13)	(-1.01)	(0.37)	(-0.88)	(1.13)	(-0.88)
WealthTransfer Emp. (-1)		1.283	0.483	1.666	0.917		
		(0.90)	(0.41)	(0.71)	(0.45)		
Competition (-1)			-1.573*		-1.586*		-1.586*
			(-1.83)		(-1.82)		(-1.82)
Uncertainty (-1)				-0.426	-0.485		-0.485
				(-0.39)	(-0.43)		(-0.43)
WealthTransfer 30% (-1)						1.283	0.917
						(0.90)	(0.45)
Const.	-37.78	-38.40	7.602	-43.30	2.529	-38.40	2.529
	(-1.58)	(-1.57)	(0.28)	(-1.19)	(0.08)	(-1.57)	(0.08)
N	238	238	238	238	238	238	238

t statistics in parentheses

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

Table 18: Dynamic panel data specification with robust std errors and interaction terms. Risk measure: Z-score

	(1) Z-score	(2) Z-score	(3) Z-score	(4) Z-score	(5) Z-score	(6) Z-score
Z-score (-1)	0.750***	0.766***	0.747***	0.750***	0.766***	0.747***
	(90.51)	(41.66)	(50.96)	(90.51)	(41.66)	(50.96)
GDP growth (-1)	-41.41	-42.42	-75.71	-41.41	-42.42	-75.71
	(-1.14)	(-0.57)	(-0.81)	(-1.14)	(-0.57)	(-0.81)
Size (-1)	0.429	3.601	0.818	0.429	3.601	0.818
	(0.24)	(1.09)	(0.33)	(0.24)	(1.09)	(0.33)
Debt (-1)	-2.872	-0.0882	-2.810	-2.872	-0.0882	-2.810
	(-1.16)	(-0.05)	(-1.15)	(-1.16)	(-0.05)	(-1.15)
Dep/Liab (-1)	-5.402	2.766	-4.622	-5.402	2.766	-4.622
	(-0.57)	(0.55)	(-0.57)	(-0.57)	(0.55)	(-0.57)
Competition (-1)	-1.644*		-1.645*	-1.644*		-1.645*
	(-1.92)		(-1.92)	(-1.92)		(-1.92)
Inter comp (-1)	2.966		3.178	2.966		3.178
	(1.24)		(1.25)	(1.24)		(1.25)
CoCoDummy (-1)	-4.166*	0.295	-4.596	-4.166*	0.295	-4.596
	(-1.73)	(0.43)	(-1.56)	(-1.73)	(0.43)	(-1.56)
WealthTransfer Emp. (-1)	0.781	1.672	0.919			
	(0.63)	(0.84)	(0.52)			
Uncertainty (-1)		-0.424	-0.441		-0.424	-0.441
		(-0.34)	(-0.35)		(-0.34)	(-0.35)
Inter uncrty (-1)		-0.0159	0.534		-0.0159	0.534
		(-0.01)	(0.48)		(-0.01)	(0.48)
WealthTransfer 30% (-1)				0.781	1.672	0.919
				(0.63)	(0.84)	(0.52)
Const.	6.745	-43.28	1.999	6.745	-43.28	1.999
	(0.25)	(-1.16)	(0.06)	(0.25)	(-1.16)	(0.06)
N	238	238	238	238	238	238

t statistics in parentheses

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

Table 19: Static panel data specification with bank fixed effects. Bank risk measure: Z-score

	(1)	(2)	(3)	(4)	(5)
	Z-score	Z-score	Z-score	Z-score	Z-score
GDPgrowth (-1)	81.16	80.93	56.47	-49.29	-113.0
	(1.41)	(1.40)	(0.98)	(-0.54)	(-1.24)
Size (-1)	0.559	0.451	-1.920	1.518	0.0413
	(0.23)	(0.18)	(-0.74)	(0.60)	(0.02)
Debt (-1)	-0.000476	0.0431	-1.340	-0.343	-1.699
	(-0.00)	(0.01)	(-0.17)	(-0.04)	(-0.22)
Dep/Liab (-1)	1.087	0.734	-7.340	3.556	
	(0.14)	(0.09)	(-0.89)	(0.45)	
CoCoDummy (-1)	-0.799	-0.621	-3.013	-1.653	-4.740^{**}
	(-0.45)	(-0.34)	(-1.52)	(-0.88)	(-2.31)
TotalWTCoCo		-19.52	-22.60	-14.88	-14.84
		(-0.48)	(-0.57)	(-0.37)	(-0.38)
Comp (-1)			-1.773^{***}		-1.851^{***}
			(-2.75)		(-3.05)
Uncertainty (-1)				-1.568^{*}	-1.994^{**}
				(-1.84)	(-2.38)
Const.	-1.025	0.458	40.08	-12.13	14.50
	(-0.03)	(0.01)	(1.09)	(-0.35)	(0.54)
N	270	270	270	270	270

t statistics in parentheses

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

Table 20: Static panel data specification with bank fixed effects and interaction terms. Bank risk measure: Asset beta

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Asset_beta	Asset beta	Asset beta	Asset beta	Asset beta	Asset beta	Asset beta	Asset beta
GDP growth (-1)	-0.106***	-0.106***	-0.100***	-0.0862**	-0.0106	-0.0122	-0.00988	-0.00409
	(-2.99)	(-2.99)	(-2.78)	(-2.51)	(-0.27)	(-0.32)	(-0.25)	(-0.11)
Size (-1)	-0.00296***	-0.00297***	-0.00215*	-0.00163	-0.00378***	-0.00356***	-0.00429***	-0.00351***
	(-2.90)	(-2.88)	(-1.68)	(-1.34)	(-3.82)	(-3.54)	(-3.33)	(-2.80)
Debt (-1)	0.00232	0.00231	0.00257	0.00271	0.00224	0.00239	0.00209	0.00235
	(0.92)	(0.91)	(1.01)	(1.12)	(0.93)	(0.99)	(0.86)	(1.02)
Dep/Liab(-1)	0.00661	0.00656	0.00592	0.00358	0.00842	0.00868	0.00887	0.00665
	(1.02)	(1.00)	(0.90)	(0.57)	(1.36)	(1.40)	(1.42)	(1.11)
CoCoDummy (-1)	0.00631***	0.00633***	0.00703***	0.0175***	0.00727***	0.00734***	0.00690***	0.0166***
	(6.28)	(6.10)	(5.74)	(7.15)	(7.28)	(7.34)	(5.96)	(7.10)
WealthTransfer Emp.		-0.000254	-0.0000522	0.000876	-0.00110	-0.00162	-0.00126	-0.000619
		(-0.06)	(-0.01)	(0.21)	(-0.27)	(-0.39)	(-0.30)	(-0.15)
Competition (-1)			0.000432	0.000704*			-0.000252	0.0000606
			(1.08)	(1.84)			(-0.62)	(0.16)
Inter comp (-1)				-0.0108***				-0.00986***
				(-4.86)				(-4.65)
Uncertainty					0.00181***	0.00167***	0.00189***	0.00168***
					(5.01)	(4.42)	(4.91)	(4.36)
Inter uncrty						0.00148		0.000864
						(1.18)		(0.72)
Const.	0.0298*	0.0299*	0.0183	0.0120	0.0378**	0.0348**	0.0449**	0.0351*
	(1.78)	(1.77)	(0.91)	(0.63)	(2.35)	(2.14)	(2.27)	(1.84)
N	218	218	218	218	218	218	218	218

t statistics in parentheses

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

Table 21: Static panel data specification with bank fixed effects and interaction terms. Bank risk measure: Equity beta

	(1) Equity beta	(2) Equity beta	(3) Equity beta	(4) Equity beta	(5) Equity beta	(6) Equity beta	(7) Equity beta	(8) Equity beta
GDP growth (-1)	-2.358***	-2.351***	-2.023***	-1.887**	-1.423	-1.439	-1.450*	-1.388
	(-3.12)	(-3.10)	(-2.65)	(-2.49)	(-1.63)	(-1.65)	(-1.67)	(-1.61)
Size (-1)	-0.0916***	-0.0910***	-0.0494*	-0.0450*	-0.0983***	-0.0967***	-0.0633**	-0.0557*
	(-4.49)	(-4.42)	(-1.84)	(-1.69)	(-4.75)	(-4.58)	(-2.21)	(-1.92)
Debt (-1)	-0.161***	-0.160***	-0.146***	-0.145***	-0.159***	-0.158***	-0.148***	-0.146***
	(-3.11)	(-3.09)	(-2.82)	(-2.84)	(-3.08)	(-3.05)	(-2.86)	(-2.85)
Dep/Liab (-1)	-0.204	-0.199	-0.206	-0.223*	-0.168	-0.167	-0.183	-0.201
	(-1.54)	(-1.48)	(-1.55)	(-1.69)	(-1.25)	(-1.25)	(-1.37)	(-1.51)
CoCoDummy (-1)	0.140***	0.139***	0.171***	0.277***	0.148***	0.148***	0.170***	0.273***
	(6.29)	(6.03)	(6.47)	(5.24)	(6.36)	(6.36)	(6.45)	(5.14)
WealthTransfer Emp.		0.0227	0.0340	0.0437	0.0154	0.0109	0.0265	0.0328
		(0.23)	(0.35)	(0.45)	(0.16)	(0.11)	(0.27)	(0.34)
Competition (-1)			0.0202**	0.0227***			0.0159*	0.0189**
			(2.39)	(2.69)			(1.77)	(2.10)
Inter comp (-1)				-0.110**				-0.105**
				(-2.31)				(-2.19)
Uncertainty					0.0172**	0.0161*	0.0119	0.00974
					(2.11)	(1.88)	(1.38)	(1.08)
Inter uncrty						0.0123		0.0108
						(0.44)		(0.39)
Const.	1.405***	1.395***	0.797*	0.742*	1.453***	1.432***	0.965**	0.869**
	(4.22)	(4.15)	(1.91)	(1.80)	(4.34)	(4.22)	(2.23)	(1.99)
N	243	243	243	243	243	243	243	243

t statistics in parentheses

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

Table 22: Static panel data specification with bank fixed effects and interaction terms. Bank risk measure: CDS

	(1) CDS	(2) CDS	(3) CDS	(4) CDS	(5) CDS	(6) CDS	(7) CDS	(8) CDS
GDP growth (-1)	-689.5	-680.8	-499.8	-569.0	1177.8	1108.7	1145.5	1000.0
	(-1.00)	(-0.98)	(-0.70)	(-0.78)	(1.63)	(1.53)	(1.58)	(1.39)
Size (-1)	158.3***	159.1***	180.5***	181.3***	220.7***	217.1***	209.4***	214.7***
	(3.46)	(3.47)	(3.58)	(3.58)	(5.10)	(5.02)	(4.53)	(4.69)
Debt (-1)	36.12	35.96	53.04	51.57	82.52	78.12	73.38	69.06
	(0.50)	(0.50)	(0.72)	(0.70)	(1.25)	(1.19)	(1.09)	(1.04)
Dep/Liab (-1)	-324.0**	-319.9**	-235.1	-233.8	6.221	-21.27	-34.70	-29.92
	(-2.42)	(-2.38)	(-1.49)	(-1.47)	(0.05)	(-0.15)	(-0.23)	(-0.20)
CoCoDummy (-1)	-78.97***	-80.44***	-70.50***	-95.99**	-63.84***	-64.80***	-69.66***	-146.7***
	(-4.29)	(-4.30)	(-3.34)	(-2.02)	(-3.70)	(-3.76)	(-3.63)	(-3.37)
WealthTransfer Emp.		148.3	139.7	113.1	211.2	240.0	219.9	174.8
		(0.50)	(0.47)	(0.38)	(0.79)	(0.89)	(0.82)	(0.65)
Competition (-1)			9.870	8.814			-6.553	-8.506
			(1.02)	(0.89)			(-0.70)	(-0.88)
Inter comp (-1)				24.29				74.68**
				(0.60)				(1.99)
Uncertainty					41.47***	36.88***	43.43***	40.84***
					(5.29)	(4.21)	(5.20)	(4.30)
Inter uncrty						23.84		27.87
						(1.17)		(1.34)
Const.	-1718.6**	-1730.5**	-2105.4***	-2112.8***	-2824.3***	-2750.3***	-2627.1***	-2686.1***
	(-2.56)	(-2.57)	(-2.74)	(-2.74)	(-4.37)	(-4.24)	(-3.72)	(-3.85)
N	141	141	141	141	141	141	141	141

t statistics in parentheses

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

Table 23: Static panel data specification with bank fixed effects and interaction terms. Bank risk measure: Z-score

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Z-score	Z-score	Z-score	Z-score	Z-score	Z-score	Z-score	Z-score
GDP growth (-1)	81.16	81.05	56.60	56.27	25.38	18.21	30.85	23.42
	(1.41)	(1.41)	(0.98)	(0.97)	(0.38)	(0.27)	(0.46)	(0.35)
Size (-1)	0.559	0.500	-1.886	-1.884	0.624	1.037	-1.592	-1.101
	(0.23)	(0.20)	(-0.73)	(-0.72)	(0.25)	(0.42)	(-0.61)	(-0.42)
L.Debt	-0.000476	0.0110	-1.371	-1.372	-0.418	-0.732	-1.453	-1.692
	(-0.00)	(0.00)	(-0.17)	(-0.17)	(-0.05)	(-0.09)	(-0.18)	(-0.21)
Dep/Liab (-1)	1.087	0.924	-7.183	-7.156	0.785	0.910	-6.466	-5.929
	(0.14)	(0.12)	(-0.87)	(-0.87)	(0.10)	(0.12)	(-0.78)	(-0.71)
CoCoDummy (-1)	-0.799	-0.726	-3.101	-3.317	-1.339	-1.290	-3.180	-3.657
	(-0.45)	(-0.40)	(-1.56)	(-0.79)	(-0.73)	(-0.70)	(-1.60)	(-0.87)
WealthTransfer Emp.		-1.721	-2.723	-2.742	-1.244	-2.452	-2.385	-3.493
		(-0.20)	(-0.32)	(-0.32)	(-0.14)	(-0.28)	(-0.28)	(-0.40)
Competition (-1)			-1.771***	-1.776***			-1.599**	-1.535**
			(-2.75)	(-2.73)			(-2.35)	(-2.23)
Inter comp (-1)				0.222				0.631
				(0.06)				(0.16)
Uncertainty					-1.017	-1.391**	-0.514	-0.874
					(-1.61)	(-2.09)	(-0.78)	(-1.25)
Inter uncrty						3.681*		3.371
						(1.72)		(1.57)
Const.	-1.025	-0.216	39.61	39.57	-0.295	-4.590	35.70	29.95
	(-0.03)	(-0.01)	(1.08)	(1.07)	(-0.01)	(-0.13)	(0.96)	(0.80)
N	270	270	270	270	270	270	270	270

t statistics in parentheses

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

Table 24: Robustness wealth transfer measures. Dynamic panel model with robust std. errors. Risk measures: Equity beta, Asset beta

	(1) Equity beta	(2) Equity beta	(3) Equity beta	(4) Equity beta	(5) Asset beta	(6) Asset beta	(7) Asset beta	(8) Asset beta
Equity beta (-1)	0.542***	0.542***	0.536***	0.536***				
	(11.86)	(11.86)	(10.75)	(10.75)				
GDPgrowth	-1.218**	-1.218**	-0.548	-0.548	-0.0245*	-0.0245*	0.0523**	0.0523**
	(-2.32)	(-2.32)	(-0.83)	(-0.83)	(-1.73)	(-1.73)	(2.16)	(2.16)
Size	-0.0470***	-0.0470***	-0.0239	-0.0239	-0.00108**	-0.00108**	-0.00116	-0.00116
	(-3.29)	(-3.29)	(-1.47)	(-1.47)	(-2.31)	(-2.31)	(-1.62)	(-1.62)
Debt	-0.0842**	-0.0842**	-0.0820***	-0.0820***	0.000610	0.000610	0.000482	0.000482
	(-2.32)	(-2.32)	(-2.72)	(-2.72)	(0.26)	(0.26)	(0.23)	(0.23)
Dep/Liab	-0.145*	-0.145*	-0.158**	-0.158**	-0.00294***	-0.00294***	-0.00201	-0.00201
	(-1.73)	(-1.73)	(-2.07)	(-2.07)	(-3.10)	(-3.10)	(-1.06)	(-1.06)
CoCoDummy (-1)	0.0724***	0.0724***	0.0930***	0.0930***	0.00279***	0.00279***	0.00388***	0.00388***
	(3.30)	(3.30)	(3.98)	(3.98)	(3.98)	(3.98)	(5.53)	(5.53)
WealthTransfer 20%	0.0112		0.0179		0.00279***		0.00198**	
	(0.56)		(0.93)		(3.36)		(2.32)	
WealthTransfer 10%		0.0112		0.0180		0.00279***		0.00198**
		(0.56)		(0.93)		(3.36)		(2.32)
Competition (-1)			0.0116***	0.0116***			0.000262	0.000262
			(2.70)	(2.70)			(1.59)	(1.59)
Uncertainty			0.00258	0.00258			0.000903***	0.000903***
			(0.71)	(0.71)			(2.96)	(2.96)
Asset beta (-1)					0.816***	0.816***	0.771***	0.771***
					(22.90)	(22.90)	(20.89)	(20.89)
Const.	0.750***	0.750***	0.422*	0.422*	0.0144**	0.0144**	0.0133	0.0133
	(3.18)	(3.18)	(1.76)	(1.76)	(2.00)	(2.00)	(1.25)	(1.25)
N	229	229	229	229	199	199	199	199

t statistics in parentheses

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

Table 25: Robustness wealth transfer measures. Dynamic panel model with robust std. errors. Risk measures: CDS

	(1) CDS	(2) CDS	(3) CDS	(4) CDS
L.CDS	0.706***	0.706***	0.633***	0.633***
	(18.88)	(18.88)	(17.69)	(17.69)
GDPgrowth	-598.6***	-598.6***	2411.3***	2411.3***
	(-2.59)	(-2.59)	(3.81)	(3.81)
Size	3.508	3.508	-2.971	-2.971
	(0.11)	(0.11)	(-0.14)	(-0.14)
Debt	55.64***	55.64***	49.85***	49.85***
	(3.25)	(3.25)	(2.88)	(2.88)
Dep/Liab	-356.2***	-356.2***	-246.3**	-246.3**
	(-6.71)	(-6.71)	(-2.49)	(-2.49)
CoCoDummy (-1)	-12.78**	-12.78**	-31.04*	-31.04*
	(-2.21)	(-2.21)	(-1.86)	(-1.86)
WealthTransfer 20%	168.8***		140.7***	
	(18.12)		(5.30)	
Wealth transfer 10%		169.0***		140.8***
		(18.12)		(5.30)
Competition (-1)			2.177	2.177
			(0.35)	(0.35)
Uncertainty			38.85***	38.85***
			(4.67)	(4.67)
Inter comp (-1)			38.15***	38.15***
			(3.58)	(3.58)
Inter uncrty			-10.20	-10.20
			(-0.68)	(-0.68)
Const.	175.0	175.0	167.0	167.0
	(0.39)	(0.39)	(0.53)	(0.53)
N	124	124	124	124

t statistics in parentheses

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

Table 26: Robustness wealth transfer measures. Dynamic panel model with robust std. errors. Risk measures: Z-score

	(1)	(2)	(3)	(4)
	Z-score	Z-score	Z-score	Z-score
Z-score	0.768***	0.768***	0.747***	0.747***
	(34.62)	(34.62)	(50.96)	(50.96)
GDPgrowth (-1)	-9.118	-9.119	-75.71	-75.71
	(-0.25)	(-0.25)	(-0.81)	(-0.81)
Size (-1)	3.205	3.205	0.818	0.818
	(1.45)	(1.45)	(0.33)	(0.33)
Debt (-1)	-0.167	-0.167	-2.810	-2.810
	(-0.09)	(-0.09)	(-1.15)	(-1.15)
Dep/Liab (-1)	1.963	1.963	-4.622	-4.622
	(0.32)	(0.32)	(-0.57)	(-0.57)
CoCoDummy (-1)	0.649	0.649	-4.596	-4.596
	(1.13)	(1.13)	(-1.56)	(-1.56)
WealthTransfer 20%	1.293		0.925	
	(0.90)		(0.51)	
WealthTransfer 10%		1.294		0.926
		(0.90)		(0.51)
Competition (-1)			-1.645*	-1.645*
			(-1.92)	(-1.92)
Uncertainty (-1)			-0.441	-0.441
			(-0.35)	(-0.35)
Inter comp. (-1)			3.178	3.178
			(1.25)	(1.25)
Inter uncty (-1)			0.534	0.534
			(0.48)	(0.48)
Const.	-38.40	-38.40	2.001	2.001
	(-1.57)	(-1.57)	(0.06)	(0.06)
N	238	238	238	238

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$