# The Credit Risk of Banks and Non-Banks during the Crisis: Evidence from the CDS Market

Burkhard Raunig*

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**Abstract**

Using three alternative decompositions of the credit default swap premium this study examines how investors judge the credit risk of banks and non-banks before, during, and after the financial crisis of 2007-2009. The empirical findings, based on a sample of 213 major US and European firms, suggest that investors clearly distinguish between both types of firms. Investors appear in general to be more concerned about bank defaults, and even more so since the end of the crisis. However, investors attach a low loss given default (LGD) to banks in normal times. During the crisis the estimated LGD's increase markedly and the difference in the LGD between both types of firms becomes statistically insignificant. However, the estimated LGD for banks does usually not exceed the estimated LGD for non-banks.

**JEL classification:** E43, G12, G13;

**Keywords:** Banks, credit risk, credit default swap, financial crisis, loss given default, risk premium

* Oesterreichische Nationalbank, Otto-Wagner-Platz 3, A-1011, Vienna, Austria. Tel: +43 1 40 420 7219, Email: burkhard.raunig@oenb.at. The opinions in this paper do not necessarily reflect those of the Oesterreichische Nationalbank.

## 1 Introduction

A credit default swap (CDS) offers compensation for losses from a default of a reference entity. The rate for such a contract, the so called CDS premium, should therefore provide valuable information about the credit risk associated with an entity. Due to a standardized contract design and the relatively high liquidity in the market the CDS premium is probably even the best measure of credit risk currently available (O'Kane and Sen, 2005). This paper studies how investors judge firm credit risk in normal times and in times of crisis using information contained in the CDS premia for major US and European companies. Given the special role banks play in an economy and given the fact that banks were at the center of the recent financial crisis the paper focuses on the question of whether investors differentiate between the credit risk of banks and non-banks. If so, along which dimensions do investors distinguish between both types of firms?

In order to be an ideal indicator of credit risk, the CDS premium would have to be directly linked to the credit risk of a firm. However, CDS premia do not just reflect pure credit risk, they also contain risk premia which complicates their interpretation. Figure 1 shows averages of month-end CDS premia for major European and US banks and non-banks over the period 2004m1 - 2010m4. Since banks were at the center of the crisis one would probably expect to see the pronounced increase in the average CDS premium for banks which is visible in the crisis period 2007-2009. However, the average CDS premium for non-banks exceeds almost always the average CDS premium for banks, before the crisis, as well as during the crisis, despite permanent worries about the soundness of the banking system, and despite the fact that the empirical default frequency (EDF), a widely used estimate of the default probability of a firm provided by Moody's KMV, is on average much larger for banks than for non-banks during the crisis (see, Figure 2).

The preceding example shows that it does not suffice just to look at the evolution of CDS premia in isolation. In order to understand how investors judge the credit risk of firms it is necessary to decompose the CDS premium into its components, namely the loss given default (LGD), the probability of default (PD) and the risk premium (RP) for bearing credit risk. The evolution of the components of the CDS premium over time may then provide information about the degree to which CDS premia reflect pure credit risk and to what an extent the CDS premia are driven by changes in the risk aversion of investors.

Recent research on the determinants of CDS premia includes Das et al. (2009), Ericsson et al. (2009), Fabozzi et al. (2007) and Zhang et al. (2009), among others. Empirical studies that examine CDS premia during the crisis are Berndt and Obreja (2010), Annaert et al. (2010) and Di Cesare and Guazzarotti (2010). Unfortunately, these studies do either not consider banks, or do not compare banks with non-banks. Furthermore, CDS premia are not explicitly decomposed into the LGD, the PD and the components of the risk premium. Norden and Weber (2010) calculate risk neutral default probabilities and upper bounds for the LGD of 20 large European banks from CDS premia for senior debt and subordinated debt of the same company. The authors obtain sharply increasing default probabilities as well as increasing LGD's during the crisis. Since subordinated debt plays a minor role for most industrial firms their methodology is not suitable for a broad comparison of banks and non-banks, however.

This study empirically examines three alternative decompositions of the CDS premium. Two decompositions exploit the EDF as an estimate of the objective (or real world) default probability of a firm. Both yield estimates of the LGD, the objective expected loss (EL) and the components of the risk premium. The decompositions differ in that the first one is linear whereas the second one has a multiplicative structure. The third decomposition models the risk neutral default probability directly and yields therefore estimates of the LGD and the risk neutral probability of default.

In the empirical analysis the decompositions of the CDS premium are estimated for a panel of 46 banks and 167 non-banks. The sample, running from 2004m1 - 2010m4 on a monthly frequency, contains essentially the largest banks in Europe and the US. The other firms in the sample are also major European and US companies, respectively, and they cover a broad range of different industries.[1] The estimation results are used to track the components of the CDS premia for banks and non-banks over time. The main empirical findings are as follows. Investors distinguish between banks and non-banks. They attach much lower LGD’s to banks in normal times (i.e. before the crisis as well as after the crisis). During the crisis the estimated LGD’s of banks and non-banks increase and the hypotheses of equal LGD’s often cannot be rejected at conventional significance levels. However, the estimated LGD for banks does typically not exceed the estimated LGD for non-banks. Relative to non-banks, the default component in bank CDS premia becomes more important in the crisis. Moreover, investors appear to be more concerned about bank defaults in general, and even more so since the end of the crisis.

The remainder of the paper proceeds as follows. Section 2 provides some basics about CDS contracts, reviews a general CDS pricing formula, derives the alternative decompositions of the CDS premium from a simplified version of this formula and translates them into econometric models. Section 3 introduces the CDS data and the explanatory variables. Section 4 summarizes the empirical analysis. The

[1] The names of the firms in the sample and their industry classification are available from the author upon request.

evolution of the components of the CDS premia for banks and non-banks over time are discussed in Section 5. The final section offers some conclusions.

## 2 Decomposing the CDS Premium

This section reviews a generic CDS pricing formula and describes the different empirical decompositions of the CDS premium that can be derived from it. Before we examine the decompositions in detail, we first turn to a brief description about how CDS contracts work and how they are priced.

### 2.1 Credit default swap basics

A CDS is a financial derivative linked to the credit risk of an underlying entity and traded over the counter. In a standard single name CDS two parties enter into a contract which terminates either at the stated maturity, or earlier at the time when a specified credit event occurs. Typical credit events include failure to meet payment obligations when they are due, bankruptcy, and some more technical credit events which are defined along with other terms of the contract by the International Swaps and Derivatives Association (ISDA). When a specified credit event occurs, the protection seller compensates the protection buyer for the incurred loss by either paying the face value of the bond in exchange for the defaulted bond (physical settlement), or by paying the difference between the post-default market value of the bond, which is fixed by an auction procedure, and the par value (cash settlement). Chaplin (2005) provides further details concerning the design and trading of CDS contracts.

**2.2 CDS pricing**

The seller of a CDS collects periodic premium payments for providing protection against default. The premium is usually expressed in basis points, as a fraction of the underlying notional, and quoted in annual terms. Just as in a standard swap contract, the CDS premium can be determined by equating the two legs of the contract.

The fee leg of the CDS consists of the expected present value of the premium payments that a protection buyer makes to the protection seller. Let $\lambda(t)$ denote the intensity process that governs the default arrival of the underlying entity. The survival probability from time 0 to time $\tau$ of the entity is then given by $S(t) = \exp\left(-\int_0^\tau \lambda(t)dt\right)$ and the expected present value of the fee leg is

$$E\left[\int_0^T D(\tau)S(\tau)Cd\tau\right]. \tag{1}$$

In Eq. (1) $T$ denotes the time to maturity of the contract, $D(\tau) = \exp\left(-\int_0^\tau r(t)dt\right)$ is the discount factor, $r(t)$ is the instantaneous risk free interest rate at time $t$, and C is the premium rate per annum.

The contingent leg of the CDS is the expected present value

$$E\left[\int_0^T D(\tau)S(\tau)\lambda(\tau)(1-R(\tau))d\tau\right] \tag{2}$$

of the payment that the protection seller makes in case of a default, where $R(\tau)$ is the recovery rate per unit face value at default time $\tau$. Equating the fee leg with the contingent leg (i.e. setting the value of the CDS to zero at the time of origination) and re-arranging yields a generic formula for the CDS premium,

$$C = \frac{E\left[\int_0^T D(\tau)S(\tau)\lambda(\tau)(1-R(\tau))d\tau\right]}{E\left[\int_0^T D(\tau)S(\tau)d\tau\right]}. \qquad (3)$$

Eq. (3) assumes continuous premium payments and the absence of counterparty credit risk (see, Duffie and Singleton (2003), Lando (2004) and Chaplin (2005) for further details concerning CDS pricing).[2]

### 2.3 Decompositions of the CDS premium

Eq. (3) is too general to yield tractable empirical decompositions of the CDS premium and needs to be simplified. Following Das et al. (2008) let us assume periods of a fixed time interval $\Delta t$ and premium payments and defaults occurring at the end of a period to obtain a discrete version of Eq. (3). Using the discrete expressions $D(i) = \exp(-r_i i\Delta t)$, $S(i) = \exp(-\lambda_i (i-1)\Delta t)$, $F(i) = (1-\exp(-\lambda_i \Delta t))$ of the components of Eq. (3) yields

$$C = \frac{E\left[\sum_{i=1}^n D(i)S(i)F(i)(1-R(i))\right]}{\Delta t E\left[\sum_{i=1}^n D(i)S(i)\right]}, \qquad i = 1,\ldots,n = T/\Delta t. \qquad (4)$$

[2] Eq. (3) does also not consider the value of a delivery option which may arise in case of physical settlement when the protection buyer has a choice from a basket of deliverable obligations. Jankowitsch et al. (2008) provide a detailed study of this issue.

If we assume a constant hazard rate $\lambda$, a constant recovery rate $R$ and set $\Delta t = 1$ we can simplify Eq. (4) further and get

$$C = (1-R)\cdot(1-\exp(-\lambda)) = (1-R)\cdot PD\,, \tag{5}$$

where $(1-R)$ is the loss given default and $PD = (1-\exp(-\lambda))$ is the risk neutral annual default probability. The approximation to the CDS premium provided by Eq. (5) is the starting point for deriving the different empirical decompositions of the CDS premium.

The first decomposition of the CDS premium substitutes the *objective* default probability $PD^*$ for the *risk neutral* default probability $PD$ in Eq. (5). Risk neutral probabilities are typically larger than objective probabilities because risk neutral probabilities incorporate the risk aversion of market participants. Using objective probabilities instead of risk neutral probabilities therefore leads to CDS premia $C^* = (1-R)PD^*$ that are smaller than the CDS premia C actually observed in the market. Defining the difference $RP = C - C^*$ as the required risk premium for bearing default risk yields the linear decomposition

$$C = (1-R)\cdot PD^* + RP\,. \tag{6}$$

Eq. (6) splits the observed CDS premium into a default component and a risk premium (see, Amato, 2005). Using an estimate of the objective default probability, $PD^e$, modeling the risk premium as a function of firm specific, market based, and macroeconomic variables, and allowing for differences between banks and non-banks yields the empirical model

$$C_{it} = \beta_0 + \beta_1 PD^e_{it} + \beta_2 d_b PD^e_{it} + \mathbf{x}'_{it}\boldsymbol{\gamma}^{nb} + d_b \mathbf{x}'_{it}\boldsymbol{\gamma}^{b} + \varepsilon_{it} \,. \qquad (7)$$

In this model $\beta_0$ is a constant, $\boldsymbol{\gamma}^{nb}$ and $\boldsymbol{\gamma}^{b}$ are parameter vectors associated with a vector $\mathbf{x}$ of variables driving the risk premium of non-banks and banks, $d_b$ is a dummy variable which takes on the value of one if the firm is a bank and zero otherwise, and $\varepsilon_{it}$ is an idiosyncratic error. Note that the coefficient $\beta_1$ in Eq. (7) provides an estimate of the LGD for non-banks, and $\beta_2$ measures differences in the estimated LGD for banks.

The first decomposition of the CDS premium presumes that the risk premium enters additively. Alternatively, one may assume that the risk premium enters in a multiplicative fashion. Using again objective default probabilities we can express Eq. (5) as

$$C = (1 - R) \cdot PD^* \cdot RP \,. \qquad (8)$$

The risk premium in Eq. (8) may then be modeled as a function $RP = f(\mathbf{x})$ of a vector of explanatory variables **x**. We turn to the actual specification of this function later in the empirical analysis in Section 3.3. Taking logarithms and allowing for differences between banks and non-banks leads to the empirical model

$$\ln C_{it} = \beta_0 + \beta_1 d_b + \beta_2 \ln PD^e_{it} + \beta_3 d_b \ln PD^e_{it} + \ln f_{nb}(\mathbf{x}_{it}) + d_b \ln f_b(\mathbf{x}_{it}) + \varepsilon_{it} \,. \qquad (9)$$

In Eq. (9) the intercept $\beta_0 = \ln(1-R)$ may now be interpreted as an estimate of the logarithm of the LGD for non-banks, the coefficient $\beta_1$ on the bank dummy variable $d_b$ measures the difference in the logarithm of the LGD for banks, and $\varepsilon_{it}$ is an individual error term. The coefficients $\beta_2$ and $\beta_3$ on the logarithm of the objective default probability for non-banks and banks can be understood as adjustment parameters that capture the term structure of default probabilities (in an admittedly simple manner). For instance, if we are given the objective probability that an industrial firm i defaults within the next year, but the time to maturity of the CDS is five years, then $\beta_2$ adjusts the annual probability upward or downward depending on the value of $PD_{it}^e$ and the value of $\beta_2$.

The first two decompositions of the CDS premium rely on the EDF as an estimate of the objective default probability. In contrast, the third decomposition models the risk neutral probabilities directly as suggested in Das et al. (2008) by assuming that the risk neutral intensity $\lambda$ in Eq. (5) is an exponential function of a vector of explanatory variables **x**. Taking logarithms in Eq. (5), exploiting the relationship $\exp(z) \approx 1+z$ for small z, substituting $\lambda = \exp(\mathbf{x}'\boldsymbol{\gamma})$ and allowing for differences between banks and non-banks yields

$$\ln C_{it} = \beta_0 + \beta_1 d_b + \mathbf{x}_{it}'\boldsymbol{\gamma}^{nb} + d_b \mathbf{x}_{it}'\boldsymbol{\gamma}^{b} + \varepsilon_{it} . \qquad (10)$$

In Eq. (10) the coefficients $\beta_0$ and $\beta_1$ again capture the logarithm of the LGD for non-banks and its difference for banks, respectively, $\boldsymbol{\gamma}^b$ and $\boldsymbol{\gamma}^{nb}$ are parameter vectors on the variables in **x** that determine the risk neutral default intensity for banks and non-banks, and $\varepsilon_{it}$ is an idiosyncratic error.

## 3 Data

The empirical analysis is based on monthly data starting in January 2004 and ending in April 2010. This time period covers the last two and a half years before the start of the financial crisis in summer 2007, the subsequent crisis period which ended in spring 2009, and the first year after the crisis. The data sources are Bloomberg and Moody's KMV database.

### 3.1 CDS premium

The empirical analysis focuses on single name CDS contracts on senior debt with a maturity of five years because this is the most frequently traded type of contract in the market. Eliminating sovereign entities, companies not listed at a stock exchange and companies that disappeared through merger yields 213 firms in the Bloomberg database for which month-end CDS premia can be matched with corresponding firm specific data from the KMV database. This set of firms contains 46 banks (including five US investment banks). These banks are basically the largest banks in the US and Europe, respectively. The remaining 167 companies belong to a broad range of different industries and are also major firms in the US and in Europe.

Table 1 reports the mean and the median as well as the first and the third quartile of the empirical distribution of the CDS premia for banks and non-banks computed over the entire sample period. The statistics indicate that both distributions are skewed to the right. The skew reflects the fact that the CDS premium tends to rise significantly once the market starts to belief that a firm is in financial troubles. The summary statistics provide also some crude evidence that the market discriminates between banks and non-banks. The values for the average and the median CDS premium for banks are only about half as large as the corresponding values for non-banks. The average CDS premium for banks computed over the pre-crisis period is even the lowest one among the 44 industries in the sample.

### 3.2 Explanatory variables

The explanatory variables include firm level variables, market variables as well as macroeconomic variables. All three types of variables have been found to be important in empirical research on the determinants of CDS premia and credit spreads, respectively. The firm level variables include an estimate of the objective default probability, the distance to default, the leverage ratio, equity returns and idiosyncratic equity volatility. The macroeconomic variables are the risk-free rate, the slope of the yield curve and stock market volatility. The market variables are the swap spread and the CDS market index. The following paragraphs describe the explanatory variables in more detail. Table 2 provides summary statistics for the variables.

*Empirical default frequency (EDF)*: The EDF provided by Moody's KMV is an estimate of the objective probability for a firm of defaulting within the next 12 month. The EDF is based on a modified Merton (1974) model for the pricing of credit risk and widely used in the financial industry. Kealhofer (2003a) outlines the KMV methodology behind the EDF in detail.

*Distance to default (DD)*: The distance to default is the number of standard deviations that the market value of the assets of a firm is above the default point in the Merton (1974) model. The DD is, in contrast to the EDF, related to the *risk neutral* probability of default. A larger DD implies a lower risk neutral default probability. The DD is calculated as

$$DD(h) = \frac{\ln(A) - \ln(DPT) + (\mu_A - 1/2\sigma_A^2)h}{\sigma_A h^{1/2}} \quad . \tag{11}$$

In Eq. (11) $A$ denotes the current market value of the firm's assets, $DPT$ is the default point of the firm, $\mu_A$ is the annualized expected return to assets, $\sigma_A$ is the annualized volatility of the market value of the firm's assets and $h$ denotes the time horizon. The monthly data for $A$, $DPT$ and $\sigma_A$ are taken from the KMV database, the time horizon is set to 5 years, and $\mu_A$ is calculated as the mean of the monthly asset returns over the last 12 months scaled by $\sqrt{12}$ to obtain the annualized mean.

*Idiosyncratic equity volatility (VID)*: Campbell and Taksler (2003) provide empirical evidence that the variation in the spreads on US corporate bonds is more strongly linked to idiosyncratic stock price volatility than to aggregate stock price volatility. Following these authors, a firm's idiosyncratic stock return is defined as the difference between its stock return and the market-wide stock return as represented by the S&P 500 and the EuroStoxx 50, respectively. The idiosyncratic volatility is then calculated as the monthly average of squared daily idiosyncratic stock returns.[3]

*Leverage (LEV)*: The leverage ratio is calculated from KMV data as the ratio of the total adjusted book liabilities to the market value of total assets multiplied by 100.

*Stock return (SR)*: This variable is the mean stock return of a firm over the last 12 month calculated from month-end stock prices from the Bloomberg database.

*Risk-free rate (RF)*: The Merton (1974) model implies a negative relationship between the risk-free rate and CDS spreads. Since market participants prefer swap rates as a measure of the risk-free interest rate (see, Longstaff et al., 2005) the five-

[3] Idiosyncratic volatility measured in this way implicitly assumes a beta of one. Campbell and Taksler (2003) find that adjusting for beta has no effect on their empirical findings.

year euro and US dollar interest rate swap rate as reported in Bloomberg is taken as the risk free rate.

*Slope of the yield curve (SLOPE)*: The slope of the yield curve is calculated as the difference between ten-year and one-year euro and US dollar swap rates, respectively. These data also come from the Bloomberg database.

*Stock market volatility (VIM)*: Forward looking implied volatility indices derived from options on stock indices are often used as a proxy for the risk aversion of investors (Coudert and Gex, 2008). Here the VIX implied volatility index derived from option prices on the S&P 500 equity index for US firms and the VSTOXX index which represents the implied volatility of the Euro Stoxx 50 index for European firms are used to capture risk aversion.

*Swap spread (SWAP)*: Longstaff et al. (2005) show that risk premia in credit spreads are positively related to bonds' average bid-ask spreads, which in turn capture changes in market liquidity. Since individual bid-ask spreads for the CDS's are not readily available, US dollar and Euro 10 year swap spreads, which are known to contain a liquidity premium along with a premium reflecting the default risk embedded in the Libor rate, serve as an indicator of liquidity.

*CDS market index (MARKET)*: The iTraxx Europe 125 index (covering European firms) and the CDX.NA index (covering US firms) are benchmark indices for the developments in the CDS market. Month-end values of these indices for CDS contracts with a maturity of five years are used to capture the general state of the CDS market.

## 4 Estimation of CDS premium decompositions

The tide of events over the sample period suggests a division of the sample into four subsamples. The decompositions of the CDS premium outlined in section 2 are then estimated over the four subsamples as well as over the entire sample. In the first subsample, 2004m1 - 2007m6, the CDS premia were in general rather low and quite stable. Then, between 2007m7 - 2008m8, increasing concerns about the quality of subprime related securities as well as frequent announcements of huge losses and provisions related to mortgage defaults led to sharply increasing CDS premia. In the third sub-period, 2008m9 - 2009m3, the failure of Lehman Brothers and other important financial institutions together with the accompanying breakdown of the money market nearly led to a collapse of the global financial system. Finally, after central bank and government interventions had helped to stabilize the financial system, the CDS premia declined again over the last sub-period 2009m4-2010m4.

### 4.1 Linear decomposition

The linear decomposition of the CDS premium is given by the equation

$$C_{it} = \beta_0 + \beta_1 EDF_{it} + \beta_2 d_b EDF_{it} + \mathbf{x}'\boldsymbol{\gamma}^{nb} + d_b \mathbf{x}'\boldsymbol{\gamma}^{b} + \alpha_i + \varepsilon_{it}.$$

The vector **x** contains the variables VID, SR, RF, SLOPE, VIM, SWAP and MARKET. Furthermore, the panel structure of the data enables the inclusion of a constant firm specific component $\alpha_i$ in the risk premium. As outlined in Section 2.3, the coefficient $\beta_1$ measures the LGD for non-banks, $\beta_2$ measures the difference in the LGD for banks, and the $\gamma$ coefficients capture the impact of the variables explaining the risk premium. Table 3 summarizes the results from a fixed effects panel estimation of the model. Columns (1) to (4) show the coefficient estimates for the subsamples defined in Section 4.1 and column (5) shows results for the entire sample.

The estimated coefficients on the EDF obtained with the full sample imply an LGD for non-banks of about 66% which is close to the standard market assumption of a loss rate of 60% and an LGD around 43% for banks. The difference in the LGD's is not statistically significant at conventional significance levels. However, the estimated LGD's vary considerably over the subsamples. For non-banks the estimated LGD ranges from 32% to 63% and peaks in the second period which covers the first part of the crisis before the failure of Lehman Brothers. The estimated LGD's for banks are substantially lower than the LGD's for non-banks, but the difference in the LGD's is statistically significant only in the pre-crisis period.

For non-banks the coefficients on the idiosyncratic volatility, the stock return and the CDS index are most of the time statistically significant and have the expected sign. The coefficient on the swap spread is only statistically significant in the second subsample. The estimated coefficients on the variables interacted with the bank dummy variable indicate that the variables explaining the risk premium tend to have a smaller impact on the risk premia for banks in the linear decomposition.

Estimating a random effects model instead of a fixed effects model yields similar coefficient estimates. Including only firm specific variables has also little impact on the estimated LGD's. However, dropping the interactions of the bank dummy with the variables explaining the risk premium leads to markedly lower LGD estimates for banks. Thus, the differences in the risk premium for banks and non-banks appear to be important in the linear decomposition. Finally, adding the firm leverage ratio to the model has little impact on the empirical results but leads to a slight decrease in the fit of the model as measured by the overall (pseudo) R-squared.[4]

## 4.2 Multiplicative decomposition

The multiplicative model given by Eq. (9) assumes an exponential functional form $RP = \exp(\mathbf{x}'\boldsymbol{\gamma})$ for the risk premium to ensure nonnegative CDS premia. The vector **x** contains the variables LEV, VID, SR, RF, SLOPE, VIM, SWAP and MARKET. Substituting the EDF for the objective default probability, including a multiplicative error term, $\exp(\varepsilon_{it})$, an independent constant firm specific risk premium, $\exp(\alpha_i)$, taking logarithms and allowing for differences between banks and non-banks yields

$$\ln C_{it} = \beta_0 + \beta_1 d_b + \beta_2 \ln EDF_{it} + \beta_3 d_b \ln EDF_{it} + \mathbf{x}'_{it}\boldsymbol{\gamma}^{nb} + d_b \mathbf{x}'_{it}\boldsymbol{\gamma}^{b} + \alpha_i + \varepsilon_{it} \,.$$

As mentioned in Section 2.3, the coefficients $\beta_0$ and $\beta_1$ can be interpreted as estimates of the logarithm of the LGD for non-banks and the difference in the logarithm of the LGD for banks, respectively. Table 4 presents the estimation results for the model. The coefficient on the bank dummy is negative and statistically significant over the entire sample period and in the first and fourth sub-period. Furthermore, the implied LGD's for banks and non-banks, given by $\exp(\beta_0 + \beta_1)$ and $\exp(\beta_0)$, are within the permitted range of 0-100%.

The estimates of the adjustment factors $\beta_2$ and $\beta_3$ for the annual EDF (expressed in percentage points) indicate that low default probabilities are adjusted upwards and high default probabilities are adjusted downwards. This pattern is

[4] The overall R-squared is defined as the squared correlation between the actual and the fitted values of the dependent variable ignoring the individual-specific effects. See Cameron and Trivedi (2009), Ch. 8 for further details.

consistent with the empirical observation that the term structure of credit spreads for firms with low credit quality tends to be hump-shaped or downward sloping, whereas credit spreads for high credit quality firms tend to slope upwards (Fons, 1994; Kealhofer, 2003b).

The estimated coefficients for the variables determining the risk premium for non-banks are most of the time statistically significant and have the expected sign. Only the negative coefficient on the implied stock market volatility is an exception. The coefficients on the interaction terms indicate some differences in the impact of the explanatory variables on the risk premium of banks. For instance, the CDS premia for banks are more sensitive to the leverage ratio and the risk free rate in the fourth sub-period, and the idiosyncratic volatility has almost no impact on bank CDS premia. Furthermore, the risk free rate sometimes has a positive rather than negative effect and swap spreads and CDS premia for banks are negatively related in the first, third and fourth subsample.

Estimating the model without interaction terms (i.e. assuming that the explanatory variables have the same impact on the CDS premia of both types of firms) yields similar implied LGD’s in the first, second and fourth subsample, but lower LGD’s in the third subsample where the financial crisis reached its peak. Estimating the model with pooled OLS (i.e. assuming the absence of an independent firm specific component in the risk premium) leads also to LGD’s that are lower for banks than for non-banks. However, in this case the implied LGD’s for non-banks exceed the permitted maximum value of 100%. Thus, independent firm specific risk premia appear to be important.

**4.3 Risk neutral decomposition**

In contrast to the former models, the risk neutral decomposition does not rely on the EDF as an estimate of the objective default probability. Instead, the risk neutral default probability is modeled directly as a function of a set of explanatory variables. The approach outlined in Section 2.3 yields the following regression:

$$\ln C_{it} = \beta_0 + \beta_1 d_b + \mathbf{x}_{it}^{'} \boldsymbol{\gamma}^{nb} + d_b \mathbf{x}_{it}^{'} \boldsymbol{\gamma}^{b} + \alpha_i + \varepsilon_{it} \, .$$

Here $\beta_0$ and $\beta_1$ may again be interpreted as the logarithm of the LGD for non-banks and the difference in the logarithm of the LGD for banks, respectively. The vector of explanatory variables does now include the distance to default, DD, obtained with the Merton (1974) model as described in Section 3.2, in addition to the variables in **x** already used in the multiplicative model. As before, the econometric specification incorporates an independent firm specific risk premium $\alpha_i$.

Table 5 summarizes the empirical results for the model. The coefficient on the distance to default is negative and statistically significant when the model is estimated over the entire sample period, but not significant in three of the four subsamples. The leverage ratio is positively related to the CDS premium and always statistically significant. The idiosyncratic volatility, the risk free rate and the firm stock return have the expected sign, are most of the time statistically significant, but less important for banks. The swap spread is also more important for non-banks. Estimating the model without interaction terms has now little effect on the empirical results. However, estimating the full model with pooled OLS leads again to higher implied LGD’s for both types of firms indicating that independent firm specific risk premia need to be considered.

**5. LGD's, expected losses and risk premia over time**

In this section we compare the components of the CDS premium for banks and non-banks obtained with the different decompositions. Table 6 shows the estimated LGD's for both types of firms for the four sub-periods. As can be seen, the LGD's for non-banks are typically larger than the LGD's for banks. Furthermore, the LGD's from the multiplicative decomposition and the risk neutral decomposition evolve similarly over time. The LGD's are quite low in the pre-crisis period, start to rise in the first phase of the crisis, reach their maximum during the peak of the crisis and fall considerably thereafter. The LGD's obtained with the linear decomposition reach their maximum in the first part of the crisis rather than in the second part where the estimated LGD for banks is unrealistically low. However, this estimate is very imprecise and not significantly different from the LGD of non-banks at conventional statistical significance levels.

The linear and the multiplicative decomposition yield both an estimate of the objective expected loss, $EL_{it} = ED \cdot LGD_{it} \cdot PD_{it}^{*}$, for a given exposure at default (ED) against firm i at time t. Figure 3 shows averages of the expected losses across banks and non-banks over time assuming that $ED$ = 1000 units of money. Before the crisis the averages are quite low for both types of firms. During the crisis the average expected losses rise considerably and even more so for banks.[5]

The estimated LGD for banks in the multiplicative decomposition is lower in the first phase of the crisis and higher in the second phase of the crisis relative to the linear decomposition. However, due to the downward adjustment of high EDF's and the upward adjustment of low EDF's the average expected losses for banks are larger

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[5] The stepwise pattern in the average losses from the multiplicative decomposition arises from the reduced variability of the adjusted EDF's.

in the first phase of the crisis and somewhat lower in the second phase of the crisis compared to the linear decomposition. In the post crisis period the expected losses decline for both kinds of firms in both decompositions. In the multiplicative decomposition the average expected loss for banks plunges nearly to the pre-crisis level.

Let us now look at the objective default component in the CDS premia in relative terms and define the relative default component in the observed CDS premium as the fraction $(LGD_{it} \cdot EDF_{it}) / C_{it}$. The average of this fraction computed over the entire sample period is on average about 0.13 for both types of firms in the linear decomposition and around 0.39 for non-banks and 0.31 for banks in the multiplicative decomposition. Figure 4 shows the monthly averages of the default component in the linear and the multiplicative decomposition over time.

In both decompositions the relative default component for banks is smaller than the relative default component for non-banks before the start of crisis. During the crisis the default component in bank CDS premia rises considerably, in particular in the multiplicative decomposition. Towards the end of the sample period the default component in the CDS premia for banks declines again. Note that between 2007m7-2007m10 the average default component in the CDS premia for banks is above 1 in the multiplicative decomposition. Given that the estimated LGD for banks in this period is only around 40%, this rather high ratio may reflect an overestimation of the objective default probabilities of banks, underpricing of the CDS contracts for banks, or both.

Let us now examine the attitude of the market participants towards default risk. The difference between the CDS premium and the default component given by $C_{it} - (LGD_{it} \cdot EDF_{it})$ is a simple estimate of the absolute risk premium (in basis points) for bearing credit risk in the linear decomposition. As can be seen in Figure 5, the average risk premium for non-banks and banks moves closely together during the most serve phase of the crisis, but typically the risk premium for non-banks exceeds the risk premium for banks.

If we express the risk premium in the linear decomposition in relative terms as a fraction of the CDS premium it turns out that the average relative risk premium for non-banks is reasonable stable (see Figure 6). In contrast, the relative risk premium for banks first exceeds (until 2008) and then undercuts the relative risk premium for non-banks. In other words, the default component in bank CDS premia became more important since 2008.

In the multiplicative decomposition the risk premium can be expressed as *RP = (1 + price of default risk),* see Amato (2005). The price of default risk can be understood as the compensation for bearing one unit of expected loss. Figure 7 indicates that the average price of default risk is for both types of firms rather stable over a large part of the sample, even during the critical phase of the crisis. The price of default risk is usually somewhat higher for banks. In the last part of the sample the price of default risk for banks increases considerably. This huge increase suggests that the aversion against bank defaults has risen markedly after the crisis. However, Figure 7 may overstate the increase in the risk aversion of investors to some extent because the estimated default component in the CDS premia for banks in this period is rather low.

The risk neutral decomposition of the CDS premium provides of course also information about the risk aversion of market participants. If we define risk aversion as the difference between the risk neutral- and the objective default probability we obtain an empirical counterpart for firm i at time t by subtracting the estimate of the objective default probability $EDF_{it}$ from the estimated risk neutral default probability $\widehat{PD}_{it} = \exp(\mathbf{x}_{it}^{'}\hat{\boldsymbol{\gamma}}^{nb} + \mathbf{x}_{it}^{'}\hat{\boldsymbol{\gamma}}^{b} d_b + \hat{\alpha}_i)$. Figure 8 plots the averages of this quantity over time. The numbers suggest that investors judge the default of a bank as a more serve event than the default of another firm. Moreover, the discrepancy in the risk aversion against the default of banks and non-banks is, with the exception of a more volatile period during the most acute phase of the crisis, fairly stable over time.

## 6. Conclusions

This study uses three decompositions of the CDS premium to empirically examine how investors judge the credit risk of banks and non-banks in normal times and in times of crisis. The empirical results from the different decompositions uniformly suggest that investors distinguish between both types of firms. In particular, investors seem to attach a much lower LGD to banks than to non-banks in normal times. During the crisis the estimated LDG's increase markedly and the difference in the LGD between banks and non-banks becomes statistically insignificant. However, the LGD for banks usually does not exceed the LGD for non-banks. The high LGD's combined with increasing default probabilities imply sharply increasing expected losses for both types of firms during the crisis. Furthermore, the default component is an important driving force behind bank CDS premia in the acute phase of the financial crisis.

Risk premia generally constitute a large part of the CDS premium according to the empirical results, and the market discriminates between banks and non-banks in this respect. The price of credit risk as well as the difference between the risk neutral and the objective default probability indicate that investors qualify a bank default as a more severe event than the default of an industrial firm. The concerns about bank defaults appear to have risen since the end of the financial crisis.

## Figures

**Figure 1: Average CDS premium.**

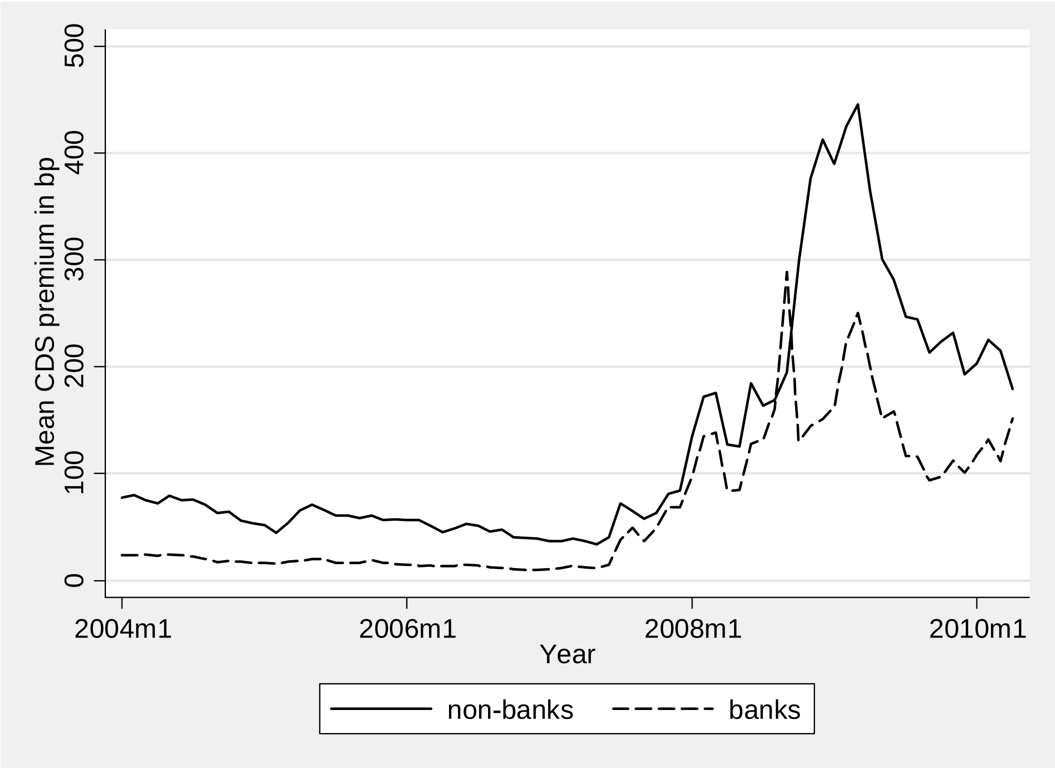


**Figure 2: Average empirical default frequency (EDF).**

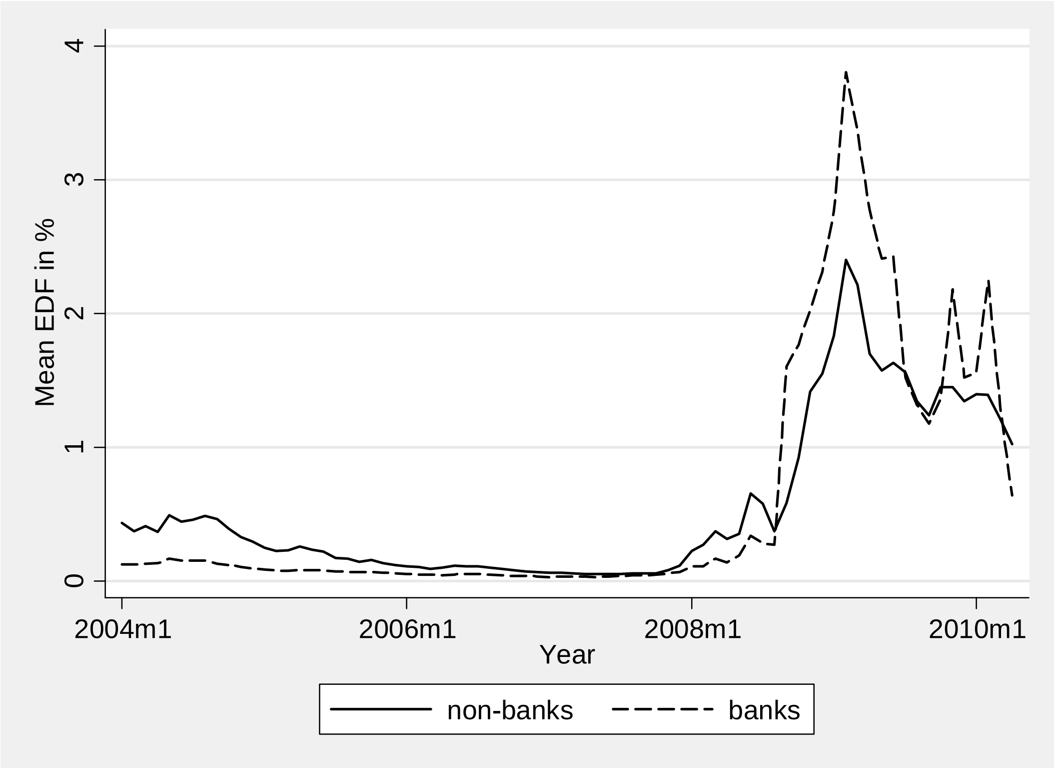


**Figure 3: Average expected loss in the linear- and the multiplicative decomposition of the CDS premium.**

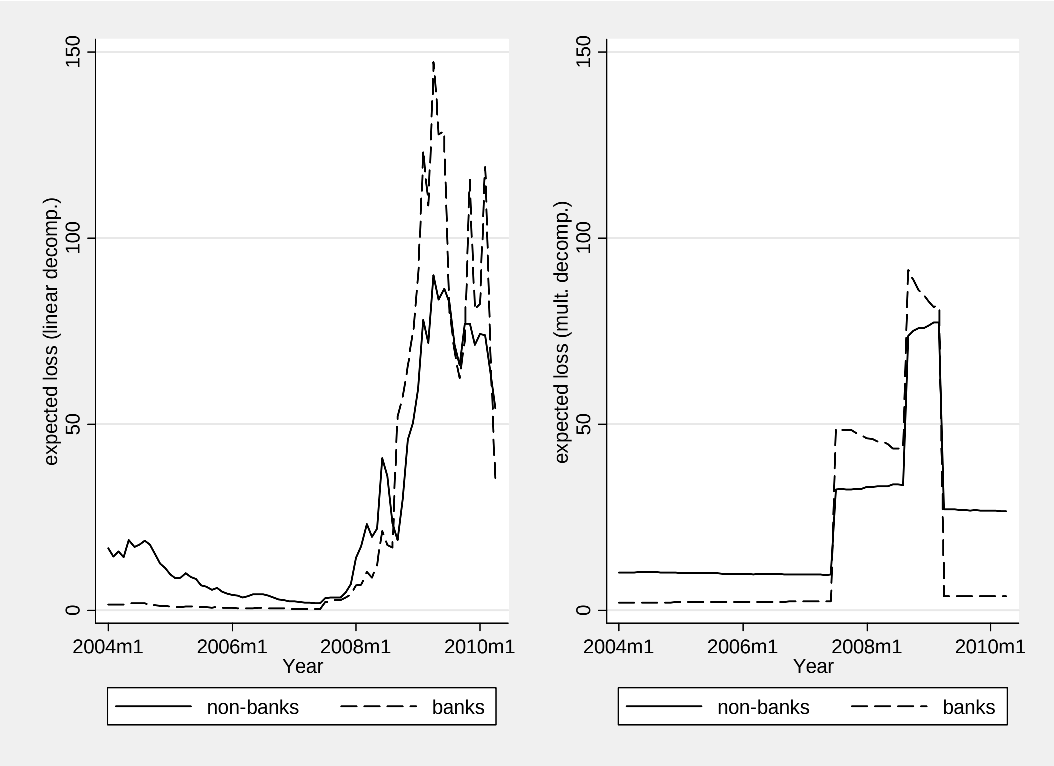


**Figure 4: Average relative default component in CDS premia**

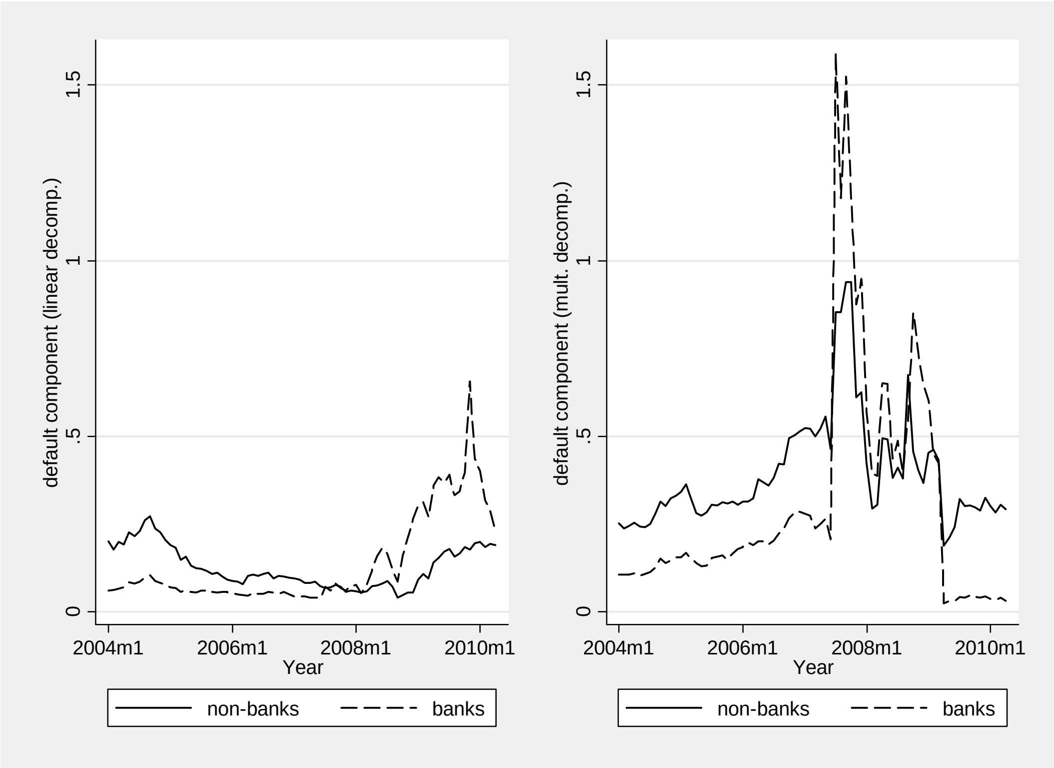


**Figure 5: Average risk premium in basis points in the linear decomposition of the CDS premium**

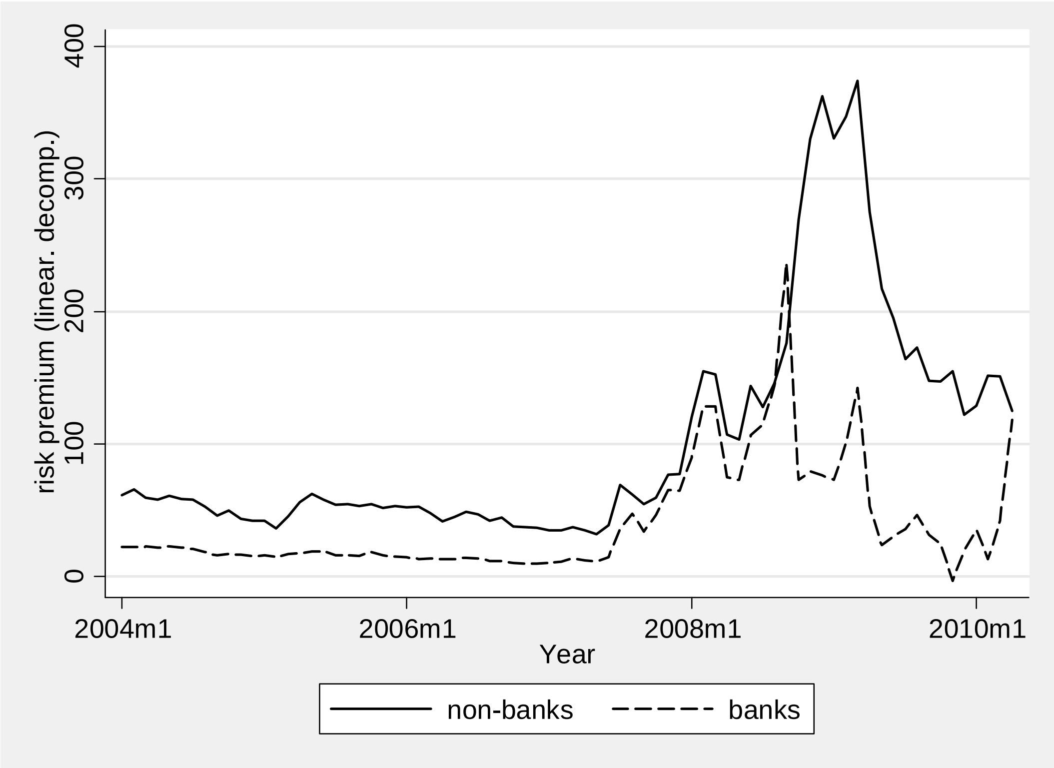


**Figure 6: Average relative risk premium in the linear decomposition of the CDS premium**

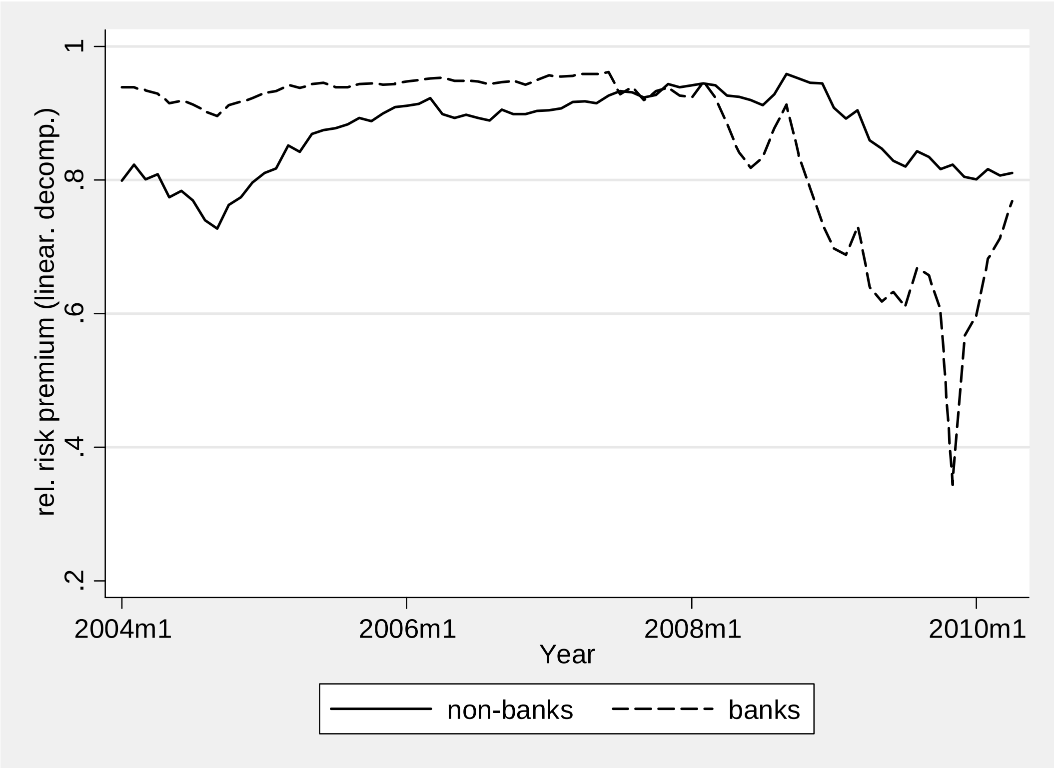


**Figure 7: Average price of default risk in the multiplicative decomposition of the CDS premium**

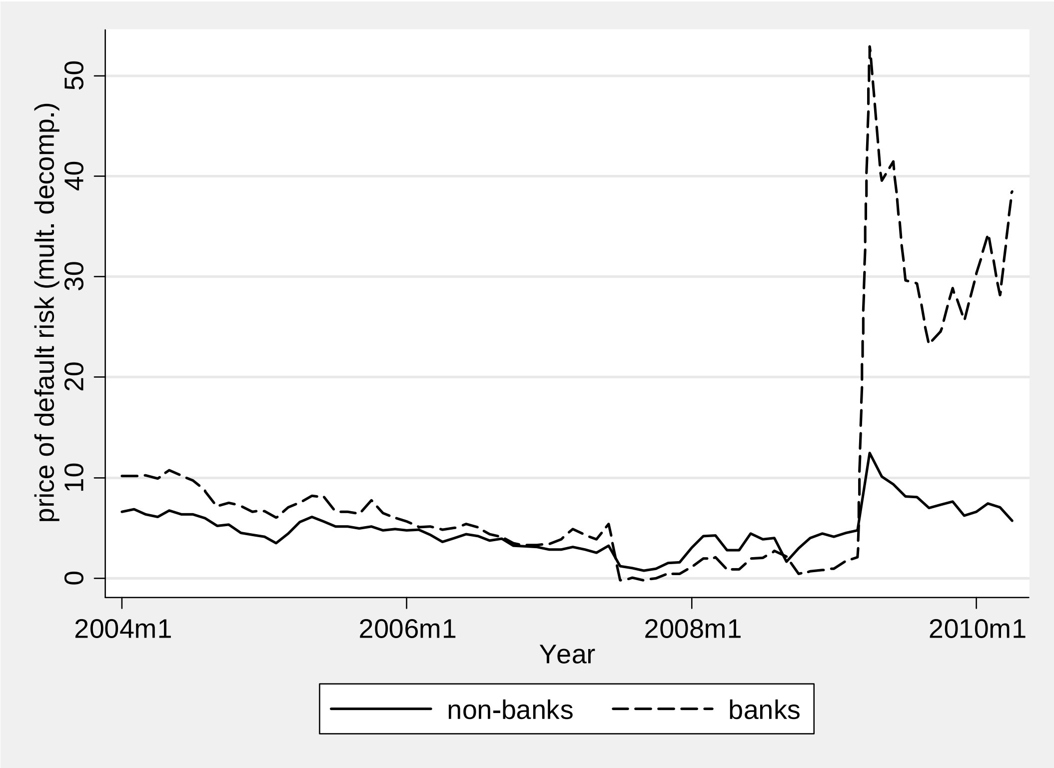
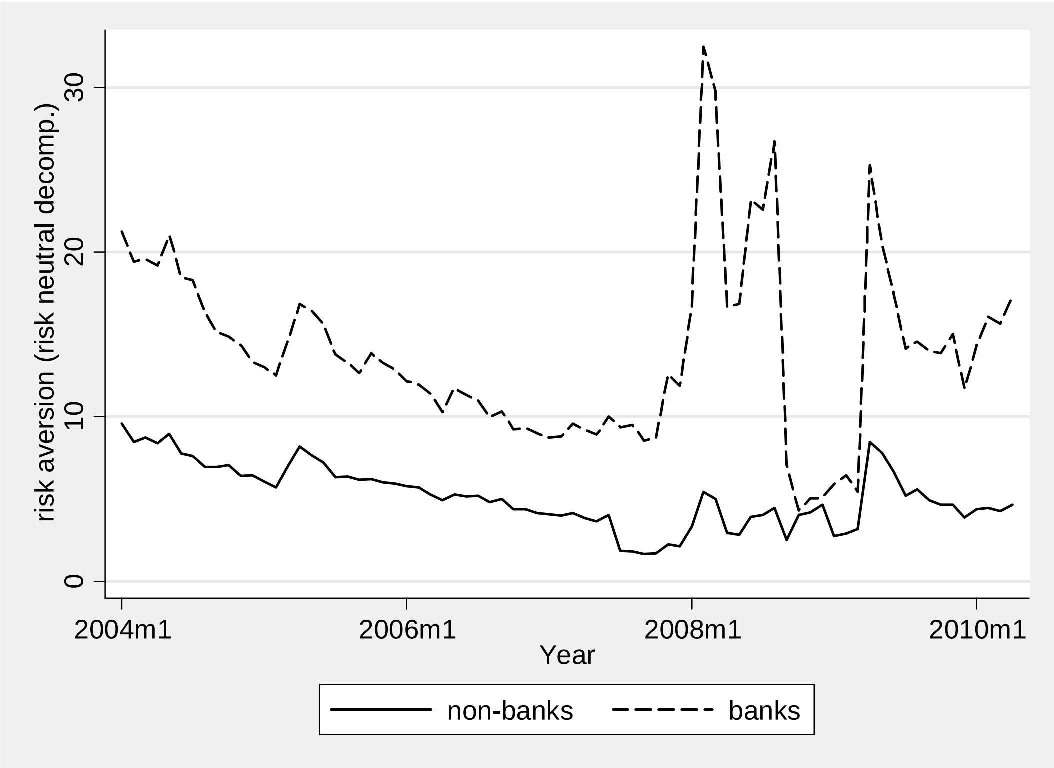


**Figure 8: Average risk aversion in the risk neutral decomposition of the CDS premium**



## Tables

**Table 1: Summary statistics of CDS premia**

| | Mean | Median | 1st quartile | 3rd quartile | N |
|---|---|---|---|---|---|
| non-banks | 126.99 | 50.43 | 29.00 | 111.63 | 12560 |
| banks | 64.28 | 27.14 | 12.67 | 90.16 | 3372 |

Notes: Sample period 2004m1 – 2010m4.

**Table 2: Summary statistics of explanatory variables**

| Variable | Mean | Median | 1st quartile | 3rd quartile | N |
|---|---|---|---|---|---|
| EDF | 0.53 | 0.08 | 0.04 | 0.20 | 15,613 |
| DD | 4.43 | 4.10 | 2.52 | 5.84 | 15,613 |
| VID | 26.32 | 19.36 | 14.23 | 28.61 | 15,459 |
| LEV | 64.90 | 64.00 | 44.20 | 89.10 | 15,613 |
| SR | 0.18 | 2.75 | -3.37 | 7.14 | 15,709 |
| RF | 3.64 | 3.62 | 2.86 | 4.23 | 16,188 |
| SLOPE | 1.25 | 1.22 | 0.39 | 2.10 | 16,188 |
| VIM | 22.21 | 18.75 | 15.42 | 26.01 | 16,188 |
| SWAP | 0.29 | 0.24 | 0.13 | 0.42 | 16,188 |
| MARKET | 67.01 | 47.00 | 35.75 | 89.13 | 16,188 |

Notes: Empirical default frequency (EDF), distance to default (DD), idiosyncratic stock return volatility (VID), firm leverage ratio (LEV), mean firm stock return over the last 12 month (SR), risk free rate (RF), slope of the yield curve (SLOPE), implied stock market volatility (VIM), swap spread (SWAP), CDS market index (MARKET). Sample period: 2004m1 – 2010m4.

**Table 3: Fixed effects panel estimates for the linear decomposition of CDS premium**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Sample | 04m1-07m6 | 07m7-08m8 | 08m9-09m3 | 09m4-10m4 | 04m1-10m4 |
| Variables | CDS | CDS | CDS | CDS | CDS |
| | | | non-banks | | |
| Const. | 11.34 | 64.01*** | 33.47 | 106.3 | 30.43* |
| | (7.131) | (23.14) | (120.7) | (308.2) | (17.02) |
| EDF | 38.48*** | 62.63*** | 32.44** | 53.02* | 65.96*** |
| | (5.051) | (10.09) | (16.39) | (28.32) | (19.32) |
| VID | 0.452*** | 0.872*** | 1.402*** | 0.223 | 1.906*** |
| | (0.100) | (0.177) | (0.492) | (0.491) | (0.427) |
| SR | -0.386 | -2.870*** | -7.908** | -5.481** | -2.604** |
| | (0.355) | (0.931) | (3.127) | (2.277) | (1.179) |
| RF | -5.344** | -3.837 | -33.48 | -164.6** | -21.12*** |
| | (2.596) | (5.694) | (25.30) | (75.61) | (4.641) |
| SLOPE | -1.740 | -1.046 | 55.04** | 165.7 | 15.42*** |
| | (1.793) | (5.553) | (23.27) | (129.1) | (4.646) |
| VIM | -0.0923 | 0.599 | -1.076 | -1.052 | -0.837 |
| | (0.110) | (0.495) | (1.119) | (1.462) | (0.529) |
| SWAP | 44.03** | -73.89*** | 310.8*** | -332.2 | 174.3*** |
| | (21.87) | (18.93) | (58.68) | (313.1) | (46.48) |
| MARKET | 1.139*** | 0.664*** | 0.123 | 1.888* | 0.434*** |
| | (0.196) | (0.150) | (0.517) | (0.994) | (0.138) |
| | | | difference banks | | |
| EDF | -26.28*** | -26.55 | -28.60 | -36.96 | -23.26 |
| | (7.216) | (43.54) | (17.40) | (29.02) | (30.57) |
| VID | -0.239 | -0.813*** | -1.330*** | 0.0588 | -2.031*** |
| | (0.176) | (0.192) | (0.503) | (0.521) | (0.519) |
| SR | 0.290 | 3.216** | 4.468 | 4.864** | 2.888** |
| | (0.385) | (1.319) | (3.465) | (2.293) | (1.358) |
| RF | 4.275 | -12.42 | 99.89*** | 94.26 | 17.86*** |
| | (2.681) | (8.591) | (29.73) | (80.51) | (5.624) |
| SLOPE | 3.401* | 17.15 | -48.98** | -179.2 | -16.38*** |
| | (1.837) | (11.30) | (23.86) | (131.1) | (6.049) |
| VIM | 0.0697 | -3.318** | -4.501*** | 0.113 | -0.403 |
| | (0.127) | (1.321) | (1.368) | (1.549) | (0.676) |
| SWAP | -36.05 | 103.4*** | -429.3*** | 243.1 | -131.3** |
| | (22.40) | (28.35) | (63.84) | (313.8) | (62.12) |
| MARKET | -0.849*** | 0.589** | 0.460 | -0.980 | 0.928*** |
| | (0.200) | (0.292) | (0.627) | (1.021) | (0.235) |
| Obs | 8,763 | 2,766 | 1,300 | 2,390 | 15,219 |
| R-sq | 0.355 | 0.652 | 0.429 | 0.500 | 0.575 |
| N firms | 212 | 206 | 192 | 188 | 213 |

Notes: Dependent variable: CDS premium (CDS). Explanatory variables: Empirical default frequency (EDF), idiosyncratic volatility (VID), stock return (SR), risk free rate (RF) slope of the yield curve (SLOPE), implied stock market volatility (VIM), swap spread (SWAP), CDS market index (MARKET). Obs and N firms denote the number of observations and the number of firms, respectively. R-sq is the overall R-squared defined as the squared correlation between the actual and the fitted values of the dependent variable ignoring the individual-specific effects. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

**Table 4: Random effects panel estimates of multiplicative CDS premium decomposition**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Sample | 04m1-07m6 | 07m7-08m8 | 08m9-09m3 | 09m4-10m4 | 04m1-10m4 |
| Variables | ln CDS | ln CDS | ln CDS | ln CDS | ln CDS |
| constant | 2.395*** | 3.620*** | 4.388*** | 3.348*** | 2.760*** |
| | (0.233) | (0.203) | (0.257) | (0.420) | (0.177) |
| bank dummy | -1.821*** | 0.261 | -0.0593 | -2.070* | -4.748*** |
| | (0.553) | (0.678) | (1.573) | (1.098) | (1.452) |
| lnEDF | 0.0407 | 0.0702** | 0.137*** | 0.0409 | 0.146*** |
| | (0.0296) | (0.0295) | (0.0359) | (0.0594) | (0.0273) |
| LEV | 0.0131*** | 0.00612*** | 0.00641*** | 0.0112*** | 0.0162*** |
| | (0.00314) | (0.00188) | (0.00234) | (0.00282) | (0.00230) |
| VID | 0.00454*** | 0.00305*** | 0.00196*** | 0.00163*** | 0.00635*** |
| | (0.000552) | (0.000572) | (0.000536) | (0.000553) | (0.000540) |
| SR | -0.00156 | -0.00622** | -0.00382 | -0.00655*** | 0.00351*** |
| | (0.00200) | (0.00284) | (0.00241) | (0.00157) | (0.00121) |
| RF | -0.0557*** | -0.0880*** | -0.180*** | -0.305*** | -0.0388*** |
| | (0.0213) | (0.0201) | (0.0353) | (0.0986) | (0.0110) |
| SLOPE | 0.0127 | -0.0518** | 0.0614** | 0.293*** | 0.0279* |
| | (0.0145) | (0.0238) | (0.0264) | (0.0997) | (0.0154) |
| VIM | -0.00656*** | -0.00446** | 0.00767*** | -0.00671*** | -0.0144*** |
| | (0.00147) | (0.00203) | (0.00158) | (0.00180) | (0.00119) |
| SWAP | 0.392* | 0.338*** | 0.975*** | -0.179 | 0.749*** |
| | (0.230) | (0.109) | (0.0818) | (0.145) | (0.115) |
| MARKET | 0.0198*** | 0.0104*** | 0.00165** | 0.0104*** | 0.0121*** |
| | (0.00122) | (0.000479) | (0.000675) | (0.00125) | (0.000555) |
| | | | difference banks | | |
| lnEDF | 0.00786 | 0.117* | -0.0634 | -0.115 | -0.0126 |
| | (0.0439) | (0.0610) | (0.0680) | (0.0750) | (0.0687) |
| LEV | 0.000960 | -0.000464 | -0.00501 | 0.0268*** | 0.0292** |
| | (0.00634) | (0.00681) | (0.0153) | (0.00929) | (0.0139) |
| VID | 0.00164 | -0.00321*** | -0.00156** | -0.000674 | -0.00605*** |
| | (0.00272) | (0.000689) | (0.000654) | (0.000993) | (0.000717) |
| SR | 0.00129 | 0.00499 | -0.00142 | 0.00412** | 0.00532* |
| | (0.00405) | (0.00889) | (0.00593) | (0.00195) | (0.00299) |
| RF | 0.120*** | -0.0480 | 0.582*** | -0.380** | 0.0976** |
| | (0.0302) | (0.0434) | (0.0735) | (0.182) | (0.0391) |
| SLOPE | 0.0183 | -0.111** | -0.0184 | -0.0530 | 0.0681* |
| | (0.0240) | (0.0437) | (0.0362) | (0.159) | (0.0376) |
| VIM | 0.00265 | -0.00360 | -0.0412*** | -0.000984 | -0.00491 |
| | (0.00279) | (0.00443) | (0.00348) | (0.00349) | (0.00372) |
| SWAP | -1.047*** | 0.229 | -1.793*** | -0.438** | 0.932*** |
| | (0.299) | (0.226) | (0.134) | (0.188) | (0.305) |
| MARKET | 0.00212 | 0.000900 | 0.00508*** | 0.000859 | 0.00529*** |
| | (0.00184) | (0.00147) | (0.00145) | (0.00179) | (0.00141) |
| Obs | 8,763 | 2,766 | 1,300 | 2,390 | 15,219 |
| R-sq | 0.323 | 0.527 | 0.551 | 0.468 | 0.607 |
| N firms | 212 | 206 | 192 | 188 | 213 |

Notes: Dependent variable: Logarithm of the CDS premium (lnCDS). Explanatory variables: Logarithm of empirical default frequency (lnEDF), idiosyncratic volatility (VID), stock return (SR), risk free rate (RF), slope of the yield curve (SLOPE), implied stock market volatility (VIM), swap spread (SWAP), CDS market index (MARKET). The bank dummy variable has the value of one if a firm is a bank and zero otherwise. Obs and N firms denote the number of observations and the number of firms, respectively. R-sq is the overall R-squared defined as the squared correlation between the actual and the fitted values of the dependent variable ignoring the individual-specific effects. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

**Table 5: Random effects panel estimates of risk neutral CDS premium decomposition**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Sample | 04m1-07m6 | 07m7-08m8 | 08m9-09m3 | 09m4-10m4 | 04m1-10m4 |
| Variables | ln CDS | ln CDS | ln CDS | ln CDS | ln CDS |
| Constant | 2.158*** | 3.319*** | 3.995*** | 3.086*** | 1.996*** |
| | (0.143) | (0.143) | (0.232) | (0.268) | (0.132) |
| Bank dummy | -1.938*** | -1.748** | -0.727 | -1.108 | -5.558*** |
| | (0.528) | (0.833) | (1.536) | (0.854) | (1.307) |
| DD | -0.00295 | -0.0137*** | -0.00149 | 0.00289 | -0.0226*** |
| | (0.00479) | (0.00501) | (0.00551) | (0.00534) | (0.00814) |
| LEV | 0.0152*** | 0.00906*** | 0.0123*** | 0.0133*** | 0.0244*** |
| | (0.00251) | (0.00188) | (0.00205) | (0.00295) | (0.00206) |
| VID | 0.00465*** | 0.00334*** | 0.00187*** | 0.00157*** | 0.00708*** |
| | (0.000597) | (0.000590) | (0.000516) | (0.000531) | (0.000615) |
| SR | -0.00166 | -0.00691** | -0.00797*** | -0.00681*** | 0.00363*** |
| | (0.00206) | (0.00276) | (0.00198) | (0.00155) | (0.00133) |
| RF | -0.0498** | -0.0883*** | -0.231*** | -0.308*** | -0.0307*** |
| | (0.0220) | (0.0196) | (0.0339) | (0.0988) | (0.0106) |
| SLOPE | 0.0221* | -0.0434* | 0.0554** | 0.309*** | 0.0513*** |
| | (0.0132) | (0.0244) | (0.0266) | (0.100) | (0.0141) |
| VIM | -0.00638*** | -0.00414** | 0.00816*** | -0.00659*** | -0.0138*** |
| | (0.00147) | (0.00204) | (0.00158) | (0.00182) | (0.00123) |
| SWAP | 0.302 | 0.314*** | 0.938*** | -0.203 | 0.560*** |
| | (0.245) | (0.113) | (0.0840) | (0.144) | (0.125) |
| MARKET | 0.0201*** | 0.0102*** | 0.000958 | 0.0106*** | 0.0121*** |
| | (0.00123) | (0.000492) | (0.000644) | (0.00121) | (0.000558) |
| | | | difference banks | | |
| DD | -0.00793 | -0.0268* | -0.0122 | 0.0543 | 0.0217 |
| | (0.0147) | (0.0162) | (0.0297) | (0.0488) | (0.0273) |
| LEV | 0.00188 | 0.0177* | -0.000380 | 0.0178** | 0.0349*** |
| | (0.00632) | (0.00955) | (0.0147) | (0.00703) | (0.0132) |
| VID | 0.00149 | -0.00344*** | -0.00150** | -0.000568 | -0.00662*** |
| | (0.00276) | (0.000714) | (0.000644) | (0.000974) | (0.000775) |
| SR | 0.00150 | 0.00663 | 0.00218 | 0.00433** | 0.00518* |
| | (0.00414) | (0.00893) | (0.00586) | (0.00196) | (0.00285) |
| RF | 0.114*** | -0.0266 | 0.633*** | -0.388** | 0.0618 |
| | (0.0318) | (0.0431) | (0.0772) | (0.191) | (0.0382) |
| SLOPE | 0.0153 | -0.127*** | -0.0166 | -0.0848 | 0.0878** |
| | (0.0237) | (0.0456) | (0.0442) | (0.164) | (0.0369) |
| VIM | 0.00252 | -0.00509 | -0.0417*** | -0.000957 | -0.00456 |
| | (0.00284) | (0.00441) | (0.00343) | (0.00360) | (0.00380) |
| SWAP | -0.956*** | 0.255 | -1.768*** | -0.369* | 1.043*** |
| | (0.310) | (0.217) | (0.138) | (0.190) | (0.331) |
| MARKET | 0.00173 | 0.00149 | 0.00560*** | 9.57e-05 | 0.00550*** |
| | (0.00187) | (0.00148) | (0.00144) | (0.00172) | (0.00127) |
| Obs | 8,763 | 2,766 | 1,300 | 2,390 | 15,219 |
| R-sq | 0.297 | 0.506 | 0.499 | 0.431 | 0.547 |
| N firms | 212 | 206 | 192 | 188 | 213 |

Notes: Dependent variable: Logarithm of the CDS premium (lnCDS). Explanatory variables: Distance to default (DD), idiosyncratic volatility (VID), stock return (SR), risk free rate (RF) slope of the yield curve (SLOPE), implied stock market volatility (VIM), swap spread (SWAP), CDS market index (MARKET). The bank dummy variable takes on the value of one if a firm is a bank and zero otherwise. Obs and N firms denote the number of observations and the number of firms, respectively. R-sq is the overall R-squared defined as the squared correlation between the actual and the fitted values of the dependent variable ignoring the individual-specific effects. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

**Table 6: Loss rates implied by CDS premium decompositions**

| Decomposition | 04m1-07m6 | | 07m7-08m8 | | 08m9-09m3 | | 09m4-10m4 | |
|---|---|---|---|---|---|---|---|---|
| | others | banks | others | banks | others | banks | others | banks |
| additive | 38.5 | 12.2 | 62.6 | (36.1) | 32.4 | (3.8) | 53.0 | (16.1) |
| multiplicative | 11.0 | 1.8 | 37.3 | (48.4) | 80.5 | (75.9) | 28.6 | 3.6 |
| risk neutral | 8.6 | 1.2 | 27.6 | 4.8 | 54.3 | (26.2) | 21.9 | 7.2 |

Notes: Loss rates for banks within brackets are not significantly different from loss rates for other firms at conventional significance levels.

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