INTERACTION BETWEEN OWNERSHIP STRUCTURE AND SYSTEMIC RISK IN THE EUROPEAN FINANCIAL SECTOR

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Abstract

This empirical study examines the interaction between systemic risk and corporate governance in European financial institutions. Specifically, we investigate how two corporate governance issues, ownership concentration, and institutional investors' presence, affect systemic risk. We use the conditional value-at-risk (CoVaR) approach (Adrian & Brunnermeier, 2016) to measure systemic risk and analyze balanced panel data of 96 listed banks from 19 European countries during the period 2011–2020. We choose the European context of its corporate governance's heterogeneity, the presence of a high level of institutional ownership, and the financial turmoil it has been through over the period analyzed. Our findings reveal that ownership concentration decreases systemic risk, while the high presence of institutional investors increases it. This study contributes to the existing literature by shedding light on the relationship between corporate governance and systemic risk, and how it varies across different ownership structures and institutional contexts. Furthermore, this study provides valuable insights for regulators and policymakers in designing effective corporate governance frameworks that can mitigate systemic risk in financial institutions.

Keywords: Corporate Governance, Ownership Structure, Institutional Investors, Systemic Risk

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1. INTRODUCTION

This paper aims to analyze the interaction between systemic risk and corporate governance factors in the European banking framework.

The 2008 Global Financial Crisis (GFC) has led, both in the US and in the EU, to a reexamination of corporate governance practices at banks, with some policymakers questioning the extent to which managerial entrenchment and the failure of the boards to monitor executives may have led to excessive risk-taking and financial instability (Reinhart & Rogoff, 2009; Kirkpatrick, 2009; Haldane, 2012).

These allegations are likely to be reasonable given that corporate governance can be broadly considered as the set of mechanisms for addressing agency problems and controlling risk within the firm. Banks and financial institutions are highly levered entities, many with access to explicit deposit insurance protection and most with implicit too big to fail guarantees (Bellavite Pellegrini et al., 2018).

Although there is growing evidence that points out the weaknesses in the governance of these firms in the months leading up to the financial crisis, there is not complete agreement on whether the implementation of typical "good" governance practices, such as having an independent board, should lead to less risk-taking[1]. There is, therefore, room for more research on the topic (Zingales, 2000).

In the specific, even though the banking crisis in the euro area has sparked considerable discussion, one issue that has been overlooked in the academic and practitioners' debate is the peculiar ownership structure of euro area financial intermediaries (Véron, 2017). The ownership structure is closely related to both individual banks' risk-taking (Jensen & Meckling, 1976; Laeven & Levine, 2009) and systemic risk (Saghi et al., 2018). This paper will, therefore, explore whether the ownership structure — as a specific feature of corporate governance — of European banks and other financial institutions may have a positive role in smoothing their contribution to the financial systemic risk.

In the economic literature, systemic risk represents "the risk that an economic shock such as market or institutional failure triggers (through a panic or otherwise) either the failure of a chain of markets or institutions or a chain of significant losses to financial institutions, resulting in increases in the cost of capital or decreases in its availability, often evidenced by substantial financial-market price volatility" (Schwarcz, 2008, p. 204). As it will be underscored in detail below, several methodologies have been developed to measure systemic risk; in this paper, we will adopt the delta-conditional value at risk (*ΔCoVaR*) as developed by Adrian and Brunnermeier (2016).

The case of European banks and financial institutions, as in our study, is noteworthy given that this geographical area is characterized by a strong heterogeneity in governance and ownership structure, which can vary according to various factors, including the country's culture and shareholders' features. Furthermore, the ownership structure of European banks is characterized by high institutional ownership (Fernández & Arrondo, 2005). This issue has direct consequences on strengthening the control mechanism due to the monitoring effect by institutional shareholders. Institutional investors strongly influence a company's internal innovation and may support risk-taking behavior (Hoskisson et al., 2002). In line with previous studies (La Porta et al., 1999; Laeven & Levine, 2009) we will analyze the shares held by bank shareholders, to understand whether it is above a certain threshold and, therefore, there is concentrated ownership.

In order to have significant data and to have a clear view of the evolution of *systemic risk* in the banking sector over the years, we will consider the period covering the GFC till the explosion of the COVID-19 pandemic. We acknowledge that the period considered is rich in events that are worthy to be analyzed considering their specifications. The austerity programs that characterized European countries as a reaction to the debt crisis or the change of approach provided by the 'whatever it takes' policies, open room for future research more focused on these events.

Therefore, the research question (*RQ*) underlying this paper is to explore *how ownership concentration and the presence of institutional investors affect systemic risk in the European banking framework.* Specifically, this paper aims to empirically test the impact of these two corporate governance issues on the systemic risk of European financial institutions. The paper focuses on ownership concentration and institutional investors' presence as the literature shows that ownership structure affects the performance of the firm, both on profitability and risk (Diez-Esteban et al., 2022; Battaglia & Gallo, 2016; Saghi et al., 2018).

The main research hypotheses we want to test are mainly the following:

H1: Ownership concentration could show a positive impact on the stability of the European banking framework;

H2: The high presence of institutional investors increases systemic risk, undermining the stability of the European banking system.

By analyzing the data of a balanced panel of 96 listed banks from 19 countries during the period 2011–2020, the paper finds that ownership concentration decreases systemic risk, whereas the high presence of institutional investors increases it. Overall, this paper provides prominent insights concerning the role of ownership structure in mitigating or exacerbating systemic risk in the European banking framework.

The rest of the paper is structured as follows. Section 2 will present the literature review and the conceptual background on the relationship between ownership structure and systemic risk. Section 3 will show the data of our sample and the methodology of our study, while Section 4 will analyze the results. Finally, Section 5 will discuss the findings, and Section 6 will summarize our work.

2. LITERATURE REVIEW AND CONCEPTUAL BACKGROUND

The ownership structure is an important determinant of corporate governance and it affects the performance of the company (Shleifer & Vishny, 1997). Transparency regarding ownership structure helps improve information in stock prices; it enhances corporate governance and increases the quality of information on the market.

Different economic systems are characterized by different ownership structures, distinguished by the size of the shares held and by the type of investor.

Since ownership structures may affect bank performance, both in terms of profitability and risk, a recent stream of research on bank risk-taking typically incorporates information on each bank's ownership structure (Diez-Esteban et al., 2022; Battaglia & Gallo, 2016; Saghi et al., 2018). Also

[1] For example, corporate governance that aligns managerial incentives with shareholder interests can potentially result in more risk-taking, as shareholders face payoffs that are restricted on the downside by limited liability (John & Senbet, 1998; John et al., 2008; Acharya et al., 2011; Anginer et al., 2018).

referring to that topic, the pre- and post-GFC literature shows mixed results without offering a conclusive view (Gropp & Kohler, 2010; Beltratti & Stulz, 2012; Ellul & Yerramilli, 2013; Erkens et al., 2012). This heterogeneity of findings suggests that results may vary with the ownership structure under investigation (i.e., insider ownership, institutional ownership, bank ownership, ownership by top executives and outside directors, etc.).

As outlined by the International Monetary Fund (IMF, 2014), institutional ownership of financial institutions is usually related to less risk-taking, while insider ownership is associated with more risk. However, the same study reveals how the presence of institutional investors and large insider ownership correlates with more risk in 2008.

On their side, Ellul and Yerramilli (2013) show that banks with higher institutional ownership take less risk as measured by their risk management index (RMI). However, in the presence of deposit insurance, they document the effect reverses and a positive correlation between tail risk and institutional ownership emerges. Erkens et al. (2012) report that financial institutions with more independent boards and higher institutional ownership experience worse stock returns during the crisis period.

In this paper we explore the idea that beyond affecting the individual risk of banks, ownership structure (i.e., ownership concentration and the category of shareholders) may be responsible for the correlation of banks' risk-taking behavior at the aggregate level, leading to more systemic risk.

According to a risk-management perspective, financial intermediaries' governance features have been observed to be responsible for the high correlation between past stock returns and the emergence of a financial crisis (Diez-Esteban et al., 2014; Fahlenbrach et al., 2012). Furthermore, such governance characteristics in a given bank may have externalities on other financial institutions and, hence, affect the overall banking systemic risk (Acharya & Volpin, 2010). Additionally, Anginer et al. (2018) found that shareholder-friendly corporate governance is associated with higher stand-alone and systemic risk in the banking sector.

Diez-Esteban et al. (2022) suggest that a higher ownership concentration promotes banks' systemic risk to a certain threshold. Initially, as more powerful owners of large banks can exploit greater bargaining power with regulators and governments in the event of financial distress, we would expect concentrated ownership to be associated with higher systemic and tail risks than banks with dispersed ownership. However, after a critical threshold, very large shareholders can also impose better monitoring on managers' actions and, in more general terms, obtain a better insight into the complex and opaque banking activities, which can lead to better control over the tail and systemic risk. Moreover, if the concentration is too high, it is more likely that large shareholders will seek to reduce risk levels given that they will now bear a very large fraction of the potential costs associated with systemic risk.

Battaglia and Gallo (2016) examine the effects of ownership on traditional measures of bank risk and proxies of bank tail and systemic risk. Based on a sample of 40 European banks over the period 2006–2010, they find that the boards' characteristics affect banks' systemic risk, except for board independence, and that this relation depends on capital regulations, banking systems' ownership structures and bank activity restrictions.

Finally, Saghi et al. (2018) empirically test whether ownership concentration contributes to explaining the cross-variation in systemic risk contribution for a sample of European banks over the 2004–2016 period and how this effect may vary depending on the largest controlling shareholder category. The results show that higher ownership concentration is associated with greater banks' systemic risk contribution. A deeper analysis indicates that banks' systemic risk contribution is even stronger for banks where institutional investors and states are the largest controlling owners.

The literature review highlights that the effects of financial institutions' ownership structure on risk-taking and systemic risk lead to mixed results.

On the one hand, in line with the agency theory, banks with controlling owners tend to be riskier than banks with large participation since those shareholders have the power and incentives to induce managers of banks to increase risk-taking (Laeven & Levine, 2009). When a bank has concentrated equity ownership, the tendency of managers to engage in less risky activities can be hindered by powerful shareholders. This results in a positive relationship between ownership concentration and risk. Indeed, powerful shareholders by their nature have bargaining power *vis-à-vis* the authorities in the event of financial difficulties; this determines a greater systemic risk for banks with concentrated ownership compared to those with dispersed ownership.

On the other hand, contrary to the agency theory, there would appear to be a negative relationship between concentrated ownership and bank default risk (Song & Li, 2012). In particular, relevant shareholders may have a better understanding of complex and opaque banking activities, which can lead to better control of systemic risk. Controlling shareholders of large banks may leverage greater bargaining power with regulators and governments in the event of financial distress and instability, therefore, concentrated ownership may be associated with higher systemic risks than banks with dispersed property.

Regarding ownership concentration, the first hypothesis (*H1*) can be specified: *Ownership concentration decreases systemic risk, and then ownership concentration shows a negative relationship with banks' systemic risk over the period analyzed.*

Institutional investors are a key group of market participants who have sufficient capacity and incentives to engage in managers' monitoring (Shleifer & Vishny, 1997). They are distinguished according to the role they play in: 1) active institutional investors, who usually only have an investment in the companies involved, and, therefore, have a more independent position; 2) passive institutional investors, who hold shares and do not actively seek to profit from short-term price fluctuations.

Active investors are likely to be more prone to risk, in fact, they encourage managers to undertake riskier investment projects to maximize their short-term investment (Almazan et al., 2005). De George et al. (2019) find that higher levels of institutional ownership are positively associated with the future risk movement of banks. These results are more relevant during market downturns, as institutional

owners experience adverse common funding-to-liquidity shocks in these periods. The consequence is possible difficulty in raising capital when they need it most.

Institutional investors may have greater incentives to engage in risky strategies (Saghi et al., 2018). These risk incentives taken on an individual level can directly translate into higher exposure to systemic risk of banking institutions.

With regard to ownership by institutional investors, the second hypothesis (*H2*) can be specified: *Ownership by institutional investors increases the systemic risk of banks, then there is a positive relationship between a high presence of institutional investors and the systemic risk.*

Considering both assumptions on institutional investors' concentration and ownership structure, we conclude that for low levels of bank ownership, institutional investors will play an active role, encouraging managers to increase their returns by pursuing riskier investments. However, when the level of ownership of banks becomes high enough, institutional investors will have greater incentives to protect their position and, therefore, will be able to engage in activities that reduce the risk-taking of a firm (Díez-Esteban et al., 2014).

3. RESEARCH FRAMEWORK

3.1. Sample description

Our sample consists of a balanced panel of 96 listed banks from 19 European countries for the period 2011–2020. Notably, the primary list of banks consisted of 121 institutions with complete financial information, but of which only 96 also provided the complete governance information we needed. We considered the idea to use unbalanced panel data, but due to the lack of information for the identified 25 banks for the most part of the period (six years over ten), we decided to eliminate those banks reaching the definitive sample of 96 banks. The following Table 1 shows the distribution of the banks across countries.

Table 1. Number of banks and % over the period 2011–2020

Country	*Number of banks*	*%*
Austria	5	5.21%
Belgium	1	1,04%
Cyprus	1	1.04%
Denmark	12	12.5%
Finland	1	1.04%
France	15	15.63%
Germany	1	1.04%
Greece	3	3.13%
Island	2	3.13%
Italy	10	10.42%
Liechtenstein	1	1.04%
Malta	1	1.04%
Norway	16	16.67%
Netherlands	1	1.04%
Portugal	1	1.04%
United Kingdom	7	7.29%
Spain	4	4.17%
Sweden	2	2.08%
Switzerland	12	12.5%
Total	96	100%

Source: Author's elaboration. Data obtained by ORBIS.

As summarized in Table 1, the countries with more banks analyzed are: Norway with 16 banks, which represents 16.67% of the total; France with 15 banks represents 5.63%; Denmark and Switzerland with 12 banks are 12.50% of the total banks. In the case of Portugal, Finland, Liechtenstein, Malta, the Netherlands, Germany, Belgium, and Cyprus, only one bank was eligible to be part of the sample.

The leading factor for selecting the countries and the number of banks for each country is data availability. Considering the whole number of European financial institutions, to build our sample of analysis we have considered those banks, and countries, that have complete financial and governance information available for the entire period ranging from 2011 to 2020. We aimed to include banks from different European countries to ensure a diverse sample. The sample consists of banks of various typologies since the European banking system is characterized by great heterogeneity. For example, we take into analysis, savings banks such as the Norwegians ones, Swiss cantonal banks, cooperative banks such as the French ones, British public companies, and medium-sized banks that operate only in a single country were analyzed. Figure 1 summarizes the number of banks divided by their specialization. Even though explaining in detail the difference among these institutions exceeds the purpose of this paper, we would like to summarize the main features of the banks shown in our sample. According to Berger et al. (2014):

1) *Commercial banks* are financial institutions that accept deposits from customers and use those deposits to make loans to businesses and individuals. They are usually for-profit institutions, and they may be publicly traded or privately held.

2) *Cooperative banks* are financial institutions that are owned and operated by their customers, who are also members and have a say in the bank's operations. Cooperative banks are typically community-based and focus on providing banking services to individuals and small businesses; they may offer many of the same services as commercial banks, but their primary focus is on serving their members rather than maximizing profits.

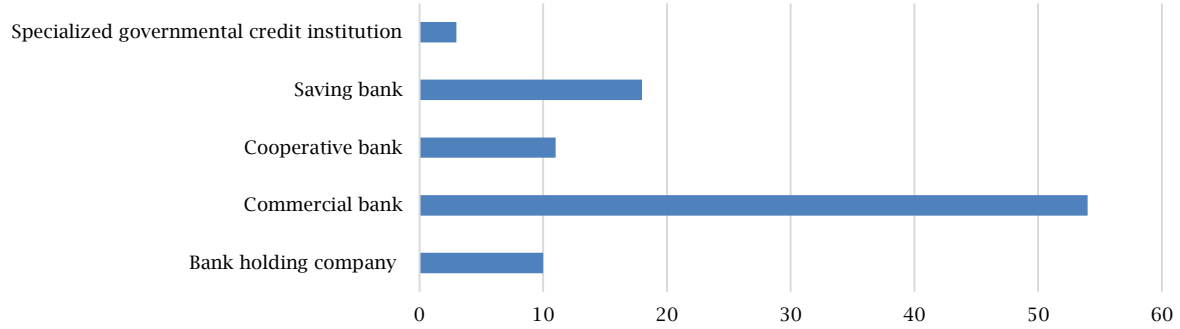
3) *Savings banks* are financial institutions that were traditionally focused on accepting deposits from individuals and providing them with savings accounts and other basic financial services. Like cooperative banks, savings banks are often community-based and may have a focus on serving local customers.

4) *Bank holding company* is a company that owns one or more banks. Bank holding companies may also own other financial institutions, such as investment firms, finance companies, or insurance companies.

5) *Specialized governmental credit institution* is a type of financial institution that is owned and operated by a government and specializes in providing credit and financing for specific industries or economic sectors. These institutions are typically created by governments to address specific financing needs that are not adequately met by private financial institutions. In many cases, specialized governmental credit institutions are set up as public-private partnerships, with

the government providing some funding and oversight, and private financial institutions providing additional funding and expertise. These institutions play an important role in promoting economic growth and development by providing financing and support to industries that might not otherwise have access to it.

Figure 1. Sample of analysis — Banks divided by specialization



Source: Author's elaboration. Data obtained by ORBIS.

3.2. Definition of the variables

The following paragraph explains the variables used in the model.

First, the dependent variable reflecting banks' systemic risk was defined. Secondly, the independent variables of interest have been identified, which in our specific case concern the ownership structure. Finally, the set of control variables and "Other variables" introduced in the regression to support the model was identified.

Table 2 shows a description of each of the variables analyzed.

Table 2. Description of the variables

Variables		***Description***
		Dependent variable
ΔCoVar	Delta-conditional value at risk	The Δ*CoVaR* of firm *i* is defined as the difference between the *VaR* of the financial system conditional on this particular firm being in financial distress (a situation in which the loss exceeds the *VaR*) and the *VaR* of the financial system conditional on firm *i* being in its median state.
		Independent variable
dCONC_lag	Ownership concentration	It is a dummy variable equals to 1 if the % held by the first three shareholders is greater than 51%, 0 otherwise. The variable has been lagged of one year.
INST_lag	Institutional investors	Weight in % of the quota held by banks and insurance companies with respect to the total shareholders. The variable has been lagged for one year.
		Control variables
LnTA_lag	Banks' size	Calculated as the logarithm of total assets at the end of the year, it controls for the fact that larger banks will have a higher association with systemic risk. The variable has been lagged for one year.
Beta_lag	Beta lagged for one year	It is the correlation between the annual value-weighted market return, excluding the company of interest, and the company's return. The inclusion of beta effectively controls the correlation in returns across the entire distribution of returns. The variable has been lagged for one year.
ROA_lag	Bank's performance	Net income divided by total assets expressed as a percentage. The variable has been lagged for one year.
DepTA_lag	Deposits/Total assets	The ratio of total deposits to total assets. The variable has been lagged for one year.
NONINT_lag	Income not from interest	The bank's (standardized) revenues do not from interests. The variable has been lagged for one year.
EqTA_lag	Equity/Total assets	The equity ratio measures the amount of leverage used by a company. It uses asset investments and the amount of equity to determine how well a company manages its debts and finances its capital requirements.
		Other variables
VaR_lag	*VaR* lagged for one year	The value of the *VaR* lagged by one year in the period considered. *VaR* is a statistic that quantifies the extent of possible financial losses for a company, portfolio, or position over a specific period of time.
ΔCoVar_lag	*ΔCoVaR* lagged for one year	The value of the *CoVaR* delta lagged by one year in the period considered.

3.3. Dependent variable

As anticipated in the previous section, even though the systemic risk is difficult to define, it deserves to be monitored and measured because it represents how much a bank or a financial institution can contribute to the distribution of system losses. In the previous literature widely used measures of systemic risk include the following: 1) the *systemic expected shortfall* (SES) and *marginal expected shortfall* (MES) by Acharya et al. (2017); 2) the *systemic risk measure* (SRISK) by Acharya et al. (2012) and the *absorption ratio* (AR) by Kritzman et al. (2011).

In this paper, the systemic risk was identified through the *ΔCoVaR*. This measure, which is based on the *CoVaR* tool used by Adrian and Brunnermeier (2016), is defined as the change in the value-at-risk of the financial system conditional on an institution being in trouble relative to its median state. The steps necessary to build this measure are shown in the Appendix.

3.4. Independent variables: Ownership structure

To measure ownership concentration, we collected shareholder information for each sampled bank and for each year from 2011 to 2020 (source: ORBIS). In line with previous studies (La Porta et al., 1999; Laeven & Levine, 2009), a control threshold was set to assume whether the share held by the top three shareholders is significant and, therefore, to have a proxy of ownership concentration. Our analysis differs from past research insofar as the threshold was higher and equal to 51%.

Starting from the data, the main three shareholders for each bank were identified, i.e., those who held the largest share. In particular, only the direct stake held in the bank was considered and not the total stake, as this represents the total stake in the bank regardless of the type of connection.

Furthermore, free-floating shares, i.e., the shares not held for control purposes and the share held by the bank itself, were excluded from the calculation of the quota of the first three shareholders. These caveats concerned, the sum of the shares of the three shareholders was identified as the basis for calculating the variable.

From an operational point of view, therefore, a dummy variable of ownership concentration has been identified, which equals to 1 if the sum of the shares held by the first three shareholders is greater than 51%, 0 otherwise. The final variable taken into consideration is the ownership concentration variable lagged by one year from the period considered.

The empirical analysis, in addition to investigating the ownership concentration, aims to consider the type of shareholders for each European bank in the sample. In particular, the ORBIS database groups shareholders into the following categories: other shareholders in the aggregate; insurance; private shareholders; banks; employees, managers, directors; public entities; foundations; mutual, pension, nominal, trust funds; hedge funds; property itself; individuals or families; private equity firms; society; financial companies; listed companies; venture capital. According to the literature, the typology of the controlling shareholder is divided into 5 kinds: banks; institutional investors, including insurance companies, mutual and pension funds, and financial companies; industrial companies; individuals or family investors; states or public authorities. Subsequently, starting from this distinction, we study which category the shareholder belongs to.

Along this way, a second variable was identified which identifies the percentage weight of shareholders such as banks and insurance companies who participate in the ownership of financial institutions with respect to the total number of shareholders. Therefore, it was useful to identify, on the one hand, the sum of the direct quota held by banks and insurance companies and, on the other hand, the sum of the direct quota held by all shareholders without distinction. Finally, the results were compared by determining the percentage of incidence of banks and insurance companies on the total shareholders. Also, the variable relating to institutional ownership lag of one year was taken into consideration.

3.5. Control variables

Control variables allow monitoring of the analysis for various bank-level factors that can affect the level of systemic risk.

In line with previous literature on risk-taking by banks (Laeven & Levine, 2009; Pathan, 2009), we focus on the size of the bank (in terms of the natural log of total assets), the performance (proxied by the *ROA*), the asset structure (expressed by the ratio of deposits to total assets), the non-interest income (the bank's standardized revenue from non-traditional activities), the beta (as the correlation with the value-weighted market's annual return) and the amount of leverage used (which is represented as the *Capital / Total assets ratio*.

3.6. Model

To test the effect of the ownership structure on systemic risk, a model is proposed that includes the variables described in the previous sections. In particular, the model was estimated with the support of independent variables, divided into variables relating to the ownership structure, control, and other variables, and the dependent variable was taken as a reference and measurement of systemic risk.

The model identifies is as follows:

$$\Delta CoVaR_{it} = \beta_0 + \beta_1 INST_{it-1} + \beta_2 dCONC_{it-1} + \beta_3 LnTA_{it-1} + \beta_4 Beta_{it-1} + \beta_5 ROA_{it-1} + \beta_6 NONINT_{it-1} + \beta_7 DepTA_{it-1} + \beta_8 EqTA_{it-1} + \beta_9 \Delta CoVaR_{it-1} + \beta_{10} VaR_{it-1} + \sum_{t=2011}^{2020} Year_i^t + \varepsilon_{it} \quad (1)$$

where, the dependent variable is the contribution to the systemic risk measured by the *ΔCoVaR* of the bank, while *dCONC* and *INST* are the ownership structure variables. Control variables follow, based on corporate and financial data of the banks: *LnTA* represents the logarithmic function of the bank's total assets; *Beta* calculated over the period 2011–2020, defines the systematic risk (market and non-diversifiable); *ROA* which identifies the profitability of the bank; *NONINT* or the non-interest portion of income; *DepTA* which expresses the ratio between total debt and assets; *EqTA* which expresses the ratio between total capital and assets.

Following Adrian and Brunnermeier (2016) and Lopez-Espinosa et al. (2012), variables such as the lagged values of *VaR* and *ΔCoVaR* were included in the model. Operationally, the series of values was calculated for each bank considering the first year as

zero (in our case 2011) and scaling the results obtained from the *VaR* and *ΔCoVaR* variables by one year in the years 2011–2020. Also, the control variables presented were all considered one-year-lagged, following the procedure described. Finally, we controlled our results for time-fixed effects.

3.7. Descriptive statistics

Table 3 presents the descriptive statistics for all the variables used in the empirical analysis. The dependent variable *ΔCoVaR* ranges from -0.608 to 2.068 with a mean of 0.395. Furthermore, as can be seen, the ownership concentration of the banks in the sample, expressed by the dummy variable *dCONC*, being binary, varies between 0 and 1 with an average of 0.445.

The *INST* variable (expressed as a percentage) which refers to the percentage weight of the stake held by institutional investors with respect to the total shareholders also fluctuates between 0 and 100%, with an average of 20.91%. This variable investigates the share held by regulated institutions, such as banks and insurance companies, excluding the percentage held by the other shareholders who participate in the bank's capital. The analysis showed that some banks did not record shares from banks and insurance companies over the entire period considered.

In any case, the prevalence of institutional ownership in European banks is confirmed, as affirmed by Franks and Mayer (1996) and Fernández and Arrondo (2005), since only 15 banks out of 96 (15.63%) have a shareholding that it does not figure the participation of banks and insurance companies in all the years of the period.

Analyzing the statistics of the control variables reveals heterogeneity among the banks in the sample, for example, in terms of size (measured by the logarithm of total assets), profitability (*ROA*), non-interest income, and *VaR*.

Table 3. Descriptive statistics of variables

Variables	*N*	*Min*	*Average*	*Max*	*Median*	*Std*	*Skew*	*Kurtosis*
Dependent variable (systemic risk variable)								
ΔCoVar	958	-0.608	0.395	2.068	0.287	0.460	0.674	-0.226
Independent variable (ownership structure variables)								
dCONC_lag	958	0	0.445	1	0	0.497	0.222	-1.953
INST_lag	958	0	20.910	100	9.780	26.997	1.554	1.765
Control variables								
LnTA_lag	958	-2.101	2.868	7.791	2.612	2.395	0.342	-0.735
Beta_lag	958	0	0.742	1.466	0.658	0.406	-0.154	-0.826
ROA_lag	958	-7.959	0.572	9.973	0.530	1.022	1.751	27.495
NONINT_lag	958	-18.672	2.235	42.537	0.153	5.600	2.709	9.512
DepTA_lag	958	0.000	0.465	0.917	0.508	0.233	-0.468	-0.530
EqTA_lag	958	-0.019	0.080	0.204	0.076	0.045	0.091	-0.352
Other variables								
VaR_lag	958	-0.705	2.771	20.733	2.447	2.323	3.649	21.054
ΔCoVar_lag	958	-0.608	0.357	2.068	0.230	0.455	0.836	-0.026

Source: Author's elaboration. Data by Refinitiv Datastream and ORBIS.

Moreover, Table 4 presents the correlation matrix between the variables that we use for our analysis. It shows a positive correlation for the measure of institutional ownership (0.28) and a negative correlation for the variable measuring ownership concentration (-0.26) with respect to systemic risk.

Table 4. Correlation matrix

Variables	*ΔCoVar*	*dCONC_lag*	*INST_lag*	*LnTA_lag*	*Beta_lag*	*ROA_lag*	*NONINT_lag*	*DepTA_lag*	*EqTA_lag*	*VaR_lag*
ΔCoVar	1									
dCONC_lag	-0.26	1								
INST_lag	0.28	-0.12	1							
LnTA_lag	0.62	-0.09	0.08	1						
Beta_lag	0.53	-0.35	0.14	0.64	1					
ROA_lag	-0.10	0.02	0.02	-0.18	0.01	1				
NONINT_lag	0.53	-0.17	0.09	0.65	0.47	0.03	1			
DepTA_lag	-0.30	-0.08	-0.13	-0.06	0.34	0.24	-0.10	1		
EqTA_lag	-0.27	0.09	-0.09	-0.13	0.14	0.40	-0.17	0.45	1	
VaR_lag	0.07	0.02	-0.05	0.22	0.18	0.01	0.05	0.28	0.33	1
ΔCoVar_lag	0.88	-0.24	0.23	0.74	0.71	-0.06	0.57	-0.12	-0.11	0.20

Source: Author's elaboration.

It is worth noting that several of the control variables are strongly correlated with each other. In particular, size is positively correlated to systemic risk (0.62) and to non-interest income (0.65), indicating that larger banks may be more involved in non-traditional banking activities; this result is in line with what was shown by the research of Addo et al. (2021). Also, like Iqbal et al. (2015), the two variables that measure the capital and income structure of banks (deposits/assets and non-interest income) are negatively correlated with each other (-0.10). Finally, *ROA*, deposits/assets, and capital/assets are negatively correlated with respect to the dependent variable of the model.

4. RESULTS

This section shows the results that emerged from the regression models. Table 5 summarizes the *ΔCoVaR* values by year and by country.

Table 6 shows the regressions carried out on three models.

Model 1 considers all the control variables and, as an explicative variable, the variable *dCONC*, which explains the ownership concentration. Model 2 considers all control variables and institutional ownership. Model 3 considers all control variables and both explicative variables.

Table 5. *ΔCoVaR* distribution for year and country

Country	*ΔCoVaR*	*Year*	*ΔCoVaR*
Austria	0.419	2011	0.417
Belgium	0.934	2012	0.442
Cyprus	0.148	2013	0.413
Denmark	0.251	2014	0.415
Finland	0.646	2015	0.394
France	0.432	2016	0.374
Germany	1.152	2017	0.367
Greece	0.359	2018	0.359
Island	0.194	2019	0.381
Italy	0.671	2020	0.383
Liechtenstein	-0.035		
Malta	0.098		
Norway	0.221		
Netherlands	1.323		
Portugal	0.680		
United Kingdom	0.656		
Spain	1.200		
Sweden	0.714		
Switzerland	-0.106		

Source: Author's elaboration.

Table 6. Regression on *ΔCoVaR*

Variables	*Model 1*	*Model 2*	*Model 3*
INST_lag		0.00086*** (0.00014)	0.00085*** (0.00017)
dCONC_lag	-0.03490** (0.00842)		-0.03374* (0.01034)
ΔCoVar_lag	0.91151*** (< 2.2e-16)	0.89742*** (< 2.2e-16)	0.89823*** (< 2.2e-16)
VaR_lag	-0.00260 (0.38287)	-0.00179 (0.54509)	-0.00217 (0.46447)
LnTA_lag	0.00995 (0.06299)	0.00923 (0.080051)	0.01121* (0.03518)
Beta_lag	0.01318 (0.67240)	0.03266 (0.26283)	0.00480 (0.87715)
ROA_lag	0.00463 (0.48919)	0.00319 (0.63261)	0.00348 (0.60178)
NONINT_lag	0.00133 (0.36969)	0.00172 (0.24508)	0.00149 (0.31439)
DepTA_lag	0.00331 (0.93922)	0.01341 (0.75682)	0.01215 (0.77839)
EqTA_lag	0.15460 (0.47725)	0.12766 (0.55534)	0.15113 (0.48416)
Fixed Effects	Yes	Yes	Yes
R^2 Adj.	0.84920	0.85041	0.85130
Obs.	958	958	958

*Note: ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.*
Source: Author's elaboration.

As can be seen, in Model 1, the corporate variable *dCONC* is statistically significant at 5% and has a negative coefficient of -0.03490. The economic interpretation of this result is that the increase in ownership concentration decreases the systemic risk over the period analyzed.

In Model 2 the corporate variable *INST* is positive and statistically significant for a level of 1%; the reported coefficient is equal to 0.00086. In this case, a positive relationship between institutional ownership and systemic risk shows that during the period we studied, the presence of institutional investors increases banks' systemic risk.

Again, in this model, the value of the lagged *ΔCoVaR* contributes positively and is statistically significant at 1% with a coefficient equal to 0.89742. The size of the banks has a positive effect on the risk, in fact, the variable has a coefficient equal to 0.00923 and is not statistically significant. As explained with details in the conclusion, the impact of banks' size on systemic risk is a topic of ongoing debate among economists and financial regulators. On one hand, larger banks may be seen as a potential source of systemic risk, as their failure could have far-reaching consequences for the financial system and the broader economy. This is because larger banks typically have more complex operations, higher levels of interconnectedness with other financial institutions, and greater access to wholesale funding markets, all of which can amplify and spread the effects of any shocks to the financial system. On the other hand, larger banks may also be better equipped to absorb and manage risks, due to their greater resources, diversification, and access to liquidity. In addition, larger banks may be subject to stricter regulatory oversight, which could mitigate the potential for systemic risk (Lopez-Espinosa et al., 2012).

Overall, the impact of bank size on systemic risk is complex and depends on a variety of factors, including the specific characteristics of the bank, the regulatory environment, and the overall state of the economy.

The hypotheses on the ownership structure of the banks, anticipated in Section 2, were tested since the two corporate variables relating to ownership concentration (*dCONC*) and ownership by institutional investors (*INST*) were included in the model. In line with what was stated by Song and Li (2012), it was assumed that the ownership concentration of banks decreases systemic risk, as shown by the negative relationship. On the contrary, we find that the presence of institutional ownership increases systemic risk, as identified by a positive relationship. This latter result is also confirmed by De George et al. (2019).

The following results may be pointed out from the Model 3:

1. For the *dCONC* variable, relating to the ownership concentration, it can be seen that the coefficient is negative (-0.03374) and statistically significant for a significance level of 10%.

2. The *INST* variable, relating to institutional ownership, reports a positive coefficient (0.00085) and the variable is statistically significant with a significance level of 1%.

Concentrated ownership has been suggested as an effective corporate governance mechanism and can be shown to increase banks' valuation (Caprio et al., 2007). Furthermore, evidence suggests that higher levels of institutional ownership are significantly associated with higher future systemic risk.

Starting from the regression with the basic models described in Table 6, we proceeded with further analysis. In the first place, an evaluation of the sample at a regional level was carried out. Our sample may be divided into European banks, which are based in a country of the European Union, and non-European banks, which are based in countries that are not members of the European Union, but are formally linked by commercial relations with it.

In this subdivision, non-European banks are those based in Switzerland, Iceland, Norway, and Liechtenstein; the United Kingdom, although it came out with Brexit on January 31, 2020, was considered part of the group of European countries since for almost all of the years of the period considered it was part of the EU.

This subdivision has brought out results, reported in Table 7, in line with the standard model. Indeed, for the corporate independent variables, the positive relationship for *INST* and the negative one for *dCONC* are maintained.

Table 7. Regression on *ΔCoVaR* by geographical area

Variables	*Model 1*		*Model 2*		*Model 3*	
	EU banks	*Non-EU banks*	*EU banks*	*Non-EU banks*	*EU banks*	*Non-EU banks*
INST_lag			0.00037 (0.14800)	0.00151*** (0.00067)	0.00036 (0.15847)	0.00142** (0.00138)
dCONC_lag	-0.03943* (0.02688)	-0.02588* (0.04369)			-0.03897* (0.02862)	-0.02106 (0.09722)
ΔCoVar_lag	0.88454*** (< 2.2e-16)	0.90259*** (< 2.2e-16)	0.87535*** (< 2.2e-16)	0.86025*** (< 2.2e-16)	0.87999*** (< 2.2e-16)	0.86660 (< 2.2e-16)
VaR_lag	-0.00682 (0.19014)	0.00075 (0.85623)	-0.00627 (0.23163)	0.00249 (0.52718)	-0.00615 (0.23917)	0.00082 (0.83965)
LnTA_lag	0.01681* (0.04691)	-0.00101 (0.84097)	0.01758* (0.03822)	-0.00009 (0.98479)	0.01722* (0.04179)	0.00173 (0.73063)
Beta_lag	-0.00998 (0.79261)	0.07267 (0.37101)	0.02282 (0.51045)	0.12500 (0.10563)	-0.01140 (0.76373)	0.08656 (0.27976)
ROA_lag	0.00870 (0.33190)	-0.00073 (0.93354)	0.00763 (0.39673)	0.00134 (0.87610)	0.00794 (0.37619)	0.00255 (0.76750)
NONINT_lag	0.00126 (0.50613)	-0.00017 (0.93882)	0.00146 (0.44328)	-0.0008 (0.73295)	0.00138 (0.46608)	-0.00122 (0.58590)
DepTA_lag	0.04488 (0.40860)	-0.01008 (0.88632)	0.06066 (0.26140)	-0.03160 (0.64204)	0.04563 (0.40043)	-0.00597 (0.93143)
EqTA_lag	-0.03176 (0.92209)	0.29107 (0.29531)	0.03817 (0.90647)	0.25300 (0.34538)	-0.01358 (0.96664)	0.35684 (0.193377)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2 Adj.	0.83917	0.84968	0.83845	0.85355	0.83942	0.85444
Obs.	650	308	650	308	650	308

*Note: ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.*
Source: Author's elaboration.

Secondly, banks based in so-called PIGS (Portugal, Italy, Greece, Spain) countries were distinguished from other banks. This analysis was possible because we consider the period 2011–2020, which was characterized by systemic crises that further worsened the public finances of countries already in difficulty.

Table 8 shows the results of the regression. It can be noted that also in this case the statistical significance is maintained for the corporate variables *dCONC* and *INST* and for the control variables of the size of the bank (*LnTA*) and the lagged *ΔCoVaR*.

Furthermore, for the variables *dCONC* and *INST*, on which the assumptions of the model are based, a negative relationship and a positive relationship are maintained, respectively.

Table 8. Regression on *ΔCoVaR* by PIGS countries

Variables	*Model 1*		*Model 2*		*Model 3*	
	PIGS [a]	*Other banks*	*PIGS* [a]	*Other banks*	*PIGS* [a]	*Other banks*
INST_lag			0.00065 (0.18890)	0.00069** (0.00419)	0.00088 (0.07226)	0.00066** (0.00652)
dCONC_lag	-0.10500** (0.006289)	-0.03261* (0.01604)			-0.11576** (0.00280)	-0.03022* (0.02529)
ΔCoVar_lag	0.87974*** (< 2.2e-16)	0.91207*** (< 2.2e-16)	0.87255*** (< 2.2e-16)	0.90420*** (< 2.2e-16)	0.86324*** (< 2.2e-16)	0.90704*** (< 2.2e-16)
VaR_lag	-0.01057 (0.31779)	-0.00223 (0.48965)	-0.01077 (0.32530)	-0.00158 (0.62307)	-0.00622 (0.56351)	-0.00215 (0.50408)
LnTA_lag	-0.00075 (0.97727)	0.008932 (0.08726)	0.02531 (0.31720)	0.00751 (0.14250)	-0.00263 (0.92045)	0.00982 (0.05957)
Beta_lag	-0.08701 (0.25482)	0.02245 (0.52622)	-0.04455 (0.55800)	0.04350 (0.18828)	-0.09195 (0.22598)	0.01469 (0.67805)
ROA_lag	0.01442 (0.34619)	0.00141 (0.84598)	0.01367 (0.38090)	0.00067 (0.92662)	0.01684 (0.27012)	-0.00015 (0.98332)
NONINT_lag	0.00335 (0.58039)	0.00150 (0.31038)	0.00031 (0.95970)	0.00167 (0.25812)	0.00386 (0.52204)	0.00161 (0.27368)
DepTA_lag	-0.00793 (0.94834)	-0.00704 (0.87587)	0.03423 (0.78130)	0.00066 (0.98841)	-0.02260 (0.85271)	0.00529 (0.90665)
EqTA_lag	-0.07158 (0.90491)	0.22264 (0.32679)	0.02116 (0.97230)	0.16903 (0.45186)	-0.21406 (0.72140)	0.23660 (0.29548)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2 Adj.	0.79394	0.85913	0.78643	0.85958	0.79681	0.86032
Obs.	180	778	180	778	180	778

Note: a. During the European debt crisis of 2009–2014, this derogatory acronym has been used to designate the economies of the Southern European countries of Portugal, Italy, Greece, and Spain
****, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.*

5. DISCUSSION

In this paper, we examined two corporate variables related to ownership concentration (*dCONC*) and ownership by institutional investors (*INST*) to test hypotheses about the impact of ownership structure on systemic risk and controlling for several variables such as bank size, lagged *ΔCoVaR*, and other factors.

The findings are consistent with our starting hypotheses, with concentrated ownership having a negative impact on systemic risk (meaning a reduction of it) and institutional ownership having a positive impact (meaning an increase of it). Our results contribute, therefore, to that field of literature according to which greater ownership concentration can lead to more efficient corporate governance and better alignment of interests between shareholders and management. This, in turn, could reduce the likelihood of risky behavior by companies and limit the potential for systemic risk.

Moreover, institutional investors can also contribute to systemic risk if they engage in herding behavior or if their investments are highly correlated with each other. For example, if a large number of institutional investors simultaneously sell their positions, it can lead to a sudden and significant market downturn. Additionally, if a significant portion of the market is held by a small number of institutional investors, the failure of one of those investors could have a cascade effect on the market. Furthermore, the presence of institutional investors in the ownership structure may be less efficient in monitoring corporate risks than concentrated ownership.

We acknowledge that these results are still partial and disputable and we do not deny that, under different circumstances in terms of regulations or economic cycles, opposite relations — coherent with other streams of the literature — may endure.

In order to strengthen our analysis, we divided the sample into two categories: European banks and non-European banks. The European banks are those based in countries that are members of the European Union, while non-European banks are those based in countries that are not members of the EU but have commercial relations with it. In coherence with our previous results, the relationship between institutional ownership (*INST*) and systemic risk remains positive with stronger results for non-European banks, while the relationship between *dCONC* (degree of ownership concentration) and systemic risk remains negative with a stronger effect for European banks.

European banks may show a greater tendency for ownership concentration to smooth systemic risk due to a combination of factors, including:

1. *The corporate governance structures*: European banks tend to have a more concentrated ownership structure and a stronger tradition of family ownership compared to banks in other regions. As a result, the largest shareholders of these banks often have a strong interest in monitoring and controlling the risk-taking behavior of the banks, which can help to mitigate systemic risk.

2. *The regulatory environment*: European banks are subject to a different regulatory environment compared to banks in other regions. In general, European regulators have decided to take a more proactive approach to regulating banks and have placed a greater emphasis on capital adequacy and risk management. This regulatory environment may also encourage the largest shareholders of European banks to take a more active role in monitoring and controlling risk-taking behavior.

3. *The market structure*: The structure of the banking market in Europe is also different from that in other regions. In many European countries, there are a relatively small number of large, dominant banks which play a significant role in the financial system. This concentration of market power may encourage the largest shareholders of these banks to take a more active role in mitigating systemic risk.

Overall, while there is some evidence to suggest that ownership concentration may have a stronger effect on systemic risk in European banks compared to non-European banks, more research is needed to fully understand the dynamics at play.

6. CONCLUSION

The purpose of this study is to evaluate the impact of the ownership structure of banks on the contribution to systemic risk. Starting from the ownership structure, we focus on the ownership concentration of the banks and on the type of shareholders who participate in their capital.

To test how these two issues affect systemic risk, a database of 96 banks from 19 European countries was built for the period 2011–2020. Subsequently, the *CoVaR* approach by Adrian and Brunnermeier (2016) is used to estimate the systemic risk, with which the contribution of each bank to the overall risk is measured. The estimate is accompanied by the implementation of supporting variables for the calculation of the *ΔCoVaR*, i.e., corporate variables and market variables (Lopez-Espinosa et al., 2012; Bellavite Pellegrini et al., 2022). Finally, the two corporate and governance variables are identified, thanks to which the contribution to systemic risk is analyzed.

The results show, at first, that ownership concentration decreases systemic risk. Secondly, there is a positive relationship between the ownership by institutional investors and the systemic risk of banks, meaning that the presence and concentration of institutional investors in the ownership leads to an increase in systemic risk. Furthermore, in line with Van Oordt and Zhou (2019), Vallascas and Keasey (2012), and Laeven et al. (2014), there is a positive relationship between the size of banks and systemic risk. In this sense, our results seem to support the 'Too big to fail' theory, according to which large banks increase systemic risk. However, this result should be controlled for time since, according to the literature, the positive relationship holds true during financial turmoil periods while acts in the opposite direction, meaning that the size acts as a shield against systemic risk, during quieter periods (Bellavite Pellegrini et al., 2022).

These considerations are valid for all three models analyzed in the standard representation and also when the sample is divided into European, non-European, and banks based in PIGS countries, and other banks. This paper contributes to the literature on systemic risk which, in relation to the ownership structure, is evolving. The historical period is driven by external forces, such as crises and market instability, so it is important to understand to what extent these events contribute

to the exposure of financial institutions to systemic risk. We also acknowledge that further research should consider that regulation plays a central role in risk control and monitoring and how it can account for the influence of the ownership structure (Jensen & Meckling, 1976; Laeven & Levine, 2009).

Based on the results of the study, the practical implications for policymakers and regulators are as follows:

1. The study underlines that ownership concentration has a smoothing effect on systemic risk, suggesting that policymakers and regulators should encourage this option as a corporate governance mechanism to reduce systemic risk in the banking sector.

2. On the opposite side, our analysis shows that institutional ownership has an increasing effect on systemic risk, indicating that policymakers and regulators need to pay attention to the potential risks associated with institutional investors' behavior and activities and take measures to mitigate them.

3. Finally, our results suggest that policymakers and regulators need to consider the potential risks and benefits associated with the size of the banks and develop suitable regulatory policies to mitigate the potential consequences on the systemic risks.

Overall, the study highlights the importance of corporate governance and ownership structure in the banking sector and emphasizes the need for policymakers and regulators to consider these factors when designing regulatory policies to mitigate systemic risk.

We acknowledge that some limitations could influence our results. First of all, the study is based on a specific time frame and the banking sector, which may limit the generalizability of the findings to other contexts. Secondly, greater evidence may be provided in the future to show the mechanisms through which our variables may cause systemic risk. Thirdly, the study uses *ΔCoVaR* as a measure of systemic risk, which takes properly the analysis of corporate variables, but may not fully capture the complexity of systemic risk in the banking sector; other measures such as *MES* and *SRISK* may be added in the future.

In the highlights of these evidences, together with the peculiarities characterizing the period of analysis, it would be appropriate to investigate such relations across time during the different crises that have taken place.

According to these reasons, further investigation of the relationship between systemic risk and ownership structures on a sample of financial institutions based in overseas countries, which were not analyzed in this research due to different regulations, is left open to future research.

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APPENDIX

For the purposes of the empirical analysis, in order to evaluate the marginal contribution of a given bank to the overall systemic risk, it is necessary to identify the *CoVaR*, such as the value at risk (*VaR*) of the financial system, conditioned by a specific event — $C(X_i)$ — relating to the i institution, so that the financial institutions are in a state of crisis.

To obtain the *CoVaR*, an event *C* is conditional which is equally probable for all the financial institutions. Usually, *C* is the loss of institution *i* that is equal to or greater than its level of VaR_q^i which, by definition, occurs with probability $(1-q)$ %. It is important to note that this implies that the probability of the conditioning event is independent of the riskiness of the business model of *i*. If we were to condition on a particular level of return (instead of a quantile), then more conservative (i.e., less risky) institutions might have a higher *CoVaR* simply because the conditioning event would be a more extreme event for less risky institutions.

$CoVar_q^{system}\big|C(X^i)$, is defined by the q-th quantile of the conditional probability distribution as follows (Bellavite Pellegrini et al., 2022):

$$Prob\,(X^{system}|C(X^i)) \leq CoVar_q^{system}\big|C(X^i) = q\% \tag{A.1}$$

CoVaR is estimated using quantile regression (Adrian & Brunnermeier, 2016). We then consider the expected value of a financial sector loss quantile regression on the losses of a particular institution i for the q%-quantile:

$$\hat{X}_q^{system\,|\,X^i} = \hat{\alpha}_q^i + \hat{\beta}_q^i X^i \tag{A.2}$$

where Eq. (A.2) denotes the expected value for the q%–quantile of the financial system conditional on realizing a return X^i of institution *i*.

Assuming that VaR_q^i equals to the q%–quantile:

$$Prob\big(X^i \leq VaR_q^i\big) = q\% \tag{A.3}$$

Then the following equation can be stated:

$$CoVar_q^{system\,|\,X^i} = \hat{X}_q^{system\,|\,X^i} \tag{A.4}$$

In essence, through quantile regression it is possible to determine the expected value of the financial system's losses based on the losses of institution *i*, and this value constitutes the *VaR* of the financial system conditional on X^i.

This holds trues because $Var_q^{system}\big|(X^i)$ is the quantile conditioned.

Then X^i=VaR_q^i defines the measure of $CoVar_q^i$:

$$CoVaR_q^i = Var_q^{system\ |\,X^i = VaR_q^i} = \hat{\alpha}_q^i + \hat{\beta}_q^i VaR_q^i \tag{A.5}$$

Subsequently, the $\Delta CoVaR$ will be defined as the difference between the *CoVaR* of the financial system conditional on the event in which the considered bank or financial institution is under stress (i.e., at the q. percentile), and the *CoVaR* of the system conditional on a median situation of the bank itself (i.e., at the 50% percentile).

$$\Delta CoVaR_q^i = CoVaR_q^i - CoVaR_{50}^i = \beta_q^i (VaR_q^i - VaR_{50}^i) \tag{A.6}$$

The $\Delta CoVaR$ captures the change in the *CoVaR* when the influencing event moves from the median return of institution i to the adverse VaR_q^i. Thus, the $\Delta CoVaR$ measures the "tail dependence" between two random return variables.

Furthermore, it is noted that, for random variables jointly normally distributed, the $\Delta CoVaR$ is related to the correlation coefficient, while the *CoVaR* corresponds to a conditional variance. The conditioning alone reduces variance, while conditioning on adverse events increases the expected return losses.

According to Adrian and Brunnermeier (2016) for the estimation of $\Delta CoVaR$, a series of state variables are identified to capture the temporal variation in the conditional moments of asset returns. Specifically, for the determination of the financial variables we refer to the studies conducted by Lopez-Espinosa et al. (2012) and Bellavite Pellegrini et al. (2022):

1) weekly price of the stock market volatility index;

2) liquidity spread calculated as the difference between the Bank of England base rate and the UK 3-month T-bill;

3) change in the French 3-month T-bill rate;

4) change in the slope of the yield curve represented by French 5-year interest rates minus 3-month government bond interest rates;

5) change in the credit spread, represented by the difference between Moody's corporate bonds (BAA rating) and 10-year German government bonds;

6) weekly stock returns of the European Stock Market Index.

Furthermore, in line with previous studies, the following corporate variables were used, collected for all the banks included in the sample (source: Datastream):

1) Market capitalization (market value) as the share price multiplied by the number of ordinary shares outstanding;

2) Security's price (price);

3) The degree of leverage (leverage): calculated as the ratio between total debt and total equity (*D/E*);

4) Total debt held: it is the sum of long-term and short-term debts;

5) Total liabilities: calculated as the sum of current liabilities and long-term liabilities.

Table A.1. Descriptive statistics corporate variables for the $\Delta CoVaR$

Variables	*N*	*Min*	*Avg*	*Max*	*Median*	*Std*
Mkt Cap. (mil.)	49.116	3	8.754	178.56	757	20.006
Price	49.116	0	137	7.006	15	596
Leverage	3.230	-71.057	548	13.95	409	1.683
Tot. Debt (mil.)	3.230	0	62.92	710.332	6.035	113.775
Liabilities (mil)	3.230	112.15	245.23	2.560	17.299	482.644

Source: Author's own calculation. Data by Refinitiv Datastream.