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The use of derivatives in banking in the pre- and post-crisis scenario

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Introduction

In 2008, with Lehman Brothers failure, one of the worst financial crises in the recent history peaked, putting in danger the global financial system. During the years preceding this event, the banking system in general and the usage of derivatives in particular have seen important changes that have either caused or magnified the already devastating effects of the crisis.

This work will investigate how the composition of U.S. banks derivatives portfolios changed during the years preceding this crisis and how it adjusted during the last five years, highlighting how the situation evolved 10 years after the crisis, examining similarities and differences in volumes and trends of derivatives usage by banks. In other words, this thesis will try to answer on whether the usage of derivatives by banks had significant changes in the pre-crisis and post-crisis scenarios, to what extent, and the reasons behind the eventual variations.

As previous literature[1] already states, the derivatives themselves are not are not instruments that are harmful for the financial systems by nature, but their usage may have a hedging or speculative purpose. The analysis, in this case, will be useful because the single types of derivatives used will be taken into consideration instead of looking at general total notional levels. By looking at the composition of the portfolios rather than their size, and to other factors such as the net current credit exposure the thesis will hopefully give a sense of the increase and or decrease of risk factors and business activity of U.S. banks in the years going from 2003 to 2008 and from 2013 to 2018.

The first chapter of the paper will introduce the banking system and the use of the derivatives by banks by first a categorization of all the different types of banks, then an introduction to the derivatives in general and then the different applications that derivatives may have in the banking system.

[1] Shanker, L. (1996). Derivatives usage and interest rate risk of large banking firms. *Journal of Futures Markets,16*(4), 459-474. doi:10.1002/(sici)1096-9934(199606)16:43.0.co;2-h

The second chapter, instead, will mainly focus on the 2008 financial crisis, by first having a look to the processes and events that brought to the threat of collapse of the financial system and then it will focus on the crucial role of derivatives in these events.

While the first two chapters will mainly have a theoretical core, the third chapter will constitute the empirical part of the paper. There will be an analysis of the derivatives notional levels made at different stages of differentiation of both five years' time-spans, the differences between the two periods and the overall changes during the last 10 years from the financial crisis.

Finally, the conclusions will offer some considerations about what these changes mean, their causes and consequences and how the financial system had benefitted from them after the shock.

Chapter 1 - The Role of Derivatives in the Banking Industry

1.1 Banking and the classification of banks

Although almost every bank has to do with derivatives to a higher or lower extent, banks can use derivatives in different ways and with different purposes, as will be discussed further on in the chapter. The differentiation in the use of derivatives will mostly depend on to which of the different possible classes the bank belongs. We shall, therefore, begin our dissertation by first giving a definition of banking activities and then describing the different types of banks.

The most general definition of banking activity is the collection of money and the subsequent issue of credit[2]. In other words, the bank matches savers and investors by exploiting economies of scale and scope, financial skills. In this way the parties will see their costs decreased and the risks of liquidity, time-mismatch and moral hazards absorbed by the bank. The classification of banks, or, at least, the one that we are going to consider, is mainly based on their business model and it is data-driven. The first example of bank that we are going to consider will be the retail banking. This kind of bank offers standardized and elementary instruments to retail customers, with a low unit value added using industrialized and standardized production processes and widespread and direct distribution channels with an individual transaction-oriented exchange method. The increase in operational efficiency is sought through the definition and implementation of repetitive processes and the greater use of technological support. Savings banks, in particular, specialise in collecting saving deposits and in providing retail payment services, credit and insurance to individuals and small or medium-sized enterprises. They mostly have a conservative business model and investment strategies. The ownership is mutual and there are no shareholders. Mortgage banks, instead, are specifically active in the real estate sector and with mortgages, just as the United kingdom's building societies that collected savings and used them to fund domestic mortgages and building activities, often operating as subsidiaries of normal banks.

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[2] Williams, B. (1997). Positive Theories of Multinational Banking: Eclectic Theory Versus Internalisation Theory. *Journal of Economic Surveys,11*(1), 71-100. doi:10.1111/1467-6419.00024

Commercial banking, the second type of banking that we are going to describe, mostly works with corporate clients such as firms and the bank in this case offers complex and integrated services and tools, products with a high level of customization and characterized by high added value. Negotiation takes place within long-lasting and consolidated relationships with high quality profiles.

Among the other kind of banks, cooperative banks are close in spirit and substance to saving banks, as for example with regards to mutual ownership. They have a tight connection with specific trades or professions. We are going to mention but not to discuss in detail, because they will not be relevant to our analysis, also girobanks, credit unions, Islamic banks, clearing banks and public banks.

Another banking division that should be taken in consideration, especially because it is one of the most active on the derivatives market. It is often affiliated with or subsidiary of larger banking institutions, but many of these systems have become household names. It offers personalized services and products to corporate customers, governments and high net worth individuals and has a centralized structure without widespread distribution channels with a certain degree of complementarity with the house markets. Another one of the activities of investment banking is the one that happens on the markets. The services comprehend advices on evaluation of companies or on deal structuring if the clients are considering mergers or acquisitions. They can assist also the client in issuing of new securities.
Last but not least, a brief description is needed of Central banks, which are far away from the ordinary banks. They are public monetary and financial institutions (MFI) established to perform a series of functions related to the management of money and credit with clients such as banks and governments. The relationship between central banks and national governments has evolved over time, in many cases, from subordination to independence from government and parliament. Central banks' several functions are banknote issuance, decisions and advices on monetary policy, lending activities to banks, general supervision and regulation of the banking sector, public debt management, payment system management, official and gold reserves management, supervision of international capital flows, exchange rate decisions, collections and elaboration of economic statistics and research. The assessment of the derivatives use by the central banks may be a difficult approach, just as in many other cases we are going to analyse, because they constitute contingent liabilities for the banks and because they are off-balance sheet there are effects on the risk and transparency of the accounts of these banks. In any case, the rationale behind the intervention of central banks in

the derivatives market shows that there are positive policy aspects also due to the possibility to enter them at a low cost and without material constraint.
In the following sections of the chapter, the description of derivatives and of their application is given, before exploring the possible uses of them by banks.

1.2 Derivatives and their application

In finance, derivatives are securities the value of which depends from another asset or index that is defined as underlying. They can be used to hedge financial risk, to make arbitrages or to speculate.
In the beginning, derivatives were used to grant stable exchange rates and for goods traded internationally. Because international currency values could vary, market operators created a system to take these differences into account. Today derivatives are based on many transactions and even more uses and there even exist derivatives based on meteorological data. For investors exposed to exchange-rate risks, for example, it is possible to hedge this risk by buying a currency derivative to maintain a stable exchange rate. This kind of risk can be hedged by derivatives like futures or currency swaps. The same derivatives can be used to speculate on price movements of underlying assets without necessarily having interests in the latter. In this sense, many derivatives are leveraged, that means that a small amount of capital is needed to have an interest in a large amount of value in the underlying asset.
There are several kinds of derivatives, one of the most common are futures. A futures contract obliges the parties to sell and buy an asset at a given price and at a given date[3]. Futures are traded in the exchange market and the contracts are standardized, which is one of the reasons of their popularity. The market operators will use the contract to hedge their risk or to speculate on the price of the underlying asset. Both the buyer and the seller of a futures contract on the underlying asset A may want to hedge the risk of rising prices in the case of the buyer and of falling prices in the case of the seller. If they were speculators, instead they could have no interest in the finalization of the contract and could have sold or closed the contract before the expiration. It is the case, indeed, that many contracts the trade may have a

[3] Bodie, Z., Kane, A., & Marcus, A. J. (2019). *Essentials of investments*. New York, NY: McGraw-Hill Education.

gain or a loss in terms of future positive or negative cash flow. This kind of contracts are defined as cash-settled and as underlying may have indexes, stocks or other items such as volatility.

Forward are another type of derivative similar to futures. They have some differences in that the forward is not standardized and is traded only over-the-counter. The parties may therefore have customized terms that affect the settlement of the contract or the terms in general. They also face counterparty risks in the case in which one of the parties may not maintain the obligations indicated in the contract. If this is the case, the other party's position becomes worthless. The risks may increase If more traders are involved to offset the original positions.

Another common derivative contract is used to exchange cash flows between parties. These have the explicative name of swaps. They can be used to swap variable and fixed interest rates on loans and therefore to hedge the interest rate risk. Obviously, there will be no need to exchange exactly the amounts of interests between the parties, but the losing party will give instead the difference between the two. The parties often use these contracts to switch the default risks on cash flows or loans from other business activities. As We are going to see, this risk transfer mechanism brought in turn to the credit crisis of 2008.

Options, finally, are the last main type of derivative contracts that we are going to analyse. They are similar to a certain extent to futures, because it is still an agreement between parties to buy or sell an asset at a given price and date, but with the difference that the buyer of the option is not obliged to exercise it while the seller is. They have therefore an obvious use in hedging or speculating on the price of the underlying. Indeed, the value of a call option at expiration, for a call option holder, equals:

$$\text{Payoff to call holder} = \begin{cases} S_T - X \; if \; S_T > X \\ 0 \quad if \; S_T \leq X \end{cases}$$

where S_T is the value of the stock at expiration and X is the exercise price. As we can see here, the value of the security is never negative, the only loss for the call holder is the price paid for the option.

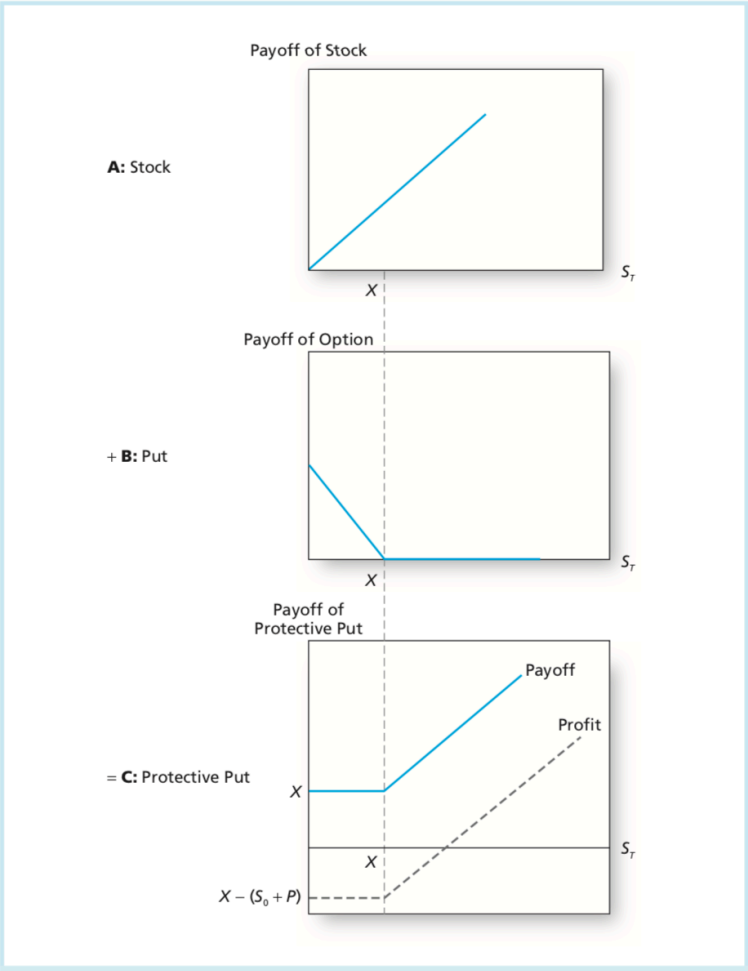
On the other hand, the value of a put option at expiration, for a put holder will be:

$$\text{Payoff to put holder} = \begin{cases} X - S_T \; if \; S_T < X \\ 0 \quad if \; S_T \geq X \end{cases}$$

where S_T is the value of the stock at expiration and X is the exercise price. The same argument applies for these derivatives. There are several ways to use combinations of options

and stocks in order to hedge the risk of decreasing value in the portfolio, as for example the "protective put" or "covered call" strategies. A graphical example of the protective put strategy follows:

Figure 1.1 – Protective Put Strategy



In the above graphs we can see how, combining the two payoffs of the two securities, the stock and the option grants a secure payoff with guarantees of lower profits, because the price of the underlying stock, with a protective put, cannot be lower than its strike price.
Other options that are less used than the ones mentioned above are:

- Options on common investment funds (ETF)
- Weekly options
- Binary options

- Binary options on credits

The above options models are the so-called plain vanilla, that is they have well defined characteristics and they are actively traded so they will have prices estimated by exchanges or by inter-dealer brokers. However, inside OTC derivatives there exist a great variety of non-standard instruments or they can be created by financial engineers. These instruments are called exotic options and are particularly useful for subjects that have peculiar hedging needs or to for those whom needs are instruments that replicate special predictions of the market. Among them we can find Asiatic options that can be divided in average price Asian options and average strike Asian options where the underlying price in the former or the strike price of the option in the latter is not established at the beginning of the contract but is determined through the mean of the different values along the contract duration. Other exotic options are the barrier options. The barrier makes the option gaining or loosing value based on the underlying price touching that barrier. These again can be distinguished in knock in and knock out options, in the first case the option starts to have value in the moment that the underlying price gets over the barrier price, while in the second case the opposite happens. Also, we can distinguish the options up and down, if the barrier price must be touched by the upper side or by the lower side.

Regarding the options pricing in general, the most utilized model is the one done by Black and Scholes, that estimates the intrinsic value and the time value of an option taking into consideration different factors[4]. The model formula follows:

$$c = S_0 N(d_1) - K e^{-rT} N(d_2)$$

$$p = K e^{-rT} N(-d_2) - S_0 N(-d_1)$$

This model takes into considerations some factors that have some degrees of influence on the value of the option:

- The price of the underlying stock
- The strike price
- The residual time to expiration

[4] Bodie, Z., Kane, A., & Marcus, A. J. (2019). Essentials of investments. New York, NY: McGraw-Hill Education.

- The volatility of the price
- The risk free interest rate
- The dividends paid during the stock life

Another fundamental relation of the options is the one between a call and a put. This relation takes the name of put-call-parity and it is needed to form all the necessary replicating portfolios to enact different strategies with options. The relation follows:

$$c + Ke^{-rT} = p + S_0$$

This shows that the value of a European call with a certain strike price and a certain maturity may be calculated by the value of an European put with the same strike price and same maturity. This accounts also for the opposite case to determine the value of a put. This relation helps the agents in the financial markets to build efficient portfolios and enact risk hedging strategies.

Derivatives have been considered enormously harmful just as financial atomic bombs, deemed to cause the financial turmoil bringing to the detriment of United States and as the tool that brought down the global economy. The formal complexity of these securities makes it difficult to the most to effectively know them. The common knowledge about them is that they were a source of excessive risk.

Nonetheless, Robert Shiller, a Yale economist doesn't agree with the argument above. Being a financial innovator and an expert risk manager, Shiller suggests that derivatives are nothing like the problem, but a solution instead. According to him, derivatives are, just as insurances, a risk-management tool. "You pay a premium and if an event happens, you get a payment.". Obviously, the above-mentioned tools may be used in different ways that can have positive or negative consequences. For Shiller the banishment of the tool is not a solution to the problem indeed.

Very few traders were active on the derivatives market although the outstanding notional was of the order of many trillions. Of all the subprime mortgages that were securitized, the far greatest part was handled by few Wall Street institutions that worked with few large institutional buyers. This made the market illiquid and opaque although it was huge. The system, instead, depended on the exceptionally numerous individual households and lenders around the world and their decisions. They did not have, however, the same opportunity to

hedge their risks in the same way that large institutions could. If the market went down, those that directly participated in the house market, would have gone down with it.
This is why Shiller suggests that the tools could be used by households and lenders to hedge the risk of falling prices. In this scenario, people could buy from brokers new types of financial instruments that, for example, would be inversely related to a regional home-price index. That is, if the house prices in that region declined those derivatives value would increase and therefore would offset the loss. Lenders, at the same time, could conversely hedge the foreclosures risk. The diversification of buyers and sellers will improve the liquidity and functionality of the market even when in difficult situations.
This argument has faced different critics based on the fact that futures contracts that have not made the equity markets or commodity markets immune from the damaging movements that have affected them. Also, critics say, the fluctuations of this new home-based market would be more interesting for speculator than being an effective tool of insurance used by homeowners.
Shiller has put new ideas that could form the ground for a hypothetical new financial revolution after the first major crisis of the Information Age economy. Albeit counterintuitive, Shiller's considerations are somewhat close to those that the doctors and scientists made when first suggesting as a remedy to some critical diseases the infection of more people through vaccinations instead of quarantines.

The next section will illustrate possible uses of derivatives by banks.

1.3 Possible uses of Derivatives in Bank

As already explained above, derivatives can be used for speculative or hedging reasons. Most of the banks that act in the derivatives market as end-users, however, use them for hedging reasons. Only certain kinds of bank may use them as speculative tools, and we will explain it later.
To explain, instead, what are the hedging usages of derivatives by banks we should first assess what are the risks that the banks want to hedge. One of the most important risks that banks face is without doubts the interest rate risk. It is the risk of variations of the interest-sensitive assets' value and also the risk of the time gap between the maturities of the assets and liabilities if the intermediary operates as asset transformer. The two cases indicate the

main components of the interest rate risk. It can be considered, indeed, simply the risk regarding the effects on a position in obligations due to variations in interest rates on the market or, by the bank point of view, the risk of refinancing and reinvesting.
In the first analysis, a change in the interest rate results in a value effect and a reinvestment effect on the bonds. This type of influence of interest rates on bonds is general, in fact it influences every person using them, from the single retail investor to the big banks.
The first effect, which in turn depends on the volatility risk of the shares, takes into account the effect of the change in interest rates on a portfolio which, as previously stated, in turn leads to a change in the price of bond assets or liabilities. This happens because an increase (decrease) in interest rates decreases (increases) the present value of securities that have a lower yield (issued at lower rates) than new ones with a higher yield and vice versa. Furthermore, an increase in interest rates also implies a decrease in the current value of stock flows. The second effect regarding the reinvestment effect concerns only securities with coupons. In fact, this effect affects the return of reinvested coupons and acts in the opposite way to the value effect. As interest rates increase, the return on the reinvested coupons will increase and will therefore have an advantage for the security holder. Each coupon that the investor will receive, if the rates are increasing, will be reinvested at ever-increasing rates, with a consequent ex-post return greater than the ex-ante return calculated before the start of the investment period.
In addition to the general risk of the interest rate affecting any bondholder, banks are subject to an additional risk caused by the misalignment (called mismatching) of assets and liabilities in the balance sheet. This mismatching produces two types of risks depending on whether the assets have a shorter or greater maturity than the liabilities.
Under normal market conditions, if the assets have a shorter maturity than the liabilities, the banks incur the risk of reinvestment. This first risk consists in the possibility that the banks at the end of the assets (which in this case will expire before the liabilities) are unable to re-utilize the liquidity at a sufficient rate greater than the rate at which they are indebted, which would result in a null profit or a loss. In fact, in this first case it could happen that if the bank is indebted at the time t_0 for 2 years and invests always at the time t_0 for 1 year, at the end of the first year (at the time t_1) there will be two possible scenarios (without considering a possible constant rate):
- The interest rates will be increased resulting in a gain for the bank (because it will invest at higher rates than those to which it is indebted)

- The interest rates decrease resulting in a loss or a loss of earnings for the bank (which will have to use the liquidity borrowed at a rate equal to or lower than the rate at which it has been in debt).

If, on the other hand, the assets have a longer maturity than the liabilities, the banks will be subject to a refinancing risk. This risk, instead, consists in the possibility that the banks at the expiry of the liabilities (which in this case will have a shorter maturity than the assets), fail to borrow at a rate sufficiently lower than the rate of the assets, which would entail a null profit or a loss . For example, if the liabilities of a bank have a maturity of 1 year while the assets have a 2-year maturity, also in this case 2 scenarios would be envisaged (again without considering a constant rate):

- The rates increase leading to a loss or zero profit to the bank
- The rates decrease resulting in a gain to the bank

Refinancing risk is the most common risk at the bank level. In fact, generally, the maturities of the banks' assets are systematically greater than the maturities of the liabilities unlike other financial intermediaries, such as for example insurance companies that tend to align their long-term liabilities with assets that have an equally long maturity. This is because the banks make a profit the greater the gap between the maturities of liabilities and assets. In fact, under normal market conditions, the shorter the maturity of the liabilities, the lower the interest rate to be paid, but the longer the maturity of the assets, the greater the interest rate that will be collected. Banks must therefore find a fair compromise between the gap in terms of deadlines and earnings, because it is true that the smaller the gap, the lower the risk but it is equally true that with a smaller gap there is a smaller gain. Precisely the issue was one of the main causes of the bankruptcy of Lehman Brothers, the excessive gap between the deadlines has in fact led to the immediate refusal by investors to continue to finance the bank in the moment of uncertainty on mortgages, which caused the bank's inability to meet liabilities due to the very long maturity of the assets.

Since the mid-1980s, many banks decided to adopt derivative hedging strategies. This decision stemmed from the fact that hedging transactions in the balance sheet (or directly aligning the value and maturity of all assets and liabilities) are very expensive in terms of the opportunity cost of the money that would be used fruitlessly for the sole purpose of covering the various deadlines. The use of derivatives, on the other hand, allows banking organizations to operate with a lower level of capital than what they would otherwise need. In fact, with the increasing volatility of interest rates, deposit institutions recognized the importance of

derivatives, in particular interest rate futures and interest rate swaps, regarding the reduction of risk and the achievement of an acceptable performance financial.

Deshmukh, Greenbaum, and Kanatas (1983) affirm that an increase in the uncertainty of interest rates encourages intermediaries to reduce interest-bearing loan activities and to increase low activity on commissions that are exempt from this risk. These commission-based activities concern, for example, the trading of derivatives, advisory services and payment services. The use of derivatives can therefore be considered a complementary activity to the loan activity for a bank, in fact interest-rate hedging transactions, in periods of high volatility, would allow the continuation of the main activity of the commercial banks or the credit function or allocative. However, the negative aspect of derivatives must also be considered, in fact derivative transactions can lead to large losses. At least in theory the presence of official regulated markets (CME, EUREX, IDEM) in the case of futures or in any case the presence of markets with a high number of trades, as in the case of interest rate swaps, should allow banking companies to reach exposure to the pre-established risk based on their propensity (established in the “risk appetite framework”). In addition, banks that use any type of derivative on interest rates, on average suffer greater growth than their Commercial & Industrial loan portfolios. This positive relationship is consistent with financial intermediation models where interest rate derivatives allow commercial banks to reduce exposure to the risk of changing interest rates and thus increase their ability to provide loans. The greater possibility of granting credit by banking intermediaries who use derivatives implies that the users of derivatives tend to be on average larger in size than non-users. J. Sinkey and D. Carter (2000) in their study "Evidence on financial characteristics of banks and do not use derivatives", on the contrary find no evidence to support the fact that banks must have a large and robust capital to use derivative instruments and instead they state that the main characteristics of the banks that use them are: a riskier capital structure (greater Debt to equity ratio), greater mismatch between assets and liabilities (and therefore greater exposure to interest rate risk), lower interest margin.

An important positive side of derivatives, however, is the reduction of the variability of profit which in turn reduces the probability of insolvency and therefore decreases the cost of indebtedness of banks. Another interesting factor is the effect on ROA and ROE that derives from the use of derivatives. According to the results of the study by Brewer, Jackson and Moser there is no correlation between the use of derivatives and the two indices, but the net interest margin is lower in users. The net interest margin represents the ability to control the spread between profits (interest income) and costs (interest expense), so it seems that non-

users of derivatives have a greater ability to do so. On the other hand, the argument is reversed as regards the profit not deriving from interest (commissions, deposit services, etc.) where users have a greater net margin than non-users. Regarding the sensitivity of user actions to certain variations in rates compared to non-users, the latter, according to the study by Brewer, Jackson and Moser, would have a greater sensitivity.

At this point it is necessary to investigate whether the banks use derivatives mainly for the purpose of limiting interest rate risk (hedging) or to increase exposure to this risk (speculation). In fact, as L. Shanker also states in his work "Derivatives Usage and Interest Rate Risk of Large Banking Firms", the use of derivatives for the sole purpose of risk management actually helps to reduce interest rate risk. To understand if banks use derivatives to speculate or to cover themselves, it is necessary to refer to studies concerning the sensitivity to systematic risk of banks as the use of derivatives varies.

Chapter 2 - Derivatives and the Financial Crisis

2.1 An analysis of the financial crisis

The subprime mortgages financial crisis started in the United States in 2006. The conditions of the crisis date back to 2003, when the supply of high-risk mortgages, that is, mortgages given to customers who normally would not have obtained credit since they would not have been able to provide sufficient guarantees, began to significantly increase. growth of subprime mortgages was stimulated by several factors that are attributable, also, to the situation of the US real estate market and the development of the processes of securitisation. Starting in 2000 and until mid-2006, prices of real estates in the United States have grown regularly and in a significant way, generating a clear housing bubble. This dynamic was favoured by the monetary policy of the Federal Reserve (FED). which maintained, until 2004, interest rates at all-time low levels trying to counter the internet bubble crisis and the September 11th, 2001 attack.

Low interest rates meant a low cost of money for borrowers of funds, i.e. for families that required mortgage loans, and therefore ended up stimulating the demand for housing, further fuelling the relative prices. Furthermore, the real estate bubble made it convenient to grant loans from financial institutions which, in the event of the borrower being insolvent, could still retrieve the money lent by foreclosing and reselling the house.

If the real estate bubble and historically low interest rates were not enough, the growth of junk mortgages was also bolstered by the development of securitization processes, i.e. by the act of credit institutions trading loans, after having 'transformed' them into a security, to third parties subjects (the so-called 'vehicle companies') and to immediately recover most of the credit that they would otherwise have received only at the end of the mortgages themselves (generally tens of years). The securitization allowed the banks, apparently, to get rid of the risk of insolvency of the funds' borrowers. In fact, it abated the incentives to correctly assess the reliability of the customers. The vehicle companies, for their part, financed the purchase of securitized mortgages through the offer to investors of mis-matched securities with a short maturity.

The special purpose vehicles (SPVs - and conduits) presented in their balance sheets assets with medium and long-term loans transferred by banks and liabilities with short-term securities (the so-called asset backed commercial paper - ABCP), guaranteed by the transferred banking assets and assisted by liquidity lines made available by the banks themselves. An alternative method of securitization envisaged the issue of so-called Collateralised Debt Obligations (CDO) again through special vehicle companies (often also referred to by the acronym CDO) and re-securitization transactions, in which the underlying assets were mainly structured securities.

In the context of low interest rates, securitized securities have been subscribed by many investors both in the US and in Europe. This circumstance created the conditions for the transmission of the crisis from the US economy to European economies.

The development of securitisations has led to the transition of the banks' business model from the originate and hold approach (in which the bank provides the loan and waits a period of time before recovering the sum loaned and the related interest) to the originate and distribute approach (the bank provides the loan and transfers it to third parties through a securitization, immediately recovering the sum lent). As a result of the securitization, the banks quickly returned to the availability of the money lent, which they could re-use to provide other mortgages to customers whose reliability was assessed in an increasingly less accurate manner. Thanks to securitization, financial institutions were able to greatly expand their activities in relation to their own capital (leverage or leverage). This allowed them to make very high profits, but also exposed them to the risk of substantial losses.

The securitization operations generated very complex structured products, little standardized and not very liquid. Furthermore, structured products were mainly traded over the counter (OTC), outside regulated markets, and in the absence of significant prices, which are prices that can be used for their assessment shared by market operators. In this context, against the opacity of the products and the difficulty of appreciating their value, the rating agencies' judgment has assumed an increasing importance as a shared reference for the evaluation of the products. The rating, however, expressed the results of estimates based on the valuation models adopted by the agencies and was therefore subject to the limits that the assumptions underlying the models themselves could present. These limits became evident following the outbreak of the sub-prime crisis, when it became clear that the agencies had used models that

were not sufficiently sophisticated, that is, based on hypotheses and scenarios on the evolution of the economic picture, which were too optimistic. In that circumstance it was also clear that the agencies had assigned ratings that were too generous (also due to conflicts of interest that created incentives in this direction) and had been proved too cautious in reviewing their judgment on the issuers that were beginning to manifest the first crisis signals.

In the beginning of 2004, the FED began to increase the interest rates in response to the recovery of the US economy. The mortgages became more and more expensive and the insolvencies cases of families that were unable to repay the ever more expensive instalments increased. The demand for real estate was reduced, with the consequent bursting of the housing bubble and contraction of the value of collaterals to guarantee existing mortgages.

The financial institutions that were most involved in the provision of subprime mortgages suffered heavy losses. Furthermore, starting from July 2007 and throughout 2008, various downgrades of the credit rating of securitized securities by rating agencies recurred. These securities, now widespread on the market, lost all their value and became illiquid, forcing the vehicle companies to request funds from the issuer banks that had guaranteed liquidity lines. Some banks, however, were unable to find the liquidity needed to meet these demands, as no financial institution was willing to give them credit. In a context of poor clarity about the distribution of structured securities in the financial system, in fact, the interbank market experienced a sharp increase in rates and a significant contraction in the willingness of banks to grant credit to other financial institutions. A liquidity crisis thus developed from the confidence crisis. The banks suffered heavy losses not only for the exposure to the vehicle companies, but also for the exposures to subjects hit by the crisis (for example, the funds that had invested in the securitized securities), or the direct possession of structured securities for reasons of investment. These circumstances led some of the major US financial institutions risking of going bankrupt, avoided thanks to the intervention of the Treasury in agreement with the FED. The investment bank Lehman Brothers, however, did not receive state aid or support from private parties and started bankruptcy proceedings on September 15th, 2008[5]. The insolvency of the American investment bank Lehman Brothers triggered a new phase of intense instability. The decision of the American Authorities to let a large financial institution fail, with a large and relevant operation outside the US, deeply shaken the confidence of the

[5] Bloomberg, 2008

operators, fuelling a climate of very strong tension and uncertainty on the markets. The default of Lehman Brothers generated widespread concerns about the solidity of other merchant banks and concerns about the effects of exposure to these institutions of all other market participants. The sharp increase in counterparty risk perceived by operators led to a new drastic reduction in liquidity on the interbank deposit market and an increase in short-term rates, despite the fact that central banks, as will be discussed below, had already initiated massive liquidity injections.

The crisis's systemic nature appeared more and more evident, with unprecedented turbulence that extended from the market of structured products to stock markets, in particular to securities of companies in the financial sector, and progressively to the entire financial system showing a high degree of interconnection. Due to the direct or indirect exposure of banks in some European countries to the phenomenon of subprime mortgages, the contagion also spread to Europe.

Soon, the subprime mortgages crisis spread to American and European real economies, causing a fall in income and occupation rates. This was also due to the restriction of bank credit to households and to businesses, to the collapse of stock markets and the progressive deterioration of the expectations of families and businesses, with consequent repercussions on consumption and investments. Finally, the commercial interdependencies between countries led to a heavy reduction in world trade.

The enlargement of the crisis led the US government to intervene with a bailout plan for large US credit institutions and financial system as a whole, divided both in nationalization operations and in private securities purchase programs. During the two-year period 2007-2009, the TARP securitized securities purchase program (called Troubled Asset Relief Program), whose size was first set at 700 billion dollars, but consequently increased to a total of 7,700 billion dollars, caused liquidity injection in the inter-bank market and interest rates close to zero by the FED in support of banks and insurance companies [6].

In Europe, the crisis came first in Northern Rock, the fifth UK credit institution specialized in real estate loans, the subject of a bank run in mid-September 2007. The British Central Bank proceeded with the nationalization of the institute, committing approximately 110 billion

[6] Ghosh, S., & Mohamed, S. (2010). The Troubled Asset Relief Program (TARP) and its limitations: An analysis. International Journal of Law and Management, 52(2), 124-143. doi:10.1108/17542431011029424

pounds. This intervention was followed by others, even in the form of recapitalisations and purchases of bonds in support of various banks in crisis.[7]

Substantial bailout plans for distressed banks were arranged by Belgium, Denmark, France, Germany, Greece, Luxembourg, the Netherlands, Portugal and Sweden. Comprehensively, the governments provided aid to the banks of the respective national systems for 3.166 billion euros in Europe, in the form of guarantees (2.443 billion), recapitalisations (472 billion) and credit lines and loans (251 billion; MBRES data in December 2013).

In particular, in Germany public aid to banks was of a considerable amount, both in the form of guarantees on bank liabilities and in the form of subscription of shares or subordinated securities (over € 380 billion in guarantees and around € 56 in capital). In Spain, the largest recapitalization intervention involved the European rescue fund (EFSF), which in 2012 granted a loan to the State of over 30 billion euros; this sum constitutes the first tranche of the 100 billion aid granted by the European Union to the country for the recapitalization and restructuring of the domestic banking system.

In Italy, on the other hand, the banking system was not assisted by significant public support measures until the end of 2011. The State limited itself, in fact, to subscribe subordinated bonds, for a total amount of just over 4 billion euro, issued by four banks, against the commitment of the issuing institutions not to reduce the credit granted to the real economy. The greatest difficulties for Italian banks, on the other hand, have been determined by the sovereign debt crisis which, having intensified since mid-2011, has caused a deterioration in bank assets due to the substantial direct investments of credit institutions in domestic public securities. The intervention of the State, in this case, took the form of a public guarantee on the bonds issued by the banks (for an amount of approximately 120 billion) with the aim of alleviating the difficulty of funding them by reducing the cost of bond funding and access to refinancing operations with the ECB guaranteed by the bonds themselves (see Consob Annual Report for 2012).

In particular, in Germany public aid to large amounts, in the form of guarantees on liabilities and in the form of subscription of shares or subordinated securities (over € 380 billion in guarantees and around € 56 in capital). In Spain, the largest recapitalization intervention

[7] - CONSOB La crisi finanziaria del 2007-2009 http://www.consob.it/web/investor-education/crisi-finanziaria-del-2007-2009

involved the European rescue fund (EFSF), which in 2012 granted a loan of 30 billion euros; this sum is the first tranche of the 100 billion aid granted by the European Union.
In Italy, on the other hand, the banking system was not supported by significant public support measures until the end of 2011. by the banks of the issuing institutions. The greatest difficulties for banks, caused by deterioration in bank assets two to the substantial direct investments of credit institutions in domestic public securities. The state of this funding, the form of a public guarantee on the bonds issued by the banks (for an amount of approximately 120 billion) and access to refinancing operations with the ECB guaranteed by the bonds themselves (see Consob Annual Report for 2012).

In addition to public interventions for the rescue and nationalization of some institutions in greater difficulty, in many jurisdictions, the securities regulators (Consob among the first) have activated urgent intervention measures, such as the prohibition of short selling of shares. In the light of these events, a European Regulation on the subject was subsequently adopted, in force since November 2012.

The crisis has also challenged the resilience of almost all the sectors of the regulation of the financial system, from that on capital requirements to that on accounting principles, due to the ability to create a system of incentives that are distorted and non-responsible. The need to review the traditionally self-regulating approach in some sectors of the financial market (including that related to rating agencies, speculative funds and so-called over-the-counter markets) also emerged, and to set more binding standards on the subject of corporate governance, especially with regard to manager remuneration and risk management policies.

Finally, the events highlighted the need for a reform of the institutional structures of financial supervision in Europe and the USA. From these reflections, following a broad and articulated debate, a new institutional architecture was designed in Europe aimed at promoting harmonized rules and uniform supervisory and enforcement practices.

2.2 The role of Derivatives in the financial crisis development

In order to investigate what role the use of the derivatives had in the financial crisis development, there is a need to briefly discuss the US regulation changes made during the last century about the requirements needed to use them.

Future contracts have been introduced in 1860s by farmers and merchants to hedge the price fluctuations risk on commodities such as wheat, corn and many other grain derivates. Soon they began to be used to hedge the price fluctuations risk of many other products such as commodities, metals energy products and financial instruments. This led to many debilitating effects to the Depression due to the speculative behaviour of investors. For this reason, President Roosevelt favoured the first form of control that affected the use of derivatives in 1936, The Commodity Exchange Act (CEA). This tightened the purely speculative use of this kind of contracts, while requiring transparency and regulation about the adequate capital to back the commitments.

During the following years, until 1980s, finance agents created a great variety of future contracts with some new elements and arrived at creating “swaps”. Due to the development of these instruments, the Commodity Futures Trading Commission (CFTC) exempted them from the CEA of 1936. Soon after, in 2000, President Clinton signed into law the Commodity Futures Modernization Act (CFMA), that removed derivative transactions from the CEA requirements. In this case, the oversight on derivatives transaction was prohibited to the Securities and Exchange Commission (SEC).

This scenario was the most indicated to lead, in less than ten years, to one of the worst economic disruption happened in the modern history. When the value of the unregulated derivatives outstanding was estimated to exceed $60 trillion, half of which was constituted by credit swaps. At the time, the Fed was maintaining low interest rates and provided federally-backed home loans that were everything but secure and that eventually were embedded in the 30$ trillion of CDS. When defaults became more and more frequent a mortgage crisis started and brought to a credit crisis which was followed by a severe financial crisis that could have led to a worldwide depression, mitigated by a huge U.S. taxpayer intervention.

The causes of this meltdown are many. Of course, the creation of Asset Backed Securities that incentivized banks and loan houses to generate and trade was one of the most important, because it steadily decreased the quality of loans granted. However, the increasing use of CDS was surely the element that magnified all the effects of the burst of the housing bubble. It was neither the use itself nor these instruments, but the pure speculative purpose of the actors in this market.

Since a CDS does not require the agents in the contract to actually own or have an interest in the underlying asset, most of those who entered these contracts were merely making a bet, either if they were the ones who paid a premium and expected a refund in case of a defaulting asset or if they were to pay a defaulting asset that was not supposed to default and, in fact, were expecting to only collect the premiums.

Speculators bought and sold, in pre-crisis years, tens of trillions of dollars of these contracts that had extremely overrated underlying pools of mortgages, that eventually went down in value when defaults started to be more and more frequent. In the same moment the sellers of these “insurances”, faced troubles since of the enormous amount they would have needed to repay all of these loans. AIG could serve as an example. By June 30, 2008, the insurance company had written $441 billion worth of swaps. The sub-prime mortgages that constituted the underlying of the insured entities started to default and as a result needed to post more collateral, in addition to the extensive write downs. The Monday after, when the rating of AIG went further down, the company needed even more collateral, but it had not. Eventually the Fed bailed out AIG and prevented that all entities that had insurance written by the insurance company would have had all their assets uncovered instantaneously, leading to a massive write-down of billions of dollars. When a similar situation occurred with Bear Stearns, in the same period, the Fed decided to act in a different way and but still bailed out the investment bank, that was eventually acquired by J.P. Morgan Chase at a ridiculous price of $2 per share, 7% of the Bear Sterns market values just two days before the failure. Shah Gilani wrote on Money Morning just after the episode that: “The counterparty risk that all Bear's trading partners were exposed to was so far and wide, and so deep, that if Bear was to enter bankruptcy it would take years to sort out the risk and losses. That was an untenable option.”.

Then the turn of Lehman Brothers, another leading investment bank, came. In New York, on September 15th, 2008, just before one o'clock in the morning, Lehman Brothers Holdings announced its intention to take advantage of the bankruptcy protection provided by Chapter 11, although its subsidiaries continued to operate normally. Lehman Brothers shares fell 80% in the pre-opening phase on the New York Stock Exchange. On September 15th 2008, the Dow Jones index closed down by 500 points, realizing the biggest fall from what followed the September 11th, 2001 attacks.

The failure of Lehman is the largest in the history of world bankruptcies. Lehman in fact passed the crash of WorldCom, the telephone group that ended up in receivership in 2002. Lehman had a debt of around 613 billion dollars.[8]

Richard Fuld, the bank administrator, who had long been presenting false balances and had paid 300,000 dollars to US congressmen and deputies and senators for the past ten years to bribe them, was investigated by other members of the congress.

On March 6th 2012, 1,268 days after the crack, Lehman Brothers Holdings, what remained from the liquidation of the bank giant that failed during the 2008 crisis came out of Chapter 11, or from the controlled administration of 639 billion dollars. The company began repaying the creditors on the following April 17th, thus closing a chapter that began on September 15th, 2008, when Lehman collapsed and started the global financial crisis. This phase saw the distribution to creditors of around 65 billion dollars, against requests for over 300 billion. "*We are proud to announce that Lehman has left Chapter 11 and begins the final part of distributing funds to creditors*," John Suckow said in a statement. The bankruptcy court had approved the repayment plan in the previous December. The new board of directors, among other things, continued with the liquidation of assets.

From this it can be clearly seen what the implications of the speculative use of massive amount of CDS have been. That is, a significant shift from unsystematic to systematic risk in the economy.

[8] Corriere Della Sera *Lehman Brothers dichiara fallimento*. https://www.corriere.it/economia/08_settembre_15/lehman_brothers_banca_crisi_credito_Usa_b8805f84-82b3-11dd-9b8b-00144f02aabc.shtml

Chapter 3 - Some Empirical Evidence

3.1 Introduction

3.1.1 The data: time frame and bank selection criteria

The research is now going to explain what the selected data are and also the timeframe of these from which they are extrapolated. A brief explanation shall be made about the source of the data itself. Since many of the stipulated contracts that are the scope of this analysis are traded over the counter, it is not an easy task to collect comprehensive data about the amount (in our case, the notional) of them traded, to quantify them and to compare them with each other.

The Bank of International Settlement (BIS) gathers annual statistics and data about exchange-traded and OTC derivatives. The first are taken by commercial data sources and bring out the notional amounts from these contracts. The latter are taken by dealers' report submitted to the Committee on the Global Financial System and then passed to the BIS at a country level rather than at single dealer level. Also, BIS presents a Triennial Central Bank Survey that contains the observations of FX instruments trading in both spot and OTC transactions, in addition to other interest rate derivatives. The reports of the turnover is not uniformed across all the 53 jurisdictions that participate in the survey, and the statistics are again reported to the BIS at a country level.
Although these research statistics contain interesting and extremely valuable information, the data inside may be out of scope of this thesis. The aim, indeed, of this work is to evaluate and compare the notional levels of derivatives usage by the banking system in the USA pre- and post-crisis periods. The three kinds of statistic offered by the BIS, in this case, would be too generic because would not give a specific consideration to the banking system (even if the OTC derivatives statistics mostly cover banks, all the derivative dealers are comprehended) or to the individual institutions.

Another source of data about derivatives usage comes from the Office of the Comptroller of the Currency (OCC), which is the supervisor of 1,307 U.S. banks and other financial institutions. It presents on a quarterly basis a report on bank derivatives activities with data contained in the Reports of Condition and Income and other financial data,

provided by all insured U.S. commercial banks and trust companies. The report mostly regards OTC derivatives, of which information are given along with a discussion of risk areas and performances. This source is the most adapt to the work of this thesis because it gives information on a frequent and specific basis.
Based on this data, the research will evaluate the notional levels of all insured U.S. commercial banks derivatives, even if, as stated in the quarterly report of the fourth quarter of 2018, four large commercial banks represent 87.3 percent of the total banking industry notional amounts. The decision to include all the banking industry permits to have a more round and solid view of the general situation of derivatives usage in United States.

The timeframe considered for the research needed to be restricted enough in order to be comparable and connected to the events of the Financial Crisis. In fact, the time frame needed also to be long enough to allow the focus on trends and macro-changes. For these reasons the periods chosen in order to cover a medium-run analysis are the ones going from the final quarter of 2003 to the final quarter of 2008, year in which Lehman Brothers went bankrupt and crisis peaked, and from the last quarter of 2013 to the last quarter of 2018.

3.1.2 The analysis

The aim of the research is to observe and discuss the trends of growth and decline of notional levels of derivatives during these periods. This will be done by comparing year on year levels, 5 years changes and 10 years changes.

The data on which this analysis will be performed are the total notional amount levels as well as the notional amounts of different derivatives. The differentiation will be made by the type of user that the bank represents for the derivatives (such as dealer or end user), by the product (futures, exchange traded options, over the counter options, forwards, and swaps) and by type of underlying (interest rate, foreign exchange, equities, commodities and credit derivatives). Attention will be posed also to the percentages that different kind of these contracts take into the derivatives portfolios of U.S. banks.

The analysis will also cover the change in net current credit exposure for the different portfolios of derivative contracts, which is the gross positive fair value of derivatives held by

banks less the benefits deriving from the bilateral netting. The latter allows the parties of a contract to have as receivables or payables only the net sum of gross positive fair values and negative fair values in the event of default or insolvency of a counterpart.

This last part of the analysis is fundamental to assess counterparty credit risk. The amount of notional of a derivative is the amount of reference that determines the payments of the contract; the credit exposure, however, is often not defined by this amount. The credit risk in a derivative depends on different variables, such as the volatility of the underlying market factors (currency, interest rate, stocks, commodities or corporate entities), whether the counterparties exchange the entire notional or not, the maturity of the contract, its liquidity and also whether and to which extent the counterpart is creditworthy.

The credit risk connected to loans and credit risk connected to derivatives is different because the nature of the potential credit exposure of a derivative is more uncertain. Banks can only estimate without certainly knowing the value of the derivative contract at different points in time because the credit exposure is a function of the market factors fluctuations.

In the majority of cases, credit risk is bilateral as it happens with swaps, that constitute the majority of the derivative contracts of banks. Each part of the contract can have a credit exposure to the counterpart at different points in the life of the contract, especially if the tenor of the contract is long enough. With a traditional loan, instead, the amount at risk is given only by the capital that is borrowed by the debtor. Furthermore, since the bank is exposed to the counterparty risk of the borrower, the credit risk is, as opposed to derivatives, unilateral.

The assessment of the credit exposure in derivatives contract implies the identification of contracts for which the bank would lose value in the event of insolvency of the contract counterpart. This is why the research needs to focus on the gross positive fair values and the gross negative fair values.

3.2 The Pre-Crisis scenario

3.2.1 Categorization of derivatives by usage

As stated above, the derivatives analyzed will be categorized by the type of users that the banks represent in the contract. This first distinction divides the total notional amounts in derivatives that the banks use as a dealer and consequently with trading purposes and derivatives that the banks use in quality of end-user, that is, without trading purposes. In this distinction credit derivatives are taken separately, since they are not differentiated between trading and non-trading.

The other distinction that needs to be done is the categorization by the product. This allows the research to analyze the distribution of the various types of products during the years. The different products taken into account will be:

- Futures and forwards
- Total options
- Total Swaps

The usage of these kind of derivatives by banks has been already discussed in this thesis, but other consideration will be made further in the paper after the analysis of the data.

The third and last distinction made will be between different types of underlying of the contracts. The different kinds are:

- Interest rate
- Foreign Exchange
- Equities
- Commodities

Again, credit derivatives are inserted in these other two distinctions. Credit derivatives do not differentiate in products or type of contract and essentially this permits to add up to the notional amounts in each of the categorizations.

3.2.2 Volumes and trends

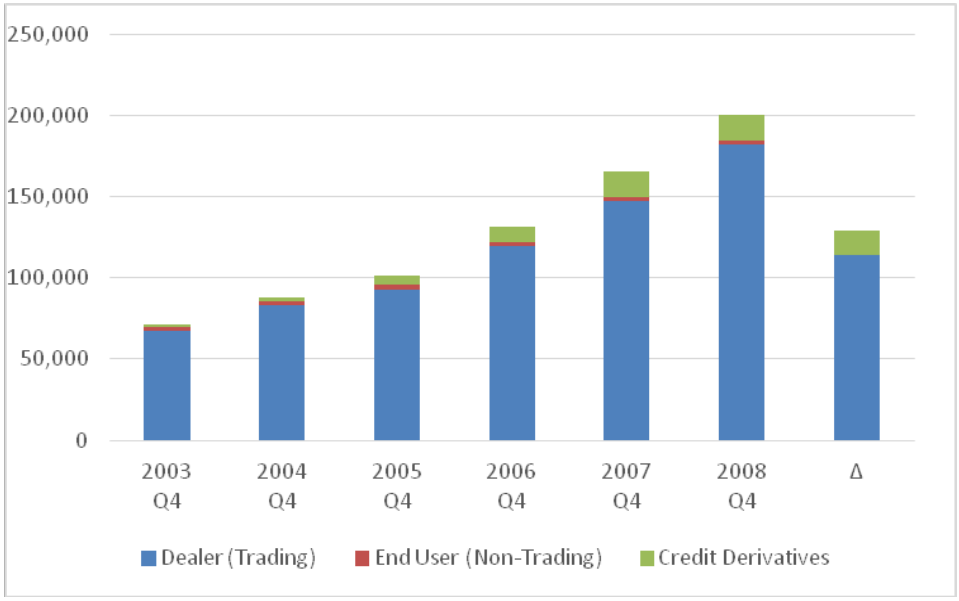
Table 1 and figure 2 show the notional levels of derivatives held by all insured U.S. banks and other financial institutions during the 4th quarters of the years going from 2003 to 2008 divided by type of user:

Table 1 – Notional levels of derivatives by type of user in $billions – pre-crisis scenario

	2003 Q4	2004 Q4	2005 Q4	2006 Q4	2007 Q4	2008 Q4	Δ	% Δ
Dealer (Trading)	67,700	82,900	93,000	119,600	147,200	181,900	114,200	169%
End User (Non-Trading)	2,400	2,600	2,600	2,800	2,600	2,600	200	8%
Credit Derivatives	1,000	2,300	5,800	9,000	15,900	15,900	14,900	1490%
Total Notional	$71,100	$87,900	$101,500	$131,500	$165,600	$200,400	$129,300	182%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Figure 2 – Notional levels of derivatives by type of user in $billions – pre-crisis scenario



Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

During the five years pre-crisis, the total notional of derivatives increased by 182 percent, from $71,100 billion to $129,300 billion.

While non-trading derivatives remained stable to a certain extent, increasing by only 8 percent going from $2,400 billion to $2,600 billion, trading derivatives and credit derivatives increased heavily. Trading derivatives, the ones with the highest weight on the portfolios, increased by 169 percent going from $67,700 billion in the final quarter of 2003 to $181,900 billion in the final quarter 2008. Credit derivatives, instead are the ones with the highest

percentage increase with an outstanding 1490 percent growth, going from $1,000 billion to $15,900. The boom of credit derivatives was one of the fundamental causes of the financial-crisis, and this vast increase is one of the proofs.

The weights of the derivatives in the portfolios during these years are presented in the table below:

Table 2 – Weights of derivatives by type of user

	2003 Q4	2004 Q4	2005 Q4	2006 Q4	2007 Q4	2008 Q4
Dealer (Trading)	95%	94%	92%	91%	89%	91%
End User (Non-Trading)	3%	3%	3%	2%	2%	1%
Credit Derivatives	1%	3%	6%	7%	10%	8%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

The change in the composition of the portfolios is due primarily to the change in the credit derivatives weight that went from constituting 1 percent of derivative portfolios to the 8 percent. Trading derivatives weight remained the highest going from 95 percent to 91 percent and non-trading derivatives weight decreased from 3 percent to 1 percent.

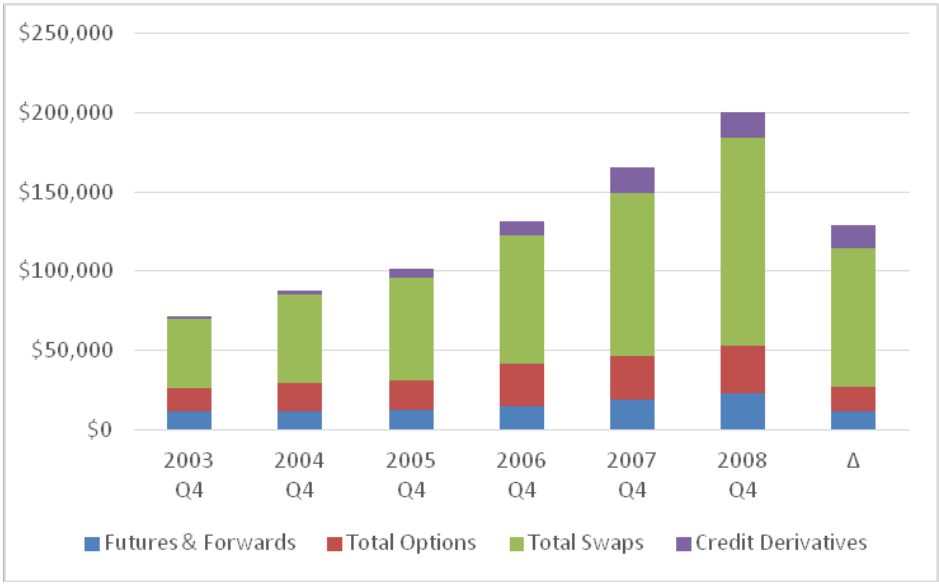
The following table and graph will present the notional levels of derivatives held by all insured U.S. banks and other financial institutions during the 4th quarters of the years going from 2003 to 2008 divided by products:

Table 3 – Notional levels of derivatives by product in $billions – pre-crisis scenario

	2003 Q4	2004 Q4	2005 Q4	2006 Q4	2007 Q4	2008 Q4	Δ	%Δ
Futures & Forwards	$11,400	$11,400	$12,100	$14,900	$18,900	$22,500	$11,100	97%
Total Options	14,600	17,800	18,900	26,300	27,700	30,300	15,700	108%
Total Swaps	44,100	56,400	64,700	81,300	103,100	131,700	87,600	199%
Credit Derivatives	1,000	2,300	5,800	9,000	15,900	15,900	14,900	1490%
Total Notional	71,100	87,900	101,500	131,500	165,600	200,400	129,300	182%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Figure 3 – Notional levels of derivatives by product in $billions – pre-crisis scenario



Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

It can be seen that during this period the division all different kinds of derivatives increased in a significant way. Futures and Forwards, as well as total options, doubled with a, respectively, 97 percent and 108 percent increase. Futures and forwards went indeed from a level of $11,400 billion to $22,500 billion, the options held, instead, went from $14,600 billion to $30,300 billion. The total notional of swaps, instead, almost tripled with an increase of 199 percent, going from $44,100 billion to $87,600 billion.

The composition of derivatives changed over this time-frame according to the table below:

Table 3 – Weights of derivatives by product

	2003 Q4	2004 Q4	2005 Q4	2006 Q4	2007 Q4	2008 Q4
Futures & Forwards	16%	13%	12%	11%	11%	11%
Total Options	21%	20%	19%	20%	17%	15%
Total Swaps	62%	64%	64%	62%	62%	66%
Credit Derivatives	1%	3%	6%	7%	10%	8%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

The order of importance of the different derivatives in the portfolios in notional terms did not change during this period, following this categorization. As previously stated, credit derivatives weight increase is the main responsible for these changes. Futures and forwards passed from having a weight of 16 percent to 11 percent. Options continued to constitute the second most important in terms of weights during all the years and, yet, decreased from 21 percent to 15 percent, while swaps remained first increasing their weight from 62 percent to 66 percent.

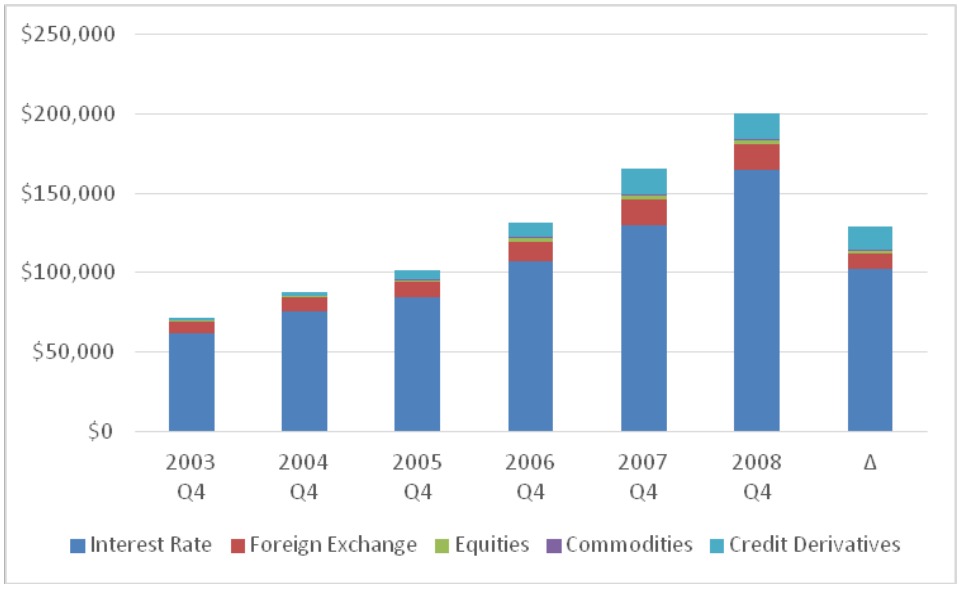
The following table and graph will present the notional levels of derivatives held by all insured U.S. banks and other financial institutions during the 4th quarters of the years going from 2003 to 2008 divided by type of underlying:

Table 4 – Notional levels of derivatives by underlying in $billions – pre-crisis scenario

	2003 Q4	2004 Q4	2005 Q4	2006 Q4	2007 Q4	2008 Q4	Δ	%Δ
Interest Rate	$61,900	$75,500	$84,500	$107,400	$129,500	$164,400	$102,500	166%
Foreign Exchange	7,200	8,600	9,300	11,900	16,600	16,800	9,600	133%
Equities	800	1,200	1,300	2,300	2,500	2,200	1,400	175%
Commodities	200	300	600	900	1,100	1,100	900	450%
Credit Derivatives	1,000	2,300	5,800	9,000	15,900	15,900	14,900	1490%
Total Notional	71,100	87,900	101,500	131,500	165,600	200,400	129,300	182%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Figure 3 – Notional levels of derivatives by underlying in $billions – pre-crisis scenario



Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

During this period, the notional levels of all of the different underlying derivatives increased. The interest rate derivatives, which constituted the majority of derivatives held in portfolios, increased by 166 percent going from $61,900 billion to $164,400 billion. Foreign exchange derivatives increased by 133 percent going from $7,200 billion to $16,800 billion. Equities derivatives increased by 175 percent going from $800 billion to $2,200 billion. Commodities increased by 450 percent going from $200 billion to $1,100 billion.

The table below will show the changes in the composition of the portfolios by this categorization:

Table 5 – Weights of derivatives by underlying

	2003 Q4	2004 Q4	2005 Q4	2006 Q4	2007 Q4	2008 Q4
Interest Rate	87%	86%	83%	82%	78%	82%
Foreign Exchange	10%	10%	9%	9%	10%	8%
Equities	1%	1%	1%	2%	2%	1%
Commodities	0%	0%	1%	1%	1%	1%
Credit Derivatives	1%	3%	6%	7%	10%	8%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Interest rate derivatives decreased their weight from 87 percent to 82 percent but remained without doubt the most important in portfolios. foreign exchange rates, equities and commodities derivatives' weights remained relatively stables during this period at respectively 8 percent, 1 percent and 1 percent.

The pre-crisis scenario saw important changes in the use of derivatives in the banking system. The most important and the most evident is the overall increase of notional levels which almost doubled in those 5 years. The other relevant aspect, as previously stated, is the dramatic increase of credit derivatives, which altered composition of portfolios and increased the risk of moral hazard by speculators. The predominant weight of derivatives that are used as a dealer by banks, swaps and derivatives that have interest rates as underlying must be taken in consideration as well. Nonetheless, it must be considered that in the final quarter of 2008, the net current credit exposure of the banking system was $804 billion.

3.3 The Present time

3.3.1 Changes in banking and derivatives use after the crisis

All the amplifications effects that credit derivatives had on the recession have brought the post-crisis discipline to the financial monitoring and to the management of credit risk, going from a micro-prudential perspective used pre-crisis to a macro-prudential one. With micro-prudential perspective, the focus was posed on the activities of the single investors, while a macro-prudential perspective the monitoring focus goes to the activities of the market and of credit institutions to avoid the event of systemic crisis that would impact the economy as a whole and that would start a recession that would harm public accounts, households and firms.

Post-crisis regulation particularly focused on financial leverage, big financial institutions default and markets interactions with the economic cycle. Broadly speaking, these measures aim to safeguard the stability of the global financial system as a whole by reducing and mitigating systemic risks.

Systemic risk is difficult to define and to measure in a precise manner, and macro-prudential approach faces also difficulties bound to the will of focusing not only to financial institutions but also to the market infrastructures and to the real economy. Furthermore, it is not clear what instruments could be used to reach this scope. The main instrument remained that of the imposition of regulatory constraints and rules about capital requirements of credit institutions. Basil 3 regulation goes towards this direction. Banks have the duty to acquire minimum reserves to be used in an anti-cyclical phase, and to be increased during cyclical phases, to mitigate credit crunch.

In 2008 the US Treasury Department published a report in which it was proposed to attribute to the Federal Reserve the control of global systemic risk, and to transfer its micro-prudential and transparency supervisory powers to two other different institutions, but in 2010 the monitoring of systemic risks was assigned to the Financial Stability Oversight Council.

Both in U.S. And in Europe many proposals were made to reach more transparency on derivatives market and many of these discussions were faced during the Pittsburgh G20 in September 2009, in which many shared decisions were taken about new policies about derivatives contracts.

However, Pittsburgh G20 did not condemn derivative products as instruments themselves as it was common thinking after the crisis, but instead condemned the speculative use of these instruments and the effect of magnifying the consequences of the economic crisis, in terms of general opaqueness of the relative markets, the increase of interconnection between market actors and the lack of trackability of the OTC market.

G20 proposals to overcome the problematics of the crisis and to give back to derivative instruments the legitimacy to be used as hedging instruments were:

- Standardization of OTC derivatives
- The possibility to track derivatives operations in trade repositories
- The duty to compensate standardized derivatives transactions by Central Counterparty Clearing Houses
- An increase in capital requirements for derivatives trading

All these proposals have been implemented in the following years by rulers of the countries in which the derivatives market was more developed, that is: United States, European Union countries, Japan, China, Hong Kong, Canada and Russia.

3.3.2 Categorization of derivatives by usage

The categorizations of the derivatives in portfolios of insured banks in U.S. in the period ranging from 2013 to 2018 will be the same used previously in the pre-crisis period analysis.

The notional amounts will be firstly divided by the type of user that the banks represent, that could be dealer or end-user. Afterwards, the notional amounts will be divided by the type of contract, that could be futures and forwards, options or swaps. The third and last categorization that will be made will be again by type of underlying. In this case the

derivatives will be divided in interest rate derivatives, foreign exchange derivatives, equities derivatives and commodities derivatives.

These are the main and most recent divisions that OCC adopts in its surveys. The adaptation of the pre-crisis data, especially of the years before 2006, to the recent standards was needed in order to achieve a more complete and exhaustive comparison.

3.3.3 Volumes and trends

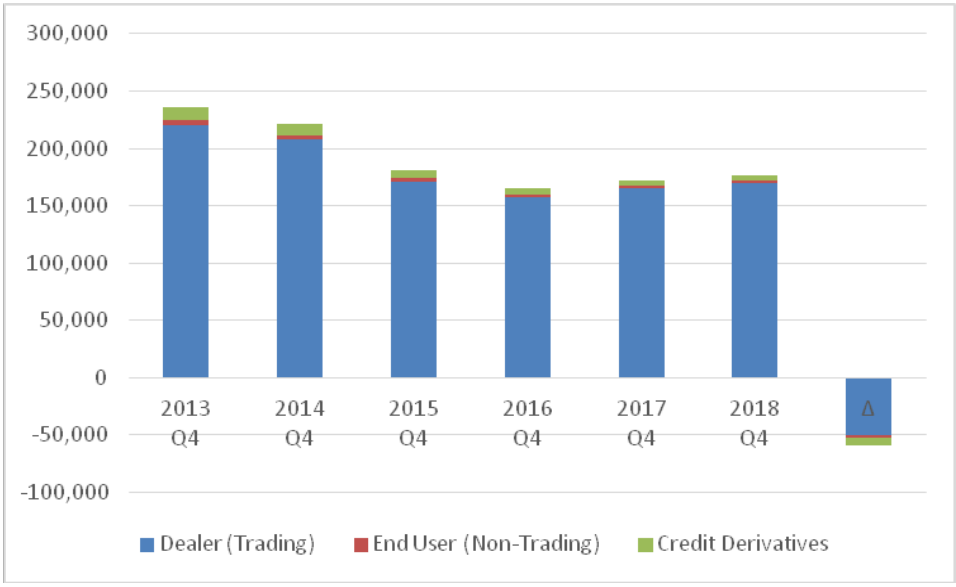
The following table and graph will show the notional levels of derivatives held by all insured U.S. banks and other financial institutions during the 4th quarters of the years going from 2013 to 2018 divided by type of user:

Table 6 – Notional levels of derivatives by type of user in $billions – post-crisis scenario

	2013 Q4	2014 Q4	2015 Q4	2016 Q4	2017 Q4	2018 Q4	Δ	% Δ
Dealer (Trading)	219,990	207,711	171,172	156,901	164,987	169,629	-50,361	-23%
End User (Non-Trading)	4,812	3,918	2,800	3,057	2,785	2,447	-2,365	-49%
Credit Derivatives	11,191	9,449	6,986	5,293	4,186	4,277	-6,914	-62%
Total Notional	$235,993	$221,078	$180,959	$165,252	$171,958	$176,353	-$59,640	-25%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Figure 4 – Notional levels of derivatives by type of user in $billions – post-crisis scenario



Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

During the last five years, the total notional of derivatives decreased by 24 percent, from $234,993 billion to $176,353 billion.

Not only non-trading derivatives, but also trading derivatives and credit derivatives decreased. Non-trading derivatives almost halved, passing from $4.812 billion to $2.447billion. Trading derivatives, the ones with the highest weight on the portfolios, decreased by 23 percent going from $219.990 billion in the final quarter of 2013 to $169.629 billion in the final quarter 2018. Credit derivatives, opposed to the pre-crisis scenario, are the ones with the highest percentage decrease with a 62 percent decrease, going from $11.191 billion to $4.277 billion. This significant crunch of credit derivatives could denote one of the signs of the post-crisis regulatory framework.

The weights of the derivatives in the portfolios during these years are presented in the table below:

Table 7 – Weights of derivatives by type of user

	2013 Q4	2014 Q4	2015 Q4	2016 Q4	2017 Q4	2018 Q4
Dealer (Trading)	93%	94%	95%	95%	96%	96%
End User (Non-Trading)	2%	2%	1%	2%	2%	1%
Credit Derivatives	5%	4%	4%	3%	2%	3%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

The composition of the portfolios remained stable and the small changes are probably due primarily to the change in the credit derivatives weight that went from constituting 5 percent of derivative portfolios to the 3 percent. Trading derivatives weight increased from 93 percent to 96 percent and non-trading derivatives weight decreased from 2 percent to 1 percent.

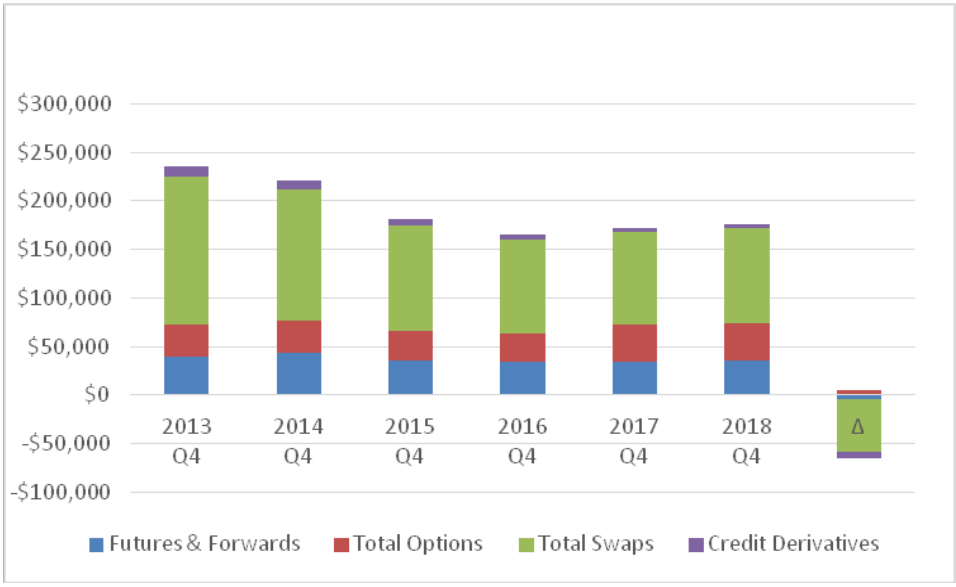
The following table and graph will present the notional levels of derivatives held by all insured U.S. banks and other financial institutions during the 4th quarters of the years going from 2013 to 2018 divided by products:

Table 8 – Notional levels of derivatives by product in $billions – post -crisis scenario

	2013 Q4	2014 Q4	2015 Q4	2016 Q4	2017 Q4	2018 Q4	Δ	%Δ
Futures & Forwards	$40,027	$43,380	$35,691	$34,201	$34,407	$36,144	-$3,883	-10%
Total Options	32,305	33,081	30,889	29,373	38,841	38,009	5,704	18%
Total Swaps	152,469	135,169	107,392	96,384	94,524	97,923	-54,546	-36%
Credit Derivatives	11,191	9,449	6,986	5,293	4,186	4,277	-6,914	-62%
Total Notional	235,992	221,078	180,959	165,252	171,958	176,353	-59,639	-25%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Figure 5 – Notional levels of derivatives by product in $billions –post-crisis scenario



Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

It can be seen that during this period the division all different kinds of derivatives decreased in a significant way except options, which increased by 18 percent passing from $32,305 billion to $38,009 billion. Futures and Forwards decreased by 10 percent; it went indeed from a level of $40,027 billion to $36,144 billion. The total notional of swaps, instead, decreased by 36 percent, going from $152,469 billion to $97,923 billion.

The composition of derivatives changed over this time-frame according to the table below:

Table 9 – Weights of derivatives by product

	2013 Q4	2014 Q4	2015 Q4	2016 Q4	2017 Q4	2018 Q4
Futures & Forwards	17%	20%	20%	21%	20%	20%
Total Options	14%	15%	17%	18%	23%	22%
Total Swaps	65%	61%	59%	58%	55%	56%
Credit Derivatives	5%	4%	4%	3%	2%	2%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Although swaps weight decreased, they remained the predominant product in portfolios, they went indeed from a weight of 65 percent to a weight of 56 percent. Futures and Forwards increased their weight from 17 percent to 20 percent and options went from 14 percent to 22 percent.

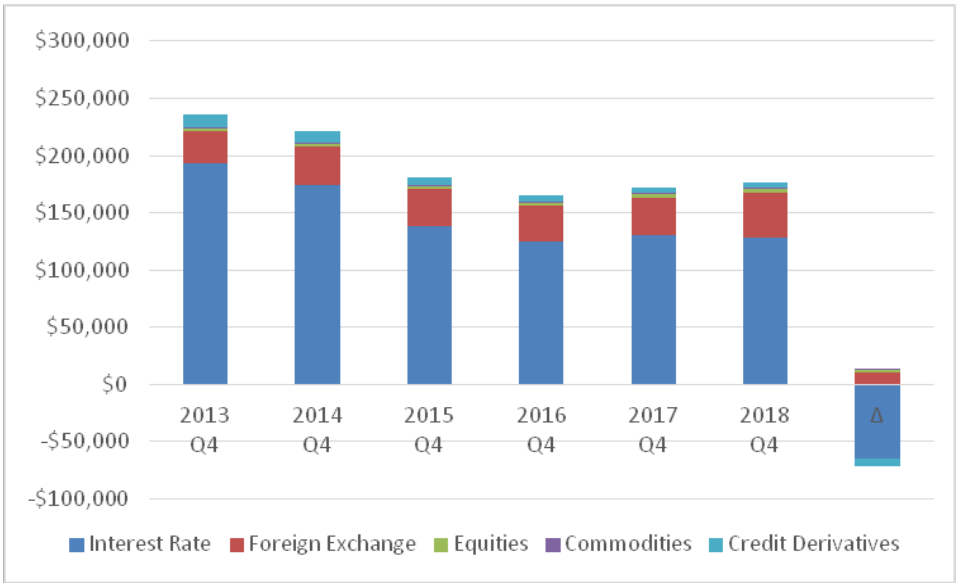
The following table and graph will present the notional levels of derivatives held by all insured U.S. banks and other financial institutions during the 4th quarters of the years going from 2013 to 2018 divided by type of underlying:

Table 10 – Notional levels of derivatives by underlying in $billions – post-crisis scenario

	2013 Q4	2014 Q4	2015 Q4	2016 Q4	2017 Q4	2018 Q4	Δ	%Δ
Interest Rate	$193,084	$174,687	$138,369	$124,488	$130,417	$128,166	-$64,918	-34%
Foreign Exchange	28,480	33,183	32,100	31,737	32,903	39,221	10,741	38%
Equities	2,028	2,537	2,395	2,475	3,080	3,374	1,346	66%
Commodities	1209	1,222	1,108	1,257	1,373	1,315	106	9%
Credit Derivatives	11,191	9,449	6,986	5,293	4,186	4,277	-6,914	-62%
Total Notional	235,992	221,078	180,959	165,252	171,958	176,353	-59,639	-25%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Figure 6 – Notional levels of derivatives by underlying in $billions – post-crisis scenario



Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

During this period, the notional levels of all of the different underlying derivatives increased making an exception for interest rate derivatives. The interest rate derivatives, which constitute the majority of derivatives held in portfolios, decreased by 34 percent going from $193.084 billion to $128.166 billion. Foreign exchange derivatives increased by 38 percent going from $28.480billion to $39.221 billion. Equities derivatives increased by 66 percent going from $2.028 billion to $3.374 billion. Commodities increased by 9 percent going from $1.209 billion to $1.315 billion.

The table below will show the changes in the composition of the portfolios by this categorization:

Table 11 – Weights of derivatives by underlying

	2013 Q4	2014 Q4	2015 Q4	2016 Q4	2017 Q4	2018 Q4
Interest Rate	82%	79%	76%	75%	76%	73%
Foreign Exchange	12%	15%	18%	19%	19%	22%
Equities	1%	1%	1%	1%	2%	2%
Commodities	1%	1%	1%	1%	1%	1%
Credit Derivatives	5%	4%	4%	3%	2%	2%

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Interest rate derivatives decreased their weight from 82 percent to 73 percent but remained without doubt the most important in portfolios. foreign exchange derivatives instead increased its weight from 12 percent to 22 percent, equities and commodities derivatives' weights remained relatively stables during this period at respectively 2 percent and 1 percent.

During the last five years the use of derivatives in the banking system revealed major changes. The overall decrease of notional levels of derivatives portfolios is without doubt one of the elements to be taken into consideration. The other relevant aspects are the significant decrease of credit derivatives, even if they constitute a small part of portfolios. As stated above, this can be understood by the new regulatory framework. The predominant weight of derivatives that are used as a dealer by banks, swaps and derivatives that have interest rates as underlying as it happened in the previous period.

Finally, analyzing the gross positive fair values and gross negative fair values it can be noted that the NCCE is of $341 billion, well below the 2008 peak of $804 billion.

3.4 Results

To compare the notional levels, ten-years variations are taken for each of the years in the time-frame. Table 12 will show the 10 years differences for the derivatives portfolios divided by type of user:

Table 12 – 10-years difference by user

	2003-2013 Q4	2004-2014 Q4	2005-2015 Q4	2006-2016 Q4	2007-2017 Q4	2008-2018 Q4
Dealer (Trading)	152,290	124,811	78,172	37,301	17,787	-12,271
End User (Non-Trading)	2,412	1,318	200	257	185	-153
Credit Derivatives	10,191	7,149	1,186	-3,707	-11,714	-11,623
Total Notional	164,893	133,178	79,459	33,752	6,358	-24,047

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

The most important period of changes that has to be taken in consideration is the one going from 2008 to 2018, the 10 years after the peak of the crisis, in which the regulatory framework tried to safeguard the institutions and the consumers. All of the notional levels decreased, especially the credit derivatives, that went from $15,900 to $4,277. Also trading derivatives decreased, even more than credit derivatives, but their change may be considered less relevant in relative terms.

Table 13 and table 14 will show respectively the 10 years differences differentiated by products and underlying.

Table 13 – 10-years variation by product

	2003-2013 Q4	2004-2014 Q4	2005-2015 Q4	2006-2016 Q4	2007-2017 Q4	2008-2018 Q4
Futures & Forwards	$28,627	$31,980	$23,591	$19,301	$15,507	$13,644
Total Options	17,705	15,281	11,989	3,073	11,141	7,709
Total Swaps	108,369	78,769	42,692	15,084	-8,576	-33,777
Credit Derivatives	10,191	7,149	1,186	-3,707	-11,714	-11,623
Total Notional	164,892	133,178	79,459	33,752	6,358	-24,047

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

Table 14 – 10-years variation by underlying

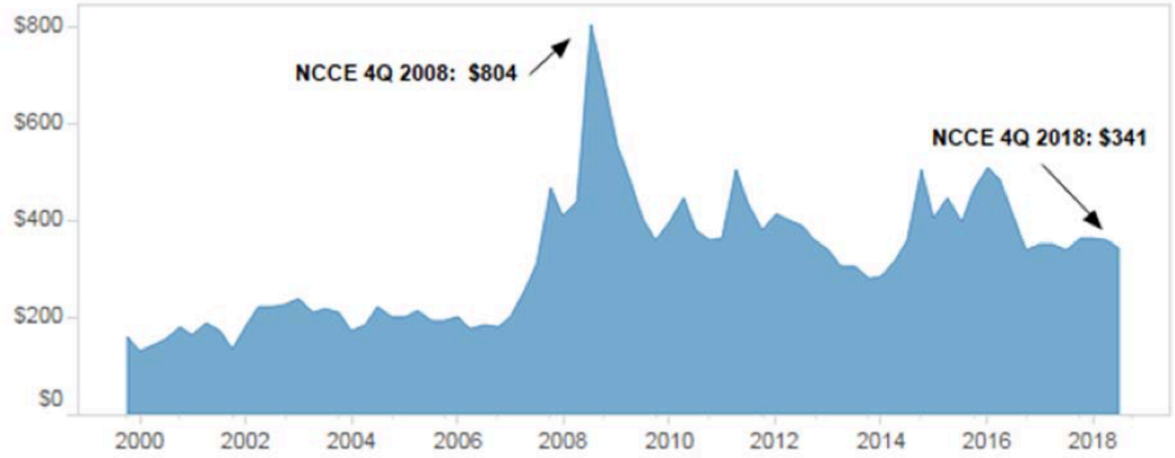
	2003 - 2013 Q4	2004 - 2014 Q4	2005 - 2015 Q4	2006 - 2016 Q4	2007 - 2017 Q4	2008 - 2018 Q4
Interest Rate	$131,184	$99,187	$53,869	$17,088	$917	-$36,234
Foreign Exchange	$21,280	$24,583	$22,800	$19,837	$16,303	$22,421
Equities	1,228	1,337	1,095	175	580	1,174
Commodities	1,009	922	508	357	273	215
Credit Derivatives	10191	7149	1186	-3707	-11,714	-11,623
Total Notional	164,892	133,178	79,459	33,752	6,358	-24,047

Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

From this data it can be seen that the most important changes during the last 10 years, in addition to the decrease of credit derivatives, are the decrease of interest rate derivatives and swaps derivatives. Together they have contributed to the $24,047 billion reduction of total notional levels.

Credit derivatives and interest rate derivatives declines in GPFV brought to a significant decline of NCCE since 2008. This can be seen in the figure below:

Figure 7 – Net Current Credit Exposure, in billions of dollars



Source: Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities*

This is a better estimator of the credit risk rather than the notional levels alone, which themselves are more a sign of business activity.

Finally, opposed to the general increase of the derivatives use in the 5 years pre-crisis, a significant decrease can be seen during the last five ears. The composition of portfolios, instead, did not receive particular shocks in these years, making trading derivatives, interest rate derivatives and swaps the most used instruments by the U.S. Banks.

Conclusions

This thesis analyzed the changes in the usage of derivatives by the banking system in the pre-crisis and post-crisis scenarios by looking at different compositions of the derivatives portfolios and valuate the differences and similarities in the trends and volumes of these portfolios.

After the analysis performed in the last chapter, it can be stated that significant changes have occurred during the considered time-frame. The overall notional level of derivatives used by banks increased heavily in the pre-crisis scenario while decreased in post-crisis scenario, but this is relevant only at a level of business activity. The substantial increase from 2003 to 2008 could be interpreted, indeed, as a blooming of the market activity correlated with the increase of the values of housing activities. The decrease instead may be due to trading compression efforts that brought a decrease of the need for risk management products. Trade compression makes numerous swap contracts (the product that had the highest decrease in the derivatives portfolios) that have similar risk and cash flows converging into fewer trades, reducing economic redundancy in derivative books, operational risks and capital costs for the largest banks. It still continues to be one of the most significant factors of decrease of the amount of notional levels of outstanding derivatives contracts as from 2013 to 2018 it went from covering $34 trillions to $216 trillions.[9] Although trade compression decreases trades, the economic exposure stays the same.

Due to Basel III rules on capital requirements and leverage ratio's reliance on gross notional exposure, this procedure permits banks to reduce capital needs for the covering of OTC derivatives trading book risk. This kind of operation, then, may in some cases have unclear effects on systemic risk because reducing exposure may not necessarily mean a decrease in default risk. This is also the case, because compression effect on bilateral trading is definitely beneficial in terms of reduction of the loss of value[10], but at the meantime the centrally cleared operations were adopted and, starting after the crisis, increased.

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[9] Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities* (Rep. No.93). (2019). Whashington, D.C.

[10] Kosmo S. (2018) *Analyzing the Effects of Trade Compression on Risk Propagation in Over-the-Counter Derivative Markets*

Due to the complexity of real-world markets in comparison to the ones modeled by the current literature because of cross-asset netting and time to maturity it is a difficult task to assess the effects that trade compression has on centrally cleared markets which today represent 40% of total derivative contracts.

The composition of the derivatives portfolios, on which the thesis focused, saw some changes during and between the two periods, but the derivatives held by banks for trading purposes remained all the time the ones that composed the significantly largest part of the portfolios. It must be also said that the trading revenues of banks, before the crisis, generally moved between 60 and 80 percent of the consolidated bank holding company trading revenue. Since then, this percentage ranged from 30 percent to 50 percent[11]. This is due to the adoption after the financial crisis of bank charters by investment banks that are included in bank holding company results but stayed outside insured commercial banks. The latter, indeed, have less legal authorities than banks holding companies, especially with respect to the trading of commodity and equity derivatives.

The main changes, instead, in the composition of these portfolios during these years were due to the rise and fall in pre-crisis and post-crisis scenario of credit derivatives. After their introduction in the banking system, they had the biggest relative increase in notional levels, followed by, after the crisis, a rapid and significant decrease. Again, to assess the reasons of these movements it should be considered the economic and regulatory framework of the past decades. To meet investor demand for higher yields, credit derivatives notional increased from 2003 to 2008 at a 100% compounded annual growth rate. In 2008 they peaked, and these derivatives were almost all credit default swaps more than a third of which referenced to sub-investment firms. In the last years instead, the notional level remained well below 2008 level, even if credit default swaps are always the majority of these derivatives and still almost a fourth of the derivatives reference to sub-investment grade firms. Again, the causes of the notional levels decrease may be found in the regulatory restrictions mainly suggested in Pittsburgh G20 and implemented in Basel III. With trade compression, however, the amounts of notional derivatives outstanding decrease and the real data of the number of trades are not easy to build. Banks are indeed more prone to trade because of reduced capital requirements for the compressed trades. For these reasons, even if the trends are confirmed to

[11] Office of the comptroller of the currency *Quarterly Report on Bank Trading and Derivatives Activities* (Rep. No.93). (2019). Whashington, D.C.

be of reduction, this does not necessarily mean that the usage of credit derivatives diminished in a significant manner. The extent, instead, to which these derivatives are used is, nonetheless, difficult to assess.

Returning to the net current exposure, instead, it can be clearly stated that it decreased from the all-time high level of 2008 and this is today one of the most comforting signs of soundness for the economy as a whole. However, the high concentration of the credit exposure in only the largest financial institutions and the benefits that leverage ratios get from compression may make this reduction less beneficial than it appears.

More generally, it can be stated that the trends that the volumes of derivatives transactions have followed in the two periods are of opposite slope, increasing in the pre-crisis scenario and decreasing in the post-crisis scenario. However, many of the good news about the recent reduction of notional amounts and credit exposure inside the banking system may be due to trade compression and net benefitting, which, despite delivering a simpler and more direct overview of the notional amounts, may be obscuring the real complexity of these transactions, with the risk of creating a new fertile soil for speculators.

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