Financial innovation and bank behavior: Evidence from credit markets[*]

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Abstract

This paper investigates whether, and through which channel, the active use of credit derivatives changes bank behavior in the credit market, and how this channel was affected by the crisis of 2007-2009. Our principal finding is that banks with larger *gross* positions in credit derivatives charge significantly lower corporate loan spreads, while banks' *net* positions are not related to loan pricing. We argue that this is consistent with banks passing on *risk management* benefits to corporate borrowers but not with alternative channels through which credit derivative use may affect loan pricing. We also find that the magnitude of the risk management effect remained unchanged during the crisis period of 2007-2009. In addition, banks with larger gross positions in credit derivatives cut their lending by less than other banks during the crisis and have consistently lower loan charge-offs. In sum, our study is suggestive of significant risk management benefits from financial innovations that persist under adverse conditions – that is, when they matter most.

Keywords: Financial innovation, credit derivatives, syndicated loans, loan pricing, financial crisis

"*Credit derivatives [have] contributed to the stability of the banking system by allowing banks . . . to measure and manage their credit risks more effectively. . . .*"

Alan Greenspan, 2005

"*The boom in subprime mortgage lending was only a part of a much broader credit boom characterized by ... the creation of complex and opaque financial instruments that proved fragile under stress.*"

Ben Bernanke, 2008

1 Introduction

Financial innovations are at the centre of the debate on how to shape the future global financial system. The dominant view prior to the crisis of 2007-2009 was that financial innovations are beneficial for the financial system. The experience of the crisis has led to an – at least partial – reassessment of this view. Many policy makers now argue that the use of financial innovations needs to be restricted or prohibited. There is also general concern that financial innovations, while beneficial under normal economic conditions, may amplify shocks in times of crisis. Whether this concern is justified depends on why and how these innovations are used in the financial system. If, for instance, the innovations are employed by financial institutions to improve risk measurement and risk control, they may serve to insulate the financial system against negative shocks. The use of financial innovations may, however, also encourage risk-taking by financial institutions and cause dependence on their continued availability. This can result in greater vulnerability in times of stress.

Despite the importance of this issue, there is relatively little evidence on the channels through which financial innovations may affect the behavior of financial institutions and on how these channels are operating under adverse conditions. In this paper we analyze the key innovation in credit markets of recent decades – credit derivatives. Specifically, we examine whether, and through which channel, the active use of credit derivatives changes bank behavior in the credit market, and how this channel was affected by the crisis of 2007-2009. Credit derivatives – unlike traditional debt instruments, such as bonds and loans – make it relatively easy to hedge or source credit risk. Banks are major players in the credit derivative market and the market has grown dramatically over the last decade. The outstanding amount at the peak of the market in 2007 was estimated at $50 trillion by the BIS and has declined to $28 trillion by the end of 2011. It should be noted that unlike some other credit markets (such as the market for structured securitization products), the market for credit derivatives did not break down during the crisis.

Studies that examine banks' use of financial innovations show that under normal economic conditions these instruments facilitate the extension of credit and result in more favorable lending conditions for borrowers. In particular, lower borrowing costs are observed for loans intended for subsequent sale (Guener (2006)) or securitization (Nadauld and Weisbach (2011)).[1] Hirtle (2009) shows that greater credit derivative use by banks increases the credit supply to large firms and lowers corporate loan spreads on average. Ashcraft and Santos (2009) document that firms with a higher default risk face higher loan spreads after they become traded in the CDS market. Ashcraft and Santos argue that this effect is driven by reduced incentives for banks to monitor the default risk of these firms. These studies all analyze the pre-crisis period. In addition, in the interpretation of the results they focus on one particular channel through which credit derivative use may affect credit markets – they do not consider several channels simultaneously. This makes it difficult to obtain a view about the dominant channel and how this channel operates under different market conditions.

Our paper aims to fill this gap by examining various channels through which banks' use of credit derivatives may influence the pricing of syndicated corporate loans – both in normal times and in times of crisis. In addition, to further the understanding of the relevant channel, we complement the loan pricing analysis with an analysis of the lending behavior of banks active in the credit derivative market. We investigate four different channels. Credit derivatives may provide benefits that can be passed on to borrowers if banks use these instruments to i) hedge credit risk, to ii) reduce economic or regulatory capital, or to iii) actively manage the credit risk of their loan portfolios. Credit derivatives can also increase borrower risk (and result in higher spreads) if

[1] There is also evidence that loan sales (Cebenoyan and Strahan (2004)) and Collateralized Debt Obligations (Franke and Krahnen (2005)) lead to an increase in lending at banks.

the transfer of risk leads to iv) incentive problems at banks. In order to identify the channel we develop hypotheses about the link between either a bank's *gross position* in credit derivatives (the sum of protection bought and sold) or its *net position* (the difference of protection bought and sold) and loan pricing. The key prediction is that the risk management channel is the only channel which can operate through banks' gross positions. For example, a risk managing bank may reduce exposures arising from their lending business by buying protection but at the same time source credit risks on underrepresented risks through a sale of protection. All other channels require the bank to take a positive net position in credit derivatives.

Our dataset is based on loan-level information from the LPC DealScan database and bank-level information from the Call Reports covering the period from 1997 to 2009. The principal result from regression analysis is that, after controlling for lender, loan and bank characteristics, banks' gross positions in credit derivatives are significantly negatively related to the loan spread they charge to the average corporate borrower. By contrast, banks' net positions in credit derivatives do not display any association with loan spreads. This result provides support for the risk management channel but is inconsistent with the other channels through which credit derivatives may affect loan pricing. The effect is robust – in particular it is still present when we control for the use of other derivatives and take into account various endogeneity concerns. The effect is larger for borrowers that are more likely to be actively traded in credit derivative markets. The estimates for firms that are rated investment grade imply that a one-standard deviation increase in the banks' gross credit derivative position lowers their loan spread by 18% (46 bps). We also find that the risk management benefits extend to firms that are unlikely to be traded in the credit derivative market: their spread is reduced by 5% (13 bps).[2] Significant risk management benefits are thus passed on to the entire portfolio of borrowers and not only the borrowers that can be easily traded. This suggests that risk management reduces a bank's overall marginal cost of risk-taking. It may also reflect pseudo pricing – the practice at banks to price non-traded credit exposures using correlated traded credit exposures.

We then turn to the analysis of loan pricing during the crisis of 2007-2009. If banks

[2] The implied annual savings per loan are still in excess of $127.000.

use credit derivatives to properly manage risks, we would expect that their pricing advantage relative to other banks is not eroded during the crisis. We first document that loan spreads increased for all banks during the crisis, reflecting the fact that the crisis was driven by systemic factors that cannot be diversified away using credit derivatives. Second, consistent with effective risk management, we find that banks active in credit derivatives still charge loan spreads that are lower than those of other banks – in fact, the loan spread difference is essentially unchanged compared to the pre-crisis period. We also investigate the relationship between credit derivative use and the characteristics of lending at the bank level. Effective risk management would suggest that banks are less likely to face constraints under adverse conditions (Froot, Scharfstein and Stein (1993)). Consistent with this argument, we find that risk management banks cut lending back by significantly less than other banks. Risk managing banks also do not seem be more aggressive as their pre-crisis lending levels are comparable to other banks. There is thus no evidence for increased risk-taking arising from credit derivative use. Furthermore, we expect banks that actively manage their credit risks to have lower loan risks and not to suffer more from the financial crisis than other banks. In accordance with this, we find that banks with a larger gross position in credit derivatives have lower charge-offs than other banks and that this difference is not eroded (even partially) during the crisis.[3]

Our paper contributes to the literature on financial innovations, risk management, banking and corporate finance. Taken together, the analysis provides consistent evidence that banks use credit derivatives to improve their management of credit risks.[4] There is no evidence in support of other channels through which credit derivatives may affect loan spreads. Corporate borrowers benefit from risk management through lower spreads and these benefits do not seem to be limited to the borrowers whose risks can be directly managed using the derivatives. Our results also show that the benefits extend to the crisis period – not only through more favorable lending conditions but also through a more stable supply of credit. All in all, our results contain a positive message

[3]We also find that over the entire sample period the volatility of the average loan spreads charged by the group of active banks is about half of the spread volatility of the other banks. This further speaks to risk management benefits.

[4]Our results on financial innovations complement recent evidence on the link between risk management, control and performance of US bank holding companies (Ellul and Yerramilli (2010)).

about the benefits of this type of financial innovation – even in circumstances where markets are under great stress.

The remainder of the paper is organized as follows. In Section 2 we develop hypotheses that allow us to identify the channel through which credit derivatives might affect corporate loan spreads. In Section 3 we describe the data. In Section 4 we outline the empirical strategy and present the results. Section 5 concludes.

2 Hypotheses

Related studies and evidence from the banking industry suggest different channels through which credit derivatives (and risk transfer activities in general) may affect bank lending behavior. Subsequently, we briefly summarize the key channels. We also explain our approach to identifying the channels empirically.

Credit derivatives allow banks to transfer risk exposures to third parties by hedging exposures through the purchase of protection. This may reduce banks' incentives to screen and monitor borrowers (e.g., Morrison (2005)). We refer to this as the *Incentives Channel*. Ashcraft and Santos (2009) provide evidence for this channel. They investigate the effect of a firm being traded in the CDS market on the spread it has to pay on its loans. Ashcraft and Santos argue that once a firm is traded in the CDS market, banks can hedge their exposure to this firm. This may, in turn, lower banks' incentives to monitor. The firm's borrowing cost should then increase – as it becomes riskier. Consistent with this, Ashcraft and Santos find that riskier and informationally opaque firms, who benefit the most from bank monitoring, face higher spreads after the onset of trading in the CDS market.[5]

Credit derivatives may also affect bank lending through the *Risk Management Channel*. According to this channel, credit derivatives allow banks to better manage the risk in their credit portfolios. Banks can buy protection on overrepresented exposures and sell protection on underrepresented exposures. Banks can also use credit derivatives to keep the overall risk of their portfolio close to the target level. Among others, such

[5] Marsh (2006) finds that the announcement effect of a new bank loan is weakened when a bank actively uses securitization techniques to transfer the risk – consistent with reduced bank incentives.

risk management in form of active credit portfolio management provides benefits as it reduces the likelihood of financing constraints becoming binding. Risk management benefits may also obtain indirectly: the use of credit derivatives may induce banks to measure and price their credit risks more rigorously. An increased awareness of risks may make banks more efficient in their lending behavior. Empirical research provides evidence that risk management benefits enable banks to extend larger loan volumes (Franke and Krahnen (2005)) or to pass on the benefits to their borrowers through lower spreads (see Cebenoyan and Strahan (2004) for loan sales). If this channel is operative, we would expect banks that are actively trading credit derivatives to reduce the interest rate charged to borrowers. Hirtle (2009) examines this hypothesis. Controlling for bank and loan characteristics, Hirtle finds that for large borrowers, the net position of credit derivatives held by banks has a negative effect on loan spreads, and argues that this finding is consistent with banks managing credit risk. Global survey evidence confirms that large international banks have been following active credit portfolio management with credit derivatives for many years (Beitel et al. (2006)).

There are two additional channels through which credit derivatives may influence loan pricing. Both channels suggest a negative effect on loan spreads. According to the *Hedging Channel,* banks hedge their exposures by purchasing protection in derivatives markets.[6] Nadauld and Weisbach (2011) study whether this channel is operative for loan pricing. Nadauld and Weisbach examine the spreads of loans that are subsequently securitized. They provide comprehensive evidence that loans that were later included in a CLO exhibit lower spreads when they are issued. Another channel, closely related to the hedging channel, is the *(Regulatory) Capital Relief Channel.* This channel is based on the idea that bank lending is constrained because of the scarcity of regulatory bank capital. Credit derivatives can be used to alleviate this constraint by buying protection from third parties, thus releasing bank capital for new lending. This allows banks to grant new loans and to price loans more aggressively. Broadly consistent with this

[6] There is no universally accepted definition of hedging and risk management in the literature. In this paper we take hedging to mean the simple shedding risk using financial instruments, while risk management goes beyond this and requires banks to actively control the risk of their portfolio, which also involves the acquisition of new risks through derivatives.

channel, Loutskina and Strahan (2006) show that securitization diminishes the impact of bank financial conditions on loan supply.

While most of the studies have focused on one channel, our paper considers these channels jointly and aims to identify the key channel(s) through which credit derivatives influence corporate loan spreads. We note that the channels vary with their prediction regarding the impact on loan spreads (a spread reduction is suggested by the risk management, hedging and capital relief channel; a spread increase is consistent with the incentive channel). However, the key innovation in our paper that ultimately allows us to identify the dominant channel is that we separately consider the effect of the *gross* and the *net* position in credit derivatives on loan spreads (the gross position is the sum of protection bought and sold, while the net position is the difference between protection bought and sold). We argue that all channels except the risk management channel require the bank to take a positive net position in credit derivatives (i.e., to be a net protection buyer). Under the hedging channel, risk is only reduced if the bank sheds risk net, that is, buys more protection than it sells. Similarly, regulatory capital relief only occurs if the bank reduces its risk overall, again requiring the bank to take a net buy position. The incentive channel also requires banks to buy protection – but not to sell. The only channel that can become operative, without requiring the bank to be a net buyer, is the risk management channel. For example, diversifying the portfolio by shedding risk on overrepresented borrowers and assuming risk on underrepresented exposures can be achieved without taking a net position. Improvement of the measurement of risks requires regular use of credit derivatives but not to take a net position. We thus argue that finding an association between gross positions and loan spreads supports the risk management channel.[7] Moreover, the absence of a relationship between the net position and the spread would be evidence against the presence of each of the three other channels.

[7] It is important to point out that risk management can also take place by taking a one-sided position (i.e., with a gross of zero). Hence, the absence of a relationship between gross positions and spreads cannot be taken to imply that there are no risk management benefits.

3 The data

Our analysis is based on individual loan transaction data from the LPC DealScan database and bank level data from the US Call Reports. From the first database we obtain information on loan characteristics of syndicated loans, such as loan spread over LIBOR, loan maturity, loan amount, currency, loan purpose and loan type. We also obtain borrower characteristics such as industry, sales, rating and stock market listing. We only consider completed term loan transactions. The database also provides information about the lead arrangers that are involved in the syndicate. In addition, we consider only loans with a single lead arranger, as in the case of multiple lead arrangers it is difficult to attribute the effects of credit derivative use of individual banks to the spread offered by the lending syndicate. We match the lead arranger with bank-level data from the Call Reports. From the Call Reports we obtain quarterly bank balance sheet and income statement information. We also collect information about banks' off-balance sheet activities from these reports. From these we construct our main variables of interest: the outstanding volume of credit derivatives purchased and sold by the bank in each quarter. Note that credit derivatives are mostly in the form of credit default swaps (CDS), which are dominated by single-name CDS on large corporate borrowers. Thus our variable of interest captures the same type of firms as observed in the syndicated lending market. The sample covers the period from the first quarter of 1997 (when reporting requirements for credit derivatives started) until the fourth quarter of 2009. The final sample comprises a total of 2566 loan observations and 76 banks.

Table 1 reports summary statistics for our sample (loan spreads, gross and net positions are winsorized at 2.5%). The average (all-in) loan spread in our sample is 259.12 basis points and varies between 30 and 455 basis points. Our main variables of interest are banks' gross and net credit derivative positions. The gross position (the outstanding sum of protection bought and sold) is on average around 40% of total assets. The net position (the difference of outstanding bought and sold protection) is only 2% of assets on average (but varies widely between banks). Figures 1a and 1b depict the evolution of the quarterly averages of the gross and net credit derivatives positions over time[8]. It can be seen that, starting from the first quarter of 1997, the gross position held by banks increases over time. The net position fluctuates between -1% and 4% of assets. We can also see that starting from the end of 2005, banks increased their net purchase of protection, presumably in anticipation of a higher share of problem loans. Moreover, the coefficient of variation (mean divided by standard deviation) of the gross and net position is comparable (0.49 and 0.42), suggesting that the measures exhibit similar overall variation. The rank correlation between both metrics is positive but rather low (0.20).

Figure 2 compares the loan spreads charged by banks that are active in credit derivative markets with those of banks that are not. For this figure we consider a bank being "active" from the moment it either purchases or sells protection for the first time. We can see that throughout the sample period, active banks tend to charge lower spreads than passive banks.[9] The mean difference in the spread of active and passive banks is 44.73 bps and this difference is significant (t-statistic of 9.79). We also note that during the sample period there does not seem to be any trend in the spread differences among the group of banks. This is first evidence for credit derivatives use being associated with a persistently lower loan spread. In addition, the figure suggests that the spreads of the active banks are more stable over time compared to their passive counterparts, consistent with risk management effects.

4 Empirical method and results

4.1 The empirical strategy

We estimate a loan-spread model that controls for loan, borrower and bank characteristics. We proxy banks' credit derivative use with the gross and net positions of credit derivatives scaled by (total) assets. A significant negative relationship between the gross position and the loan spread supports the risk management channel. A neg-

[8]These figures exclude the Bank of America, which bought very large amounts of protection in 2005 and 2007.

[9]In the figure, for some quarters averages for passive banks are missing since there were no loans originated by these banks.

ative significant coefficient on the net position would provide evidence for the hedging or capital relief channel, while a positive relationship would be consistent with credit derivatives leading to incentive problems. The various channels also lead us to expect that the impact of credit derivative use may depend on the borrower type and whether banks operate under adverse circumstances. In a second step, we also study whether the loan-spread impact differs among borrowers and whether it changes during the crisis of 2007-2009.

In order to investigate whether credit derivative use has an effect on loan spreads, we estimate a standard loan pricing model (see Harjoto et al. (2006)), which we augment by adding banks' gross and net positions in credit derivatives as main explanatory variables:

$$\begin{aligned} spread_{b,f,l,t} &= \alpha + \beta_1 bank_b + \beta_2 year_t + \beta_3 grossCD_{b,t} + \beta_4 netCD_{b,t} + \sum_{i=1}^{K} \phi_i F_{i,f,t} \\ &\quad + \sum_{i=1}^{K} \gamma_i L_{i,b,f,l,t} + \sum_{i=1}^{K} \delta_i B_{i,b,t} + \epsilon_{b,f,l,t}, \end{aligned} \quad (1)$$

where b denotes the bank, f the borrower (firm), l the loan and t time. In (1) *spread* is the loan spread, *bank* is a set of bank dummies and *year* is a set of time dummies. The term $grossCD$ denotes the sum of credit protection sold and purchased by a bank and $netCD$ is the difference between credit protection purchased and credit protection sold. The terms F_i denote borrower characteristics. These include dummies indicating the industry group of the borrower and the logarithm of the sales in US dollars. We expect firms with more sales to have lower spreads since large firms are more likely to have built a reputation and are less likely to suffer from problems of informational asymmetries. We also include a dummy indicating whether the borrower is listed on the stock market (*ticker*). We expect a negative association between this dummy on one side, and the loan spread on the other side. This is because public firms are likely to face lower informational asymmetries. Further we control for a set of dummies that indicate the S&P senior debt rating of the borrower (using non rated firms as the omitted category). Within the set of ratings, we expect higher rated firms to be charged lower spreads.

The terms L_i refer to loan characteristics. Following Harjoto, Mullineaux and Yi (2006), these controls include two dummy variables that indicate whether the database denotes a loan as *secured* and whether it denotes a loan as *unsecured* (the omitted category are loans for which securitization information is missing). It is not clear what sign to expect for these dummies. Safe borrowers may use collateral to signal their type to the lender (Besanko and Thakor (1987) and Chan and Kanatas (1985)). If this is the case, secured loans should be associated with lower spreads. However, there is evidence suggesting that lenders require collateral for riskier borrowers, which would lead to higher spreads (Berger and Udell (1990) and Berger, Frame and Ioannidou (2011)). We also include among the controls the logarithm of the loan amount in US dollars ($log(amount)$). Again, the loan amount coefficient can be positive or negative. Larger and safer firms usually demand larger loans, hence we should expect lower spreads for such loans. However, larger loans also have a higher probability of default and may in addition result in overexposures in banks' credit portfolios, suggesting higher spreads. The next set of variables contains dummies for the loan maturity: *shortmaturity* for term loans with maturity of less than two years, *intermediatematurity* for term loans with maturity between two and five years, and *longmaturity* for term loans with a maturity exceeding five years. The expected sign on these dummies is also ambiguous. There is some evidence of longer maturity loans being associated with higher spreads (Dennis, Nandy and Sharpe (2000)) but other studies show that short maturity loans exhibit higher spreads (Strahan (1999)). We further include a set of loan purpose dummies (*corporatepurposes*, *acquisitions*, *backupline*, and *debtrepayment*). Finally, we consider dummies for the tranche type. $TERM$ indicates terms loans without a tranche structure and $TERMA$, $TERMB$, $TERMC+$ indicate whether a loan is designated to tranche A, B, C or higher, respectively (for details, see also Nadauld and Weisbach (2011)).

The terms B_i stand for bank characteristics. We include as a proxy for bank size the logarithm of assets. We expect this coefficient to be negative given that larger banks are expected to have a lower cost of funds due to better access to debt markets. We also include a measure of a bank's liquidity equal to cash plus securities over assets ($liquid\ assets/TA$). We expect this coefficient also to be negative, reflecting that also liquid banks find it cheaper to fund loans. Further we include as additional controls the return on assets (ROA), the amount of charge-offs over assets ($chargeoff/TA$), subordinated debt over assets ($subdebt/TA$) and equity over assets ($equity/TA$).

4.2 Credit derivative use and loan spreads

Table 2 reports the results of regressions that relate loan spreads to banks' credit derivative positions. All regressions include borrower controls, loan controls and dummies for industry, loan purpose and year. Standard errors are clustered at the bank level. Regression 1 includes the bank controls next to the gross and the net positions. The coefficient of the gross position takes a negative value (-8.66) and is significant at the 1%-level. The coefficient of the net position is not significant. This result provides support for the risk management channel but not for the other channels. The magnitude of the effect for the gross position indicates economic significance. It implies that a one standard-deviation increase in the ratio of the gross position over (total) assets decreases loan spreads by about 8 basis points. Given a mean spread of 259 bps this implies spreads fall on average by 3%. The implied annual savings for borrowers are about \$127.000 per loan as the average loan size is \$159 mln in our sample. This is a considerable impact – in particular since this is the impact on the *average* borrower in the syndicated loan market (many of these borrowers are not actively traded in the credit derivative market). Also note that the gross and net position exhibit approximately the same relative variation compared to their mean (coefficient of variation), indicating that there is no bias in favor of finding a significant effect on one or the other measure.

Among the borrower controls, we can see that larger firms are charged lower spreads. The same is found for firms which have a stock exchange listing – but the significance is only marginal. Various rating category dummies turn also out to be significant (the insignificance of the other rating dummies is due to the fact that for these ratings there are only few observations). Among the significant rating categories, loan spreads are found to decline with the firm's S&P rating – as expected. Turning to the loan controls, we find that there is a negative and significant association between loan amount and loan spreads. This may reflect the tendency for large loans to be given to larger, established, firms. Secured loans have significantly higher, and unsecured loans have significantly lower, spreads. This is explained by banks being more likely to require collateral for lending to risky firms (see Berger, Frame and Ioannidou (2011)). Among the maturity variables, the long-term dummy enters with a negative sign and is weakly significant (at the 10% level). The loan tranche indicators are positive and significant. Since the omitted category is loans without a tranche structure, this indicates that tranched loans are more risky and consequently command higher spreads. From the bank controls only the charge-offs are significant. They enter with a positive sign. This result likely reflects that banks that have many problem loans in their book incur higher costs and pass these costs on to their borrowers.

Regression 2 includes bank fixed effects instead of bank controls. The coefficient on the gross position increases in absolute value to -10.35. The net position remains insignificant. The other coefficients in the model are mostly unchanged. We take this model to be our baseline model. There is the concern that the insignificance of the net position is driven by a potential multicollinearity between net and gross positions. However, the correlation among these variables is not very high (0.22). To be sure, regression 3 reports results where the gross position is excluded. The net position remains insignificant. The impact of the net position may conceivably also depend on whether the net is positive or negative. We thus modify the baseline model by including separate terms for positive and negative net-positions (unreported). These terms are each insignificant and the gross position remains significant.

Some of the previous results suggest that loan characteristics and loan spreads are jointly determined. In regression 4 we follow the literature by estimating a model that excludes the loan controls. The coefficient of the gross position now increases in absolute value to -13.69. This surely reflects that some of the loan controls are correlated with credit derivative use at banks. However, the coefficient on the gross position remains significant and that on the net position stays insignificant. The key result is thus robust to the exclusion of potentially endogenous loan controls.

A key concern at this stage is that banks also have means for risk management other than through credit derivatives. Use of these means is conceivably correlated with credit derivatives. The gross credit derivative position may hence also proxy for general sophistication in bank risk management. In this case, our estimated effects cannot (exclusively) be attributed to credit derivatives. To address this issue, regression

5 controls for the stock of other derivatives used for hedging (these derivatives include interest rate, foreign exchange, equity, and commodity derivatives). The coefficient on the gross position is essentially unchanged and the other derivatives turn out to be insignificant. We have also estimated a version of regression 5 where instead of including the sum of all other derivatives we include each derivative separately. The results for our variables of interest are essentially unchanged (not reported here). This result suggests that the risk management benefits do indeed come through credit derivatives. Among the other derivatives all are insignificant except the commodity derivatives (which are significant at the 10% level).

Another important issue is the potential endogeneity of the gross credit derivative position. A bank that pursues a risky strategy may simultaneously underprice in the syndicated lending market and write protection in the CDS market. Alternatively, a bank that faces good lending opportunities may have low lending rates and hedge the additional amount of loans using credit derivatives. However, this type of endogeneity affects the net position of credit derivatives. It is more difficult to conceive how endogeneity may affect gross positions. Endogeneity problems are also limited in our setting since we control for bank fixed effects and time effects. Nonetheless, we also employ an IV-estimation to account for remaining endogeneity. Our instruments for the gross position are other derivatives held for trading purposes.[10] Banks typically start hedging activities in derivatives following trading in derivatives. We thus expect derivatives for trading to be a good explanatory variable for credit derivatives (Minton, Stulz and Williamson (2009) find that use of credit derivatives is highly correlated with the trade of other derivatives). At the same time, we do not expect trading of derivatives to have a direct independent effect on the lending business of banks. Trading is typically done in response to short-term profit opportunities and it is difficult to conceive of how this should affect a bank's lending strategy. In addition, in most banks trading activities and lending activities are carried out in separate organizational entities that do not communicate. Regression 6 reports results from an IV-regression where the gross credit derivative position is instrumented with the various other derivatives held for trading (interest rate, foreign exchange, equity and commodity derivatives). The F-test

[10] The Call Reports distinguish derivatives held for trading for all derivatives except credit derivatives.

of 636.38 in the first stage of the IV regression indicates that trading derivatives are good instruments as they are highly correlated with credit derivatives. The J-test has a p-value of 0.40. This indicates absence of endogeneity for the instruments, confirming that non-credit derivatives trading activities are not related to loan pricing. The coefficient of the gross position is still significant. The size of the coefficient decreases in absolute size, but only slightly so (to -9.22). A specific type of endogeneity may arise from a contemporaneous dependence of gross positions on demand or supply side considerations. In regression 7 we thus include the one-year lagged gross position – instead of the contemporaneous one. The coefficient now increases in absolute size (to -11.50) and is significant at the 1% level. We conclude that our results are not driven by endogeneity problems associated with banks' gross positions in credit derivatives.

Call Report data does not differentiate between credit derivatives used for trade and not for trade. This opens up the possibility that our results are influenced by market-making activities of banks. In a robustness check we hence exclude dealer banks from the sample. Following Hirtle (2009) we define dealer banks as banks that have more than $10 billion in credit derivatives at some point in our sample and banks that are among the two largest credit derivatives users in a given period. Column 8 shows that the coefficient increases in absolute value and remains negative and significant (the effect remains economically significant; a one standard-deviation increase in the gross position decreases loan spreads by about 2.6%).[11] We have also run other robustness checks, such as allowing for group-specific trends for active and passive banks, clustering at the firm level and scaling variables by loans instead of assets (not reported here). These do not show any noteworthy change in our variables of interest.

In sum, the evidence in this section suggests a stable and negative association between banks' gross credit derivative positions and loan spreads. The effect is robust to controlling for various forms of biases that may arise in the context. No association between net positions and loan spreads can be found. The results thus lend support to the hypothesis that banks use credit derivatives to manage risks more effectively and

[11] We have also estimated our model using the approach in Minton et al. (2009) to exclude dealers from the sample, which is only to include banks with a (strictly) positive net position. The results are similar.

pass on gains to borrowers. By contrast, there is no support for other channels through which credit derivative may affect loan spreads.

4.3 Loan spreads by borrower type

The baseline analysis shows that borrowers at banks active in credit derivatives benefit from lower loan spreads. In this section we analyze whether this effect is uniform across borrowers, or whether specific types of borrowers benefit more. Since the universe of liquid credit derivatives mainly consists of large, investment-grade rated corporate borrowers, our expectation is that risk management gains are the largest for these firms.

For this we add interaction terms between gross positions and borrower types to the baseline model. Table 3 reports the results. Regression 1 shows the results of a specification that looks at whether the credit derivative effect is different for large firms. The dummy variable *Large* indicates whether a firm belongs to the 25% largest percentile of our sample in terms of sales. The interaction term of this variable with the gross amount in credit derivatives captures the difference in the effect of risk management for these firms. The coefficient of the interaction term is negative and significant, indicating that the largest firms benefit more from risk management at banks.

Regression 2 studies whether investment grade rated firms experience a different loan spread effect. We include interaction terms with dummies indicating whether the firm is a low risk entity (i.e., the S&P rating of its senior debt is A or better) or a high risk entity (i.e., the S&P rating is BBB or worse). The omitted category are unrated firms. The low risk interaction term obtains a very high coefficient in absolute values (-42.24) but is only weakly significant. The low significance most likely reflects limited rating coverage in our sample (low risk firms represent only a fraction of 0.7% in the sample while high-risk firms are 16%; the remaining 83.3% are unrated firms). The combined coefficient from the interaction term and the non-interacted gross position is -52.76. Thus, a one-standard deviation increase in gross positions at banks results in a loan spread for firms rated low-risk that is 46 bps lower (equivalent to a spread reduction of 18%).

We also study whether firms listed at the stock market benefit more from banks' use of credit derivatives. Stock market listing – after controlling for the presence of a rating

– is likely to be unrelated to a firm's presence and liquidity in the credit derivative market. Consistent with this we find that the interaction term of stock market listing and the gross credit derivative position is insignificant (see regression 3).

Regressions 1-3 have considered whether firms more likely to be actively traded experience different credit derivative effects. In the respective regressions, the non-interacted gross-position coefficient stays significant. This result suggests that firms less likely to be actively traded also benefit from enhanced risk management. In regression 4 we address this question directly. We constrain our sample to the set of firms that are unrated (and hence are very unlikely to have active credit derivatives trading). The effect on the gross position is significant and the coefficient (-13.23) is of similar magnitude to the one in the baseline model. This suggests that risk management benefits also extend to the firms for which the bank cannot directly manage risks using credit derivatives. This is consistent with risk management (balancing risks within the portfolio, keeping total risks close to the desired levels and improved measurement of risks) that reduces the banks' *overall* (marginal) cost of taking on risk. It may also partially reflect *pseudo-pricing* – the practice of banks to price untraded exposures using correlated traded exposures – which allows banks to reduce risks on exposures for which credit derivatives do not exist.

In sum, the evidence in this section suggests that firms generally seem to benefit from credit derivative use at banks, but firms that are more likely to be actively traded in the credit derivative market are the largest beneficiaries.

4.4 Loan spreads during the crisis of 2007-2009

It has been argued that financial innovations, while beneficial in normal times, may amplify the effects of crises. While this is likely to be the case under (for example) the incentive channel, the presence of a risk management channel suggests that benefits continue to be present under adverse circumstances. We note that the risk management channel, unlike the incentives, hedging and capital relief channel, is likely to be persistent over time. This is because banks' decision to engage active credit portfolio management is typically a one-time decision, and bank risk culture tends to be a stable characteristic (see Ellul and Yerramilli, 2010; Fahlenbrach, Prilmeier and Stulz, 2011).

In this section we investigate whether the difference in loan pricing between active and passive banks persists during the crisis of 2007-2009. For this purpose, we re-estimate the baseline model allowing the coefficient of interest and the intercept to differ after the onset of the financial crisis.

Table 4 presents the results. Regression 1 includes a dummy indicating the crisis period (which we take to start in the last quarter of 2007). This dummy is significant and its coefficient indicates that loan spreads increase during the crisis period by 42.66 bps. Regression 2 includes the interaction term between the gross position of credit derivatives and the crisis dummy. The non-interacted gross position term stays significant and obtains a coefficient of -12.19. The interacted gross position term is insignificant. This result suggests that the benefits of credit derivative use remain unchanged after the onset of the financial crisis.

A concern with regression 2 is that banks may have changed their credit derivative activities in response to the crisis. The crisis interaction term in regression 2 relates to the contemporaneous gross position. It thus does not directly measure benefits from risk management prior to the crisis. In regression 3 we look at how loan spreads change for banks depending on their credit derivative activity prior to the crisis. We thus include an interaction term of the crisis dummy with banks' gross position in the third quarter of 2007. We find that the interaction term remains negative and insignificant. The persistence of the loan spread benefit is thus not driven by banks' responses to the crisis but by prior engagement in credit derivative markets.

We finally consider whether net positions in credit derivative markets lead to different loan spreads in the crisis. We thus include the net position and the net position interacted with the crisis dummy. The interaction term is insignificant. We also note that our prior results are unchanged as the non-interacted net term also remains insignificant.

In conclusion, the evidence suggests that even though loan spreads generally increased after the onset of the financial crisis, the benefits of borrowing from banks' engaging in risk management via credit derivatives persist during the crisis.

4.5 Credit derivative use and bank lending

The evidence from the loan-level regressions supports the hypothesis that banks use credit derivatives for risk management purposes. In this section we look at banks' lending characteristics in general. If banks successfully manage their risks, we would expect banks active in credit derivative markets to experience lower losses on loans. In addition, we would expect these banks to be less likely to be constrained when credit risks in the economy worsen and also to exhibit more stable lending behavior.[12]

Specifically, we relate in this section lending characteristics at the bank level to banks' use of credit derivatives. First, we study whether charge-offs on commercial and industrial loans are related to credit derivative use and whether this effect changes during the crisis. Second, we study how the lending volume of banks before and during the crisis depends on the credit derivative activities. For this analysis we use yearly bank level data from the Call Reports. We include in our sample observations for the years 2006 to 2010. We estimate two models:

$$Netchargeoffs/TA_{b,t} = \alpha + \beta_1 Crisis_t + \beta_2 GrossCD_{b,t} + \beta_3 Crisis_t * GrossCD_{b,t} + \sum_{i=1}^{K} \phi_i B_{i,b,t} + \epsilon_{b,t} \quad (2)$$

$$CommercialLoans/TA_{b,t} = \alpha + \beta_1 Crisis_t + \beta_2 GrossCD_{b,t} + \beta_3 Crisis_t * GrossCD_{b,t} + \sum_{i=1}^{K} \phi_i B_{i,b,t} + \epsilon_{b,t} \quad (3)$$

In the first model, the dependent variable is the sum of net charge-offs (charge-offs minus recoveries) of commercial and industrial loans minus the net gains of credit derivatives scaled by assets. We include the gains on credit derivatives in order to capture potential risk management benefits: if a bank effectively manages its risk, charge-offs (recoveries) of loans should be off-set by gains (losses) in credit derivatives holdings. The terms B_i stand for other bank characteristics. These include: subordinated debt, equity, liquid assets, total loans and commercial loans (scaled by assets). We also include the logarithm of assets and the ROA.

[12] Figure 2 already suggested that the loan pricing behavior of active banks is more stable than that of passive banks (the standard deviation of the quarterly spreads of the active banks is nearly 50% less than that of the passive banks).

If credit derivative use extends risk management benefits, we should see that banks with larger gross amounts of credit derivatives face a lower level of net charge-offs in a given period. We hence expect the coefficient on the gross amount of credit derivatives to be negative in the first model. The crisis regressions have shown that (although spreads increased across the board) the loan spread differential between banks active on both sides of the credit derivative market and other banks persisted during the crisis. This result suggests that banks with active risk management did not encounter larger losses than other banks. Accordingly, we expect the interaction term of the gross position and the crisis dummy in the model to be insignificant or even negative.

The dependent variable in the second model are commercial loans scaled by assets. We include the same set of bank controls but exclude the dependent variable. Banks that successfully manage their risk should be less constrained under adverse conditions. They should have more stable lending and possibly be able to expand lending activities (relative to passive banks) in times of crisis. We thus expect the interaction term of the gross derivative position with commercial lending to be non-negative or even positive.

Table 5 displays the results of both models. In both regressions standard errors are clustered at the bank level. Regression 1 displays the results for the net charge-off regression. We see that banks with higher gross positions have significantly lower charge-offs as indicated by the coefficient of the gross positions. The coefficient on the crisis dummy is positive and significant – indicating that charge-offs increased during the crisis. The interaction term of the crisis dummy with the gross position is insignificant. Thus, the advantage (in terms of lower charge-offs) of banks active on both sides of the credit derivative market persists during the crisis.

Regression 2 estimates the lending volume model. We find that the coefficient for the gross position in credit derivatives is not significant in this regression, indicating that active users of credit derivatives do not extend more commercial and industrial loans than other banks. The negative sign on the crisis dummy shows that the volume of commercial and industrial loans extended by banks overall decreases during the crisis. The interaction terms of the crisis dummy and the gross position is positive and significant. Thus, banks active on both sides of the market increased their lending volume relative to passive banks. This is consistent with risk management stabilizing the lending activities of these banks.

Summarizing, the bank-level regressions suggest that banks active on both sides of the credit derivative market face lower charge-offs in both normal times and in times of crisis. In addition, they are able to expand their lending relative to passive banks in crisis times. These findings are consistent with risk management benefits from credit derivative use.

5 Conclusions

The debate on the costs and benefits of financial innovations is still ongoing. There is no consensus about whether their impact on the financial system is broadly a positive one or not. To a significant extent this is owed to the fact that we have little knowledge about the channels through which financial innovations affect the behavior of players in the financial system. In this paper we have investigated financial innovations and their role in the economy by studying their impact on loan pricing. We focus on credit derivatives – probably the most significant financial innovation of the past decade. There are several potential channels through which credit derivatives may impact lending behavior and affect economic activity. We derive hypotheses that relate these channels to loan pricing and use a new empirical strategy that allows us to identify the key channel.

We estimate a standard pricing model for syndicated loans that includes information on banks' use of credit derivatives and controls for loan, borrower and bank characteristics. Our key result is that a bank's gross position in credit derivatives has a significantly negative and robust effect on corporate loan spreads. We argue that this indicates that banks use credit derivatives for risk management purposes and pass the arising benefits (at least partly) on to borrowers. Such benefits include a better risk-balance within the loan portfolio, an improved ability to keep risk-levels at target ratios but also banks becoming more sophisticated in the measurement and control of their credit risks. We also find that the benefits from risk management persist after the onset of the financial crisis. In addition, banks that actively manage their risks with credit derivatives exhibit lower losses and have a more stable supply of loans during the financial crisis. Taken together, our paper provides consistent evidence on significant real effects of financial innovations that are present independent of economic conditions. While our analysis indicates risk management benefits at the individual bank- and borrower-level we leave the analysis of systemic and macroeconomic implications of banks' use of credit derivatives for future research

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Table 1: Descriptive statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
Loan characteristics				
Spread (in bps)	259.120	108.591	30	455
Log(amount)	18.133	1.307	13.081	21.821
Secured	0.446	0.497	0	1
Unsecured	0.054	0.227	0	1
Short Maturity	0.093	0.291	0	1
Intermediate Maturity	0.481	0.499	0	1
Long Maturity	0.363	0.481	0	1
TERM	0.518	0.499	0	1
TERM A	0.119	0.324	0	1
TERM B	0.332	0.471	0	1
TERM C	0.029	0.169	0	1
Borrower characteristics				
Log(sales)	19.232	1.732	0.693	25.710
Ticker	0.426	0.494	0	1
AAA	0.0003	0.019	0	1
AA	0.0007	0.027	0	1
A	0.008	0.090	0	1
BBB	0.047	0.211	0	1
BB	0.104	0.306	0	1
B	0.159	0.366	0	1
CCC	0.027	0.164	0	1
CC	0.001	0.033	0	1
C	0	0	0	0
Bank characteristics				
Gross CD/TA	0.404	0.817	0	3.988
Net CD/TA	0.021	0.050	-0.039	0.225
Derivatives not for trade/TA	0.302	0.330	0	1.263
Log(assets)	19.216	1.996	9.998	21.566
ROA	0.006	0.005	-0.043	0.068
Sub Debt/TA	0.331	0.140	0.0006	0.848
Liquid Assets/TA	0.196	0.112	0	0.991
Charge-offs/TA	0.002	0.003	0	0.072
Equity/TA	0.094	0.099	0.051	0.961

Table 2: Credit derivative use and loan spreads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	Spread	Spread	Spread	Spread	Spread	Spread	Spread	Spread
Gross CD/TA	-8.666***	-10.35***		-13.69***	-10.19***	-9.225**		-22.29***
	(2.306)	(2.131)		(1.893)	(2.085)	(4.676)		(7.341)
Net CD/TA	32.07	18.13	4.622	24.16	17.45	16.66		37.94
	(43.29)	(31.76)	(29.69)	(31.64)	(31.80)	(46.14)		(64.40)
Derivatives					2.404			
not for trade/TA					(9.249)			
Gross CD/TA lag							-11.50***	
							(3.558)	
Net CD/TA lag							-20.01	
							(20.72)	
Log(sales)	-6.085***	-6.043***	-5.964***	-13.59***	-6.044***	-6.035***	-5.653***	-4.743***
	(1.490)	(1.498)	(1.495)	(2.241)	(1.497)	(1.593)	(1.590)	(1.595)
AAA	-57.93***	-66.70***	-72.59***	-88.81***	-67.30***	-67.34***		-67.53***
	(12.60)	(14.19)	(14.17)	(14.08)	(13.57)	(14.71)		(12.93)
AA	-39.17	-51.51	-52.98	-38.49	-51.83	-51.67	-47.54	68.00***
	(80.82)	(84.51)	(84.02)	(84.38)	(84.65)	(83.44)	(85.82)	(11.30)
A	-70.07**	-68.00**	-68.31**	-81.97**	-68.13**	-68.04**	-66.01*	-82.59**
	(32.20)	(32.78)	(33.51)	(35.14)	(32.68)	(26.90)	(38.06)	(31.24)
BB	-7.938*	-7.235*	-6.946*	5.922	-7.242*	-7.204	-5.876	-5.707
	(4.038)	(3.673)	(3.685)	(4.340)	(3.678)	(6.361)	(4.329)	(6.885)
B	29.57***	30.40***	30.79***	50.07***	30.38***	30.44***	31.10***	24.47***
	(6.741)	(6.247)	(6.194)	(7.592)	(6.235)	(5.888)	(7.255)	(8.200)
CCC	81.92***	81.58***	81.78***	104.5***	81.62***	81.60***	92.58***	82.08***
	(6.899)	(6.874)	(6.908)	(9.091)	(6.825)	(12.33)	(7.400)	(7.071)
CC	177.1***	178.7***	180.8***	186.8***	178.0***	178.9***	177.4***	164.1***
	(46.03)	(45.00)	(44.00)	(39.45)	(45.31)	(41.06)	(43.48)	(46.69)
Ticker	-12.89*	-9.228	-9.682	-11.15	-9.236	-9.277**	-11.47*	-11.61
	(7.024)	(6.588)	(6.622)	(6.857)	(6.591)	(4.326)	(6.248)	(8.838)
Log(amount)	-15.57***	-16.87***	-16.78***		-16.87***	-16.86***	-16.01***	-15.79***
	(2.333)	(2.452)	(2.431)		(2.459)	(2.225)	(2.796)	(2.499)

Table 2: Credit derivative use and loan spreads (cont.)

Variables	(1) Spread	(2) Spread	(3) Spread	(4) Spread	(5) Spread	(6) Spread	(7) Spread	(8) Spread
Secured	17.27***	16.79***	16.48***		16.82***	16.76***	12.83**	15.43**
	(5.343)	(5.255)	(5.294)		(5.247)	(4.607)	(5.615)	(7.309)
Unsecured	-59.57***	-59.41***	-60.21***		-59.38***	-59.50***	-59.23***	-59.77***
	(7.541)	(7.898)	(7.956)		(7.937)	(8.046)	(9.595)	(10.04)
Interm. maturity	-8.870	-10.66	-11.18		-10.64	-10.72*	-10.31	1.420
	(8.911)	(8.745)	(8.826)		(8.722)	(6.001)	(7.634)	(7.638)
Long maturity	-11.28	-8.677	-8.986		-8.657	-8.710	-8.629	-3.077
	(7.960)	(7.595)	(7.634)		(7.597)	(6.608)	(9.142)	(11.93)
TERM A	27.75***	25.20***	25.78***		25.16***	25.26***	24.14***	25.03***
	(5.764)	(5.120)	(5.331)		(5.097)	(5.869)	(5.903)	(6.081)
TERM B	59.97***	55.60***	56.31***		55.59***	55.68***	53.12***	56.94***
	(6.342)	(6.924)	(6.900)		(6.923)	(5.535)	(7.259)	(9.597)
TERM C	43.86***	38.58***	40.53***		38.61***	38.79***	31.49***	44.25***
	(9.597)	(9.454)	(9.340)		(9.451)	(10.84)	(10.34)	(16.14)
ROA	-295.0							
	(376.2)							
Subdebt/TA	-11.40							
	(33.35)							
Liquid Assets/TA	-31.44							
	(24.31)							
Chargeoff/TA	1,743***							
	(476.7)							
Log(assets)	-3.269							
	(2.730)							
Equity/TA	-5.095							
	(26.74)							
F-stat IV						636.38		
J-test p-value						0.40		
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Purpose Dummies	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,487	2,566	2,566	2,566	2,566	2,566	2,289	1,860
R-squared	0.350	0.386	0.383	0.306	0.386	0.386	0.371	0.391

The dependent variable is the all-in loan spread in basis points. All models are estimated using OLS with clustered robust standard errors at the bank level (in parentheses). ***, ** and * denote significance at the 1%, 5% and 10% level respectively. Model (5) uses IV estimation.

Table 3: Loan spreads by borrower type

Variables	(1) Spread	(2) Spread	(3) Spread	(4) Spread
Gross CD/TA	-6.386***	-10.52***	-10.52***	-13.23***
	(2.048)	(2.455)	(3.310)	(2.777)
Large	-15.49*			
	(9.088)			
Gross CD/TA*large	-7.191***			
	(2.447)			
Low risk rated		-46.71		
		(43.90)		
High risk rated		1.860		
		(3.937)		
Gross CD/TA*low risk rated		-42.24*		
		(23.27)		
Gross CD/TA*high risk rated		0.157		
		(2.097)		
Ticker	-8.080	-10.60	-9.366	-8.597
	(6.845)	(6.485)	(7.164)	(11.44)
Gross CD/TA*ticker			0.507	
			(3.673)	
Borrower Controls	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,566	2,566	2,566	1,672
R-squared	0.389	0.363	0.385	0.374

The dependent variable is the all-in loan spread in basis points. All models are estimated using OLS with clustered robust standard errors at the bank level (in parentheses). ***, ** and * denote significance at the 1%, 5% and 10% level respectively.

Table 4: Loan spreads during the crisis of 2007-2009

	(1)	(2)	(3)	(4)
Variables	Spread	Spread	Spread	Spread
Crisis	42.66***	45.14***	45.39***	45.70***
	(13.84)	(14.29)	(13.49)	(14.34)
Gross CD/TA		-12.19***	-12.10***	-12.38***
		(1.974)	(1.933)	(2.157)
Gross CD/TA*crisis		-0.349		-3.124
		(3.081)		(4.731)
Net CD/TA				25.68
				(26.39)
Net CD/TA*crisis				127.4
				(165.4)
Gross CD 07/TA*crisis			-0.472	
			(2.363)	
Borrower Controls	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Observations	3,730	2,524	2,524	2,524
R-squared	0.421	0.389	0.389	0.389

The dependent variable is the all-in loan spread in basis points. All models are estimated using OLS with clustered robust standard errors at the bank level (in parentheses). ***, ** and * denote significance at the 1%, 5% and 10% level respectively.

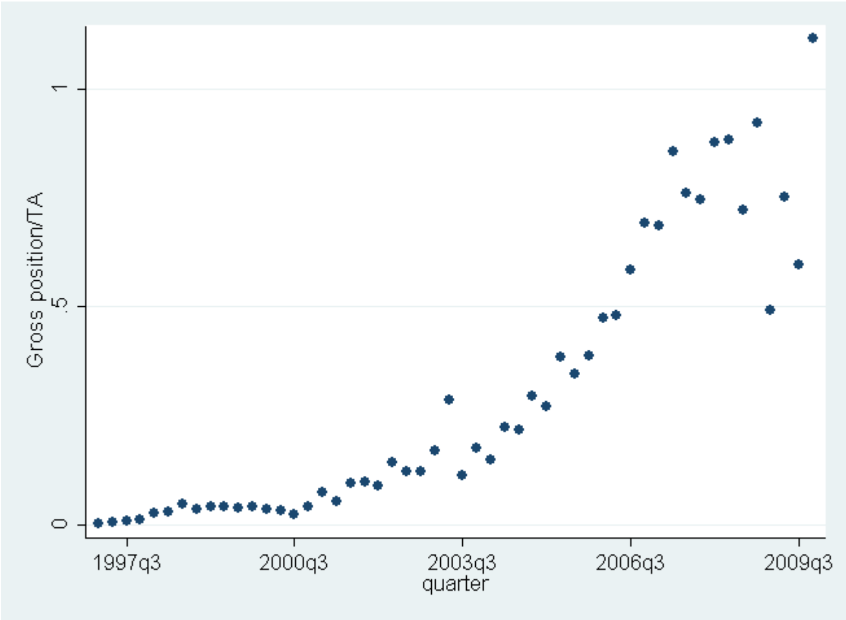
Table 5: Credit derivative use and bank lending

Variables	(1) Charge-offs commercial/TA	(2) Commercial loans/TA
Crisis	0.000383***	-0.0307**
	(4.97e-05)	(0.0127)
Gross CD/TA	-0.300***	-12.57
	(0.104)	(19.89)
Gross CD/TA*crisis	0.120	41.93**
	(0.113)	(19.79)
Sub debt/TA	9.82e-05	-0.0769***
	(0.000158)	(0.0254)
Liquid assets/TA	0.000517***	0.0979***
	(0.000181)	(0.0325)
Equity/TA	0.000566**	-0.00101
	(0.000264)	(0.0405)
Log(assets)	9.72e-05***	0.00989***
	(1.39e-05)	(0.00212)
Total loan/TA	0.000887***	0.221***
	(0.000177)	(0.0321)
Commercial loans/TA	0.00305***	
	(0.000242)	
ROA	-0.0357***	-0.144
	(0.00205)	(0.253)
Constant	-0.00217***	-0.174***
	(0.000278)	(0.0489)
Observations	1,984	1,984
R-squared	0.358	0.145

The dependent variable in model (1) is the net charge-offs minus CDS gains scaled by total assets. The dependent variable in model (2) is the total volume of commercial loan extended scaled by total assets. All models are estimated using OLS with clustered robust standard errors at the bank level (in parentheses). ***, ** and * denote significance at the 1%, 5% and 10% level respectively.

Figure 1: Gross and net credit derivative positions (scaled by total assets)

(a) Gross credit derivative positions



(b) Net credit derivative positions

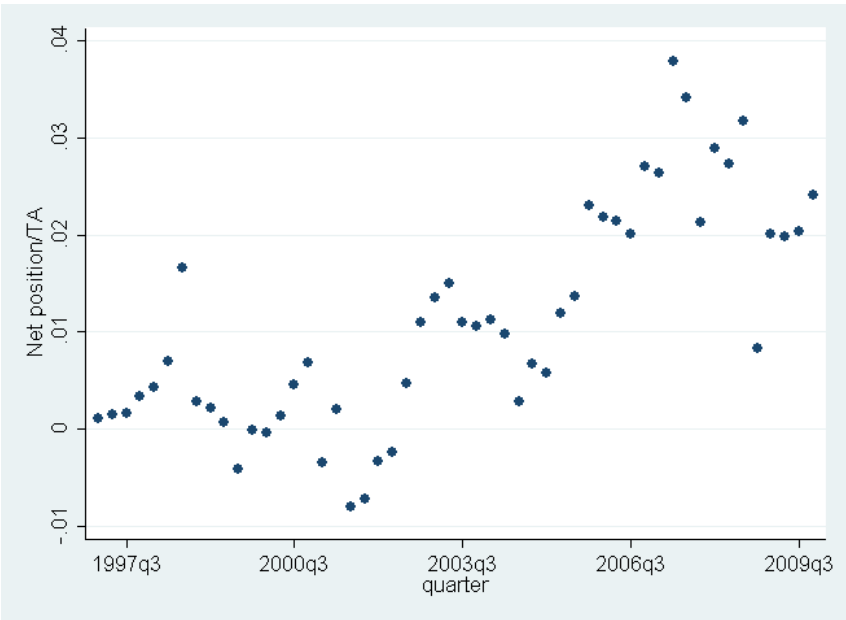
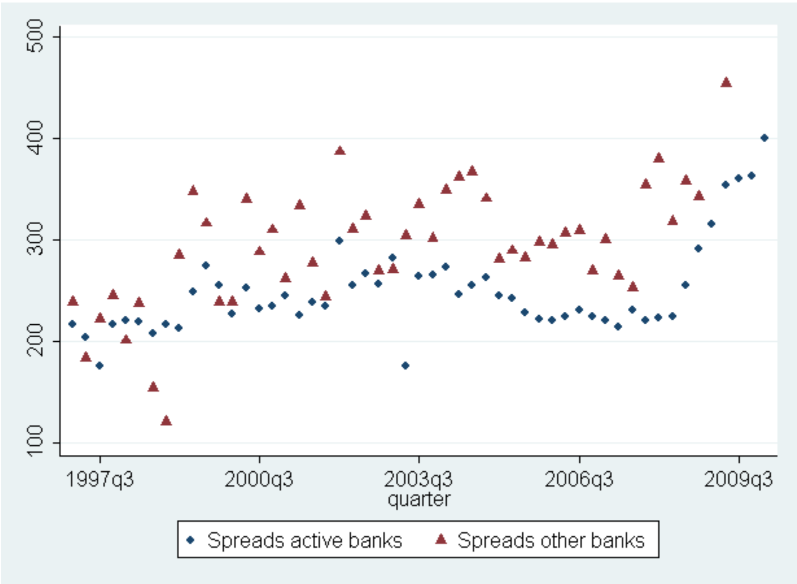


Figure 2: Spreads (all-in) of active versus other banks



Appendix: Description of Variables

Gross CD/TA: Sum of credit derivative protection bought and sold divided by assets.
Net CD/TA: Difference between credit derivative protection bought and sold divided by assets.
Derivatives not for trade/TA: Total amount of derivatives used for hedging divided by assets. Equal to the sum of commodities, interest rate, equity and foreign exchange derivatives.
Log(Assets): Natural logarithm of the book value of total assets.
ROA: Net income by assets.
Sub Debt/TA: Subordinated debt divided by assets.
Liquid Assets/TA: Cash plus securities divided by assets.
Charge-offs/TA: Total charge-offs divided by assets.
Equity/TA: Bank equity divided by assets.