LUISS Guido Carli
LIBERA UNIVERSITÀ INTERNAZIONALE DEGLI STUDI SOCIALI

DEPARTMENT OF BUSINESS AND MANAGEMENT

CHAIR OF INTERNATIONAL FINANCE

THE RISK AND USE OF DERIVATIVES. EVIDENCE FROM EUROPEAN BANKING SECTOR

SUPERVISOR

Prof. Pierpaolo Benigno

CANDIDATE

Vitaliy Karaba

CO-SUPERVISOR

Prof. Nicola Borri

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Introduction

Bank participation in the market for derivatives has been growing rapidly in recent years. Financial instruments like swaps, futures and options now form an important share of total assets at most of the banks and their impact became increasingly controversial in the last years of the 20th century, up until the recent financial crisis when participation in these markets had accounted for increasing share of bank revenues. Especially, after global financial crisis in 2008, banks' derivative activities have become increasingly debated. In fact, the effect of derivative use on risk measure and value is especially important in banking since banks dominate most derivative markets. Many observers are concerned that derivatives could be too risky for banks, still US Federal Reserve Board Chairman Alan Greenspan sustained that derivatives had contributed to the development of a "far more flexible, efficient and resilient financial system that existed just a quarter-century ago", whereas in contrast, the noted US investor Warren Buffet[1] described some derivatives as "financial weapons of mass destruction."

The aim of this thesis is to deepen understanding of the role of banks in the derivatives market and to analyse and the impact of such instruments on banks performance and risk. The sample of our study consist of European listed banks consisting of the EU-28 countries considering all available data for the past ten years till 2013 and also were included listed banks from Switzerland, Turkey and Russia.

The structure of this paper is organized as follows. Chapter 1 defines derivatives and explains their usage with quick overview of theoretical and regulatory background. Chapter 2 review the core findings of previous literature in the topic of interest. Chapter 3 describes the data, methodologies and sources that are used. Chapter 4 discusses the results of the regression and Chapter 5 analyse the characteristics of the banks that are more involved in derivatives activities, Chapter 6 summarize the conclusions.

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[1] See pp. 13-15 of Berkshire Hathaway's 2002 annual Report at **www.berkshirehathaway.com/2002ar/2002ar.pdf.**

Chapter 1. Derivatives definition

In the first chapter it is provided a quick overview of derivatives contracts as financial instruments. First part explains their usage with quick overview of theoretical and regulatory background, providing definition, summarising the main types of contracts. Subsequently is made an overview of over the counter derivatives markets and exchange-traded ones. Ultimately are discussed some particularities of derivatives accounting.

1.1. *Evidence on the European market*

The derivatives market had expanded exponentially from 2000s as the benefits from their usage, for instance effective risk transfer and mitigation, have become gradually more important. Europe is key role player by market share in this segment, as derivatives have become an important part of the European financial services sector and a contributor to economic development.

With near 44% of the total global outstanding volume, the European derivatives market has a considerably higher share compared to its total share of equities or bonds, consequently together North American market it is one the most important region in the global derivatives market. Regarding exchange traded derivatives, both in the US and the EU, commodities, derivatives, futures and options are mainly exchanged on public markets, such as the Chicago Mercantile Exchange (CME) and Eurex.

Chapter 2. Impact of derivatives in literature

Though the primary users of derivatives are financial institutions such as banks, insurance companies, and money managers, the use of derivatives by non-financial firms is very significant. A considerable number of studies are focused on impact of derivatives and their usage by non-financial companies. The majority

of these studies use samples of U.S. firms principally because of data availability, good quality of disclosures and significant number of companies to study.

2.1. *Studies on banking industry*

We can classify studies on the subject of the importance of derivatives in the banking industry into two parts:

- In part one we list the studies relative commercial banks and the use of derivatives;
- Second part examine how use of derivatives impact of the various types of bank risks;

Choi and Elyasiani (1997)[2] estimates the interest rate and exchange rate risk betas of 59 large U.S. commercial banks and find that options are related positively to currency risk and interest-rate, overall, the exchange rate risk betas are more significant than the interest rate risk betas, while currency swaps reduce exchange rate risk.

Chaudhry and Reichert (1999) and Chaudhry et al. (2000) find that the use of options tends to increase all market-based measures of bank risk, while empirical results suggest that interest rate and currency swaps significantly reduce bank risk and used primarily for risk-control purposes. And ultimately the use of forward contracts and currency commitments contributes marginally to any type of risk.

Some other studies are focused primarily on impact of credit derivatives and hedging against financial distress Duffee and Zhou (2001). Norden, Buston, and Wagner (2011) that banks use credit derivatives to improve their credit risk management.

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[2] Choi, J., Elyasiani, E., 1997. Derivative exposure and the interest rate and exchange rate risks of U.S. banks, *Journal of Financial Services Research* 12, 267-286

Chapter 3. Derivatives and systematic risk

3.1. *Research Method*

The aim this study is to verify the impact of derivatives use on systematic risk where the variable of systematic risk is measured by bank's beta, in particular, whether or not exist any linear relationship, positive or negative.

In case of positive linear relationship, an increase of derivatives usage would increase the systematic risk of the bank, and vice versa, in case of negative linear relationship, a higher usage of derivatives would result in decreasing of beta, which could be explained as a result of efficient hedging policies implemented by the banks.

The main variable of interest is the total amount of the derivatives used by the banks, that for comparability purposes is given by the ratio of derivatives to total assets and used as independent variable together with other control variables in our regression model.

3.2. *Control variables definition*

In order to control the outcome and construct more statistically significant result Multiple linear regression is preferred to simple linear regression. In our analysis we will use several control variables, that were used by authors in previous mentioned literature and other more specific, found to be significant for measuring systematic risk. The control variables are:

Size; Loans to customer deposits; Book to market ratio; Net interest margin; Leverage; Dividend pay-out

The approach used to study the relationship between bank's historic beta as a proxy of systematic risk and derivatives is multivariate analysis that will be conducted using formula that is explained in detail further.

3.3. *Regression model*

In order to examine the extent to which banks, either through their use of derivative with different underlying assets for trading or hedging purpose, can mitigate a market wide decline. We follow approach similar to Hentschel and Kothari (2001). The multivariate regression model that estimates banks beta, as function of both on-balance sheet derivatives and traditional on-balance sheet banking activities as follows:

$$\beta_x = \alpha_0 + \alpha_1 DERIVMV_i + \alpha_2 DE_i + \alpha_3 LNMVASSET_i + \alpha_4 LLRGR_i + \alpha_5 DIVP_i + \alpha_6 NIM_i + \alpha_7 LTCD_i + \alpha_8 PB_i + \varepsilon_i$$

DERIVMV	total derivatives ratio, calculated as notional amount of derivatives divided by market value of assets;
DE	debt-to-equity ratio;
LNMVASSET	the natural logarithm of a bank's market value of total assets to control for the effect of size;
LLRGR	Loan loss reserves to gross loans
DIVP	Dividend payout ratio
LTCD	Loans to total customer deposits;
NIM	Net interest margin;
PB	Price-to-book ratio;

Chapter 4. Empirical research

In this paragraph, we use a Multiple Linear Regression Model explained in chapter 3 to verify, whether the derivatives usage by the banks is actually significant and how it relates to banks systematic risk. Using dependent and

explanatory (control) variables, the regression equation will identify the best fitting line based on the Ordinary Method of the Least Squares (OLS).

$$\beta_x = \alpha_0 + \alpha_1 DERIMV_i + \Sigma\, \gamma j\, CONTROL ijt + \varepsilon i$$

Using this model, where *CONTROL* stands for the γ_j control variables of firm *i* in year *t*, we will verify if there is enough evidence in order to reject the null hypothesis, which is formulated as follows:

- H_0) In the sample, there is no linear relationship between the usage of derivatives and systematic risk;
- H_1) In the sample, there is a linear relationship between derivatives usage and systematic risk:

4.1. *Discussion of the results*

The aim of this chapter was to investigate whether the derivatives usage by the banks is significant and how it affects the banks systematic risk. For this purpose we used a Multiple Linear Regression Model with DERIMV as variable of interest and a set of control (explanatory) variables.

We find statistically significant results in line with previous literature that as expected, the higher derivatives usage corresponds to higher systematic risk. In first case using ordinary Method of the Least Squares (OLS) we find evidence in order to reject the null hypothesis. In fact the coefficient of DERIMV is statistically significant using even different reference indexes for Beta calculation. The highest explanatory power ($R^2 = 26{,}46\%$) was obtained using as dependent variable the market Beta in reference to local index of home country of the bank, however the models with other dependent variables provide also significant statistical results in particular the benchmark index for European market DJSTOXX 600.

Ultimately in order to consider and take advantage of the panel structure of the data we performed tests in order to verify the possible improvements over pooled OLS. Both tests for fixed and random effects resulted positive and lastly

Hausman test confirmed higher efficiency for fixed effects estimator. As presented in the summary table below, the variable of interest DERIVMV obtained positively correlated coefficient (0,89) with even higher statistical significance (T-stat 4.83) considering fixed effects model. The FE model still presented slightly lower explanatory power of ($R^2 = 19{,}79\%$) as some coefficients of the control variables like EPS and LTCD became less significant considering bank-specific effects. However, such accounting predictors of systematic risk as

Summary table of regressions using pooled OLS[3]

Dependent variable	Beta (β) DJSTOXX	"-"	"-"	"-"	Beta (β) DJSTOXX	Beta (β) DJES50I	Beta (β) LocIndex[4]
Intercept	-.5909 (-5.90)	-.6868 (-6.13)	-.8867 (-7.84)	-1.0676 (-8.89)	-1.385 (-8.63)	-1.197 (-9.27)	-.9523 (-10.28)
DERIVMV	.3710 (2.29)	.4447 (2.70)	.5300 (3.26)	.6168 (3.67)	.5643 (2.99)	.4641 (2.83)	.5572 (4.13)
LNTotAssets	.0988 (15.16)	.1023 (14.68)	.1068 (15.49)	.1291 (16.50)	.1486 (14.78)	.1315 (15.50)	.1220 (19.42)
PriceBook		.0424 (3.53)	.0499 (4.18)	.0480 (3.90)	.0751 (5.12)		-.0004 (-3.58)
NIM			1.219 (4.89)	1.0835 (4.34)	.8643 (3.72)	.7648 (3.78)	.9817 (4.91)
LLRGL				2.380 (6.36)	1.770 (3.03)	1.664 (3.29)	.6293 (2.12)
LTCD				-.0509 (-3.17)	-.0875 (-4.23)	-.0885 (-5.02)	-.1051 (-8.32)
DebtEquity				-.00951 (-4.64)	-.0165 (-6.18)	-.0136 (-6.06)	-.0053 (-3.30)
EPS				-.00025 (-3.77)			-.0002 (-4.29)
DIVP					.0210 (0.70)	.0317 (1.21)	
Observations	2322	1994	1994	1953	1072	1075	1950
R^2	0.1346	0.1503	0.1768	0.1941	0.2418	0.2600	0.2647
F-test	180.42	117.36	85.39	58.53	42.38	53.56	87.34

[3] Table 7 reports the estimates of regression coefficients and corresponding T-statistic values are reported in parenthesis.
[4] Beta (β) LocIndex- is calculated in reference to local index of the bank's home country

size, loan loss ratio and debt to equity ratio remained significant across different estimation models and reference indexes.

Chapter 5. Determinants of derivatives use

5.1. *Analysis description*

Derivatives provide an efficient for risk management tool and to analyse which are the characteristics of the banks that are more involved in derivatives activities we will use the created database and analogous regression methodology as in previous chapter.

The involvement of the bank and the extent of its activity is defined by notional amount of derivatives divided by the book value of total assets (DERIVTA). Whereas the main characteristics are analysed through different proxy variables of size, leverage, diversification, market risk and liquidity.

5.2. *Regression model*

In the following section is described the multiple regression model using notional amount of derivatives scaled by total assets (DERIVTA) as a dependent variable of the model. The explanatory variables were selected by comparing the most used in the literature. The regression equation is formulated as follows and explanatory variables are described in the summary table below.

$$DERIVTA_{it} = \alpha_0 + \alpha_1 LNASSET_{it} + \alpha_2 DE_{it} + \alpha_3 LIQUID_{it} + \alpha_4 LTA_{it} + \varepsilon_{it}$$

Labels	**Description**	**Proxy for**	**References**	**Exp. Sign**
DERIVTA	Notional amount of derivatives divided by total assets	Derivatives usage	Sinkey and Carter (2000)	

LNASSET	Natural logarithm of total assets	Bank size	Adkins, Carter, Simpson (2007) Sinkey and Carter (2000) Shiu, Moles, Shin (2008)	(+)
DE	debt-to-equity ratio	Leverage risk	Sinkey and Carter (2000)	(+)
LIQUID	Liquid assets to total assets	Liquidity risk	Ashraf ,Goddard, Yener (2005) Li and Marinc (2013) Sinkey and Carter (2000)	(-)
LTA	Loans to total assets	Diversification	Khasawneh and Hassan(2009) Shiu, Moles, Shin (2008)	(-)

5.3. *Results discussion*

From the data analyzed in this chapter can conclude that in general bank size and derivatives usage are positively correlated. This result as expected is supporting the theory of scale economies in derivatives activities. Relying on results of fixed effects model it was possible to obtain a positive coefficient (0,00367) with t-statistic (2,30) and p-value of 0,022, which mean we can reject the null hypothesis in favor of positive linear relationship between bank size and higher derivatives usage. Undoubtedly, risk management or hedging program may have elevated cost of implementation, which create some entry barriers for smaller banks.

Bank's leverage was the second financial characteristic that was analyzed. We have obtained strong evidence that higher debt-to-equity ratio as a proxy for financial distress is positively correlated with derivatives usage. In instance, this result can be reasonable, as highly leveraged institutions prefer to increase hedging due higher probability of going bankrupt. From this perspective, lower level of equity capital as a consequence represents higher leverage and increased probability of financial distress, consequently more leveraged banks are using

more derivatives in order to hedge interest rate exposures and reduce the

Table 16 : Summary of regression results. Pooled OLS versus FE and RE[5]

	POLS	*p-val.*	FE	*p-value*	RE	*p-value*
Dependent variable	DERIVTA		DERIVTA		DERIVTA	
Intercept	-.1454 (-12.22)	0,000	.0300 (1.18)	0.239	-.0692 (-3.51)	0.000
LNASSET	.01403 (20.14)	0.000	.00367 (2.30)	0.022	.0102 (8.60)	0.000
LTA	-.1116 (-14.27)	0.000	-.06946 (-6.02)	0.000	-.0836 (-8.19)	0.000
DebtEquity	.00263 (12.64)	0.000	.00083 (4.56)	0.000	.00104 (5.80)	0.000
LIQUID	-.0038 (-0.37)	0.714	-.0800 (-8.44)	0.000	-.0655 (-7.14)	0.000
Observations	2708		2708		2708	
R^2 within	-		0.0466		0.0413	
R^2 between	-		0.2758		0.3603	
R^2 overall	0.3373		0.2329		0.3052	

likelihood of default.

Liquidity ratio has proven to be statistically significant for fixed and random effects models with significant coefficient at 1% confidence level and high t-statistic. The negative sign of coefficient in line with our expectations confirms that for European banks in the sample liquidity can be thought of as alternative for hedging. In fact, observed banks with higher ratio of liquidity to total assets use much less derivatives, including derivative for hedging activities. From the obtained results we can conclude that in general, banks that are

[5] In the table the relative t-statistic values are reported in the parenthesis under coefficients

substantially involved in derivatives activities have much lower liquidity in their balance sheets, conversely banks with higher amount of liquidity use much less derivatives as liquidity is considered as hedging substitute.

Ultimately, coefficient of loan-to-asset ratio (LTA) is statistically significant across all regression methodologies. In particular for fixed effects model we have found coefficient to be negative (-0.069) with high t-statistic (-6.02) and significant at 1% level. Considering that LTA was considered as a proxy for the extent of diversification of assets, we can conclude that banks with higher derivatives activities are more diversified. In fact, considering negative sigh of coefficient, less diversified banks with higher LTA have much lower involvement in derivatives activities. In contrast banks with more diversified sources of revenue and that are involved in activities beyond traditional intermediation may use derivatives as alternative to tradition banking activities and not only lower specific risks. Consequently higher degree of diversification is positively correlated with derivatives usage.

Chapter 6. Conclusions

Analysing last twenty years of the evolution of financial markets it is impossible to ignore such rapid growth of derivatives usage by almost any type of company, both financial and non-financial. Participation of financial institutions in the derivatives market had been growing almost unstoppably until 2008 financial crisis. However, even if after the crisis the gross market value of derivatives contracts declined, for some types of contracts exchange by nominal amounts continued to expand. Different financial instruments like options, futures and swaps nowadays constitute an important part of bank's balance sheets. For the reason that most of derivatives markets are dominated by banks, especially after the 2008 financial, crisis their involvement in such markets are increasingly debated and remain a major issue for financial regulators.

In order to deepen understanding of the role of banks in the derivatives market and to analyse and the impact of such instruments on banks performance and risk

we analysed the sample of European listed banks. The study attempted to investigate the relationship between financial derivatives and systematic risk in the European banking sector. For such purpose we used the notional amounts of derivatives obtained from Bankscope database by using a sample of 261 banks with highest market capitalisation. Due to database limitations, it was not possible to distinguish between different types of financial derivatives. However, after the analysis of derivatives market in Chapter 1, we can conclude that Interest Rate derivatives (IR Swaps in particular) constitute the major part of this financial contracts, besides most of the examined financial literature reported also that Interest Rate Derivatives were positively related to the market risk.

In Chapter 2 were examined and summarised the main findings in the literature. Subsequently in Chapter 3 was represented a brief description of the data the research method was discussed, in particular which control variables were included in the regression model and why.

The regression results and summary tables are presented in Chapter 4. To obtain more robust results and for comparative purposes, were used different reference indexes for calculation of the systematic risk (β). In particular were used two different benchmark indexes STOXX Europe 600 index, STOXX Europe 50 and lastly multi-index method was implemented, calculating Beta to bank-specific local indexes.

After examining several regressions, we find strong empirical evidence in order to reject the null hypothesis. In fact the coefficient of DERIMV is statistically significant for all reference indexes. The simple OLS provided high explanatory power with range of R^2 from 19% to 26,46% depending on selected reference index and control variables.

Ultimately, the panel structure of the data was considered by performing tests in order to verify the possible improvements over pooled OLS. Both executed tests for fixed and random effects resulted positive. Both fixed effects and random effects model provided results in line with pooled OLS for the variable of interest DERIVMV. On the basis of obtained results we can conclude that for the examined dataset there is positive linear relationship between usage of derivatives and systematic risk of the banks.

The most relevant accounting predictors of systematic risk were size, loan loss ratio and debt to equity ratio. The coefficients of this control variables remained significant with 1% confidence level across different estimation models and reference indexes. Even if other control variables of the model were statistically significant, the major explanatory power of variation of Beta was given by the bank size given by natural logarithm of total assets. The size coefficient is positively correlated with systematic risk independently of reference index and estimation methodology. This explained that even with higher diversification opportunities, the larger banks have higher market risk exposure.

In conclusion, Chapter 5 provide more detailed analysis of the main motivations of the banks to participate in derivatives market. In particular we analysed specific accounting characteristics of the banking institutions that are more involved in derivatives activity. We can conclude that banks with major derivatives usage are larger in amount of total asset under management, have higher degree of leverage, less liquid assets and are overall more diversified.

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