TILBURG UNIVERSITY

Master Thesis: "The impact of the Derivatives' use, as a hedging instrument, in the European Banking Sector"

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1. Introduction

"Derivatives are financial weapons of mass destruction." -**Warren Buffett**

"These derivatives represent a natural extension of the market for similar products that 'unbundle' risks, such as certain interest rate and foreign exchange products. When used properly, credit derivatives can help to diversify credit risk, improve earnings, and lower the risk profile of an institution." -**US Office of Comptroller of Currency**

The derivative market has experienced a tremendous growth worldwide, the last decade, as it was giving the investors the possibility to invest in segments of the markets that were not attainable before. With the introduction of derivatives, and especially credit derivatives, banks could lower their regulatory needs for costly capital charges, reducing the overall cost of financing (Watson and Carter, 2006)[1]. On the other hand, moral hazard, limited disclosure and incentive problems are also associated with derivatives. That is why many blame derivatives, and especially credit derivatives, to have a significant contribution to the credit crisis.

Nijskens and Wagner (2010) argue that one cause of the financial crisis was the way how banks transferred credit risk in the financial system. They find that the market anticipated those risks coming from the use of CDO's, before the crisis occurred. Moreover, they conclude that while banks were hedging their individual risks, they posed a bigger risk in the whole financial system. Allen and Carletti (2005) focus on liquidity. They claim that credit risk transfer will be beneficial when there is a uniform demand for liquidity by banks. However, if banks bear idiosyncratic liquidity risk and decide to hedge in an interbank market, this credit risk transfer may increase the risk of crisis as it leads to contagion between the sectors.

In another study there is no systematic effect on bank values from derivatives use (including CDS) in different periods of growth (Cyree, Huang and Lindley, 2011). Furthermore, they do not find evidence supporting the affirmation that derivatives use

[1] Retrieved from : Allen N. Bergen, Philip Molyneux, John O. S. Wilson (2012), *The Oxford Handbook of Banking*, Oxford University Press

increases speculating behaviour of banks and that their contribution was significant to the loss of value during the mortgage crisis. Stulz (2009) enforces this view by admitting that CDSs did not cause the credit crisis, as the over-the-counter CDS market was working properly during the first year of the crisis. In an earlier paper together with Minton and Williamson (2008) they admit that the use of credit derivatives as a hedging instrument is limited due to moral hazard and adverse selection problems and also, because banks are unable to hedge accounting when hedging credit derivatives. Finally, in a comparison between credit derivatives and loan sales in US commercial banks (Bedendo and Bruno,2012), it is concluded that the financial institutions which engage intensively in loan sales face bigger risks and had higher default rates during the crisis. The credit risk transfer benefits and drawbacks are, surprisingly, stronger for loan sales than for credit derivatives. From the current literature it is visible that there are opposing views concerning the role that derivatives play when hedging risk. Many blame credit derivatives to be the cause of the last credit crisis due to their complexity and opaqueness. Others disagree.

The Credit Derivatives market has grown extensively in Europe as it accounts for 50% of the total market share of the worldwide derivative market. London has a market share of 40% on the credit derivatives. For the rest of Europe this amount reaches up to 10%[2]. Since half of this market is located in Europe it would be interesting to study the impact of derivatives in this region, taking into account the fact that most studies are focused on the American market or the world market of derivatives. In addition, in US the credit crisis is vanishing whereas in Europe it still goes on. Most argue that the crisis in Europe is related to sovereign debt, but derivatives are also to be blamed.

The aim of this research is to answer the question whether derivatives use has any impact in bank's idiosyncratic risk or the risk of the financial system (systemic risk). The sample is comprised by European listed banks consisting of the EU-15 countries and Switzerland, starting from 1998 till 2012. 1998 is picked as an initial year as it is the first year that banks were asked to report their CDS exposure (Nijskens and Wagner, 2010). The 14 years of observations will be grouped in two periods: the pre-crisis period and the crisis period (2007-2012). The purpose is to study how the impact of derivatives use, as a hedging instrument on risk, both firm specific and systematic, evolves over time. The idiosyncratic risk is measured by the idiosyncratic volatility of returns, whereas systemic

[2] "British Banker Association Credit Derivatives Report"

risk is measured by bank's beta. The main variable of interest is derivatives size given by the natural logarithm.

The main findings of this paper are: a) there is a statistically significant effect of bank's derivatives use on idiosyncratic risk, but there is no economic significance; b) there is both a statistical and economic significant effect on systemic risk, expressed by bank's betas.

The remainder of the paper is organised as follows. Chapter 2 discusses the theoretical background while chapter 3 summarizes the main findings of previous literature in the topic of interest. Chapters 4 and 6 describe the econometric methodologies that are used: chapter 4 describes the methodology of the first part of the analysis and chapter 6 that of the second. Chapter 5 discusses the results of the baseline regression, robustness checks and endogeneity issues of the first part of the analysis; that is the effect on idiosyncratic risk. Chapter 7 presents the outcomes of the research of the derivatives use effect on systemic risk. Chapter 8 concludes.

2. Theory of derivatives

2.1 Introduction

This chapter begins by defining the financial derivatives and what are the motives behind their use. Perspectives on derivative use follow. This is section 2 of the chapter. The focus of the third section will be on credit derivatives. What are the main groups of credit derivatives? Why do we use credit derivatives and what are the good and bad sights of these instruments? The final section will conclude.

2.2 Financial Derivatives

The term financial derivative refers to a security whose payoff derives from the value of another underlying asset (Sundaram & Das, 2011). The most common types of underlying assets include financial assets, commodities, exchange and interest rates, market indices and sometimes the price of another derivative security.

Table 2.1: Amounts outstanding of over-the-counter (OTC) derivatives by risk category and instrument (in billions of US dollars); BIS estimates – End December 2012

	Notional amounts outstanding					Gross market values				
Risk Category / Instrument	**Dec 2010**	**Jun 2011**	**Dec 2011**	**Jun 2012**	**Dec 2012**	**Dec 2010**	**Jun 2011**	**Dec 2011**	**Jun 2012**	**Dec 2012**
Total contracts	**601,046**	**706,884**	**647,777**	**639,366**	**632,579**	**21,296**	**19,518**	**27,278**	**25,392**	**24,740**
Foreign exchange contracts	**57,796**	**64,698**	**63,349**	**66,645**	**67,358**	**2,482**	**2,336**	**2,555**	**2,217**	**2,304**
Forwards and forex swaps	28,433	31,113	30,526	31,395	31,718	886	777	919	771	803
Currency swaps	19,271	22,228	22,791	24,156	25,420	1,235	1,227	1,318	1,184	1,247
Options	10,092	11,358	10,032	11,094	10,220	362	332	318	262	254
Interest rate contracts	**465,260**	**553,240**	**504,117**	**494,427**	**489,703**	**14,746**	**13,244**	**20,001**	**19,113**	**18,833**
Forward rate agreements	51,587	55,747	50,596	64,711	71,353	206	59	67	51	47
Interest rate swaps	364,377	441,201	402,611	379,401	369,999	13,139	11,861	18,046	17,214	17,080
Options	49,295	56,291	50,911	50,314	48,351	1,401	1,324	1,888	1,848	1,706
Equity-linked contracts	**5,635**	**6,841**	**5,982**	**6,313**	**6,251**	**648**	**708**	**679**	**645**	**605**
Forwards and swaps	1,828	2,029	1,738	1,880	2,045	167	176	156	147	157
Options	3,807	4,813	4,244	4,434	4,207	480	532	523	497	448
Commodity contracts	**2,922**	**3,197**	**3,091**	**2,994**	**2,587**	**526**	**471**	**481**	**390**	**358**
Gold	397	468	521	523	486	47	50	75	62	53
Other commodities	2,525	2,729	2,570	2,471	2,101	479	421	405	328	306
Forwards and swaps	1,781	1,846	1,745	1,659	1,363					
Options	744	883	824	812	739					
Credit default swaps	**29,898**	**32,409**	**28,626**	**26,931**	**25,069**	**1,351**	**1,345**	**1,586**	**1,187**	**848**
Single-name instruments	18,145	18,105	16,865	15,566	14,309	884	854	958	715	527
Multi-name instruments	11,753	14,305	11,761	11,364	10,760	466	490	628	472	321
of which index products	7,476	12,473	10,514	9,731	9,663					
Unallocated	**39,536**	**46,498**	**42,610**	**42,057**	**41,611**	**1,543**	**1,414**	**1,976**	**1,840**	**1,792**
Memorandum Item:										
Gross Credit Exposure						3,480	2,971	3,912	3,668	3,626

Source: Banks for International Settlements website (http://www.bis.org).

The size of the world derivative market is huge. The Bank of International Settlements estimates the amount of total contracts to be around $632,579 billion (Table 2.1). Considering the fact that in 2008 the total value amounted only to $80,3 billion, one can undoubtedly agree that besides the fact that the market is colossal it has been growing intensely. It has been widely argued that one of the catalysts of the recent credit crisis was the use of the instruments called credit derivatives. In table 2.1 the size of credit derivatives, such as Credit Default Swaps is small compared to other securities such as Interest Rate contracts. However, it should be kept in mind that table provides us only with the notional amounts which say nothing about the riskiness of these securities. The interest rate contracts might be a lot bigger in size but credit derivatives are even riskier. Since this study focuses on risk, both idiosyncratic and systemic, and credit derivatives are considered to be from the riskiest instruments, a lot of attention will be given in these securities, later in the chapter.

According to Sundaram and Das (2011) there are three popular ways of classification of derivatives. First, one can classify derivatives according to the underlying.

Table 2.2: Main financial derivatives according to their underlying and contract type

	CONTRACT TYPES				
UNDERLYING	Exchange-Traded Futures	Exchange-Traded Options	OTC Swap	OTC Forward	OTC Option
Equity	DJIA Index Future, Single-stock Future	Option on DJIA Index Future Single-share Option	Equity Swap	Back-to-back Repurchase Agreement	Stock Option Warrant Turbo warrant
Interest Rate	Eurodollar future Euribor future	Option on Eurodollar Future Option on Euribor future	Interest Rate Swap	Forward Rate Agreement	Interest Rate Cap and Floor, Swaption, Basis Swap, Bond option
Credit	Bond future	Option on bond future	CDS, Total Return Swap	Repurchase Agreement	CDO
Foreign exchange	Currency future	Option on currency future	Currency Swap	Currency forward	Currency option
Commodity	WTI crude oil futures	Weather derivative	Commodity Swap	Iron ore Forward Contract	Gold Option

According to this classification there are equity derivatives, currency derivatives, interest-rate derivatives and so on. Secondly, derivatives can fall into two classes those that involve a commitment to a given trade and those where one party has the option to enforce or opt out of the trade or exchange. Derivatives that fall in the first group are forwards futures and swaps whereas derivatives that fall in the latter group are called options. Thirdly, derivatives can be traded through organized exchanges or over the counter, that is, through contracts that are negotiated privately between the parties. Figure 2.1 gives an overview of the main types of financial derivatives.

There are four main reasons why someone should use derivatives (Finan, June 2013).At first, derivatives are used to reduce the exposure of risk (hedging). Through hedging the cash flows from the derivative are used to offset or mitigate the cash flows from a prior market commitment. (Sundaram and Das, 2011) Secondly, motive of derivative use is speculation aiming at profiting from the anticipated market movements. Speculation increases the risk exposure, thus, the potential gain or loss is magnified relative to the initial investment. Thirdly, the use of derivatives implies less transaction costs (commission costs, trading costs). According to Keith Sill (1997) the derivatives market success constitutes on the fact that they make the financial markets more efficient. Borrowing and lending occurs at lower cost when derivatives are used, resulting in lower transaction costs. Robert Merton argues that large firms will have lower transaction costs in the securities market due to the large trade volume that is being undertaken. Lastly, derivatives use through asset management activities and regulatory restrictions, maximise the return on investments. For example, in order to pay fewer taxes one can use derivatives to produce losses. This practice is called regulatory arbitrage.

Finan (2013) argues that there are three different user perspectives on derivatives; the end-user perspective, the market-maker perspective and the economic observer perspective. End users, that include corporations, investment managers and investors, use derivatives in order to achieve their goals such as speculation, risk management, cost reduction or regulation avoidance. Market –makers, which usually are traders or intermediaries between different end users, buy from end users that sell at low price and sell to end users that want to buy at higher price. Commissions for the trading transactions might be charged. The final perspective is that of the economic observer, whose role is to regulate and supervise the markets.

2.3 Credit Derivatives

The 21st century credit markets are not simple anymore. It is still possible to get funds from loans and “plain vanilla” securities, however there is a general trend of turning to derivatives and other hybrid securities (Partnoy and Skeel, 2007). With the introduction of derivatives, financial institutions and especially banks are no longer monitors and risk bearers but they shift risks to other parties. These derivatives whose payoffs are linked in some way to a change in credit quality of an issuer are called credit derivatives. The focus in this section will be on the two major categories of credit derivatives, that are CDO’s (collateralized debt obligations) and CDS’s (credit default swaps)

2.3.1 Credit Default Swaps

A Credit Default Swap is a two-sided contract in which the protection seller obtains a periodic payment from the protection buyer in exchange for a single contingent payment following a credit event (failure to pay, bankruptcy, repudiation/moratorium, obligation default, obligation acceleration or restructuring) on a specified underlying instrument (Sundaram, Das, p.779). They are of great importance to the credit derivative market as they also form synthetic CDOs, CDX and iTraxx credit indices (p.779). Table 3.1 shows the total size of the CDS market and how many contracts are used by the financial firms during 2012.

“The most obvious reason is that credit default swaps provide a simple device for banks and others to hedge the risks associated with a particular company or group of companies” argues Alan Greenspan[3]. The purchase of CDSs offers to banks the autonomous administration of their lending relationships reducing thus the potential downside costs of default by the borrower. CDS can be used to measure the lender’s exposure to a specific borrower. Moreover in combination with other derivatives or multi-issuer swaps different risk profiles can be created. Furthermore, there is a common belief that the CDS use might cause a more focused monitoring of corporate borrowers. Partnoy and Skeel (2007) explain that banks focus on more complex, borrower-specific risk as they have a distinct advantage in monitoring and evaluation.

[3] Partnoy, Skeel (2007), THE PROMISE AND PERILS OF CREDIT DERIVATIVES, p15, note 6

A second explanation of the CDS use is liquidity increase and access to capital. Liquidity in the banking industry is increased since banks can lend at lower risk once they have purchased the credit default swaps. In addition, these securities restrain bank's downside risk (risk is shifted to other parties) making banks willing to lend more money to businesses, extending thus companies' access to capital from bank lending (Partnoy and Skeel, 2007)

The International Swaps and Derivatives Association (ISDA) have standardized the CDS market, reducing the transaction costs of the credit default swaps deals.

Table 3.1: Credit default swaps, by sector[4]- Notional amounts outstanding at end December 2012 (in millions of US dollars)

Instruments and counterparties	Total			Financial firms		
	Bought	Sold	Total	Bought	Sold	Total
Total CDS contracts	19,844,151	19,373,095	25,068,701	4,939,556	4,971,713	6,420,181
Reporting dealers	14,099,838	14,197,285	14,148,578	3,397,376	3,584,825	3,491,113
Other financial institutions	5,612,046	5,107,677	10,719,723	1,510,058	1,378,349	2,888,407
Central counterparties	2,443,819	2,447,024	4,890,843	738,017	664,143	1,402,160
Banks and security firms	1,609,066	1,354,014	2,963,080	374,983	339,521	714,504
Insurance and financial guaranty firms	190,739	67,577	258,316	49,244	18,313	67,557
SPVs, SPCs and SPEs	406,326	180,553	586,879	52,826	46,476	99,302
Hedge funds	372,871	584,291	957,162	148,449	159,073	307,522
Other financial customers	589,225	474,218	1,063,443	146,538	150,824	297,362
Non-financial institutions	132,267	68,131	200,398	32,123	8,537	40,660
Single-name instruments	11,710,867	11,629,055	14,308,939	3,157,013	3,198,412	3,853,346
Reporting dealers	8,989,015	9,072,968	9,031,000	2,440,530	2,563,644	2,502,095
Other financial institutions	2,647,473	2,522,820	5,170,293	684,979	626,964	1,311,943
Central counterparties	1,030,628	1,047,417	2,078,045	186,437	193,720	380,157
Banks and security firms	962,116	815,629	1,777,745	247,234	224,471	471,705
Insurance and financial guaranty firms	74,848	39,079	113,927	39,607	14,841	54,448
SPVs, SPCs and SPEs	145,229	80,035	225,264	42,536	17,188	59,724
Hedge funds	157,772	306,553	464,325	59,773	66,568	126,341
Other financial customers	276,880	234,107	510,987	109,391	110,177	219,568
Non-financial institutions	74,379	33,266	107,645	31,505	7,802	39,307
Multi-name instruments	8,133,284	7,744,040	10,759,762	1,782,543	1,773,301	2,566,835
Reporting dealers	5,110,823	5,124,317	5,117,578	956,846	1,021,181	989,018
Other financial institutions	2,964,573	2,584,857	5,549,430	825,079	751,385	1,576,464
Central counterparties	1,413,191	1,399,607	2,812,798	551,580	470,423	1,022,003
Banks and security firms	646,950	538,385	1,185,335	127,749	115,050	242,799
Insurance and financial guaranty firms	115,891	28,498	144,389	9,637	3,472	13,109
SPVs, SPCs and SPEs	261,097	100,518	361,615	10,290	29,288	39,578
Hedge funds	215,099	277,738	492,837	88,676	92,505	181,181
Other financial customers	312,345	240,111	552,456	37,147	40,647	77,794
Non-financial institutions	57,888	34,865	92,753	618	735	1,353

Source: Banks for International Settlements website (http://www.bis.org).

[4] Data on total notional amounts outstanding are shown on a net basis, i.e. transactions between reporting dealers are counted only once. Data on notional amounts outstanding bought and sold are shown on a gross basis. The definitions of notional amounts outstanding are available under section 2 of the statistical notes. Sector refers to the economic sector of the obligor of the underlying reference obligation(s) (http://www.bis.org/statistics/dt25.pdf)

The pricing of CDS is available to the market, providing thus additional market information about the company's financial condition. The informational value about credit risk is the fourth benefit of these instruments. When comparing CDS to published credit ratings from agencies such as S&P and Moody's as a barometer of corporate stability Partnoy and Skeel (2007) claim that the ratings might be inaccurate. Instead, CDS pricing might provide better, up-to-date company information for the companies that participate in this securities market.

Despite the fact that the derivatives use ameliorates the informational quality of the credit market, facilitates governance of banks and other creditors and increases liquidity, it might create problems as well.

A potential problem that CDS use might create is the reduction of incentives for banks to monitor. Partnoy and Skeel (2007) argue that due to the protection offered by the CDS, the incentives of banks to actively monitor are diminished. Consequently, on the borrower's part there is moral hazard, as they are subject to financial discipline from their lenders.

Furthermore, a lender that has a long position on CDS might have an incentive to benevolently destroy value (Partnoy and Skeel, 2007). To put it in other words, if the lender benefits more from the default, he will use the leverage allowed by its loan to force oversight, ignoring the costs.

The CDS market is an opaque one. The market, investors and creditors cannot know with certainty whether the lender's position is hedged with these type of derivatives. Thus it is impossible for them to adjust their behaviour (Partnoy and Skeel, 2007). The ambiguity of the credit derivatives market eases the procedure of forcing default for those parties that benefit by doing so.

Partnoy and Skeel (2007) argue that CDS have an effect on systemic risk. Many investors put highly leveraged bets on these instruments and even a small market change might cause a crisis. Liquidity problems in the financial markets arise from the rush to disentangle the numerous interconnected contracts. Taking into account the size of the derivatives market a crisis caused by them might cause a seizure throughout the global financial market. To sum up, the CDS have opposing effects on systemic risk.

2.3.2 Collateralized Debt Obligations

As mentioned above, the second most important group of credit derivatives are collateralized debt obligations, leveraged and structured transactions that are backed by one or more classes of fixed income assets[5]. CDO's are not based only on portfolios of high yield corporate bonds, as they used to when they were first introduced, but also on credit default types, other asset classes and other CDO's. In a CDO market different baskets of default risk are put in different tranches and then are sold off. The senior tranche has priority over cash flows. Other mezzanine tranches follow that grand the subordination required to give the senior tranche a higher credit rating. In the bottom of the hierarchy the "equity" tranche is located that works as a barricade for first credit loss (Sundaram, Das, p.792)

Partnoy and Skeel mention in their paper (2007) that CDO's complete the markets for fixed income securities in the sense that they create investment opportunities. He further explains that when a CDO is issued a financial institution sells debt to a Special Purpose Entity which splits the debt and links the pieces of debt with new securities. The quality between the pieces differs and the tranche with the least quality or the most junior one does not get an investment-grade rating.

Another benefit of CDO's is the provision of new diversification opportunities. Investors benefit from the purchase of different portfolios of fixed income instruments. Those that buy from the high rated tranche would benefit from a higher yield than if they were to buy high rated bonds. Investors that buy from the junior tranches have a high leveraged position in corporate bonds and higher returns due to high risk of this tranche. Synthetic CDO's also offer diversification benefits that come to the cost of relatively high which are expected to decline as the technology becomes more standardized (Partnoy and Skeel, 2007) Thus CDO's will be similar to indices of CDS as they will offer a financial instrument based on the performance of a range of CDS.

The CDO technology and the mathematical sophistication of these instruments is another argument that favours their existence. CDOs offer value creation by allowing a more accurate security pricing. They also can create new instruments that will be used by investors for a variety of profitable objectives (Partnoy and Skeel, 2007).

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[5] Partnoy, Skeel (2007), THE PROMISE AND PERILS OF CREDIT DERIVATIVES, p16, note 19

Most potential problems created by the CDOs are comparable to those of the CDSs. One of these problems is the reduction of the monitoring role of banks. In addition, there exist incentives to misprice CDOs and for the purpose of risk shifting between the different tranches the collateral is being manipulated by the CDO managers. Other problems of CDOs similar to CDSs are the opaqueness of this market and the increase in systemic risk. Partnoy and Skeel (2007), note that the above arguments apply with an equal or greater intensity in the case of CDOs.

A principal problem of the CDOs is that transaction costs are very high, which makes Partnoy and Skeel (2007) believe that the benefits might be offset by the costs. An additional problem stemming from the complexity and opaqueness of this market is the rating "arbitrage" opportunity created, that does not add any further value (Partnoy and Skeel, 2007). Collateralized Debt Obligations are used to arbitrage a price disparity in the fixed income markets or to convert the accurately priced fixed income instruments into overvalues ones. All in all, in the last decade the presence of CDOs has been a proof of a significant and prevalent market imperfection. Howbeit, one cannot say that CDO's should seize to exist. In the presence of better and more complete regulatory requirements this market would have a great contribution in the efficiency of the market.

2.4 Concluding Remarks

Chapter two highlighted the most important parts of the theory of derivatives, both financial and credit ones. Even though this research takes into account all the derivatives that banks use, credit derivatives are thought to be the most important group as they were blamed to be significant contributors of the financial crisis. The benefits and drawbacks were mainly discussed, as this paper is not going into the complex analysis of derivative pricing.

3. Prior research and Empirical evidence

3.1 Introduction

The previous chapter was a summary of the theory of derivatives. In the present chapter we will discuss any prior literature that refers to derivatives and how did they impact the recent financial crisis. This is section two. Section 4 encapsulates the results of previous research in the European region and section 5 concludes.

3.2 Arguments for the impact of derivatives found in literature

There are numerous studies that examine the relationship between derivatives and particularly credit derivatives and idiosyncratic bank's risk but also market risk. Yet, this relationship remains ambiguous.

The introduction of credit derivatives made possible diversification in new segments of the credit markets that were not available before. Securitization has favoured the risk exposure expansion in other segments of industries or other countries, which was impossible in the past due to market imperfections (De Marzo, 2005). Securitization instruments and especially credit derivatives are used for risk management purposes as they can adjust the risk profile of a financial institution allowing them to optimize their credit risk portfolio and lower the degree of concentration (Ibanez, Scheicher, p.619).Furthermore, these risk transfer instruments allow banks to reduce their regulatory requirements so that they reduce the overall cost of financing (Watson and Carter, 2006).

Ibanez and Scheicher (p.600)[6] claim that the recent credit crunch highlights some important elements of the market for the credit risk shifting, such as investors' over trust on credit ratings, high degree of opacity and complexity and numerous incentive problems, that hurt the well functioning of the markets in times of stress. Partnoy and Skeel (2006) indicate that derivatives have an impact on systemic risk and they might cause a market failure as they reduce the borrowers monitoring incentives. Minton, Stulz and Williamson (2008) support the previous argument discussing that due to moral hazard and adverse selection banks can use derivatives for hedging purposed only to a limited extent. Banks

[6] Allen N. Bergen, Philip Molyneux, John O. S. Wilson (2012), The Oxford Handbook of Banking, Oxford University Press, Chapter 24: Securitization; Instruments and Implications

cannot use hedge accounting when they use derivatives as hedging instruments. In their study on US banks they find that credit derivatives are used mainly for dealer activities. Only less than 2% of the loans are hedged with credit derivatives. What is more the total notional amount of credit derivatives is larger than the total credit exposure. In 2005 the total credit protection was around 5.5 trillion dollars while the protection bought (used as hedging measure) was 0.5 trillion dollars. Therefore, since the degree of credit derivative practice to hedge loans was limited, the only way that those instruments could make the financial system safer was to create fewer risks for banks when banks would take positions on them for reasons other than hedging. However the financial crisis according to Minton Stulz and Williamson has shown that the existence of these positions has affected systemic risk.

In response to the previous arguments that banks make a limited use of derivatives due to agency problems, it is argued that CDO-transactions eliminate adverse selection and moral hazard problems by a significant "first loss position" of the originator (Franke and Krahen, 2005). The size of the position on these securities goes in line with the probability of default of the underlying portfolio and usually only a small part of the portfolio losses is transferred in the CDO transaction.

It is widely argued among scholars that credit default swaps had a significant contribution to the credit crisis. The main reason is due to the fact that CDS trade in an unregulated over-the-counter market. In other words the trading is done directly between two parties without any supervision making those contracts prone to default risk. However, Stulz (2009) argues that CDS were not liable for the credit crisis as the CDS market worked well during the first year of the crisis and if one was to eliminate off-exchange trading of CDS could reduce social welfare. Before the crisis investors believed that the AAA tranches of securitization were quite safe. However, the crisis showed the opposite when many AAA tranches unexpectedly lost value resulting in a reduced confidence in financial institutions. In this scenario, derivatives exposures sometimes raised uncertainty about the financial soundness of some institutions and led to some losses but they also allowed institutions to hedge.

Allen and Carletti (2005) relate credit risk transfer to liquidity. When banks have a uniform liquidity demand the transfer of credit risk can be favourable as the risk sharing can be improved. On the other hand, there is a risk of reduction in welfare when banks that face firm specific liquidity risk decide to hedge it in an interbank market as it might induce contagion and thus boost the risk of crisis.

Calice, Ioannidis and Williams (2010) investigate how the CDS index market is correlated with the financial institutions asset and equity values from 2003 to 2009. They observe that the CDX and iTraxx index markets are highly positively correlated with the sensitivity of default risk across the financial system. Furthermore, during the crisis years they confirm a co- movement of the volatility of the CDS index market with the equity volatility of the large and complex financial institutions.

A recent study from Bedendo and Bruno (2012) shows that credit derivatives have less benefits and flaws than loan sales and securitization. Thus, the riskiness of the latter instruments is higher and banks that engage on those activities face higher risk of default during the crisis. Brunnermeier (2009) argues that credit risk transfer activities reduced the monitoring incentives of the users increasing risk taking. Findings (Bedendo and Bruno, 2012) propose that the credit risk transfer instruments are basically used to increase banks' asset return by taking more risk. Banks that make an intensive use of these instruments have lower loan portfolio quality which increases the default rate in periods of recession. However, the default rate depends on the instrument as derivatives default rate is lower than that for funded tools.

The need of additional financial resources was the main incentive that drove credit risk transfer, reducing most short-lived funding channels. Evidence shows that these financial resources were used to expand banks' lending in good times but also in recessions.

Cyree Huang and Lindley (2011) believe that derivatives did not contribute to any loss of value during the subprime crisis. They divide their study in two periods in a high growth (2003-2005) and low growth (2007-2009) period but they do not find a "deep-seated" effect of derivatives use on bank values in both periods meaning that derivative activities for risk management and customers are restricted. Even in the financial institutions that are more prone to taking risk shifting opportunities such as the large and poorly capitalized banks there is no evidence that derivatives cause an increase in the speculating behaviour of these institutions.

On the other hand, Nijskens and Wagner (2010) main finding is that banks which use credit risk transfer activities are considered riskier by the market. Beta is increased by 0.06 on banks that trade CDS. The increase in beta comes from a higher correlation between banks which means that while banks look less risky on an individual basis due to volatility decline, they pose more risk in the whole financial sector due to the correlation and beta increase. They argue that institutions need to be regulated according to their contribution to systemic risk as well as according to their idiosyncratic risk. What is more, they detect the market awareness for the risk that those banks were posing as the beta increase was there before the beginning of the crisis.

3.3 Evidence on the European Market

Michalak and Uhde (May 2012) propose that credit risk securitization affects negatively European stock listed banks' financial soundness. These results hold even when they control for reverse causality by substituting banks' z-score with market based indicators of bank's risk. Moreover, securitization has a negative effect on capital environment and banks' profitability but a positive effect on banks' volatility. Furthermore, they claim the existence of a direct and indirect effect between securitization and bank's health. The direct effect stems from the fact that European banks engage in securitization activities in order to use them as a source of regulatory capital arbitrage keeping the vast part of their credit risk exposures in the first-loss position. The indirect effect can be seen when banks after selling the securities use the liquid capital of these transactions as a funding source to invest in new riskier assets. Due to the aforementioned results they believe that the enhancement of the new Basel III framework with stricter leverage, liquidity and capital requirements is a step in the right direction. Improving the minimum capital requirements that involve securitization exposures will be beneficial knowing that securitization increases bank risk. Bedendo and Bruno (2012) disagree as they believe that the new requirements may downsize the credit risk transfer activities, meaning tighter credit supply in the economy.

In an earlier study (Uhde, Michalak, 2010) which focuses again in the European banking particularly in EU-15 and Switzerland it is concluded that credit risk securitization is positively related to banks systemic risk. They also find that the increase on market risk is more consistent for large banks that make a frequent use of these securities. However, securitization is more relevant for small and medium sized banks. Another important finding of Uhde and Michalak is that the risk-transfer effect resulting from securitization is related to the transaction volume, the transaction types, the reference portfolio, the size of the banks and the regulatory framework. This effect is also more noticeable when the ex-ante market risk is low.

Franke and Krahen (2005) having analyzed the impact of CDO transactions on the default risk exposures, systematic risk and stock prices of the banks draw the conclusions that the banking system is not efficiently hedged against macro shocks since banks usually retain the non-securitized senior portion in synthetic deals. Banks should sell these senior positions to remote investors to improve financial stability. Franke and Krahen's result is in conformity with the previous European studies considering the increase in bank's betas on the announcement of a CDO issue. On the other hand, the stock price effect remains insignificant.

Yet, Uhde and Michalak claim the need of further investigation on the impact of securitization on market risk. In chapter 5, this issue will be addressed.

3.4 Concluding remarks

Chapter three served as a brief summary of the existing literature on the topics of derivatives, risk management, financial crisis and how they are related. It is visible that there are opposing views concerning the role that derivatives play in the risk management arena. Still, this field of research is young and there is room for further analysis. The chapters that follow will research the impact of derivative instruments on idiosyncratic and systemic risk.

4. Data and Methodology: The impact of derivatives on firm specific risk.

The focus of chapter 4 will be on the methodology that is used to examine the effects of derivatives use on banks idiosyncratic risk. Section one will focus on the description and gathering process of data. Section two analyzes the empirical model and summarizes the main steps that were taken to obtain the results.

4.1 Data and Sources

This empirical analysis focuses on the impact of derivatives use on both idiosyncratic and systemic risk. In this part only the effects on idiosyncratic risk will be discussed. The target is the European banking system. Therefore, all the commercial and investment banks of the EU-15 and Switzerland are investigated. Banks consolidated data are taken into account only. The initial sample comprises of 2258 European banks. The time period of our interest is from 1998, the year when banks were required to report their CDS exposure, till the most recent data which is 2012. In such manner, the pre-crisis period and crisis period are captured. The Bank scope database provided by Bureau van Dijk provides the entire bank's consolidated financial data. Beside Bank scope, DataStream database provided by Thomson Reuters has been used for the stock prices and returns. Once having the initial sample of 2258 banks, we choose those banks that have at least seven years of data on derivatives size. The final sample constitutes of 84 commercial and investment banks. Table A.1 provides a list of the final sample of the banks being used, their geographical distribution and specialisation. Table A.2 explains lists the variables that have been used, how they are constructed and mention the data source.

4.1.1 Firm Specific Risk

Bank's stock price idiosyncratic volatility, is adopted as a proxy for idiosyncratic bank risk. This is the dependent variable of the main regression. The idiosyncratic volatility is calculated as follows:

$$\text{Idiosyncratic Volatility} = St.Dev\,[R_i\text{-}R_f\text{-}\beta_i * (R_M - R_f)]$$

$$= St.Dev\,\left[\frac{P_{t,i} - P_{t-1,i}}{P_{t,i}} - R_f - \beta_i * (R_M - R_f)\right]$$

It is the standard deviation of the returns in excess of the CAPM. Once the daily stock price data is obtained from DataStream for the entire sample, the risk free rates for the countries that banks are located in are gathered. The countries participants in Euro zone have all the same risk free rate which is the Euribor 3-month rate (EIBOR3M). UK's risk free rate is equivalent to the yield of the 3-month UK T-bills (TRUK3MT) whereas the benchmark for Switzerland's risk free rate is the Swiss Liquid Financing rate (SWLOMBD). Bank's betas can be obtained through DataStream as well. Finally, the benchmark used for the market returns is the FTSE Euro First 300 Index, which will be discussed in more detail in chapter 6.

4.1.2 Variables of Interest

The main variable of interest is the size of the derivative transactions that banks engage in a certain year from out selected time period. Due to data restrictions it was not possible to distinguish between different types of derivatives. Therefore, the analysis will focus on the overall derivatives used by banks including CDSs and CDOs. There were two main groups of derivatives, those listed in the balance sheet as assets and those listed as derivatives.

In the regressions conducted, instead of using the actual values of derivatives it is decided to use the natural logarithm of derivatives. The reason of doing so is to simplify the model. The natural logarithm simplifies the number and the complexity of interaction terms.[7] What is more, by using the logarithm the model fit is improved, as it alters the scale and brings the variables closer to normal distribution. A third and final reason of implementation is for convenience. The "log" function is interpreted as a percentage change in the statistical table results.

Apart from the overall effect of derivatives, of great importance is to observe the effect of derivatives in the crisis years. The variable "derivatives_2" is constructed by multiplying the variable "ln_derivatives" with a time dummy which takes the value 1 for the years 2007-2012.

4.1.3 Control Variables

[7] http://stats.stackexchange.com/questions/298/in-linear-regression-when-is-it-appropriate-to-use-the-log-of-an-independent-va

In order to investigate the relationship between derivatives and idiosyncratic risk it is crucial to control for other factors that might affect firm specific risk, derivatives use or both and therefore reduce any omitted variable biases. Mainly bank specific variables and ratios are used as control variables (Table A.2). Most control variables in previous research have shown to affect market valuations and have an effect on bank's decisions to use derivatives (Cyree, Huang, Lindley (2011) and Michalak, Uhde (2012)).

4.2 Empirical Model

To study the relationship between bank's returns volatility and derivatives the following model of panel[8] data is estimated:

$$y_{it} = a_i + \beta D_{it} + \gamma d_i D_{it} + \delta' x_{it}' + \varepsilon_{it}$$

It is a multivariate analysis where y_{it}, the dependent variable, is the idiosyncratic volatility, D_{it} is the size of the derivative transactions of each bank expressed by the natural logarithm and x_{it}' is a vector of the control variables: ROA, ROE, CAPRATIO, Interbank ratio, Liquid Assets Ratio, Asset growth, Loan to Customer Deposits ratio and Tier 1 Regulatory Capital Ratio. d_i is the dummy variable that takes value of 1 for the years 2007-2012 and value 0 for the rest. The parameters that will be estimated are a_i, β, γ, δ . Last, ε_{it} denotes the error term.

At first, the regressions for the three models: pooled OLS, fixed effects (FE) and random effects (RE) are run. Table A.6 gives an overview of all the estimators that were used in the first steps of the analysis. Upon finishing the regressions, a modified Wald test for group wise heteroskedasticity in fixed effect regression models is conducted. The results of the test suggest that the null (homoskedasticity) is rejected. To control for heteroskedasticity it is advisable to use the option robust in both fixed effects and random effects. The appropriateness of the random effects model can be checked by running the Breusch-Pagan Lagrange Multiplier test. The results of the likelihood ratio test suggest that the random effect is appropriate as the null hypothesis is not rejected. There is evidence of significant differences across countries; therefore, one cannot run a simple OLS regression. Furthermore, a Hausman test is run to choose between random and fixed effects. The results of the Hausman test show that the fixed effects are appropriate as the null

[8] It is a short panel data since there are only 15 time observations and 74 units (commercial and investment banks) see: Cameron and Trivedi, 2009, 8.2.1

hypothesis (random effect) is rejected. Since the simple Hausman test is not applicable to the robust standard error option, it is substituted by the Robust Hausman test. However, both tests show the same results: the model of fixed effects is appropriate to use as the null hypothesis suggesting that the individual effects are random is rejected.

5. Empirical Results: The impact of derivatives on firm specific risk.

In this chapter the main findings of this analysis will be analysed. At first, the main findings of the baseline regression will be discussed. Secondly, the results from the Instrumental Variable approach will be examined. Next, the outcome of the robustness checks will be presented. Last part concludes.

5.1. Main Findings from the Volatility Regressions

Table (A.4) shows that the use of derivatives has a significantly (0.1%) positive impact on firms volatility in specification 1. When "derivatives_2" is included, that accounts for the years of the crisis 2007 till 2012, the effect of derivatives on idiosyncratic volatility remains positive and significant at a 99% confidence interval, whereas "derivatives_2" enters the regression significantly (0.01%) positively (specification2). In the last specification, when the control variables enter the regression, the effects of both "ln_derivatives" and "derivatives_2" remain the same: positive but only 5% significance for the "ln_derivatives" variable and positive but significant in a 0.1% significance level for the variable "derivatives_2". The fact that the estimators of the regression do not change when new variables are added implies that the results are robust. There is a positive and statistically significant effect of derivatives use on idiosyncratic risk. However during the second period the results gain significance implying that during the crisis years the effect was more dominant. These results contradict the view of Cyree, Huang and Lindley (2011) that do not find any systematic effect on bank values from the use of derivatives in both periods: before and during the crisis years.

So far statistical significance has been discussed. However if an estimator is statistically significant that does not automatically imply an economic significance. To check for economic significance one should multiply the marginal effect by the standard deviation of the variable of interest (ln_derivatives and derivatives_2). One standard deviation change in (3.079) in ln_derivatives leads to (3.079*0.0033 = 0.0102) 1.02 % change in volatility of returns. During the crisis period a one standard deviation in derivatives size (derivatives_2) (7.761) lead to (7.761*0.0006=0.0046) 0.5% change in the volatility of returns. The effect is rather small, only 1.02% and 0.5%, so it is concluded that the effects of derivatives use on bank's idiosyncratic risk is not economically significant.

Among the bank- specific control measures, the Returns on Assets (ROA) enter the regression significantly negatively (1% significance level specification 3 and 5% significance level, specification 4).The results are in line with theory: higher ROA signifies safer banks (lower volatility). The control variables Capital Ratio (CAPRATIO) and Return on Equity (ROE) do not enter the regression with any statistical significance. However the sign of the estimators are in accordance with what theory suggests. Asset liquidity has a significant, on a 99% confidence interval, negative effect on volatility in specification 4. Specifically, banks with higher liquidity ratios have lower volatilities of their stock returns. At last, one would expect a significant impact of Tier 1 Regulatory Capital Ratio on bank volatility, as it measures the ability of banks to endure future loses, making it a core measure of a bank's financial strength according to Michalak and Uhde (2012). As it can be seen from the regressions in both specifications 3 and 4, Tier1 estimator is significant in a 99.9% and 95% confidence interval respectively.

Last but not least, the regression results provide three R-squared measures. R-squared is a measure of goodness of fit. In other words it shows the percentage of total variation that is explained by the model. The within R-squared is higher than the between and overall R-squared, as the within estimator best explains the within variation (fixed effects model). The within R-squared is 0.3524 and shows that 35.24% of the variation is explained by the model. This R-squared results show that it is likely to predict the outcomes according to the generated plot.

5.2 Robustness check

In order to check the robustness of the results in the previous section, the vce (cluster) option is added to the fixed effect regressions. Table A.5 summarizes the results. The overall result remains the same even when the robust command is added. The statistical significance and standard errors of the variables of interest remain the same. However there are some minor changes in the control variables. Tier 1 loses statistical significance (1% compared to 0.1%) when the cluster robust option is used. Furthermore, the robust standard errors are higher than the simple standard errors overall. Finally, the R-squared values remain the same as in section 5.1. The results of table A.5 reconfirm the results of the previous section implying the robustness of the initial results.

5.3. Endogeneity – Reverse Causality

The results from the regression (FE) above can be biased due to likely reverse causality. The direction of causality between bank's volatility and derivatives is not clear. It may be that derivatives affect bank's volatility but it might also be that banks with higher volatility use derivatives to lower their volatility. The issue of reverse causality is addressed by introducing the Two Stage Least Squares Instrumental Variable (2SLS IV) technique with fixed effects and a robust clustering on the bank level. There are two Instrumental Variables to be used, the first is loan size and the second is the loan size to total assets ratio. Banks use derivatives to hedge their risk. One would expect that banks with higher loans will make larger use of derivatives. Loan size is calculated as the one year lag of the natural logarithm of the bank net loans (Michalak, Uhde, 2012). The second Instrumental Variable, the ratio of loan size to total assets is used to control for size. The results of the IV regressions are given in tables A.7 and A.9.

5.3.1 Instrumental Variable – Loan Size

The results suggest that the main regressions may not be biased by reverse causality. Comparing Table A.5 with Table A.7 findings, the sign, size and significance of "ln_derivatives" variable in specification 1 and "derivatives_2" variable in specification 2 have not changed. The Liquid Assets ratio enters the regression with a statistical significance of 5% (specification1 and 2). Tier 1 is degree of significance has not changes in the 1st specification but has gained significance in the 2nd specification (1% level). The rest of the control variables remain the same. Regarding the quality of the instrumental variable chosen, loan size (lnloans) may be correlated with bank's volatility. Therefore a table with correlations between volatility, loan size and derivatives is given in appendix (Table A.8). It is shown that asset size is both correlated with volatility and derivative use and the results are significant. However the correlation with derivatives is much higher than with volatility of bank's returns. Furthermore, the exclusion of the instrumental variable will not generate any further endogeneity problems as the coefficients of the derivatives variables do not change.

5.3.2 Instrumental Variable – Loan to total asset ratio

The reason of using loan to total asset ratio as mentioned above is to remove the size effect and therefore have a more efficient instrumental variable. The results are given in table A.9. These findings again suggest that the main regressions are not biased by reverse causality in the first specification. The variables of interest remain the same after the inclusion of loan-to-total asset ratio as an instrumental variable. As it is shown from table A.10 the correlation between volatility and loan to asset ratio is not significant, but the correlation between derivatives and loan to asset ratio is significant in a 95% confidence interval. This suggests that the loan to asset ratio is a better instrumental variable than loan size. Once more it is shown that the exclusion of the instrumental variable does not generate any further endogeneity problems as the coefficients of derivatives variables are same with those of the initial regressions.

5.4 Concluding Remarks

The main conclusion of this first part of the analysis is that there is evidence of statistically significant effects of derivatives use by banks in their firm specific risk, but there is no evidence of economically significant effects. The degree that idiosyncratic volatility is affected by bank's derivatives use is very small. The results are robust and it is unlikely that there are issues related to endogeneity in the analysis above.

6. Data and Methodology: The impact of derivatives on systemic risk.

Chapters 4 and 5 studied the relationship between derivatives use and idiosyncratic risk. In the following two chapters the focus is switched to systemic risk. In chapter 6 the methodology that is used to examine the effects of derivatives use on the risk of the financial system, is set up. Section one's focus is on the data description and gathering process. Section two describes the empirical model that is used and which steps were taken to obtain the results that will be discussed in chapter 7.

6.1 Data and Sources

In this section the same banks that were used in the previous chapters are used. That is, 84 commercial and investment banks from the 15 countries part of the European Union and Switzerland. The time period of interest remains the same, from 1998 to 2012. Banks consolidated financial data are offered from the Bank Scope database. Macroeconomic data is gathered from the World Bank database, World Development Indicators. The third source of data comes from the DataStream database. The dependent variable in this second part which is bank's beta is obtained from this database. Market value of bank equities and data on the FTS Euro First 300 Index are available in DataStream as well. A more analytical explanation of the variables list that is used and data sources can be found under Appendix, Table B.1.

6.1.1 Systemic Risk

Bank's historic beta is the dependent variable of this analysis as it is used as a measure of systemic risk. Data on bank's historic beta are obtained from DataStream. Bank's beta describes the correlated volatility of the bank in relation to the benchmark's volatility. This benchmark is the overall financial market. Beta measures systemic risk based on how returns co-move with the market. In other words, it indicates the expected percentage change in the bank's securities excess returns for a 1% change in the market's excess return[9].

6.1.2 Variables of Interest

[9] Berk, DeMarzo, Corporate Finance, Global Edition, 2nd Edition

The variables of interest are same as the ones in Part 1 of the analysis. Construction of derivatives size is same as in part 4.1.2. In this second part apart from the overall effect, there is interest to study the effects of derivatives before and during the crisis. In this way, the total period of 15 years is grouped in two other periods, as it is done in chapter 4.

6.1.3 Control Variables

When studying the effect of derivatives used from banks in the systemic risk it is important to control for other factors that might affect systemic risk and therefore reduce any omitted variable biases. The control variables used can be divided in two big groups: bank specific and macroeconomic (Table B.1). The reason of choosing these variables is because they have proven to affect bank's decision's to use derivatives firstly and they also have an impact on systemic risk.

Bank specific control variables used are Tier 1 Regulatory Capital Ratio, Market-to Book Ratio, Bank's size and Liquidity Ratio. The macroeconomic control variables used are GDP growth rate, inflation rate and interest rate. Apart from these variables it is chosen to use the returns of FTSEurofirst 300 Index as another control variable. The main reason of choosing this index is because it measures the performance of European portfolios. More precisely it measures the performance of Europe's largest 300 companies, by market capitalisation, and it covers 70% of Europe's market capitalization.

6.2 Empirical Model

The approach used o study the relationship between bank's historic beta as a proxy of systemic risk and derivatives is similar to the one used in the previous part. A multivariate analysis will be conducted and the model that needs to be estimated is given below:

$$y_{it} = a_i + \beta D_{it} + \gamma d_i D_{it} + \delta' x_{it}^{'} + \varepsilon_{it}$$

In this panel data, y_{it} the dependent variable is the bank's historic beta, D_{it} is the size of the derivative transactions of each bank expressed by the natural logarithm, as in part 1, and $x_{it}^{'}$ is a vector of the control variables. d_i is the dummy variable that takes value of 1 for the years 2007-2012 and value 0 for the rest. The parameters that will be estimated are $a_i,\ \beta,\ \gamma,\ \delta$. The error term is denoted by ε_{it} .

The procedure is the same as in part 1. In the beginning there are three models to be estimated: pooled OLS, fixed effects (FE) and random effects (RE). The modified Wald test for group wise heteroskedasticity in fixed effect regression rejects the null hypothesis (homoskedasticity). This indicated the need to use robust errors instead of the simple standard errors that the statistical package STATA provides. In order to choose between the three models it is required to run a simple Hausman test and then the Robust Hausman test. Both tests suggest that random effects need to be used as the null hypothesis that says random effects are efficient cannot be rejected. According to Cameron and Trivedi (259) both random effects and pooled OLS can be used. When regressing these models though one can see that by using the pooled OLS model the standard errors are a lot smaller which implies an efficiency of this model. Therefore, in part two it is decided to use a pooled OLS model.

7. Empirical Results: The impact of derivatives on firm specific risk.

This chapter analyses the main findings from the regressions. Section 1 discusses the results of the main regression. Section 2 checks whether the results of the baseline regressions are robust and section 3 reviews the outcome of the Instrumental Variable regressions. The main conclusions of this chapter are summarized in section 4.

7.1. Main Findings from the Beta Regressions.

Table B.3 summarizes the regression results. As mentioned in part 6.2 a pooled OLS regression is run. It is shown from the table that there is a significant effect of derivatives use on historic beta (specification 1, 3 and 4). However, in specification 4 the degree of significance has declined and it is only 10%. This happens because in specification 4 the variable "derivatives_2" is introduced which takes away the significance from the variable "ln_derivatives". The high statistical significant effect of "derivatives_2" on the proxy of systemic risk, historic beta (specification 2, 4 and 5), shows that the effect is higher in the crisis period. The fact that the estimates remain significant in all specifications, especially the estimator of "derivatives2" suggests that the results are robust. These findings are in line with other findings which argue that securitization has a positive impact on systemic risk (Uhde, Michalak, 2010) and that credit risk transfer affects negatively systemic risk.

A one standard deviation change in "ln_derivatives" leads to a (3.079*0.0295 =0.0908) 9.08% change in bank's beta. The effect is a lot higher in bank's beta than in volatility. Thus, the results are also economically significant apart from statistically significant. During the 2007-2012 period, a one standard deviation in derivatives size (7.761) leads to a (7.761*0.0308=0.239) 23.9% change in bank's beta. The effect is even higher during the crisis period. A 23.9% change due to derivatives is not considered a neglible effect. Therefore, there is again economic significance in these results.

Out of the macroeconomic control variables inflation and interest rate have a statistically significant effect on systemic risk. Inflation enters the regression statistically negatively on a 99.9% confidence interval. Interest rate, on the other hand affects significantly positively (1% level) the beta of the banks. When interest rate increases, beta increases and consequently risk increases. The other control variables in specification 4 do not enter the regression significantly however they have the expected signs. Two more variables, size and liquidity enter the regression (specification 5) and the estimates do not change. This suggests again that the results are robust. Surprising is the fact that there is no statistical significance in the Tier 1 Regulatory Capital Ratio and that the sign is negative which contradicts the theory. However, the estimated coefficient is small and almost zero (only 0.0072). The R-squared is 0.2307 and shows that only 23.07% of the variation is explained by the model.

7.2 Robustness check

The vce (cluster) option is added in the OLS regressions to check whether the results are robust. Table B.4 summarizes the results. The coefficients of the main variables of interest remain the same. However, in specification 3 when adding the robust option the effect of derivatives on banks beta becomes statistically significant. On the other hand, the variable "derivatives_2" loses its significance with the inclusion of the vce (cluster) option. Still, the overall effect remains the same which brings us to the conclusion that the results of the baseline regression are robust.

7.3. Endogeneity – Reverse Causality

To address the issue of endogeneity the same instrumental variables as in chapter 4 are used. That is loan size which is constructed as one year lag of the natural logarithm of the bank net loans and loan to total asset ratio to control for the size effect.

7.3.1 Instrumental Variable – Loan Size

Banks use derivatives to hedge their risk. As argued in chapter 4, one would expect that banks with higher loans will make larger use of derivatives. On the other hand, there is no direct effect between loan size and beta of a bank. The results of the IV regressions are given in table B.6.

The variables of interest have not changed significantly. "ln_derivatives" and "derivatives_2" are still positive and significant. The overall effect of derivatives has gained significance (95% compared to 90%) when the instrumental variable has been introduced. On the other hand the impact of derivatives in the second period has lost its significance; it is significant on a 1% level compared to 0.1% level in the baseline regression. Sign and significance of other control variables have not changed.

The correlation matrix (Table B.7) is given to check the quality of the instrumental variable. From the table (B.7) one can see that there is a significant correlation (5% level) between the loan size and beta. Yet, the correlation of loan size and derivatives is a lot higher than with historic beta. Next, to find whether the exclusion of the instrumental variable might generate further endogeneity problems, one can run a Hausman test. This test compares the two scenarios: Pooled OLS and 2SLS-IV. The null hypothesis which states efficiency and consistency of the OLS estimates, cannot be rejected (Prob>chi2 = 0.7155). It can be concluded from the results of the Hausman test that the Instrumental variable can be excluded.

7.3.2 Instrumental Variable – Loan Size to Total Asset Ratio

The results of the regressions are given in table B.8. The inclusion of the instrumental variable results in statistically significant estimates for both variables “ln_derivatives” and “derivatives_2” on a 5% and 1% level respectively in the second specification. The correlation matrix table shows that the correlation between beta and loan to asset ratio is significant in a 5% level. However, the correlation between the loan to asset ratio and derivatives is higher. To check the quality of the instrumental variable a Hausman test is conducted again as in section 7.3.1. The null hypothesis, cannot be rejected (Prob>chi2 = 0.9388) and suggests that the instrumental variable can be excluded without posing any endogeneity problems. However, the fact that the correlation between bank’s beta and loan to total asset ratio is significant might also suggest that the loan to total assets ratio is a weak instrumental variable.

7.4 Concluding Remarks

The second part of this research tried to evaluate the effect of derivatives use by banks in the systemic risk. The main conclusion advocates the view of previous research that there is an impact in systemic risk stemming from the use of derivatives. The overall results remain robust not only with the inclusion of other control variables, but also when the vce (cluster) command substitutes the simple standard errors. Finally, endogeneity checks showed that it is unlikely to have a reverse causality issue. Nonetheless, the fact that there is a significant correlation between the instrumental variable and the dependent variable raises questions that the quality of the instrumental variable might be weak.

8. Conclusion

Using a sample of 85 commercial and investment banks from EU-15 and Switzerland over the period 1998 to 2012, this research provides empirical evidence that derivatives and in particular credit derivatives that banks use have a positive impact in both idiosyncratic bank's risk and systemic risk. The empirical findings, on the one hand, contradict the views of Cyree Huang and Lyndley (2011) that there is no impact of derivatives on idiosyncratic risk. On the other hand, they support the findings of Nijskens and Wagner (2011) that derivatives use by banks results in an increase of systemic risk.

The impact of derivatives use on idiosyncratic risk is not economically significant whereas their impact on systemic risk is. Furthermore, the impact on systemic risk is more significant, statistically and economically, during the period 2007-2012. The same holds for the impact on idiosyncratic bank's risk. It is higher during the crisis years.

The results of the baseline regressions are robust and they hold for both parts of the analysis, even when the issue of reverse causality is addressed by employing the instrumental variable techniques.

One of the limitations of this paper is the sample size. One could argue that 85 banks are not representative of the whole European financial system. Due to data restrictions, this was the maximum amount of information to be gathered. Furthermore, the choice of instrumental variables, especially in the second part of the analysis may not be the best choice. The fact that the Loan-to-Asset Ratio is significantly correlated with beta raises doubts about the strength of this instrumental variable (IV). However, it is difficult to find a proper IV that will be correlated with derivatives but not with risk (volatility of returns and beta). The choice of a bigger sample bank size and a better instrumental variable, to satisfy the required conditions is left to future research.

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APPENDIX:

Table A.1: List of sample banks; geographical distribution and specialisation.

Country	Name	Specialisation
AUSTRIA	Raiffeisen Bank International AG	Commercial Banks
	Erste Group Bank	Bank Holding & Holding Companies
BELGIUM	Dexia	Bank Holding & Holding Companies
	KBC Groep NV	Bank Holding & Holding Companies
DENMARK	Nordea Group Danmark	Commercial Banks
	Danske Bank A/S	Commercial Banks
FINLAND	Pohjola Bank Plc	Commercial Banks
FRANCE	Credit Industriel et Commercial	Commercial Banks
	Credit Agricole Corporate and Investment Bank	Commercial Banks
	BNP Paribas	Commercial Banks
	HSBC France	Commercial Banks
	Credit du Nord	Commercial Banks
	Le Credit Lyonnais	Commercial Banks
	Société Générale	Commercial Banks
	Natixis	Commercial Banks
GERMANY	SEB AG	Commercial Banks
	Commerzbank AG	Commercial Banks
	Deutsche Bank AG	Commercial Banks
	Aareal Bank AG	Commercial Banks
	IKB Deutsche Industriebank AG	Investment Banks
	Deutsche Postbank AG	Commercial Banks
	Dresdner Bank	Commercial Banks
GREECE	Emporiki Bank of Greece	Commercial Banks
	Pireaus Bank	Commercial Banks
	Eurobank Ergasias	Commercial Banks
	Attica Bank SA	Commercial Banks
	T Bank S.A.	Commercial Banks
	Alpha Bank A.E	Commercial Banks
	National Bank of Greece S.A.	Commercial Banks
	Agricultural Bank of Greece	Commercial Banks
	General Bank of Greece SA	Commercial Banks
	Marfin Egnatia Bank SA	Commercial Banks
IRELAND	DePfa ACS Bank	Investment & Trust Corporations
	Allied Irish Banks plc	Commercial Banks
	Irish Bank Resolution Corporation Limited-IBRC	Commercial Banks
	Bank of Ireland	Commercial Banks
	Permanent TSB Plc	Commercial Banks
ITALY	Unione di Banche Italiane Scpa-UBI Banca	Commercial Banks
	Banca Popolare di Spoleto SpA	Commercial Banks
	Credito Bergamasco	Commercial Banks
	Banco di Sardegna SpA	Commercial Banks
	Allianz Bank Financial Advisors S.p.A	Commercial Banks
	Banca Popolare di Milano SCaRL	Commercial Banks
	Banca Carige SpA	Commercial Banks
	Mediobanca SpA	Commercial Banks
	Credito Emiliano SpA-CREDEM	Commercial Banks

	Banca Profilo SpA	Commercial Banks
	Banca Intermobiliare di Investimenti e Gestioni	Commercial Banks
	Intesa Sanpaolo	Commercial Banks
	Banca Mediolanum SpA	Commercial Banks
	UniCredit SpA	Commercial Banks
	FinecoBank Banca FinEco SpA-Banca FinEco SpA	Commercial Banks
	Credito Artigiano	Commercial Banks
	Banque Internationale à Luxembourg SA	Commercial Banks
LUXEMBOURG	ING Groep NV	Bank Holding & Holding Companies
NETHERLANDS	RBS Holdings NV	Bank Holding & Holding Companies
	SNS Reaal NV	Bank Holding & Holding Companies
	Storebrand Bank ASA	Commercial Banks
NORWAY	Banco Espirito Santo SA	Commercial Banks
PORTUGAL	Baco Commercial Portuges, SA Milenium	Commercial Banks
	Banco BPI SA	Bank Holding & Holding Companies
	Banco Bilbao Vizcaya Argentaria SA	Commercial Banks
SAPIN	Bankinter SA	Commercial Banks
	Banco Pastor SA	Commercial Banks
	Banco Popular Espagnol SA	Commercial Banks
	Banco Guipuzcoano SA	Commercial Banks
	Banco de Sabadell SA	Commercial Banks
	Banco de Valencia SA	Commercial Banks
	Banco Santander SA	Commercial Banks
	Swenska Handelsbanken	Commercial Banks
SWEEDEN	Swedbank AB	Savings Bank
	EFG International	Commercial Banks
SWITZERLAND	Credit Suisse Group AG	Bank Holding & Holding Companies
	UBS AG	Commercial Banks
	Investec Plc	Investment Banks
UNITED	Hitach Capital (UK) Plc	Investment Banks
KINGDOM	Barclays Plc	Bank Holding & Holding Companies
	National Westminster Bank Plc-NATWEST	Commercial Banks
	Royal Bank of Scotland Plc	Commercial Banks
	Close Brothers Group Plc	Investment Banks
	Lloyds Banking Group Plc	Bank Holding & Holding Companies
	Northern Rock (Asset Management) Plc	Real Estate & Mortgage Bank
	Standard Chartered Bank	Commercial Banks
	Bradford & Bingley Plc	Commercial Banks

Table A.2: List of variables and data sources

Variable	Description	Data Source
Volatility	Idiosyncratic Volatility. Measure of a financial Institution's risk	Datastream,Author's calc
Derivatives Assets	The book value of Bank's asset derivatives	Bankscope
Derivatives Liabilities	The book value of Bank's liability derivatives	Bankscope
Derivative Size	The natural logarithm of the sum of asset derivatives and liability derivatives (Ln_derivatives)	Bankscope,Author's calc
Derivatives_2	Size of derivative transactions during the time period 2007-2012	Bankscope,Author's calc
tdum	Time dummy. It takes the value 1 for years 2007-2012 and 0 for the rest.	
ROA	Ratio of Net Income on Total Assets	Bankscope
ROE	Ratio of Net Income on Total Equity	Bankscope
Interbank Ratio	Ratio of money lent to other banks divided by money borrowed from other banks.	Bankscope
Loan-to-Deposit Ratio	Loans to customer Deposits	Bankscope
Tier 1	Ratio of accounting value of bank's Tier 1 Capital to risk weighted assets	Bankscope
CAPRATIO	Ratio of Total Equity to Total Assets	Bankscope,Author's calc.
Loan size	1 year lag of ln loans.	Bankscope,Author's calc.
Loans-to- Assets Ratio	Ratio of Net loans to Total Assets	Bankscope,Author's calc.
Asset Growth	Growth Rate. Calculated as: total assets(t)-total assets(t-1)/total assets (t-1)	Bankscope,Author's calc.
Liquid Assets	Accounting Value of bank's liquid assets. (1-net loans/total assets)	Bankscope,Author's calc.

Table A.3: Summary statistics

Variable	Mean	Standard Deviation	p50	Min	Max	N
Volatility	0.0233	0.0167	0.0191	1.3e-05	0.1072	627
Derivatives Assets	4.1e+07	1.1e+08	1.6e+06	0	9.8e+08	646
Derivatives Liabilities	4.1e+07	1.1e+08	1.6e+06	0	9.7e+08	646
Derivatives	8.3e+07	2.1e+08	3.3e+06	0	2.0e+09	646
Derivatives (ln)	15.18	3.079	15.04	6.908	21.39	633
Derivatives2	9.84	7.761	12.91	0	21.39	633
ROA	0.0017	0.02	0.0046	-0.2445	0.0308	643
ROE	0.0724	1.76	0.0973	-16.82	36.38	643
CAPRATIO	0.0505	0.0274	0.0452	-0.0545	0.1857	646
Interbank Ratio	1.001	1.187	0.66	0.0285	9.306	622
Loan-to-customer Deposits	151.5	85.81	135.4	5.1	858.9	621
Liquid Assets	0.4509	0.1963	0.4011	0.0959	0.9696	646
Asset Growth	0.0947	0.6099	-0.0058	-0.8251	7.063	563

Table A.4: Volatility and Derivatives (baseline regressions, Fixed Effects)

	(1) Volatility b/se	(2)Volatility b/se	(3)Volatility b/se	(4)Volatility b/se
Ln_Derivatives	0.0083*** (0.001)	0.0029** (0.001)	0.0077*** (0.001)	0.0033* (0.001)
Derivatives_2		0.0008*** (0.000)		0.0006*** (0.000)
ROA			-0.1538** (0.056)	-0.1327* (0.054)
ROE			-0.0007 (0.001)	-0.0003 (0.001)
CAPRATIO			-0.1065 (0.069)	-0.0824 (0.066)
Interbank Ratio			0.0001 (0.001)	-0.0003 (0.001)
Liquid assets			-0.0452*** (0.011)	-0.0327** (0.011)
Asset Growth			0.0003 (0.001)	0.0001 (0.001)
Loan-to- Deposit Ratio			0.0001*** (0.000)	0.0000** (0.000)
Tier1			0.1166 ** (0.031)	0.0420 (0.031)
_cons	-0.1034*** (0.012)	-0.0288 (0.015)	-0.0869*** (0.019)	-0.0236 (0.021)
Within R2	**0.1643**	**0.2629**	**0.2997**	**0.3524**
df_r	**531.0000**	**530.0000**	**375.0000**	**374.0000**
bic	**-3592.1823**	**-3662.8343**	**-2758.7790**	**-2788.9123**

The panel model estimated is: *Idiosyncratic volatility = α + β1*ln_Deriavtives+β2*Derivatives_2 + β3*ROA+β4*ROE+β5*CAPRATIO+β6*Interbank Ratio + β7*Liquid Assets + β8*Asset Growth + β9*Loan-to-Deposit Ratio + β10*Tier1 + ε*. Standard errors are in parenthesis.

* Statistically Significant at the 5% level

** Statistically significant at the 1% level

*** Statistically significant at the 0.1% level

Table A.5: Volatility and Derivatives (main regressions, Fixed Effects, robust standard errors)

	Volatility b/se	Volatility b/se	Volatility b/se	Volatility b/se
Ln_Derivatives	0.0083***	0.0029*	0.0077***	0.0033*
	(0.001)	(0.001)	(0.001)	(0.002)
Derivatives2		0.0008***		0.0006***
		(0.000)		(0.000)
ROA			-0.1538*	-0.1327
			(0.070)	(0.074)
ROE			-0.0007	-0.0003
			(0.001)	(0.001)
CAPRATIO			-0.1065	-0.0824
			(0.071)	(0.072)
Interbank Ratio			0.0001	-0.0003
			(0.001)	(0.001)
Liquid assets			-0.0452**	-0.0327*
			(0.013)	(0.013)
Asset Growth			0.0009	0.0005
			(0.001)	(0.001)
Loan-to-Deposit Ratio			0.0001**	0.0000**
			(0.000)	(0.000)
Tier 1			0.0835**	0.0709*
			(0.031)	(0.031)
_cons	-0.1034***	-0.0288	-0.0797***	-0.0266
	(0.016)	(0.016)	(0.020)	(0.024)
Within R2	**0.1643**	**0.2629**	**0.2997**	**0.3248**
df_r	**81.0000**	**81.0000**	**78.0000**	**78.0000**
bic	**-3598.6023**	**-3669.2543**	**-2764.9167**	**-2789.5421**

The panel model estimated is: *Idiosyncratic volatility = α + β1*ln_Deriavtives+β2*Derivatives_2 + β3*ROA+β4*ROE+β5*CAPRATIO+β6*Interbank Ratio + β7*Liquid Assets + β8*Asset Growth + β9*Loan-to-Deposit Ratio + β10*Tier1 + ε*. Clustered Robust Standard errors are in parenthesis.

* Statistically Significant at the 5% level
** Statistically significant at the 1% level
*** Statistically significant at the 0.1% level

Table A.6: Overview of all estimators.

Variable	OLS_rob	FE	FE_rob	RE	RE_rob
lnDerivatives	-0.0000	0.0029	0.0029	0.0001	0.0001
	(0.0003)	(0.0010)	(0.0011)	(0.0003)	(0.0003)
Derivatives2	0.0009	0.0008	0.0008	0.0009	0.0009
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
_constant	0.0134	-0.0288	-0.0288	0.0118	0.0118
	(0.0042)	(0.0158)	(0.0158)	(0.0049)	(0.0046)
N	**614**	**614**	**614**	**614**	**614**
R2	**0.1877**	**0.2626**	**0.2629**		
R2_overall		**0.0999**	**0.0999**	**0.1874**	**0.1878**
R2_between		**0.0101**	**0.0101**	**0.0295**	**0.0295**
R2_within		**0.2629**	**0.2629**	**0.2535**	**0.2523**

Sigma_u	**0.0137**	**0.0137**	**0.0081**	**0.0081**
Sigma_e	**0.0130**	**0.0130**	**0.0130**	**0.0130**
rho	**0.5281**	**0.5281**	**0.2801**	**0.2801**

Table A.7: Volatility and Derivatives (IV estimation, fixed effects, vce (bootstrap) option)

	Volatility **b/se**	**Volatility** **b/se**
Ln_Derivatives	0.0079***	0.0034
	(0.001)	(0.002)
ROA	-0.1308	-0.1178
	(0.077)	(0.132)
ROE	-0.0008	-0.0005
	(0.002)	(0.003)
CAPRATIO	-0.1253	-0.1107
	(0.088)	(0.088)
Interbank Ratio	-0.0004	0.0000
	(0.001)	(0.001)
Liquid assets	0.0435*	-0.0331*
	(0.018)	(0.016)
Asset Growth	-0.0004	0.0002
	(0.001)	(0.001)
Loan-to-Deposit Ratio	0.0001*	0.0000
	(0.000)	(0.000)
Tier 1	0.1189**	0.0801**
	(0.038)	(0.030)
Derivatives_2		0.0006***
		(0.000)
_cons	-0.0900***	-0.0279
	(0.021)	(0.033)
R2		
df_r		
bic	.	.

The empirical model is the same as in tables 4 and 5. Specifications 1 and 2 are estimated by means of a 2SLS Instrumental Variable Regression. Ln_Derivatives is instrumented by one year lag of the natural logarithm (ln) of net loans. Standard errors are given in the brackets.

* Statistically Significant at the 5% level
** Statistically significant at the 1% level
*** Statistically significant at the 0.1% level

Table A.8: Correlation Matrix (5% significance level)

	Volatility	Ln_Deriva-tives	Deriva-tives_2	ROA	ROE	CAPRATIO	Interbank Ratio
Volatility	1.0000						
Ln_Derivatives	0.1410*	1.0000					
	(0.0005)						
Derivatives_2	0.4333*	0.3201*	1.0000				
	(0.0000)	(0.0000)					
ROA	-0.2382	0.0171	-0.1438*	1.0000			
	(0.0000)	(0.6690)	(0.0003)				
ROE	-0.0065	0.0601	0.0049	0.1276*	1.0000		
	(0.8716)	(0.1317)	(0.9016)	(0.0012)			
CAPRATIO	-0.1539*	-0.4321*	-0.1050*	0.2684	-0.0415	1.0000	
	(0.0001)	(0.0000)	(0.0082)	(0.0000)	(0.2938)		
Interbank Ratio	-0.0936*	-0.2322*	-0.0799*	0.0620	0.0485	0.1344*	1.0000
	(0.0216)	(0.0000)	(0.0487)	(0.1233)	(0.2282)	(0.0008)	
Liquid Assets Ratio	-0.0343	0.4195*	0.0392	0.0278	0.0306	-0.2048*	0.0245
	(0.3911)	(0.0000)	(0.3249)	(0.4378)	(0.4378)	(0.0000)	(0.5423)
Asset Growth	0.1672*	0.0517	0.2158*	-0.0418	-0.0030	-0.0952*	-0.0631
	(0.0001)	(0.2253)	(0.0000)	(0.3235)	(0.9434)	(0.0239)	(0.1422)
Loan-to-customer Deposit Ratio	0.1600*	0.1090*	0.1438*	-0.0780	-0.0346	-0.0527	-0.2052*
	(0.0001)	(0.0071)	(0.0004)	(0.0526)	(0.3905)	(0.1893)	(0.0000)
Tier 1	0.0359	-0.0012	0.1322*	0.1799*	-0.0165	0.3204*	0.3151*
	(0.3936)	(0.9766)	(0.0016)	(0.0000)	(0.6913)	(0.0000)	(0.0000)
Loan size	0.1362*	0.8398*	0.2609*	0.0291	0.0661	-0.4018*	-0.2343*
	(0.0013)	(0.0000)	(0.0000)	(0.2466)	(0.1357)	(0.0000)	(0.0000)

	Liquid Asset Ratio	Assets Growth	Loan-to-Customer Deposit Ratio	Tier 1	Loan-to-deposit Ratio
Liquid Assets	1.0000				
Asset Growth	0.0096	1.0000			
	(0.8203)				
Loans-to-customer Deposit Ratio	-0.3120*	-0.0187	1.0000		
	(0.0000)	(0.6650)			
Tier 1	0.3389*	-0.0171	-0.1772*	1.0000	
	(0.0000)	(0.7004)	(0.0000)		
Loan Size	0.0702*	0.0408	0.1885*	-0.1487*	1.0000
	(0.0942)	(0.3650)	(0.0000)	(0.0006)	

Table A.9: Volatility and Derivatives (IV estimation, fixed effects, vce (bootstrap) option)

	Volatility b/se	**Volatility b/se**
Ln_Derivatives	0.0077***	0.0033*
	(0.004)	(0.001)
ROA	-0.1538	-0.1327
	(0.119)	(0.106)
ROE	-0.0007	-0.0003
	(0.003)	(0.002)
CAPRATIO	-0.1065	-0.0824
	(0.070)	(0.083)
Interbank Ratio	0.0001	-0.0003
	(0.002)	(0.001)
Liquid assets	-0.0452**	-0.0327*
	(0.014)	(0.014)
Asset Growth	0.0003	0.0005
	(0.002)	(0.001)
Loan-to-Deposit Ratio	0.0001*	0.0000*
	(0.000)	(0.000)
Tier 1	0.1166*	0.0709
	(0.046)	(0.038)
Derivatives_2		0.0006***
		(0.000)
_cons	-0.0869**	-0.0266
	(0.027)	(0.021)
R2		
df_r		
bic	.	.

The empirical model is the same as in tables 4 and 5. Specifications 1 and 2 are estimated by means of a 2SLS Instrumental Variable Regression. Ln_Derivatives is instrumented by the Net Loans-to-Total Asset Ratio. Standard errors are given in the brackets.

* Statistically Significant at the 5% level
** Statistically significant at the 1% level
*** Statistically significant at the 0.1% level

Table A.10: Correlation Matrix (5% significance level)

	Volatility	Ln_Derivatives	Deri-Vatives_2	ROA	ROE	CAPRATIO	Interbank Ratio
Volatility	1.0000						
Ln_Derivatives	0.1410*	1.0000					
	(0.0005)						
Derivatives_2	0.4333*	0.3201*	1.0000				
	(0.0000)	(0.0000)					
ROA	-0.2382*	0.0171	-0.1438*	1.0000			
	(0.0000)	(0.6690)	(0.0003)				
ROE	-0.0065	0.0601	0.0049	0.1276*	1.0000		
	(0.8716)	(0.1317)	(0.9016)	(0.0012)			
CAPRATIO	-0.1539*	-0.4321*	-0.1050*	0.2684*	-0.0415	1.0000	
	(0.0001)	(0.0000)	(0.0082)	(0.0000)	(0.2938)		
Interbank Ratio	-0.0936*	-0.2322*	-0.0799*	0.0620	0.0485	0.1344*	1.0000
	(0.0216)	(0.0000)	(0.0487)	(0.1233)	(0.2282)	(0.0008)	
Liquid Asset Ratio	-0.0343	0.4195*	0.0392	0.0278	0.0306	-0.2048*	0.0245
	(0.3911)	(0.0000)	(0.3249)	(0.4818)	(0.4378)	(0.0000)	(0.5423)
Asset Growth	0.1672*	0.0517	0.2158*	-0.0418	-0.0030	-0.0952*	-0.0631
	(0.0001)	(0.2253)	(0.0000)	(-0.3235)	(0.9434)	(0.0239)	(0.1422)
Loans-to-customer Deposit Ratio	0.1600*	0.1090*	0.1438*	-0.0780	-0.0346	-0.0527	-0.2052*
	(0.0001)	(0.0071)	(0.0004)	(0.0526)	(0.3905)	(0.1893)	(0.0000)
Tier 1	0.0359	-0.0012	0.1322*	0.1799*	-0.0165	0.3204*	0.3151*
	(0.3936)	(0.9766)	(0.0016)	(0.0000)	(0.6913)	(0.0000)	(0.0000)
Loan- to- Asset Ratio	0.0359	-0.0012*	-0.1322*	-0.1799*	-0.0165	0.3204*	-0.3151*
	(0.03936)	(0.9766)	(0.0016)	(0.0000)	(0.6913)	(0.0000)	(0.0000)

	Liquid Assets	Assets Growth	Loans-to-customer deposit Ratio	Tier 1	Loan-to-Asset Ratio
Liquid Assets	1.0000				
Asset Growth	0.0096	1.0000			
	(0.8203)				
Loans-to-customer Deposit Ratio	-0.3120*	-0.0187*	1.0000		
	(0.0000)	(0.6650)			
Tier 1	0.3389*	-0.0171	-0.1772*	1.0000	
	(0.0000)	(0.7004)	(0.0000)		
Loan-to-asset Ratio	-1.0000*	-0.0096	0.3120*	-0.3389*	1.0000
	(0.0000)	(0.8203)	(0.0000)	(0.0000)	

Table B.1: Variable Description and Data Sources

Variable	Description	Data Source
Beta	A measure of systematic risk of the bank in comparison to the whole financial system. Calculated: Cov (bank; financial system)/Var(financial system)	Datastream
GDP Growth	Annual (%)	World Development Indicators
Inflation	Consumer Prices, annual (%)	World Development Indicators
Interest Rate	Lending Rate minus Deposit Rate (%)	World Development Indicators
Tier 1	Ratio of accounting value of bank's Tier 1 Capital to risk weighted assets	Bankscope
MBR	Market-to-book ratio. Ratio of the market value of bank's equity capital to the accounting value of equity capital.	Bankscope,Datastream author's Calc.
Liquid Assets	Accounting Value of bank's liquid assets. (1-net loans/total assets)	Bankscope, author's calc.
Size	Market Value of bank's equity. Given in (ln)	Datastream,author's calc.
FTSE Euro First 300	It includes the 300 largest companies ranked by market capitalization in the FTSE Developed Europe Index. Return calculated as (price(t)-price(t-1))/price(t-1)*100	Datastream,author's calc.
Loan size	1 year lag of ln loans.	Bankscope, author's calc.
Loan-to Asset ratio	Ratio of Net loans to Total Assets	Bankscope, author's calc.

Table B.2: Summary Statistics

Variables	Mean	Standard Deviation	p50	Min	Max	N
Historic beta	1.005	0.5668	1.04	-1.645	2.733	626
Asset Derivatives	4.1e+04	1.1e+05	1602	0	9.8e+05	646
Liabilities Derivatives	4.1e+04	1.1e+05	1572	0	9.7e+05	646
Derivatives	8.3e+04	2.1e+05	3322	0	2.03+06	646
Derivatives (ln)	8.268	3.079	8.136	0	14.48	633
Derivatives2*	5.41	4.732	5.999	0	14.48	633
FTSE Euro First 300 Returns	5.26	21.5	9.373	-44.78	33.13	643
GDP Growth	1.164	3.729	1.728	-14.8	12.1	646
Interest Rate	4.117	2.176	3.549	-0.6142	9.605	314
Inflation	3.325	4.146	2.214	-4.48	25.23	626
Market-to-Book Ratio	4.759	26.94	1.281	-15.54	328.4	626
Liquid Assets	45.09	19.63	40.11	9.592	96.96	646
Tier 1 Regulatory Capital Ratio	9.509	3.699	8.8	-6	50.1	582
Size	8.374	1.904	8.446	1.593	11.98	626

Table B.3: Beta and Derivatives (main regressions, Pooled OLS, standard errors)

	Beta b/se	Beta b/se	Beta b/se	Beta b/se	Beta b/se
Ln_Derivatives	0.0520**	0.0197	0.0482***	0.0295	0.0244
	(0.013)	(0.014)	(0.010)	(0.016)	(0.024)
Derivatives_2		0.0194***		0.0308***	0.0311***
		(0.004)		(0.009)	(0.009)
FTSE Euro First			-0.0029	0.0018	0.0020
300 Returns			(0.003)	(0.002)	(0.002)
GDP Growth			0.0095	-0.0053	-0.0050
			(0.013)	(0.010)	(0.011)
Inflation			-0.0045	-0.0300***	-0.0304***
			(0.009)	(0.009)	(0.009)
Interest rate			0.0564*	0.0845**	0.0850**
			(0.025)	(0.028)	(0.028)
MBR			0.0021	0.0021	0.0017
			(0.002)	(0.002)	(0.002)
Tier1			0.0413***	-0.0039	-0.0072
			(0.010)	(0.012)	(0.012)
Liquid Asset Ratio					0.0026
					(0.003)
Size					-0.0065
					(0.038)
_constant	0 .5701***	0.7240***	0.0020	0.4484*	0.4513
	(0.113)	(0.117)	(0.165)	(0.202)	(0.281)
R2			**0.1857**		
df_r			**233.0000**		
bic	.	.	**399.1696**	.	.

The panel model estimated is: *Beta = α + γ1*ln_Deriavtives+γ2*Derivatives_2 + γ3*ROA+γ4*ROE+γ5*CAPRATIO+γ6*Interbank Ratio + γ7*Liquid Assets + γ8*Asset Growth + γ9*Loan-to-Deposit Ratio + γ10*Tier1 + ε*. Standard errors are in parenthesis.

* Statistically Significant at the 5% level

** Statistically significant at the 1% level

*** Statistically significant at the 0.1% level

Table B.4: Beta and Derivatives (main regressions, Pooled OLS, clustered robust standard errors)

	Beta b/se	Beta b/se	Beta b/se	Beta b/se	Beta b/se
Ln_Derivatives	0.0520**	0.0197	0.0482***	0.0295	0.0244
	(0.017)	(0.015)	(0.014)	(0.019)	(0.035)
Derivatives_2		0.0194***		0.0308	0.0311
		(0.005)		(0.020)	(0.021)
FTSE Euro First			-0.0029	0.0018	0.0020
300 Returns			(0.003)	(0.002)	(0.002)
GDP Growth			0.0095	-0.0053	-0.0050
			(0.011)	(0.011)	(0.011)
Inflation			-0.0045	-0.0300	-0.0304
			(0.011)	(0.018)	(0.018)
Interest rate			0.0564	0.0845*	0.0850*
			(0.043)	(0.041)	(0.042)
MBR			0.0021**	0.0021	0.0017
			(0.001)	(0.001)	(0.001)
Tier1			0.0413	-0.0039	-0.0072
			(0.026)	(0.039)	(0.040)
Liquid Asset Ratio					0.0026
					(0.004)
Size					-0.0065
					(0.047)
_constant	0 .5701***	0.7240***	0.0020	0.4484	0.4513
	(0.143)	(0.130)	(0.321)	(0.395)	(0.483)
R2			**0.1857**		
df_r			**72.0000**		
bic	.	.	**399.1696**	.	.

The panel model estimated is: *Beta = α + γ1*ln_Deriavtives+γ2*Derivatives_2 + γ3*ROA+γ4*ROE+γ5*CAPRATIO+γ6*Interbank Ratio + γ7*Liquid Assets + γ8*Asset Growth + γ9*Loan-to-Deposit Ratio + γ10*Tier1 + ε*. Standard errors are in parenthesis.

* Statistically Significant at the 5% level

** Statistically significant at the 1% level

*** Statistically significant at the 0.1% level

Table B.5: Overview of all estimators.

Variable	OLS_rob	FE	FE_rob	RE	RE_rob
Ln_Derivatives	0.0326	0.0137	0.0137	0.0197	0.0197
	(0.0151)	(0.0296)	(0.0474)	(0.0144)	(0.0151)
Derivatives_2	0.0155	0.0203	0.0203	0.0194	0.0194
	(0.0057)	(0.0047)	(0.0069)	(0.0040)	(0.0053)
_constant	0.6434	0.7731	0.7731	0.7240	0.7240
	(0.1284)	(0.2295)	(0.3702)	(0.1171)	(0.1295)
N	**613**	**613**	**613**	**613**	**613**
R2	**0.0695**	**0.0644**	**0.0644**		
R2_overall		**0.0626**	**0.0626**	**0.0663**	**0.0663**
R2_between		**0.0387**	**0.0387**	**0.0407**	**0.0407**
R2_within		**0.0644**	**0.0644**	**0.0643**	**0.0643**
Sigma_u		**0.4292**	**0.4292**	**0.4065**	**0.4065**
Sigma_e		**0.3792**	**0.3792**	**0.3792**	**0.3792**
rho		**0.5616**	**0.5616**	**0.5347**	**0.5347**

Table B.6: Volatility and Derivatives (IV - Loan size, Pooled OLS)

	Beta **b/se**	**Beta** **b/se**
Ln_Derivatives	0.0493***	0.0285
	(0.013)	(0.015)
FTSE Euro First	-0.0040	-0.0026
300 Returns	(0.003)	(0.003)
GDP Growth	0.0152	0.0137
	(0.015)	(0.014)
Inflation	-0.0089	-0.0266*
	(0.009)	(0.011)
Interest rate	0.0650*	0.0809**
	(0.028)	(0.028)
MBR	0.0018	0.0018
	(0.002)	(0.002)
Tier1	0.0308**	0.0141
	(0.011)	(0.012)
Derivatives_2		0.0370**
		(0.011)
_constant	0.1228	0.3547
	(0.196)	(0.207)
R2	**0.1639**	**0.2140**
df_r	**182.0000**	**181.0000**
bic	-	-

The empirical model is the same as in tables 3 and 4. Specifications 1 and 2 are estimated by means of a 2SLS Instrumental Variable Regression. Ln_Derivatives is instrumented by one year lag of the natural logarithm (ln) of net loans. Standard errors are given in the brackets.

* Statistically Significant at the 5% level
** Statistically significant at the 1% level
*** Statistically significant at the 0.1% level

Table B.7: Correlation Matrix (5% significance level)

	Beta	Ln_ Derivatives	Derivatives_2	FTSE Euro First 300	GDP Growth	Inflation	Interest Rate
Beta	1.0000						
Ln_Derivatives	0.2383*	1.0000					
	(0.0000)						
Derivatives_2	0.2123*	0.4742*	1.0000				
	(0.0000)	(0.0000)					
FTSEEuro First	-0.0198	-0.0700	-0.2298*	1.0000			
300 Returns	(0.6214)	(0.0791)	(0.0000)				
GDP Growth	-0.0363	0.0294	-0.2706*	0.6930*	1.0000		
	(0.3651)	(0.4597)	(0.0000)	(0.0000)			
Inflation	0.0292	0.0105	0.0732	0.0735	0.0745	1.0000	
	0.4653	0.7912	0.0659	0.0624	0.0586		
Interest rate	0.0182	-0.0189	0.0637	-0.1029	0.0520	0.6721*	1.0000
	0.7534	0.7411	0.2644	0.0700	0.3581	0.0000	
MBR	0.0778	-0.1518*	-0.0681	0.0221	-0.0168	-0.0325	-0.0415
	0.0518	0.0002	0.0923	0.5825	0.6751	0.4166	0.4743
Tier 1	0.1722*	-0.0012	0.1261*	-0.0416	0.0065	-0.0374	-0.1452*
	0.0000	0.9766	0.0025	0.3173	0.8762	0.3678	0.0198
Loan size	0.1794*	0.8398*	0.4160*	-0.0292	0.0383	-0.0094	-0.0655
	0.0000	0.0000	0.0000	0.4868	0.3609	0.8234	0.3141

	MBR	Tier 1	Loan size
MBR	1.0000		
Tier 1	0.1241*	1.0000	
	0.0031		
Loan size	-0.2573*	-0.1487*	1.0000
	0.0000	0.0006	

Table B.8: Volatility and Derivatives (IV – Loan-to-Total Asset ratio, Pooled OLS)

	Beta b/se	Beta b/se
Ln_Derivatives	0.0522**	0.0408*
	(0.017)	(0.019)
FTSE Euro First	-0.0028	-0.0015
300 Returns	(0.003)	(0.003)
GDP Growth	0.0094	0.0091
	(0.013)	(0.013)
Inflation	-0.0046	-0.0211*
	(0.009)	(0.010)
Interest rate	0.0564*	0.0721**
	(0.025)	(0.025)
MBR	0.0022	0.0024
	(0.002)	(0.002)
Tier1	0.0412***	0.0257*
	(0.010)	(0.011)
Derivatives_2		0.0330**
		(0.012)
_constant	-0.0307	0.1227
	(0.200)	(0.221)
R2	**0.1852**	**0.2276**
df_r	**233.0000**	**232.0000**
bic	**-**	**-**

The empirical model is the same as in tables 3 and 4. Specifications 1 and 2 are estimated by means of a 2SLS Instrumental Variable Regression. Ln_Derivatives is instrumented by the Net Loans-to-Total Asset Ratio. Standard errors are given in the brackets.

* Statistically Significant at the 5% level

** Statistically significant at the 1% level

*** Statistically significant at the 0.1% level

Table B.9 Correlation Matrix (5% significance level)

	Beta	Ln_deri-vatives	Derivatives_2	FTSE Euro First 300	GDP Growth	Inflation	Interest Rate
Beta	*1.0000*						
Ln_Derivatives	0.2383*	1.0000					
	0.0000						
Derivatives_2	0.2123*	0.4742*	1.0000				
	0.0000	0.0000					
Ftseur1st3-n	*-0.0198*	-0.0700	-0.2298*	1.0000			
	0.6214	0.0791	0.0000				
GDP Growth	-0.0363	0.0294	-0.2706*	0.6930*	1.0000		
	0.3651	0.4597	0.0000	0.0000			
Inflation	0.0292	0.0105	0.0732	0.0735	0.0745	1.0000	
	0.4653	0.7912	0.0659	0.0624	0.0586		
Interest rate	0.0182	-0.0189	0.0637	-0.1029	0.0520	0.6721*	1.0000
	0.7534	0.7411	0.2644	0.0700	0.3581	0.0000	
MBR	0.0778	-0.1518*	-0.0681	0.0221	-0.0168	-0.0325	-0.0415
	0.0518	0.0002	0.0923	0.5825	0.6751	0.4166	0.4743
Tier 1	0.1722*	-0.0012	0.1261*	-0.0416	0.0065	-0.0374	-0.1452*
	0.0000	0.9766	0.0025	0.3173	0.8762	0.3678	0.0198
Loan-to-Asset	-0.1833	-0.4195*	-0.1090*	0.0139	-0.0380	0.0852*	0.0875
Ratio	0.0000	0.0000	0.0061	0.7249	0.3347	0.0304	0.1218

	MBR	Tier 1	Loan-to-Asset Ratio
MBR	1.0000		
Tier 1	0.1241*	1.0000	
	0.0031		
Loan-to-Asset	-0.2516*	-0.3389*	1.0000
Ratio	0.0000	0.0000	