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Use of Derivatives and Market Valuation of the Banking Sector: Evidence from the European Union

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Abstract: (1) Background: This paper aims to investigate whether the derivatives usage by the banking sector in the European Union has impacted its market valuation in the aftermath of the financial crisis. (2) Methods: Our analysis takes 120 European financial institutions listed on the European Union stock exchange over a period of 14 years into account (2008–2021). We use the generalized method of moments (GMM) to assess whether the use of derivatives allows financial intermediaries to increase their market value. Control variables, such as size, profitability, expectations of the market, bank risk, liquidity performance, and financial condition, are also taken into consideration. (3) Results: Our main findings suggest that market value is affected negatively by derivative asset accumulation. (4) Conclusions: The results are in line with the studies that investigated the impact of financial derivatives on the market value and found a negative connection between the two, justified by the suboptimal hedging or the higher volatility of the earnings.

Keywords: risk management; financial derivatives; financial services sector; GMM

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1. Introduction

In the last few decades, particularly from the subprime crisis onwards, derivatives have been seen as powerful, speculative, and controversial financial instruments, as well as a relevant factor in destabilizing the global financial system (Paletta and Patterson 2010; Mayordomo et al. 2014; Brunnermeier et al. 2020). There is some concern, usually raised by regulators, that excessive use of derivatives by banks has severe implications, as far as concerns regarding the external effects on the payment system and potential collapse of the credit markets. Individual decisions of banks, concerning their derivatives' holdings, might have negative consequences at a system level (Mayordomo et al. 2014). The systemic risk becomes larger when financial institutions take similar positions in the derivatives market, and the failure of one institution may lead to the loss of many others. A recent study on the impact of derivatives on bank risk and profitability, in the case of 25 banks from developed markets, has shown, however, that banks' use of financial derivatives has decreased bank risk (Ahmed 2021).

Not all derivatives used by banks have a speculator purpose. Previous studies have not thoroughly investigated the most critical role of derivatives, the hedging one, which could diminish systemic risk. Hedging derivatives offset the potential adverse fluctuations in interest rates, market prices, or foreign exchange rates (Bartram et al. 2009). Financial derivatives can become a crucial instrument used by banks to generate alternative sources of income by hedging their risk exposure (Bazih and Vanwalleghem 2021). The market for derivatives continued to grow in the aftermath of the financial crisis on both OTC and stock exchanges and cover, at this moment, almost all type of financial exposure (BIS 2021). The significant growth of derivative holdings in banks' balance sheets could be motivated by their use for hedging purposes supported by the theory of rationality (Koppenhaver 1985; Jaffe 2003).

Determining the benefits of transferring risks with the help of financial derivatives has been a topic of research, though not investigated enough, at least in what concerns the European financial services sector (banks and other bank holding companies), despite the dual role that these financial institutions have on derivative markets (intermediary, as well as the player). According to Bachiller et al. (2021), hedging risk with the help of derivatives proves to be beneficial, in terms of firm value in the case of the non-financial sector. Little is known about the implications of using derivatives for a bank's value, profitability, and financial system stability. Choi et al. (2016) proved that the derivatives holdings, in the case of the US bank holding companies, contributed to enhancing market values, but only up to a certain point, from where excessive holdings led to a deterioration in the market values. On the contrary, Bazih and Vanwalleghem (2021) found that derivatives' usage undermined bank value in the case of their sample of emerging market banks. Using a sample of European banks, Chang et al. (2018) found a positive relationship between bank profitability and derivative usage between 2004 and 2008. Moreover, they found that banks with a high level of liquidity are more likely to use derivatives. The empirical results outline that derivatives' usage leads to an increase in both bank risk and market value. While financial derivatives play a significant role against market high volatility for both the financial and non-financial sectors (Said 2011), any regulation on derivatives holdings by banks should be carefully designed to avoid market losses (Choi et al. 2016).

The purpose of the paper is to answer the following question: did the derivative usage trigger higher market valuation for the banking sector listed on the European stock markets after the financial crisis in 2008, or did the derivatives' usage make it more vulnerable in this respect? Our study contributes to the existing literature on risk management and firm value by providing a unique sample of analysis, one of European Union financial institutions over a relevant period, the aftermath of the financial crisis (2008–2021). Moreover, it contributes to a better understanding of the investors' behaviour, considering that financial stocks represent one of the most attractive investment opportunities in the European stock markets. Many vulnerabilities exist in the European stock markets, especially when market participants are willing to take on much risk. Financial regulators should be interested in understanding the contribution of derivatives to bank value and systemic risk to consider new regulatory initiatives.

The remainder of the paper is structured as follows. Section 2 outlines the previous relevant literature. Section 3 describes the data and methodology, as well as presents and discusses the empirical results, while Section 4 concludes.

2. Theoretical Background

2.1. Derivatives, Risk Management, and Firm Value

According to Modigliani and Miller's perfect capital market hypothesis (Modigliani and Miller 1958), the hedging policy does not lead to value creation for individual firms. However, more recent theories relax the assumptions of Modigliani and Miller and argue that, in real financial markets, firms face a variety of frictions. Consequently, an optimal hedging policy leads to firm value maximization (Khediri 2010). This increase in firm value comes, according to the literature, from lowering the volatility of earnings (Smith and Stulz 1985; Purnanandam 2007), increasing debt capacity (Ross 1977; Leland 1998), decreasing information asymmetry (De Marzo and Duffie 1995), reducing financial distress costs (Leland 1998; Graham and Rogers 2002), decreasing tax payments (Smith and Stulz 1985), and mitigating the under-investment problem (Froot et al. 1993). The empirical literature provides no explicit findings on whether the use of derivatives leads to a higher firm valuation, mainly due to the specificities of prior empirical studies, such as data, model specifications, methodology, or chosen country of analysis. However, using a meta-analysis from 51 empirical studies, a general conclusion can be drawn that the use of financial derivatives increases firm value in the case of non-financial firms and that the premium depends on the nature of the derivative product (Bachiller et al. 2021).

However, the impact on financial firms' valuation from using derivatives has not gained sufficient attention in the literature. Some previous studies focus on the determinants that drive banks to use derivatives (Brewer et al. 2000; Kim and Koppenhaver 1993; Sinkey and Carter 2000; Shyu and Reichert 2002). The size and degree of expertise in using any kind of derivatives are found to be positively and significantly associated with derivatives use by banks (Fung et al. 2012; Minton et al. 2009; Mayordomo et al. 2014). Large banks have the possibility of covering the operational costs associated with derivative use and possess more in-house knowledge and expertise to manage their portfolios (Bazih and Vanwalleghem 2021). Nevertheless, internationally exposed banks are more likely to hedge their currency exposure (Alayannis and Ofek 2001). Whidbee and Wohar (1999) argue that using derivatives also depends on the importance of outside directors to the board.

The reasoning behind the use of derivatives by financial firms was found to be similar to the one in the case of other non-financial corporate users, i.e., exploring new techniques of managing risk and enhancing income (Koski and Pontiff 1999; Schrand and Unal 1998; Brewer et al. 1996; Cummins et al. 1997; Colquitt and Hoyt 1997; De Ceuster et al. 2003). A part of the literature investigates the relationship between derivatives and bank risk (Shanker 1996; Reichert and Shyu 2003; Morrison 2005; Mayordomo et al. 2014). Based on this relationship is the belief that using derivatives could lead to a reduced incentive on the part of the banks to monitor their loan portfolios. Guay (1999) argued that firms that use derivatives experience lower interest and exchange rate risks than firms that are not using derivatives. In the same sense, Bartram et al. (2011) revealed that systemic risk is diminished by using financial derivatives and simultaneously, and a higher market value is obtained. On the contrary, Hentschel and Kothari (2001) have shown few differences regarding the risk between firms using derivatives and those that do not use such instruments. It is stated that, in the banking industry, hedging may benefit both banks' shareholders and bondholders through a lower risk-based capital requirement and lower deposit insurance premium (Deng et al. 2021).

Banks have two possible reasons for using derivatives: hedging and speculation. First, hedging allows banks to manage their risks. Interest rate uncertainty represents a significant risk for banks that can be easily hedged with the help of derivatives. Brewer et al. (2000) explored the effects of interest-rate derivatives on systemic risk, in the case of bank holding companies, and found that not all types of derivatives affect, in the same manner, the systemic risk and interest rate derivatives acting against systemic risk. Choi et al. (2016) found that interest rate derivatives are the primary source of high valuations for US banks, concluding that hedging derivatives, rather than trading derivatives, contribute to the US bank holdings' market values. Minton et al. (2009) argued that hedging loans with credit derivatives might be limited, due to adverse selection and moral hazard problems. Speculation is another purpose of derivative trading by banks. While speculative trading might be restricted, due to the regulatory nature of the banking sector, the benefits of speculation are apparent, creating additional profit, at the cost of additional risk (Choi et al. 2016). Banks generate profits from derivatives usage through commissions and fees, without a hedging objective (Li and Marinč 2014). This activity proved prolific, mainly in offsetting the declining spreads of traditional bank lending (Egly and Sun 2014).

Only a handful of studies aim to investigate the connection between the use of derivatives by banks and market value (Cyree et al. 2012; Choi et al. 2016; Chang et al. 2018; Bazih and Vanwalleghem 2021). Cyree et al. (2012) did not detect any systematic effects of derivative use on the market values of US commercial banks. However, they investigated the role of derivatives before and during the financial crisis. Choi et al. (2016) concluded that the effect of derivatives holdings for hedging purposes had an active role in adding value to the US banking holding companies between 2000–2010. Chang et al. (2018) investigated the determinants and effects of derivatives' usage by European banks during 2004–2008. They find that higher profitability banks are more likely to use foreign exchange and interest rate derivatives and that positive risk exposure and market value are driven by banks that operate derivatives. On the contrary, Bazih and Vanwalleghem (2021) found a significant and negative connection between derivatives and bank value in the case of emerging markets. This conclusion was supported by Khediri (2010), who concluded that, although the decision to use derivatives does not impact market valuation, the extent of derivative use determines lower market valuation (Khediri 2010).

2.2. The Derivatives Market at the European Level

Despite their increasing complexity, derivatives have become widespread in the last two decades in the European Union. The financial sector (represented by credit institutions and investment firms) dominated the derivatives market in 2020, expressing a significant proportion of the total notional outstanding (64%) (Figure 1).

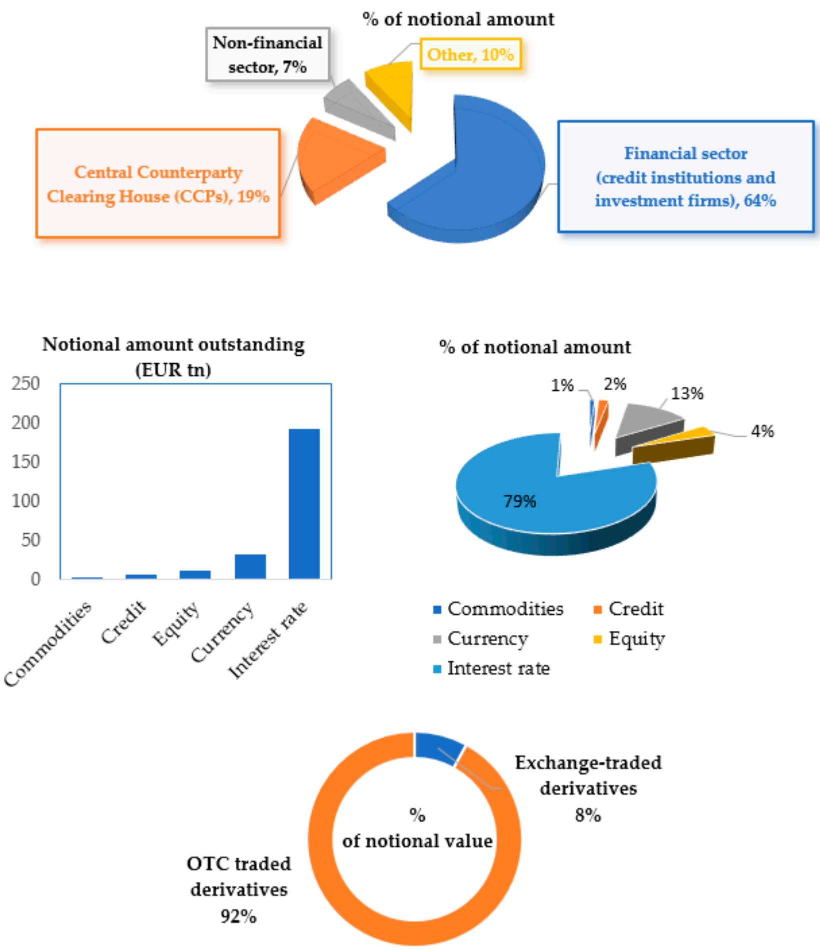

Figure 1. European derivatives market at a glance (2020). Note: Statistical data were provided by ESMA (2021). Statistics do not include data for the United Kingdom. Source: authors' computation.

The interest rate derivatives accounted for 79% of the notional amount, followed by currency derivatives (13%) and equity derivatives (4%). Credit derivatives represented only 2% of notional outstanding, while commodities represented only 1%. The total notional amount of derivatives cumulated 244 trillion euros in 2020. The OTC market was where most derivatives transactions took place at the European level in 2020 (accounting for 92% of the total notional value).

3. Empirical Background

3.1. Data and Variables Specification

Data were obtained from ORBIS for all European Union public listed companies belonging to the financial service activities sector (monetary intermediation and activity of holding companies). ORBIS provides information about derivatives holdings (derivatives assets) in the financial service activities sector, except insurance companies and pension funds. Our sample also included companies from the United Kingdom, since this country was part of the European Union for almost all analysis periods (2008–2021) and due to its central role in the EU derivative market. We have excluded companies with missing reports for more than five years, regarding financial derivatives holdings in the analysis period, resulting in a final sample of 120 companies (Table 1).

Table 1. Sample of analysis.

Sample	Number of Companies
Sector: Financial service activities, except insurance and pension funding *Location*: European Union countries and the United Kingdom *Status of the company*: Active, publicly listed companies	5744
Companies with known values of derivative assets over the period of analysis	155
Companies with no less than five years of missing reports of derivative holdings	120

Source: Authors' computations.

We employed the price-to-book ratio to estimate the firm value as the dependent variable, in line with Choi et al. (2016). It is defined as the ratio between the market value and the company's book value at each firm's end of the fiscal year. We use the holdings of derivatives by banks (annual percentage change in derivatives' assets) to capture the extent of derivative usage. We also include various control variables that were previously considered relevant by other studies (Table 2).

Table 2. Variables used in the study.

Type of Variable	Variables	Computation Description	Abbreviation
Dependent variable	Firm value	Price-to-Book (P/B) ratio	PBR
Interest variable	Derivatives holdings	% annual change in derivatives' assets	DAP
Control variables	Size	Log (total assets)	LTA
	Profitability	Return on equity	ROE
	Expectations of the market	Price-to-earnings ratio	PER
	Bank risk	Non-performing loans/gross loans	NPL
	Liquidity performance	Net loans/total assets	NLTA
	Financial condition	Book equity/total assets	CAR

Source: Authors' computation.

Size. We controlled the scale effect, using the natural logarithm of total assets to control firm size. This variable is correlated with bank value in the literature (Choi et al. 2016; Bazih and Vanwalleghem 2021), and some studies point out that larger banks might be more inclined to realize risky trading, due to a "too big to fail" moral hazard problem (Ashraf et al. 2007).

Profitability. In the literature, profitability is considered to be an essential value driver. We used return on equity as in previous studies (Chang et al. 2018; Bazih and Vanwalleghem 2021).

Expectations of the market. We considered the price-to-earnings ratio (P/E), one of the most used fundamental analysis indicators, measured as the ratio between market price per share and earnings per share. A high P/E percentage could mean that investors expect the company to generate high future profits and, thus, are willing to pay more now for the stock acquisition. A low P/E could mean that the company will experience lower growth, but at the same time, it can indicate that the company is undervalued or performing well, in comparison to its past trends (Ghaeli 2017).

Bank risk. The bank risk could also be reflected in the market value (in line with Choi et al. (2016)). In this sense, the ratio of non-performing loans to total loans (NPL) accounts for the loans, leases, and debt securities in the past 90 days or more.

Liquidity performance. Computed as the ratio between net loans and total assets, this variable accounts for the financial institutions' liquidity and should be a variable connected with the market value (Chang et al. 2018).

Financial condition. Additionally known as the capital adequacy ratio, the capital asset ratio is generally computed as book equity-to-risk-weighted assets and controls the bank's financial situation (Choi et al. 2016). It is one of investors' and analysts' most important financial ratios. It measures the bank's financial stability, showing its available capital as a percentage of its risk-weighted credit exposure. Due to data availability, we have computed the bank capital as the ratio between book equity and total assets (Chang et al. 2018; Bazih and Vanwalleghem 2021). Theoretically, this variable should be positively correlated with market value, indicating an increase in the financial stability of the bank. However, previous empirical results have shown that the connection between the capital asset ratio and market value could also be negative (Choi et al. 2016).

3.2. Methodology

To quantify the effect of derivatives usage on the market value of the financial sector, we estimated a regression model using a panel setting. First, we used a pooled OLS (POLS), disregarded the panel structure, and assumed that unobserved individual effects were insignificant. This assumption was rejected in the Breusch–Pagan and LM test (BP LM). To model the impact of the unobserved personal effects, we then used random effects (RE) and fixed effects models (FE). The main difference is that the random effects estimator assumes that unobserved individual effects are not correlated with the included regressors. Hence, we can treat it as random. While with fixed effects estimator, we relaxed this assumption and allowed for the possible correlation. We chose between the FE and RE models based on the Hausman test. The test checked whether the estimates by the two estimators were systematically different and compared the results of FE (consistent estimator) with RE (efficient estimator). Under the null, they were not systematically different, and rejecting the null means we need to use FE. Finally, we decided to move to a dynamic setting because we considered that the previous values might have influenced the variation of the dependent variable.

Consequently, we estimated a dynamic panel data model with the Arellano–Bond two-step GMM estimator (generalized method of moments estimator). In all the models, the standard errors were clustered at the firm level.

Specifically, the regression model is expressed as follows:

$$y_{it} = \alpha_i + \rho y_{it-1} + \alpha_1 DAP_{it} + \beta X_{it} + \varepsilon_{it} \tag{1}$$

where:
y_{it}—the price-to-book ratio of the ith company at the tth moment;
y_{it-1}—the lagged price-to-book ratio;
DAP_{it}—% annual change in derivatives' assets of the ith company in the tth moment;

X_{it}—vector of control variables: log of total assets, ROE, price-to-earnings ratio, non-performing loans/total assets, net loans/total assets, equity/total assets;
ε_{it}—error term.

3.3. Results and Interpretation

Table 3 shows the descriptive statistics for the variables. The average price-to-book ratio was 0.938, with a minimum level of −6.122 and a maximum level of 8.559 (see Appendix A Figure A1 for the dynamics of this variable). The derivatives' annual percentage change ranged between −1% and 9.9%, with an average of 0.22%. This range outlines that, in general, financial institutions increased their derivatives' holdings over the analyzed period; however, the change in derivatives' holdings did not surpass 10% over the whole period of analysis. ROE ranged between −10% and 2%, showing reduced profitability in the analyzed period. The price-to-earnings ratio was shown in the sample between 0.0016 and 6.6178, with an average level of 0.1453, a value that shows, without further analysis, a devaluation of shares on the stock market, with the company being more likely to outperform earnings forecasts. The non-performing loans did not surpass 100% of the total assets, with an average value of 8.38%. The average percentage of assets tied up in loans was 57.62%. The capital asset ratio showed, over the whole period of analysis, even values below the minimum capital ratio under Basel II (8%) and Basel III (10.5%). However, the average capital asset ratio was 12.26%, a value that surpasses these minimum thresholds. A correlation matrix is presented in Appendix A Table A1.

Table 3. Descriptive statistics.

Variable	Mean	Std. Dev.	Minimum	Maximum	Observations
PBR	0.9380	0.9100	−6.122	8.559	1527
DAP	0.2283	1.0917	−1.0000	9.9091	1559
LTA	17.0013	2.0654	12.5901	21.6919	1696
ROE	0.0537	0.3039	−9.9230	2.0029	1695
PER	0.1453	0.2656	0.0016	6.6178	1329
NPL	0.0838	0.1066	0.0000	0.9698	1511
NLTA	0.5762	0.1893	0.0001	0.9014	1616
CAR	0.1226	0.1372	−0.0393	0.9675	1696

Note: PBR—price-to-book ratio; DAP—% annual change in derivatives' assets; LTA—log (total assets); ROE—return on equity; PER—price-to-earnings ratio; NPL—non-performing loans/gross loans; net loans/total assets; CAR—equity/total assets. Source: Authors' computations.

In the following table (Table 4), we summarize the results of the regressions, where in column 1, we first considered only the interest variable (derivatives' holdings). Then, we added the control variables, and finally, in column 3, we re-estimated the model with robust standard errors clustered at the firm level. The results of the regression, considering estimations other than the dynamic one, can be found for comparative reasons in Appendix A Table A2.

First, we can see a significant lag effect of the price-to-book ratio (PBR) on the dependent variable. About 46.7% of the adjustment in PBR was due to lag effects.

Market value is negatively associated with the increase of derivatives holdings. A rise of 1 pp in derivatives' assets decreases PBR by about 0.142 pp. This result is in line with Bazih and Vanwalleghem (2021), who found a negative relation between derivatives usage and firm value in the case of emerging markets. Still, interestingly, it is contrary to the findings of Choi et al. (2016) and Chang et al. (2018). The market participants' increased risk, associated with growing derivatives, can explain the negative relationship. An increasing derivative holding could trigger the expectation that the earnings will experience higher volatility and that the financial institution is exposed to more risk. These statements were also supported by previous empirical studies that have shown that derivatives' usage not always ensures perfect hedging, meant to offset the inherent business risk, but sometimes leads to suboptimal hedging, which can increase bank risk (Huan and Parbonetti 2019).

The company's size also negatively influences the market value; a 1% increase in the total assets decreased PBR by about 0.16 pp. On the other side, the company's profitability positively impacts the market value; a 1% increase in ROA increased PBR by about 3.48 pp. PER did not have a statistically significant effect on PBR, although the sign of its impact was positive. According to the first three estimations (see Appendix A Table A2), the non-performing loans were negatively associated with market value, but not statistically significant in the validated model (GMM). The percentage of assets tied up in loans was negatively associated with the market value, suggesting that higher liquidity does not positively affect market valuation. A similar conclusion can be drawn in the case of the last control variable (the capital asset ratio), which was negatively related to the market value, a counterintuitive finding, considering the literature. An increase in this ratio is usually seen as positive, meaning that a bank is safe and likely to meet its financial obligations. However, the previous empirical results have shown that an increase in liquidity may be negatively associated with bank value (Choi et al. 2016).

The validity of the instruments in the GMM model was confirmed by the Hansen test (p-value of 0.2499).

Table 4. Results of the regressions.

VARIABLES	GMM		
	(1)	**(2)**	**(3)**
DAP	−0.167 ***	−0.142 ***	−0.142 ***
	(0.00279)	(0.00361)	(0.0381)
LTA		−0.160 ***	−0.160 **
		(0.0115)	(0.0779)
ROE		3.484 ***	3.484 **
		(0.0493)	(1.443)
PER		0.188 ***	0.188
		(0.0211)	(0.180)
NPL		3.578	3.578
		(0.0885)	(1.479)
NLTA		−0.966 ***	−0.966 *
		(0.0790)	(0.503)
CAR		−7.888 ***	−7.888 **
		(0.276)	(3.933)
LPBR	0.496 ***	0.467 ***	0.467 ***
	(0.00271)	(0.00624)	(0.0500)
Constant	0.457 ***	4.005 ***	4.005 ***
	(0.00511)	(0.197)	(1.407)
Observations	1072	1072	1072
Number of companies	119	119	119
Hansen p-value	0.0957	0.2499	0.2499

Note: DAP—% annual change in derivatives' assets, LTA—log (total assets), ROE—return on equity, PER—price-to-earnings ratio, NPL—non-performing loans/gross loans, NLTA—net loans/total assets, CAR—equity/total assets, LPBR—lagged price-to-book ratio. Clustered (at the firm level) robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' computations.

While derivative accumulation proved to decrease market valuation over the entire period of analysis, it is also possible that external shocks influenced this impact. Therefore, we constructed a dummy variable to analyze the connection between derivatives' holdings and market values of the financial sector, allowing for a potential effect on the valuation, due to the financial crisis period (2008–2010). The dummy variable took the value 1 for 2008–2010 and 0 for the rest of the period. As we can observe in Table 5, when looking at the coefficient of the global financial crisis (GFC), there was no statistically significant impact of the financial crisis on PBR due to the crisis period. We also considered an interaction term to depict the difference in the effects of derivative holdings on the market value during the financial crisis. We can see that the coefficient was statistically significant and negative. That means that, for the non-crisis period, a 1% increase in the derivatives' holdings decreased the PBR by 0.113 pp. In contrast, the negative impact was more significant by 0.353 pp (0.466 pp). However, the negative influence of the derivatives' accumulation on the market value was still negative, but significantly higher in magnitude in the crisis period.

Table 5. Results of the regressions, considering the financial crisis period.

VARIABLES	GMM		
	(1)	(2)	(3)
DAP	−0.134 ***	−0.113 ***	−0.113 ***
	(0.00281)	(0.00329)	(0.0397)
GFC*DAP	−0.415 ***	−0.353 ***	−0.353 *
	(0.0349)	(0.0614)	(0.214)
GFC dummy	0.0984 ***	0.0835 ***	0.0835
	(0.0133)	(0.0169)	(0.0657)
LTA		−0.0913 ***	−0.0913
		(0.00981)	(0.0746)
ROE		3.275 ***	3.275 **
		(0.0473)	(1.460)
PER		0.146 ***	0.146
		(0.0196)	(0.173)
NPL		3.785	3.785
		(0.0777)	(1.532)
NLTA		−1.407 ***	−1.407 ***
		(0.0509)	(0.480)
CAR		−5.001 ***	−5.001
		(0.254)	(4.065)
LPBR	0.501 ***	0.469 ***	0.469 ***
	(0.00283)	(0.00829)	(0.0513)
Constant	0.437 ***	2.801 ***	2.801 **
	(0.00541)	(0.186)	(1.323)
Observations	1072	1072	1072
Number of companies	119	119	119
Hansen p-value	0.0643	0.1703	0.1703

Note: GFC—global financial crisis (period dummy), LPBR—lagged price-to-book ratio, DAP—% annual change in derivatives' assets, LTA—log (total assets), ROE—return on equity, PER—price-to-earnings ratio, NPL—non-performing loans/gross loans, NLTA—net loans/total assets, CAR—equity/total assets. Clustered (at the firm level) robust standard errors in parentheses for column 3. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' computations.

The results of the regression, considering estimations other than the dynamic one, can be found, for comparative reasons, in Appendix A Table A3.

4. Conclusions

We found empirical evidence that using derivatives by the European financial sector (credit institutions and bank holdings) negatively impacted the market valuation from 2008–2021. In particular, derivative accumulation decreased the market value of the financial sector, suggesting that market participants reacted negatively to the increased use of derivatives by banks. These results are supported by previous studies that have shown that the use of derivatives leads to a reduction in the market value (Bazih and Vanwalleghem 2021), but also by the studies that connect the aggressive use of derivatives with an increased bank risk (Li and Marinč 2014; Huan and Parbonetti 2019) and financial turmoil (Acharya and Richardson 2009; Khediri 2010).

The implications of the results are essential for both regulators and investors. Regulators, on the one hand, should be interested in determining the consequences of derivatives' usage by banks, among them being the contribution that it might trigger systemic risk, given the external effects that the financial system holds on the payment system and the potential collapse of the credit markets. On the other hand, investors are interested in establishing the determinants of market valuation of the financial sector, one of the most attractive sectors of the European stock markets.

Our study had some limitations that could be further considered when approaching future research. First, due to data availability, we did not consider the purpose of the banks when using derivatives: speculation or hedging. This differentiation might lead to different results, when considering the impact of derivatives holdings on the market value. Second, we could extend the analysis period, considering both pre-crisis and post-crisis data, and observe whether there is a difference in the relationship between derivatives and firm valuation. Finally, more recent advances can be used, concerning econometric estimation, to refine the results and correct the potential estimation problems (Alvarez and Arellano 2022; Bao and Yu 2022).

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

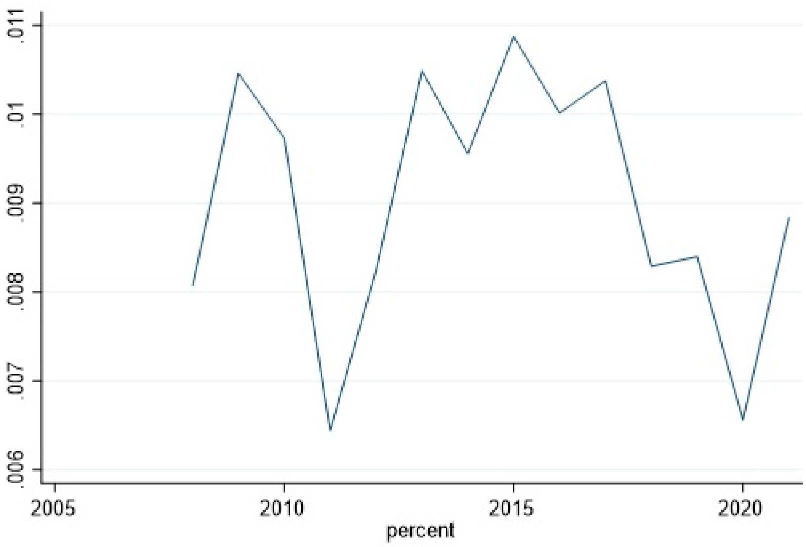

Figure A1. Dynamics of average PBR over the period of analysis. Source: Authors' computations.

Table A1. Correlation matrix.

	PBR	ROA	DAP	LTA	ROE	PER	NPL	NLTA	CAR
PBR	1								
ROA	0.5129	1							
DAP	0.0088	0.0289	1						
LTA	−0.2021	−0.3788	−0.1016	1					
ROE	0.5644	0.8091	0.0536	−0.204	1				
PER	0.0531	−0.15	−0.0036	0.0569	−0.1916	1			
NPL	0.0441	0.1298	−0.0014	−0.1915	0.0173	0.1398	1		
NLTA	−0.2014	0.0042	0.0076	−0.2181	−0.0843	−0.0629	−0.0505	1	
CAR	0.0498	0.5485	−0.0051	−0.5753	0.1317	−0.0873	0.2346	0.1769	1

Source: Authors' computations.

Table A2. Results of the regressions when using other estimations.

VARIABLES	POLS	FE	RE
DAP	−0.0519 ***	−0.0541 ***	−0.0519 ***
	(0.0159)	(0.0166)	(0.0159)
LTA	−0.0980 ***	−0.164 **	−0.0980 ***
	(0.0299)	(0.0822)	(0.0299)
ROE	2.055 ***	1.477 **	2.055 ***
	(0.726)	(0.590)	(0.726)
PER	0.0652	0.0283	0.0652
	(0.0795)	(0.0594)	(0.0795)
NPL	−0.557 **	−0.821 ***	−0.557 **
	(0.276)	(0.296)	(0.276)
NLTA	0.00341	0.443 *	0.00341
	(0.256)	(0.236)	(0.256)
CAR	0.147	0.896	0.147
	(1.064)	(1.073)	(1.064)
LPBR			
Constant	2.444 ***	3.334 **	2.444 ***
	(0.667)	(1.480)	(0.667)
Observations	1151	1151	1151
Number of companies	120	120	120
R^2	0.2126	0.0771	0.2126
Hausman *p*-value			0.0000
BP LM			0.0000

Note: DAP—% annual change in derivatives' assets, LTA—log (total assets), ROE-return on equity, PER-price-to-earnings ratio, NPL—non-performing loans/gross loans, NLTA—net loans/total assets, CAR—equity/total assets, LPBR—lagged price-to-book ratio. Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' computations.

Table A3. Results of the regressions, considering the financial crisis period, when using other estimations.

VARIABLES	POLS	FE	RE
DAP	−0.0199	−0.0228	−0.0199
	(0.0203)	(0.0207)	(0.0203)
GFC*DAP	−0.0875 **	−0.0839 *	−0.0875 **
	(0.0418)	(0.0437)	(0.0418)
GFC dummy	0.0587	0.0319	0.0587
	(0.0457)	(0.0431)	(0.0457)
LTA	−0.0934 ***	−0.163 *	−0.0934 ***
	(0.0292)	(0.0825)	(0.0292)
ROE	2.070 ***	1.499 **	2.070 ***
	(0.714)	(0.575)	(0.714)
PER	0.0622	0.0252	0.0622
	(0.0785)	(0.0587)	(0.0785)
NPLA	−0.540 *	−0.827 **	−0.540 *
	(0.287)	(0.318)	(0.287)
NLTA	0.00591	0.451 *	0.00591
	(0.259)	(0.239)	(0.259)
CAR	0.0246	0.617	0.0246
	(1.102)	(1.114)	(1.102)
LPBR			
Constant	2.363 ***	3.327 **	2.363 ***
	(0.672)	(1.511)	(0.672)
Observations	1151	1151	1151
Number of companies	120	120	120
R^2	0.2244	0.0818	0.2244
Hausman p-value			0.0000
BP LM			0.0000

Note: GFC—global financial crisis (period dummy), LPBR—lagged price-to-book ratio, DAP—% annual change in derivatives' assets, LTA—log (total assets), ROE—return on equity, PER—price-to-earnings ratio, NPL—non-performing loans/gross loans, NLTA—net loans/total assets, CAR—equity/total assets. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' computations.

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