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The Effect of Credit Derivatives Usage on the Risk of European Banks

El efecto del uso de derivados de crédito en el riesgo de los bancos europeos

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Abstract

It was generally believed by top regulators that credit derivatives make banks sounder. After the international financial crisis, the positive view of the role of credit risk transfer has changed and credit derivatives have been blamed as one of the responsible of the subprime credit crisis. Our purpose is to analyze whether the risk taken by European banks is affected by the use of credit derivatives. There are very few empirical works regarding this subjec and, in particular, in the European banking sector. We use as measures of risk the Z-score and other proxies of credit risk like the risk-weighted assets and non-performing loans (NPL) ratio. In summary, our results show that European banks that use credit derivatives for hedging experience an improvement in their level of financial stability, while those who opt for a speculative position test negative. Accordingly and based on these data, the cause of the current crisis in Europe could not be directly attributed to the use of credit derivatives.

Keywords: Banking Sector; Credit Derivatives; Credit Default Swaps; Bank Risk; Z-Score; Financial Credit Crisis.

Resumen

En general, existía la creencia de que los derivados de crédito contribuían a la solidez de los bancos. Después de la crisis financiera internacional, la visión positiva del papel de transferencia del riesgo de crédito ha cambiado y los derivados de crédito han sido señalados como uno de los responsables de la crisis del crédito subprime. Nuestro propósito es analizar si el riesgo asumido por los bancos europeos se ve afectada por el uso de derivados de crédito. Hay muy pocos trabajos empíricos sobre este tema, y en particular, en el del sector bancario europeo. Utilizamos como medida de riesgo el Z-score y otras proxies del riesgo de crédito, como los activos ponderados por riesgo y la tasa de morosidad (NPL). En resumen, nuestros resultados muestran que los bancos europeos que utilizan derivados de crédito para cubrirse experimentan una mejora en su nivel de estabilidad financiera, mientras no afectaría a su estabilidad a los que optan por una posición especulativa. En consecuencia y en base a estos datos, la causa de la actual crisis en Europa no se puede atribuir directamente a la utilización de derivados de crédito.

Palabras clave: Sector bancario; Derivados de crédito; Permuta de incumplimiento crediticio (CDS); Riesgo bancario; Z-score; Crisis de crédito financiera.

JEL Classification: G 14, G 15, G21.

1. Introducción.

The credit derivatives are recent products (appear at the beginning of the 1990s) and banks are the major participants in this market. They make a wide use of credit derivatives, acting as buyers, as protection sellers, or buyers and sellers at the same time; that is, they can use CDS to hedge their exposure to loans and bonds, as well as to trade credit risk and also to play an important role in intermediation. One of the reasons why we are interested in these products is that many studies on the causes of the current financial crisis conclude that the origin was linked to securitization and credit derivatives, because they helped to create new complex products.

So far, the research on this topic is not conclusive. On the one hand, there are those who believe that credit derivatives have contributed towards the resistance of the financial system during financial crises (Das, 1998; IMF, 2003; BIS, 2004; Batten and Hogan, 2002; JP Morgan, 2006; Mengle, 2007 and Angelini, 2012). On the other hand, there has also appeared a negative view of the role of credit derivatives that have been blamed for the difficulties associated with the subprime credit crisis (Duffee and Zhou, 2001; Instefjord, 2005; Morrison, 2005; Gibson, 2007; Shao and Yeager, 2007 and Heyde and Neyer, 2010).

Based on these two views and the scarcity of empirical works and taking into account that the main elements in this international financial crisis are credit derivatives (this work is not concerned with the securitization) and banks, the question arises whether the use of credit derivatives reduces or increases the risk profile in banks. Note that despite the importance of the issue, there are very few empirical studies and most of them are referred to the U.S. market. In addition, existing papers have considered the total credit derivatives but have not differentiated between those that are classified in the hedging portfolio and the trading portfolio. Another issue not covered in the previous papers is the existence of endogeneity between the variables. Therefore, our work uses much more complete information about the literature and, at the same time, provides empirical evidence on an issue that has not been addressed at the European level.

More specifically, our aim is to see the effect on financial stability of credit derivatives usage by banks. But considering that as different alternatives of these products can be made also the consequences may be different depending on the use that is made. We make a differentiation of these products based

on the portfolio in which they are included. The results of our analysis is that European companies experience an improvement in their financial stability (Z-score) when they use credit derivatives classified in the hedging portfolio and have a net buyer position, not being significant for those classified in the trading portfolio. The reason is the improvement the stability of their ROAA through hedging.

This work contributes to the existing literature by presenting unpublished evidence of the impact of credit derivatives on the European financial institutions. In addition, the database uses information not used so far, with a breakdown of derivative positions in more detail than for the U.S. market. Finally, the methodology used, dynamic panel data, allows us to control the endogeneity problem inherent in the variables under study.

The paper is organized as follows: first we proceed to make a compilation and summary of the main existing research that investigates the impact of the use of these products in banking. Then we conduct the empirical analysis, proceeding to define the independent, dependent and control variables and the descriptive analysis. And finally, we present the statistical model used to contrast the assumptions and the main results.

2. Related literature.

Reviewing the literature on credit derivatives we find contradictory views of their effects. The classic positive perspective of credit derivatives might be contained in the following words of Greenspan (2004): "The new instruments of risk dispersion (credit derivatives) have enabled the largest and most sophisticated banks in their credit-granting role to divest themselves of much credit risk by passing it to institutions with far less leverage". Also included in this group are the works of Das (1998), IMF (2003); BIS (2004), Batten and Hogan (2002), JP Morgan (2006), Mengle (2007) and Angelini (2012), who indicate that these products help to reduce risk in banks. This positive effect is attributed to the best diversification and reduction of risks, the increase in efficiency in banks, the improvement of liquidity through the credit risk transfer to the markets, and the flexibility for hedging risks and the separation of risk-taking from investment.

However, there is a significant set of works that argue that the use of these products has a negative effect[1] on bank risk. Duffee and Zhou (2001), Instefjord (2005), Morrison (2005), Gibson (2007), Shao and Yeager (2007) and Heyde and Neyer (2010) indicate that credit derivatives, in some cases, can increase bank risk.

[1] Among these, they emphasize: counterparty risk (Gibson, 2007; Thompson, 2009; Heyde and Neyer, 2010; Stulz, 2010), credit contagion (Jorion and Zhang, 2007; Babus, Carletti and Allen, 2009; Heyde and Neyer, 2010; Stulz, 2010), monitoring (Morrison, 2005; Partnoy and Skeel (2006), Minton *et al.*, 2009), market manipulation (Acharya and Johnson, 2007; Stulz, 2010), asymmetric information (Duffee and Zhou, 2001; Minton *et al.*, 2009), transparency (Stulz, 2010) and instability (Heyde and Neyer, 2010).

Using theoretical models, some authors such as Duffee and Zhou (2001) and Heyde and Neyer (2010) conclude that the use of credit derivatives is not always beneficial. Duffee and Zhou (2001) observed that if there is "adverse selection", the loan-sale market is much less useful. For Heyde and Neyer (2010), in a recession or in a boom period, the CDSs induce the banks to increase their investments in a risky and illiquid credit portfolio.

Other authors examine the reaction after hedging by banks with these products, such as reducing their monitoring and screening efforts (Morrison, 2005), the use of the capital structure (Jiangli and Pritsker, 2008) and the increase in lending (Instefjord, 2005 and Wagner, 2007). More specifically Instefjord (2005) in his paper, investigates whether credit derivatives make banks more exposed to credit risk because of identifying a dual effect (positive or direct impact and negative or indirect impact). When the bank has access to hedging instruments such as credit derivatives, on the one hand it provides better transmission and distribution of credit risk (enhancing risk-sharing when used as a hedging instrument), but on the other hand, and as a consequence of the above, they also make further acquisition of risk more attractive (major credit, a more aggressive participation). The result of these actions could have a negative effect and offset the benefits of hedging. The same conclusion is provided by Froot and Stein (1998) in making a rigorous theoretical analysis of active risk management. Therefore, these products can destabilize the banking sector and this can be dangerous in a systemic sector such as banking.

At the empirical level, very few studies have attempted to contrast or analyze the effects of credit derivatives in the banking sector. In this sense, Shao and Yeager (2007) have examined the effects of credit derivatives on bank risk, return, and changes in their loan portfolios and their capital levels. In this paper, they investigate the use of credit derivatives by U.S. bank holding companies (BHCs) between 1997 and 2005. From a global perspective, the full-sample results show that the use of credit derivatives increases the overall risk, lowers returns and is associated with the shift to riskier loans (more commercial and industrial (C&I) loans and less residential mortgage loans). A similar conclusion can be extracted from the work of Minton *et al.* (2009). They found that most U.S. banks' credit derivatives positions result from dealer activities rather than from loan hedging. They add that, even when banks have a so-called matched book, where they simultaneously buy and sell protection, counterparty risk may be very important. Consequently, their results show that one has to be careful in drawing conclusions because the subprime crisis has shown that the dealer positions of banks in credit derivatives have substantial risks and these positions create systemic risk. In addition, Nijskens and Wagner (2011) also analyze the effect of using credit derivatives on individual risk of the entities and the risk of the banking system. These authors concluded that the CDSs reduce the risk of individual banks but increase systemic risk, since banks would end up being more correlated, as CDSs are bought and sold with each other. Despite the negative effects supported by limited empirical references all made in the U.S., Stulz (2010), which analyzes how credit de-

fault swaps may have contributed to the credit crisis, does not believe that the possible negative aspects[2]related to credit derivatives are the direct cause of the subprime crisis. The origins of the financial crisis are defaults on subprime mortgages and the disappearing liquidity for such securitizations.

3.Empirical analysis.

Credit institutions may use derivatives to transfer or take on new risk. As already mentioned, banks use these products for hedging and for trading activities. As noted by Shao and Yeager (2007), Instefjord (2005) and Morrison (2005), it seems intuitively logical to think that protection buyers can reduce credit risk, compared to the increased exposure that may be experienced by protection sellers. But even buyers of protection may increase the risk[3] by investing in riskier portfolios after making coverage. Thus credit derivatives can reduce the financial soundness of banks, increasing their risk even when these products are used as hedging instruments. Consequently, the main goal of this paper is to analyze the effects of the use of credit derivatives on the overall risk for the European banks. For this purpose, we have developed a database with the consolidated financial statements of 134 European financial institutions during the period 2006-2010. Financial institutions used were obtained by applying the following criteria:

1. World Region/Country: European Union of 15.
2. Accounting standards: International Accounting Standards, International Financial Reporting Standards (IFRS).
3. Specialisation: Commercial banks, Savings banks, Cooperative banks, Real estate &mortgage banks, Investment banks, Bank holdings & Holding companies, Private banking / Asset management companies.
4. Listed banks: Listed banks.
5. Status: Active banks.
6. Last available year: 2010.

We have focused on Europe for several reasons, among them because there are not previous works on credit derivatives for European banks. In addition, European banks are also being affected by the current financial crisis. With respect to the period, it includes a stage before and after the crisis. In addition, prior to 2005 the information about credit derivatives is very little or non-existent.

[2] Negative aspects: reduction of incentives for monitoring, changed incentives for investors, counterparty risks, credit contagion, sheer size of gross exposures of dealers, market manipulation, creation of a large web of exposures across financial institutions and the over the counter market.
[3] Consistent with assuming more risk (lower quality, adverse selection and moral hazard credit expansion) that is hedged.

3.1. Description of the variables.

3.1.1. Dependent variables.

In our case, we have analyzed different options, trying to specifically consider the impact of the use of derivatives of both credit risk and the risk of bankruptcy. We have chosen to consider the Z-score ratio. The analysis is supplemented by other indicators of risk such as the risk-weighted assets and the rate of non-performing loans. The Z-score ratio seems interesting as a measurement indicative of the distance to default of a particular entity within a period of time. This ratio, used frequently in various empirical research papers as a measure which serves to determine the financial stability and risk of an entity, most notably by Boyd and Runkle (1993), De Nicoló *et al.* (2004), and Michalak and Uhde (2009), is determined in the following way:

$$Z \equiv \frac{\mu + k}{\sigma} \qquad [1]$$

where:

μ is the ROAA variable (Return on Average Assets),

k is the balance of capital relative to total assets of the entity (equity / total assets) and

σ is the standard deviation (volatility) of ROAA.

We estimate the variable Z-score for each of the financial institutions in the sample and in each of the years studied (2006-2010). The ratio Z-score measures "the distance to insolvency of an entity" so that a higher Z-score implies a lower probability of default risk (or financial stability), and vice versa.

Furthermore, we analyze the effect of the use of credit derivatives with other variables which are commonly used as proxies of the risk. One of the variables we have considered is the ratio of credit risk-weighted assets relative to total assets (RWA Credit / total assets), in line with the studies by Avery and Berger (1991), Shrieves and Dah (1992), Berger and Udell (1994), and Jacques and Aggarwal (2001), who use this ratio as a measure of credit risk. In this way we also analyze the impact of derivatives of credit on credit risk, this being one of the main risks which affects the operation.

Finally, we believe that the simple analysis of the evolution of this ratio is not enough, due to the possible direct and indirect impact of credit derivatives which we have already mentioned above. Taking this into account, the evolution of the non-performing loans (NPL) ratio has been incorporated in our study (non-performing loans / total gross loans). Thus, if a positive effect of credit derivatives is observed in the behavior of the default rate (increase in the rate) for all entities included in the sample, one might interpret this to mean that the indirect effect has had a negative influence on the risk profile of credit

institutions (greater risk), as the reinvestment of funds has been made in lower credit quality assets, or vice versa.

3.1.2. Independent variables and hypothesis

In previous papers, as well as indicated by Dias and Mroczkowski (2010), to determine the strategy followed, the net position held by the banks has been taken into account. We also consider the net position of the notional amount (net position of credit derivatives / credit portfolio) as Shao and Yeager (2007) and Minton *et al.*, (2009). But we use a greater degree of detail, because we use the net position of the hedging and trading portfolio and the net position by product type (CDSs and CLNs because it is deemed to be the most important in terms of the contracted amount). Thus, we have hand collected this information about those products contained in the annual accounts or in the published Pillar 3 Disclosures documents. In particular, these authors and also the European Central Bank Report (2004) assume that when banks act as net buyers of credit protection they have a hedged position. We follow these authors[4].

As a result, the relationship (*use of credit derivatives - financial stability)* that is expected will depend on the net position that the entity has and our assumptions are:

- *In the case of a net buyer position of the trading and hedging portfolio and of CDSs (It is understood that the bank follows a hedging strategy), we expect a positive relationship with the Z-score and negative with the ratio RWA Credit. If there were no negative indirect effect, a negative relation is expected with the ratio NPL. If there were negative indirect effect would be the opposite (hypothesis 1a).*
- *For net seller position behavior would be the contrary, that this type of strategy increases the risk of the entities (hypothesis 1b).*
- *With regard to the CLNs, due to the structure of the product, in this case it is the buyer of this product who assumes the credit risk. As a result, it is expected that positive net positions increase the risk of the company (hypothesis 1c).*

3.1.3. Control variables.

In addition to the independent variables for our study, we have included in the model a set of control variables, based on those used in the work of Shao and Yeager (2007), Garcia and Robles (2008) and Michalak and Uhde (2009).

[4] The limitations identified by Minton *et al.* 2009 are:
"a bank could have a net purchase of credit protection as part of its dealer activities;
the simultaneous purchase and sale of credit protection on different names could also decrease the bank's exposure to credit risk by diversifying its exposures and
it ignores basis risk that could arise from net purchases of credit protection to names other than the names in the bank's credit portfolio".

In this regard, we have taken into account the ratio of *the level of loans divided by total assets* in order to measure the effect of diversification. It is expected that as this ratio increases the portfolio loans are more diversified and they consequently have a positive impact on financial stability and negative impact on the credit risk proxies.

The *total assets* variable is included because it is another determinant of the risk. Larger banks may have more experience and capacity in the management of the risk than those of smaller size, as well as better conditions for diversifying their portfolios (Garcia and Robles, 2008). Thus, we expect a positive relationship with the Z-score ratio and negative with risk-weighted assets and the NPL ratio.

Also, we have controlled for the effect that the profitability and liquidity may have on the risk. As in Michalak and Uhde (2009), we have opted to include the *net interest margin*, the *liquidity* ratio and *efficiency* ratio. For the first two variables we can expect a positive effect on financial stability and negative risk-weighted assets and the NPL ratio, and of opposite sign to the efficiency ratio as defined in terms of costs compared to income.

We have also considered the possible impact of the level of exposure to *interest rate risk*, for which, as in the work of Shao and Yeager (2007), the gap between assets and current liabilities has been considered. A positive effect is expected on the level of risk so that a greater gap is negatively correlated with the Z-score and positively with the other two variables considered in the work.

Finally, we have included the securitized volume (securitization / total assets) that, like credit derivatives, can be used for hedging credit risk. In reference to empirical evidence of the effect that the securitization of assets has on bank financial stability, it should be noted that the results are not conclusive. On the one hand, some authors argue that securitization has a positive impact on the increased risk of the entity (Michalak and Uhde, 2009; Hänsel and Krahnen, 2007; Franke and Krahnen, 2007; Lockwood *et al.*, 1996). Against these, Jiangli and Pritsker (2008) and Uzun and Webb (2007) conclude that mortgage securitization has a positive effect on the financial stability of financial institutions. In our particular case, given that our analysis sample is limited to the scope of the work done by Michalak and Udhe (2009), we assume the negative impact of the securitization on financial stability.

Table 1. Variables and hypotheses considered

Variable		Prediction	Definition	Source
Total Risk [Z-Score]		Dependent variable	Ratio of the sum of equity capital to total assets and ROAA regarding the standard deviation of ROAA (sdROAA)	Bankscope, Authors' calculation
Credit Risk	Risk-weighted assets [Weightedas]	Dependent variable	RWA Credit / total assets	Bankscope
	NPL ratio % [Impairedtogrossloans]	Dependent variable	(non-preforming loans / total gross loans)	Bankscope
Equity Ratio [Equitytoas]		+	Equity / total assets	Bankscope
Net Position of trading [tradnetpos]		+	Net Position of credit derivatives in the trading portfolio/credit portfolio	Annual report and Pillar III disclosures
Net Position of hedging [hedgingnet]		+	Net Position of credit derivative of the hedging portfolio/credit portfolio	Annual report and Pillar III disclosures
Net Position CDSs [cdstotnet]		+	Net Position of CDSs/credit portfolio	Annual report and Pillar III disclosures
Net Position CLNs [clnnetpos]		-	Net Position of CLNs/credit portfolio	Annual report and Pillar III disclosures
Size [Logtotalac]		+	Ln (total assets)	Bankscope Authors' calculation
Net interest margin % [Netinteres]		+	(Interest income - interest expense) / assets	Bankscope
Efficiency ratio % [CosttoInco]		-	Cost to income	Bankscope
Liquidity % [Liquidity]		+	Liquid / Deposits & Short term funding	Bankscope
Credit Portfolio % [Netloansto]		+	Net lending / total assets	Bankscope
Securitization [Securitiza]		-	Securitization / total assets	Annual report and Pillar III disclosures Authors' calculation
Gap assets and liabilities short-term [GAP]		-	(Liquid Assets– Deposits & Short term funding) / total assets	Bankscope Authors' calculation

Note: In this case the signs that appear in the table refer to the relationship between the different variables and the variable global risk (Z-score). As regards the risk-weighted assets and NPL ratio, the sign is the contrary.
If there is indirect effect, the signs referred to credit derivatives and to NPL ratio would be the opposite.

Source: Own elaboration.

4. Descriptive analysis.

As a first step to the realization of multivariate analysis, table 2 presents the main descriptive statistics. As can be seen, the banks in the sample have an average total risk indicator (Z-score) of 2.07, although there is a wide dispersion, so that we find entities that were negative and others whose distance to default has values above 16. This dispersion also characterizes the other risk proxies, where there are entities that have little NPL, compared to others whose value exceeds 34. The same applies to risk-weighted assets. As for the variables representative of the use of credit derivatives, we can see how the average values are close to zero. This is because a significant number of entities do not use these products. However, noting the range of these values we can see the predominance of net buying positions, when we refer to hedge positions, and net selling positions in the case of trading operations, which practically coincide with the positions in CDS. In relation to CLNs, the net positions represent a very low proportion of the loan portfolio and buyer profile.

Table 2. Descriptive statistics for the variables in the sample

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Total Risk [Z-Score]	639	2.07053	2.78513	-3.05606	16.60133
NPL ratio [Impairedn]	422	4.87744	4.41957	0.07000	34.10000
Risk-weighted assets [Weightedas]	452	0.59133	0.20455	0.00000	1.30000
Net Position of trading [tradnetpos]	617	-0.00263	0.09353	-2.03420	0.70644
Net Position of hedging [hedgingnet]	617	0.00123	0.00990	-0.02819	0.13548
Net Position CDSs [cdstotnet]	617	-0.00102	0.09253	-2.03420	0.70644
Net Position CLNs [clnnetpos]	617	0.00010	0.00156	-0.00241	0.02810
Size [Logtotalac]	656	4.34760	1.01253	1.68191	6.41275
Equity Ratio [Equitytoas]	655	0.11336	0.14898	0.00238	0.97349
Net interest margin % [Netinteres]	652	2.25573	3.72136	-25.67900	52.71300
Efficiency ratio % [CosttoInco]	647	64.46294	23.30394	3.36000	352.30800
Liquidity % [Liquidity]	631	43.61182	65.33164	0.81800	862.83200
Credit Portfolio % [Netloansto]	624	55.25257	22.53893	0.00000	97.43800

Securitization [Securitiza]	670	0.03925	0.07958	0.00000	0.58979
Gap assets and liabilities short-term [GAP]	640	-0.39657	0.25983	-0.88782	0.52619

In the same way, in table 3 we show the number of entities and the percentage of the total sample that use credit derivatives, as well as the role played in that market. As is observed in the early years, there is an increase in the use of credit derivatives. The net buyer position of credit protection entities exceeds every year entities with a net selling position.

Table 3. Number of entities operating credit derivatives and net position

	2006		2007		2008		2009		2010	
	Nº entities	%	Nº entities	%	Nº entities	%	Nº entities	%	Nº entities	%
Number of entities that do not use credit derivatives.	86	64.1	83	61.9	76	56.7	77	57.4	77	57.4
Number of companies that use credit derivatives.	48	35.8	51	38.0	58	43.2	57	42.5	57	42.5
Net buyers of credit protection.	13	9.7	17	12.6	23	17.1	22	16.4	21	15.6
Net sellers of credit protection.	7	5.22	6	4.48	14	10.4	17	12.6	12	8.96

Source: Own elaboration.

In the table 4, we show for each of the countries included in the sample the number of banks classified according to their specialisation. As you can see, the countries with the largest number of banks in the sample are Italy, UK, France, Denmark and Spain, these countries are the 73.13% of the banks of the sample, and these countries have a high weight in the European economy. Moreover, also it is possible to verify how the vast majority of the sample banks are commercial banks and Bank Holdings & Holding companies, more specifically they represent 76.12% of the sample banks.

Table 4. Countries and specialisation of de banks

	Specialisation									
Country	Commercial banks	Saving banks	Cooperative banks	Real estate & Mortgage banks	Investment banks	Private banking & Asset management	Bank holdings & Holding companies	Total	%	Use credit derivatives
Austria (AT)	4		3	1			1	9	6.72	5
Belgium (BE)							3	3	2.24	2
Denmark (DK)	11						1	12	8.96	3
Finland (FI)	2						1	3	2.24	1
France (FR)	7	1	7	2	1			18	13.43	6
Germany (DE)	7					1	3	11	8.21	5
Greece (GR)	1	1						2	1.49	3
Ireland (IE)	2							2	1.49	2
Italy (IT)	14		6		2		3	25	18.66	14
Luxembourg (LU)							2	2	1.49	1
Netherlands (NL)	1						4	5	3.73	2
Portugal (PT)	2						2	4	2.99	3
Spain (ES)	7	1	1			1		10	7.46	4
Sweden (SE)	2	1			1		2	6	4.48	4
United Kingdom (GB)	10				1	1	10	22	16.42	6
Total	70	4	17	3	5	3	32	134	100	
%	52.24	2.99	12.69	2.24	3.73	2.24	23.88	100		
Use credit derivatives	35	2	7	0	4	0	13			

Source: Own elaboration.

In the same way, and after subdividing the sample between those entities that do and do not use credit derivatives (differentiated as 1 and 0, respectively), we have obtained the following differences of means, which are listed in table 5. As can be seen, very significant differences have been found in a number of variables. Thus, companies that use credit derivatives have a substantially higher level of risk, measured by any of the variables used, than those who do not, except in the case of risk-weighted assets. On the other hand, companies that rely on the use of derivatives have a larger size, which is consistent with the existence of economies of scale in the use of these instruments. In addition, the use of derivatives is associated with a lower net interest margin and a smaller gap of interest rates. To finish, it is important to emphasize the higher

level of securitized assets by the users of derivatives, a fact which supports the hypothesis of complementarity in the use of both instruments.

Table 5. Comparison of the independent variables between users and non-users of credit derivatives

	Credit Derivatives	N	Mean	T
Total Risk	0	335	2.41588	3.316***
[*Z-score*]	1	304	1.68995	0.001
NPL ratio	0	153	0.17208	3.721***
[*Impairedloans*]	1	269	4.28263	0.0002
Risk-weighted assets	0	184	0.66451	6.592***
[*Weightedas*]	1	268	0.54108	0.0000
Size	0	351	3.73542	-21.820***
[logtotalassets]	1	305	5.05209	0.0000
Net interest margin %	0	347	2.65712	2.955***
[*Netinteres*]	1	305	1.79906	0.0032
Efficiency ratio %	0	345	64.5322	0.080
[*CosttoInco*]	1	302	64.38377	0.9356
Liquidity	0	326	45.4745	0.740
[*Liquidity*]	1	305	41.62089	0.4595
Credit Portfolio %	0	319	57.00265	1.988*
[*Netloansto*]	1	305	53.42217	0.0472
Securitization	0	365	0.22333	-6.185***
[*Securitiza*]	1	305	0.59497	0.0000
Gap assets and liabilities short-term	0	335	-0.43198	-3.648***
[*GAP*]	1	305	-0.35767	0.0003

Note: This table presents the mean difference of the dependent and independent variables used in the empirical analysis between companies that use credit derivatives (1) and do not use credit derivatives (0). The t-statistic is used for the test of the equality of means. In this selection we considered the Levene test of equal variances. Significance level: *** means significant at 1% level, ** at 5% level, and * at 10% level.

5. Multivariate analysis.

The relationship between risk and the use of credit derivatives may be affected by endogeneity problems; the use of derivatives can be influenced by ex-ante risk, which could be correlated with the ex-post risk measures. To control this effect, the work of Shao and Yeager (2007) opts for Heckman methodology in two stages: in the first of these a probit model to calculate the probability of using credit derivatives is estimated, while the second is an ordinary linear regression analysis of fixed effects, which includes the Mills ratio. Against this alternative, we have opted to use the methodology of dynamic panel data, whose main advantage is that it allows us to control the unobserv-

able heterogeneity and in this way to avoid biased estimators. This aspect is very important in our analysis, as each credit institution has its own culture and its own way of managing risk. In addition, given the possible endogenous relationship between variables that is the subject of study, we have opted for a methodology based on dynamic panel data, which has been estimated using the generalized method of moments (GMM).

The dynamic panel data model to estimate the impact of using credit derivatives in the banking sector stability is

$$Y_{it} = \alpha_{it} + \beta_1 Y_{it-1} + \beta_2\, CD_{it} + \beta_3[logtotalassets]_{it} + \beta_4[Netinteres]_{it} + \beta_5[CosttoInco]_{it} + \beta_6[Liquidity]_{it} + \beta_7[Netloansto]_{it} + \beta_8[Securitiza]_{it} \quad [2]$$

In this model, *Y* represents the ratio Z-score of a particular entity *i* in period *t*, which is determined by the volume of credit derivatives used during the review period, in addition to a set of control variables, which we have already presented above. For its part, ε_{it} represents the error term, whereas α and β denote the parameters to be estimated. The parameter $\beta_2$refers to our independent variable. We aim to build as many models as independent variables we have defined ([tradnetpos], [hedgingnet], [cdstotnet] y [hedgingnet]), and for this we alternate the different independent variables in the parameter β_2 .

5.1. Empirical results.

The most notable of the results obtained from the analysis is the fact that the use of credit derivatives has a significant positive impact on the Z-score only when these products are used as hedging instruments, an aspect that is not committed to trading operations or for the overall net position with CDS (table 6). However, the expected sign is positive for both positions, according to the provisions of the assumptions. Therefore, the European entities that use credit derivatives with hedging purposes and that have a net buyer position experience an improvement in their financial stability. These results are consistent with those obtained by Shao and Yeager (2007), as these authors conclude that the use of credit derivatives has a positive impact on net protection buyers. However, the fact that net protection sellers reduce their financial stability is not confirmed. On the other hand, it is also necessary to point out that there is a significant negative relationship for companies that operate with CLN, which can be explained by the drop in value experienced by these instruments. In short, the results suggest that when institutions use these products for hedging purposes they can obtain an improvement in risk indicators, supporting the positive vision suggested by authors such as Batten and Hogan (2002), JP Morgan (2006), Mengle (2007) and Angelini (2012).

Moreover, just as one would expect, the control variable size has been significant with the positive sign expected, while the control variables efficiency and securitization had the expected negative sign. Thus, the size and efficiency

have a positive effect on financial stability, while the securitization, in accordance with the proposal by Michalak and Uhde (2009) for the European market, has a negative effect.

Table 6. Estimates of the effect of the credit derivatives on the financial stability of the European financial institutions (GMM).

	Z-score	*Z-score*	*Z-score*	*Z-score*
Z-scoret-1	*0.7177** (0.000)*	*0.7197** (0.000)*	*0.7228** (0.000)*	*0.6865 (0.000)*
Net position of trading	*0.6071 (0.622)*			
Net position of hedging		*7.4099* (0.050)*		
Net position CDS			*0.8666 (0.573)*	
Net position CLN				*-35.7755** (0.000)*
Size	*0.33090** (0.010)*	*0.2137 (0.117)*	*0.2788* (0.025)*	*0.3124* (0.024)*
Net interest margin	*0.0747 (0.866)*	*0.0020 (0.968)*	*-0.0002 (0.996)*	*0.0043 (0.931)*
Efficiency ratio	*-0.0313** (0.000)*	*-0.0309** (0.000)*	*-0.0311** (0.000)*	*-0.0320** (0.000)*
Liquidity	*0.0008 (0.764)*	*0.0009 (0.743)*	*0.0007 (0.786)*	*0.0015 (0.615)*
Credit portfolio	*0.0042 (0.485)*	*0.0069 (0.23)*	*0.0052 (0.407)*	*0.0058 (0.351)*
Securitization	*-2.6794* (0.068)*	*-2.5332* (0.095)*	*-2.4103* (0.021)*	*-2.9495* (0.021)*
Gap assets and liabilities short-term	*0.5127 0.435*	*0.4561 (0.497)*	*0.6242 (0.327)*	*0.4057 (0.554)*
Year 2007	*0.2385 (0.081)*	*0.2617* (0.088)*	*0.2297* (0.090)*	*0.2618* (0.066)*
Year 2008	*0.2564 (0.026)*	*0.2456* (0.063)*	*0.2578 (0.032)*	*0.2208* (0.053)*
C	*0.6709 (0.325)*	*0.875969 (0.0268)*	*0.7861 (0.246)*	*0.6221 (0.379)*
M2	*-0.22 (0.824)*	*-0.07 (0.943)*	*-0.26 (0.793)*	*-0.17 (0.868)*
Hansen test	*106.13 (0.433)*	*112.3 (0.295)*	*107.36 0.418*	*101.34 (0.5)*
Wald (χ2)	*296.13 (0.000)*	*287.99 (0.000)*	*286.94* (0.000)*	*391.84 (0.000)*
Number of observations	*476*	*476*	*476*	*476*

In table 7 and table 8 are respectively the panel data estimates for the generalized method of moments, where the dependent variable is the ratio *Weightedas* (RWA Credit/Total Assets) for table 7 and the ratio NPL (non-performing loans/total gross loans) for table 8.

The results obtained are significant only for trading operations whose coefficient is negative, which can be interpreted as net buying positions reducing the level of risk-weighted assets, while the opposite would happen in the case of the net selling positions. These results may be influenced by the fact that the test sample is different and we don´t have as much data as on Z-score. In the case of hedging positions and CDS, the sign has the same relation with the dependent variable, and confirms that companies acting as net buyers have a positive effect on risk reduction. In addition, liquidity, size, proportion of loan portfolio and the interest rate gap are the only control variables that affect the level of risk-weighted assets.

On the other hand, the analysis of the effect on the NPL rate reveals that no variable is significant. These results can be explained by the fact that trading in credit derivatives risk mainly affects the positions maintained in large companies or sovereign risk, while the delinquency rate comes mainly from retail operations. Thus, increased financial stability through credit derivatives are produced by hedging the market risk of the underlying assets and not through the control of delinquency in loan portfolios.

Table 7. Estimates of the effects of the use of derivatives for risk-weighted assets of european financial institutions (gmm method)

	(RWA Credit /Total Assets)	(RWA Credit / Total Assets)	(RWA Credit / Total Assets)	(RWA Credit /Total Assets)
Risk-weighted assets [*Weightedas*] *t*-1	0.5571167** (0.000)	0.5543108** (0.000)	0.5530137** (0.000)	0.5389737** (0.000)
Net position of *trading*	-0.0852198* (0.047)			
Net position of *hedging*		-0.4664682 (0.118)		
Net position CDS			-0.0384412 (0.453)	
Net position CLN				-0.8443886 (0.779)
Size	-0.0524914** (0.001)	-0.0604009** (0.001)	-0.0576269** (0.001)	-0.0647293** (0.002)
Net interest margin	0.0127897 (0.192)	0.0134035 (0.236)	0.0148101 (0.141)	0.0159542 (0.118)
Efficiency ratio	0.0003186 (0.301)	0.0002938 (0.273)	0.0002635 (0.331)	0.0003513 (0.185)
Liquidity	-0.000783 (0.114)	-0.0009122* (0.031)	-0.0007095* (0.075)	-0.0007856* (0.024)

	(RWA Credit /Total Assets)	(RWA Credit / Total Assets)	(RWA Credit / Total Assets)	(RWA Credit /Total Assets)
Credit portfolio	0.0025632** (0.000)	0.0025814** (0.000)	0.0026793** (0.000)	0.0026142** (0.000)
Securitization	0.0263365 (0.686)	-0.0125245 (0.857)	0.0230359 (0.745)	0.0360406 (0.640)
Gap assets and liabilities short-term	0.1171204 (2.35)	0.1502806* (0.033)	0.1183193 (0.108)	0.1336914* (0.069)
Year 2007	-0.0284834* (0.043)	-0.0305972* (0.029)	-0.0284606* (0.055)	-0.0275251* (0.042)
Year 2008	0.0024282 (0.822)	0.0036263 (0.758)	0.0023758 (0.841)	0.0019266 (0.862)
C	0.3931178** (0.005)	0.4525103** (0.002)	0.4101426** (0.003)	0.4560079** (0.001)
M2	-0.32 (0.747)	-0.29 (0.772)	-0.36 (0.716)	-0.33 (0.729)
Hansen test	89.65 (0.858)	88.68 (0.874)	89.25 (0.864)	89.12 (0.862)
Wald ($\chi 2$)	1081.37 (0.000)	1208.12 (0.000)	828.96 (0.000)	705.68 (0.000)
Number of observations	344	344	344	344

Table 8. Estimates of the effects of the use of derivatives for NPL of European financial institutions (GMM method)

	(non-performing loans/total gross loans)	(non-performing loans/total gross loans)	(non-performing loans/total gross loans)	(non-performing loans/total gross loans)
NPL [*Impairedloans*] *t*-1	0.9476788** (0.000)	0.9085208** (0.000)	0.9486359** (0.000)	0.9512798** (0.000)
Net position of *trading*	0.7865731 (0.648)			
Net position of *hedging*		-8.804782 (0.193)		
Net position CDS			0.3954388 (0.821)	
Net position CLN				-70.91038 (0.466)
Size	0.0738343 (0.831)	0.4070226 (0.276)	0.1584014 (0.656)	0.7514511* (0.085)

	(non-performing loans/total gross loans)	(non-performing loans/total gross loans)	(non-performing loans/total gross loans)	(non-performing loans/total gross loans)
Net interest margin	-0.1805434 (0.639)	-0.3145029 (0.455)	-0.2086747 (0.580)	-0.2441769 (0.574)
Efficiency ratio	0.0086932 (0.236)	0.0089362 (0.170)	0.0081382 (0.150)	0.0094658 (0.107)
Liquidity	0.0104558 (0.548)	0.0103177 (0.515)	0.0116494 (0.553)	0.00229 0.907)
Credit portfolio	0.0308421 (0.121)	0.0327467* (0.032)	0.0329947* (0.026)	0.0299635 (0.120)
Securitization	1.567628 (0.508)	0.7749458 (0.778)	1.323728 (0.567)	-1.017411 (0.622)
Gap assets and liabilities short-term	-0.9037744 (0.642)	-2.047015 (0.330)	-1.01609 (0.661)	-2.259207 (0.231)
Year 2007	1.174623** (0.000)	1.183114** (0.000)	1.138073** (0.000)	1.130082** (0.001)
Year 2008	-0.2945611 (0.286)	-0.156762 (0.611)	-0.2175924 (0.478)	-0.2001075 (0.545)
C	-2.800479 (0.404)	-4.596403 (0.176)	-3.34766 (0.329)	-6.080015 (0.116)
M2	0.44 (0.661)	0.64 (0.524)	0.42 (0.675)	0.41 (0.685)
Hansen test	84.07 (0.934)	80.96 (0.961)	79.54 (0.970)	83.43 (0.910)
Wald (χ2)	418.04 (0.000)	668.46 (0.000)	474.63 (0.000)	384.08 (0.000)
Number of observations	324	324	324	324

Note: Tables 7 and 8 report the panel data estimates for the generalized method of moments where the dependent variable are the impact on credit risk (RWA Credit /Total Assets**)** and the impact on NPL (non-performing loans/total gross loans). We analyzed the possible existence of specification errors, the level of model fit, normality and multicollinearity. According to Arellano and Bond (1991), as the number of periods is small relative to the number of companies, to gain efficiencies we chose to take as valid instruments all possible lagged values of variables from t-2. Also, to eliminate the individual effect of each company, the variables have been transformed into first differences. M2 is the contrast of second-order serial correlation using the waste in first differences, asymptotically distributed as a N (0.1) under the null hypothesis of no serial correlation. Hansen is a test for overidentifying restrictions, asymptotically distributed as a χ2 under the null hypothesis of no relationship between instruments and error, which has verified the validity of the instruments (degrees of freedom in parentheses). The Wald χ2 test is a goodness of fit, asymptotically distributed as a χ2 under the null hypothesis of no joint significance of the explanatory variables (excluding time dummies), which validated their explanatory power (degrees of freedom in parentheses). ** means significant at 1% level and * at 5% level.

6. Conclusion.

The objective of this work is to study the impact of the use of credit derivatives on the stability of the banking sector. Ultimately, the main motivations for this paper are the lack of empirical studies that analyze the effect of using credit derivatives on the financial stability of the banking sector and the absence of works referring to the European market; and as a result of the foregoing, the ignorance of the role played by these products in the financial crisis that started in 2007. The literature on this subject is not unanimous, and there are clearly contradictory views, some which consider that their use is beneficial, and some which point out that their use is harmful. By one hand, we have built a specific database (collected by hand) and we have broken down positions in derivatives referring to the European banking sector. We have used as a variable that is representative of the use of derivatives the net position (notional) that each entity has contracted. In addition, we have considered the information provided by companies that categorize these products within their trading and hedging portfolio, and we have considered it necessary also to carry out the analysis of the effect on risk by product type. We use technical analysis of panel data calculated by the generalized method of moments (GMM). Using this method allows us to control both unobserved heterogeneity and endogeneity problems of the explanatory variables, avoiding the appearance of bias in the estimates.

The highlight of the results of our analysis is that the use of credit derivatives has a significant impact on the Z-score. More specifically, European companies experience an improvement in their financial stability when they use credit derivatives classified in the hedging portfolio and have a net buyer position. This result is on the lines established by Shao and Yeager (2007). For CLN products, we observed a significant negative relationship whose explanation could be the loss of value experienced by these instruments when credit deterioration has occurred in recent years. We also found that the size and efficiency have a positive effect on global financial stability, while securitization in accordance with the proposal by Michalak and Uhde (2009) for the European market has a negative effect.

Our results do not allow us to confirm, as in the case of Shao and Yeager (2007), that sellers of protection see their profitability increase. In addition, the use of credit derivatives does not affect the leverage position of banks, indicating that institutions are not taking advantage of the improving solvency caused by hedging to increase their level of leverage.

Finally, we analyzed the impact of net positions in credit derivatives risk-weighted assets and the NPL rate. The results obtained are significant only for trading operations whose coefficient is negative, which can be interpreted as net buyer positions reducing the level of risk-weighted assets. This result is in line with that reported for the case of global risk, confirming that the net buyer positions reduce risk-weighted assets, while in the case of selling the effect is the opposite. In addition, we have observed that the effect on NPL is

not significant. Thus, increased financial stability through credit derivatives are produced by hedging the market risk of the underlying assets and not through the control of delinquency in loan portfolios.

In short, our results show that European banks that use credit derivatives for hedging experience an improvement in their level of financial stability, while those who opt for a speculative position test negative. This conclusion is in line with Shao and Yeager (2007). On the other hand, contrary to the findings established by these authors, entities are not observed exploiting the coverage to undertake more risky strategies, both in terms of leverage of portfolio that ultimately increases financial instability, and in terms of Z-score, risk-weighted assets or NPL. Furthermore, while in the European market banks using derivatives have a greater net buying position, we could say that they use these products mainly for hedging purposes. Accordingly and based on these data, it was not possible to attribute the direct cause of the current crisis in Europe to credit derivatives. Among our future research is on the one hand, you extend the years of the sample, and use some other variable market risk.

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