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HAZARDOUS TIMES FOR MONETARY POLICY: WHAT DO TWENTY-THREE MILLION BANK LOANS SAY ABOUT THE EFFECTS OF MONETARY POLICY ON CREDIT RISK?

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Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk?*

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Abstract

We investigate the impact of the stance and path of monetary policy on the level of credit risk of individual bank loans and on lending standards. We employ the Credit Register of the Bank of Spain that contains detailed monthly information on virtually all loans granted by all credit institutions operating in Spain during the last twenty-two years – generating almost twenty-three million bank loan records in total. Spanish monetary conditions were exogenously determined during the entire sample period.

Using a variety of duration models we find that lower short-term interest rates prior to loan origination result in banks granting more risky *new* loans. Banks also soften their lending standards – they lend more to borrowers with a bad credit history and with high uncertainty. Lower interest rates, by contrast, reduce the credit risk of *outstanding* loans. Loan credit risk is maximized when both interest rates are very low prior to loan origination and interest rates are very high over the life of the loan. Our results suggest that low interest rates increase bank risk-taking, reduce credit risk in banks in the very short run but worsen it in the medium run.

Risk-taking is not equal for all type of banks: Small banks, banks with fewer lending opportunities, banks with less sophisticated depositors, and savings or cooperative banks take on more extra risk than other banks when interest rates are lower. Higher GDP growth reduces credit risk on both new and outstanding loans, in stark contrast to the differential effects of monetary policy.

Keywords: monetary policy, low interest rates, financial stability, lending standards, credit risk, risk-taking, business cycle, bank organization, duration analysis.

JEL: E44, G21, L14.

"The Fed has a new problem: convincing investors it does not need to cut interest rates yet. (…) A rate cut does not just increase the supply of cash; it directly influences people's calculations about risk. Cheaper money makes other assets look more attractive – an undesirable consequence at a moment when risk is being repriced after many years of lax lending."

"Monetary Policy – Hazardous Times," Leaders, Opinion, *The Economist*, August 23rd, 2007

"The root cause of this credit correction was the Federal Reserve's willingness to keep money too easy for too long. The federal funds rate was probably negative in real terms for close to two years between 2003 and 2005. This led to a misallocation of capital. (…) An emergency rate cut, as some in the market seem to be anticipating or hoping for carries the risk of introducing even greater moral hazard into the financial system"

"The Bernanke Call – II," Review & Outlook, Editorial, *The Wall Street Journal*, August 11th, 2007

"A cut in the Fed funds rate, in contrast, would do little to solve the interbank problem. The main effect could be to reawaken banks' appetite for risk."

"The Fed and LIBOR," Lex, Opinion, *The Financial Times*, September 8th, 2007

"But knowing that the political pressure to intervene is asymmetric, asserted far more strongly when markets turn illiquid and asset prices fall than when markets are excessively liquid and asset prices booming, central banks ought also to avoid bringing such situations upon themselves. Better to *lean against the wind* with prudential norms, tightening them as liquidity exceeds historical levels, than to ignore the boom and be faced with the messy political reality of forcibly picking up the pieces after the bust."

"Central Banks Face a Liquidity Trap", Raghuram G. Rajan, *The Financial Times*, September 7th, 2007

I. Introduction

The summer of 2007 was hot for financial markets and central banks. Troubles in the credit markets negatively affected banks, liquidity evaporated in the interbank markets and central banks intervened on a scale not often seen before. Many market observers immediately argued that during the long period of low interest rates, stretching from 2001 to 2005, banks softened their lending standards and loaded up on excess risk. During the crisis many market participants, nevertheless, clamoured for central banks to reduce the interest rates again to alleviate their financial predicament.

Hazardous times for monetary policy indeed: on the one hand, low interest rates may create excessive risk-taking; on the other hand, low interest rates may reduce the risk of outstanding bank credit. In this paper we provide the first hard evidence on this treacherous dilemma by answering the following questions: Do low interest rates encourage bank risk-taking, but at the same time reduce credit risk on outstanding loans? What is the impact of the stance and path of monetary policy on credit risk? And, do monetary and output changes have a similar effect on bank risk?

Though the effects of monetary policy on the volume of credit in the economy have been widely studied (see e.g. Bernanke and Blinder (1992), Bernanke and Gertler (1995), Kashyap and Stein (2000)), its effects on the composition of credit, in particular on the riskiness of borrowers, have not yet been empirically explored. On the basis of recent theoretical work we can understand how changes in short-term interest rates may affect risk-taking in financial institutions. Matsuyama (2007) for example shows that an increase of the borrowers' net worth (through a decrease in interest rates e.g.) reduces agency costs thus making financiers more willing to lend to riskier borrowers (with less access to pledgeable assets). Low borrowers' net worth, on the other hand, may impel financiers to flee to quality (Bernanke, Gertler and Gilchrist (1996)). Low interest rates may also abate adverse selection problems in the credit markets, causing banks to relax their lending standards and increase their risk-taking (Dell'Ariccia and Marquez (2006)). In general, low interest rates make riskless assets less attractive for financial institutions increasing their demand for riskier assets with higher expected returns (Rajan (2006)).[1]

We study the impact of the stance and the path of monetary policy on the risk-taking and loan credit risk of banks. For econometric identification, exogenous monetary policy and comprehensive data on individual bank loans are needed. The Credit Register of the Bank of Spain is uniquely suited. The Register contains detailed monthly information on virtually *all*, new and outstanding, commercial and industrial loans by *all* credit institutions in Spain during the last twenty-two years – generating almost twenty-three million bank loan records in total. The Register also contains essential information on lending standards and loan performance that are key to our analysis. Spanish monetary conditions were exogenously determined during this period, initially from 1988-98 through a policy that aimed at a fixed exchange rate with the *Deutsche Mark*, as of 1999 within the Eurosystem.[2] For this reason we use the German then Euro overnight interbank rates as our measure of monetary policy stance.

Using a variety of duration models and controlling for bank, firm, loan and macroeconomic characteristics, we analyse how short-term interest rates prior to loan origination and during the life of the loan affect the loan hazard rate (default probability per unit of period). We find that the hazard rate increases with <u>lower</u> interest rates at loan origination but also increases as a result of <u>higher</u> rates during the life of the loan.

We not only find that lower interest rates prior to loan origination result in banks granting loans with higher credit risk, but also that banks soften their lending standards: they lend more to borrowers with a bad credit history and with higher uncertainty. All these results suggest that bank risk-taking increases when interest rates are lower prior to loan origination and that in this way monetary policy affects the composition of credit in the economy (i.e., the quality distribution of borrowers in the banks' loan portfolios).

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[1] Den Haan, Sumner and Yamashiro (2007) document aggregate shifts within credit categories following monetary and output changes. They suggest their findings may be caused by a decline in bank risk-taking when short-term interest rates are high. See also Borio (2003), Borio and Lowe (2002) and Crockett (2003).

[2] As a result of the textbook 'Mundell-Fleming trilemma' (Blanchard (2006) or Krugman and Obstfeld (2006) for example) Spanish monetary policy was consequently no longer independent from German monetary policy.

Conditioning on the loan being granted, lower interest rates reduce the credit risk of outstanding loans. Consequently, there is a completely different impact of lower interest rates on the credit risk of new vis-à-vis outstanding loans. In the short-term, lower interest rates reduce the total credit risk of banks since the volume of outstanding loans is larger than the volume of new loans. In the medium-term, however, low interest rates worsen the total credit risk in banks. Our results, therefore, suggest that low interest rates encourage risk-taking, reduce credit risk in the short-term but worsen it in the medium-term.

Risk-taking is not equal for all type of banks: small banks, banks that are net lenders in the interbank market – i.e., banks with fewer good lending opportunities and/or banks that are less monitored by other banks – and savings or cooperative banks take on more extra risk than other banks when interest rates are lower. Therefore, balance-sheet strength, investment opportunities, moral hazard and bank ownership shape the effects of monetary policy on risk-taking.

In stark contrast to the differential effects of monetary policy, we find that higher GDP growth reduces credit risk both for new and outstanding loans. This result and the main result of the paper may imply that there may be other financial inefficiencies outside the traditional channels (Rajan (2006)) that explain the results of this paper.

To the best of our knowledge, Ioannidou, Ongena and Peydró (2007) and this paper are the first to investigate the impact of monetary policy on risk-taking. Ioannidou et al. (2007) have access to loan pricing, which allows them to improve the econometric identification of whether short-term interest rates cause extra bank risk taking. They find that, when interest rates are low, not only do banks take on higher risk but they also reduce the loan rates of risky vis-à-vis riskless borrowers. This paper, by contrast, uses data from a bigger and more developed country and analyses the dynamic implications of monetary policy and GDP growth for bank credit risk over a long time period and exploiting more variation in bank characteristics.

The rest of the paper proceeds as follows. Section II further reviews our empirical strategy. Section III models the time to default of bank loans and introduces the variables employed in our empirical specifications. Section IV presents the results. Finally, Section V summarizes the results and concludes.

II. Empirical Strategy

We want to investigate the effects of the stance – and path – of monetary policy on bank risk, in particular the impact of short-term interest rates prior to loan origination and during the life of the loan on the loan default risk. Essential ingredients in our empirical strategy are a valid measure of bank credit risk, the exogeneity of monetary policy, and a methodology that accounts for its dynamic context. Spain delivers the first two elements, i.e. the Credit Register of the Bank of Spain – that we have access to – contains comprehensive information on Spanish bank lending necessary to construct a valid measure of risk, and Spain had a reasonably exogenous monetary policy since 1988. We estimate duration models to analyze the dynamic impact of monetary policy on credit risk.

An ideal *ex ante* <u>measure of credit risk</u> requires access to the precise, evolving, and truthful predictions of the default probability bank loan officers (may) hold for each individual loan at each moment in time. Internal or external credit ratings are sometimes rather crude and static proxies (for such predictions). The loan rate may suffer as a proxy from the variation over time in the price of risk (Ioannidou et al. (2007)).

The coverage and time span of the Credit Register, however, assures that a proxy that relies on *ex post* default information comes close to the predictions the bank loan officers originally had. Indeed, the Register, first employed by Jiménez and Saurina (2004) and Jiménez, Salas and Saurina (2006) for example, contains confidential and detailed monthly information on (almost) *all* commercial and industrial loans given by *all* credit institutions operating in Spain during a 22-year period. The credit register is *almost* comprehensive, as the reporting threshold for a loan is only 6,000 Euros. This low threshold alleviates any concerns about unobservable bank activity. The Register contains complete records on almost 23,000,000 bank loans.

The dataset further contains detailed firm, bank and loan information, such as: *Firm* identity, province and industry; *bank* identity, legal status, size, and various asset classes; and *loan* instrument, currency, maturity, degree of collateralization, and the amount available and drawn. Crucial for our purpose, the dataset also includes unique loan repayment information (i.e., whether the loan is overdue or not). Hence, we know whether and when a loan defaults. There is, however, no information on the interest rate of the loan. The only comparable dataset, we are currently aware of, that is both comprehensive and containing default information is the Bolivian Credit Register analyzed in Ioannidou and Ongena (2007) and Ioannidou et al. (2007).[3]

[3] The incomplete coverage of the widely used U.S. (National) Survey of Small Business Finances or other private datasets like Loan Pricing Corporation dataset (e.g., Petersen and Rajan (1994), Berger and Udell (1995), Bharath, Dahiya, Saunders and Srinivasan (2006)) complicates the analysis of individual bank risk taking. The reporting threshold in the *Deutsche Bundesbank*'s Credit Register dealt with in Ongena, Tümer-Alkan and von Westernhagen (2007) for example is 1,500,000 Euros. Non-performance of individual loans seems not recorded in the otherwise comprehensive Belgian or Italian Credit Registers (e.g., Degryse, Masschelein and Mitchell (2006), Sapienza (2002)).

There are around 350 commercial banks, savings banks, cooperatives and credit finance establishments operating in Spain at any moment in time during the sample period. Reporting institutions that wish to study the credit record of any applicant have access to the Register, but only at an aggregate level and without the possibility to obtain the borrower's history.

We extract quarterly records on business loans running from 1985:I to 2006:IV and study the impact of monetary policy on bank risk from 1988:II onwards. Monetary policy was mostly exogenously determined during this period and can be adequately measured by German and Euro overnight interest rates (the latter interest rate starts in 1999:I).[4] The sample period spans more than a complete domestic economic cycle.

Our duration analysis relies on a dynamic proxy for risk, i.e., the time to default. We define default on payment (i.e., the event we wish to model) to occur when, three months after the date of maturity or the date of an interest payment, the debt balance remains unpaid.

[4] Until 1983 monetary policy was based on a quantity target approach. Starting in 1984, without explicitly abandoning a quantity target, the Bank of Spain started to devote much more attention to interest rate developments (i.e., adherence to quantity targeting meant increasing the volatility in interest rates). Hence, around the mid-eighties quantity targeting was leaving room for interest rate targeting. In 1986 Spain joined the European Union, thus opening the economy to the business cycles in other large European countries. Accordingly, monetary policy was paying more and more attention to the exchange rate and, in particular, to the bilateral peseta/Deutsche mark exchange rate. In doing so, the monetary policy authorities were trying to incorporate an element of discipline and credibility in its fight against inflation. By mid-89 Spain joined the European Monetary System and, thus, its exchange rate mechanism, making explicit the exchange rate target with the Deutsche mark. In addition, in order to convince the public of the commitment the new regime entailed and counteracting the concurrent expansionary fiscal policy, temporary credit growth ceilings were established (second half of 1989 and 1990). The second half of 1992 witnessed the collapse of the exchange rate mechanism (the Italian lira and British pound in fact left the system) while other currencies, including the Spanish peseta were devaluated (in September 1992, November 1992 and May 1993). From 1994 to 1998 monetary policy was oriented towards joining the Eurosystem and, thus, was also supporting an exchange rate target and closely tied to the core of European monetary policy (i.e., German monetary policy). All in all, it seems fairly reasonable to use German monetary policy as a *good* and *exogenous* proxy for the Spanish monetary policy stance.

When we analyze the impact of interest rates prior to loan origination on loan time to default, we employ the time to default of individual bank loans, observed *ex post* as our measure of bank risk-taking *ex ante*. However, we do observe all new and outstanding loans over a very long time period and can control for multiple bank characteristics and time-varying macro conditions in our estimations making it harder to argue that the realizations of time to default systematically differs from the expectations. Our results further hold for other *ex ante* proxies of risk based on lending standards at the time of the loan origination, such as lending to borrowers with credit history of past defaults and lending to firms that are new borrowers in the banking system (which imply that banks face high uncertainty on these borrowers).

We employ duration models to disentangle the impact on the time to default of monetary policy around loan origination from the impact during the life of the loan. Equivalent to the time to default in duration models is the hazard rate, which is the probability of loan default during each period given default did not occur before. The hazard rate constitutes in effect a proper and intuitive measure of per period risk-taking. To construct a measure of loan default that is normalized per unit of period (hazard rate) is crucial, since theory (e.g. Matsuyama (2007) and Dell'Ariccia and Marquez (2006)) shows that monetary policy affects risk taking and lending standards and, therefore also maturity.

The final step in our empirical strategy consists in exploiting the cross-sectional implications of the sensitivity in bank risk-taking to monetary policy according to the strength of banks' balance sheet (Matsuyama (2007)) and moral hazard problems (Rajan (2006)). Hence, we include interactions of the interest rates with bank characteristics and study their impact on risk.

III. Model and Variables

A. Duration Analysis

Following Shumway (2001), Chava and Jarrow (2004) and Duffie, Saita and Wang (2007) for example we analyze the time to default (of the individual bank loan) as a measure of risk. This section develops the econometric methodology we employ.[5]

Let T represent the duration of time that passes before the occurrence of the default of the loan. In the econometrics literature, the passage of time is often referred to as a spell. Repayment of the loan will prevent us from ever observing a default on this loan and hence the loan spell can be considered right censored.[6] We return to right censoring later in this section.

A simple way to describe the behavior of a spell is through its survivor function, $S(t) = P(T \geq t)$, which yields the probability that the spell T lasts at least to time t. The behavior of a spell can also be described through the use of the hazard function. The hazard function determines the probability that default will occur at time t, conditional on the spell surviving until time t, and is defined by:

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T < t + \Delta t | T \geq t)}{\Delta t} = \frac{-d \log S(t)}{dt} = \frac{f(t)}{S(t)}, \quad (1)$$

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[5] Heckman and Singer (1984b) and Kiefer (1988) review duration analysis. Duffie et al. (2007) discuss empirical bankruptcy models. Ongena and Smith (2001) and Farinha and Santos (2002) employ duration analysis for other applications in empirical banking.

[6] Loans to small firms typically carry a relatively short maturity, often without early repayment possibilities; hence, we choose to ignore early repayment behavior captured in the competing risk model of McDonald and Van de Gucht (1999) for example.

where $f(t)$ is the density function associated with the distribution of spells. Neither the survivor function nor the hazard function provide additional information that could not be derived directly from $f(t)$. Instead these functions present from an economical and conceptual point of view interesting ways of examining the distribution of spells.

The hazard function provides a suitable method for summarizing the relationship between spell length and the likelihood of switching. The hazard rate provides us effectively with a per-period measure of risk taking. When $\lambda(t)$ is increasing in t, the hazard function is said to exhibit positive duration dependence, because the probability of ending the spell increases as the spell lengthens.

When estimating hazard functions, it is econometrically convenient to assume a proportional hazard specification, such that:

$$\lambda(t, X(t), \beta) = \lim_{\Delta t \to 0} \frac{P(t \le T < t + \Delta t | T \ge t, X(t), \beta)}{\Delta t} = \lambda_0(t) \exp(\beta' X_t), \tag{2}$$

where X_t is a set of observable, possibly time-varying explanatory variables, β is a vector of unknown parameters associated with the explanatory variables, $\lambda_0(t)$ is the baseline hazard function and $\exp(\beta' X_t)$ is chosen because it is non-negative and yields an appealing interpretation for the coefficients, β. The logarithm of $\lambda(t, X(t), \beta)$ is linear in X_t. Therefore, β reflects the partial impact of each variable X on the log of the estimated hazard rate.

The baseline hazard $\lambda_0(t)$ determines the shape of the hazard function with respect to time. The Cox (1972) partial likelihood model bases the estimation of β on the ordering of the duration spells as it specifies no shape for $\lambda_0(t)$. On the contrary, the Weibull specification assumes $\lambda_0(t) = \lambda\alpha t^{\alpha-1}$, and allows for duration dependence, i.e., it reflects the fact that the loan has survived until t. When $\alpha > 1$ the distribution exhibits positive duration dependence. The exponential distribution, which exhibits constant duration dependence, is nested within the Weibull as the case $\alpha = 1$. To estimate hazard functions maximum likelihood methods are used.

Explanatory variables can vary through time. To obtain interpretable estimates from the proportional hazard models, it is required that the variables be either "defined" or "ancillary" with respect to the duration of a spell (see Kalbfleisch and Prentice (1980)). A defined variable follows a deterministic path. *Age* is an example of a defined variable because its path is set in advance of the loan, and varies deterministically with loan duration. An ancillary variable has a stochastic path, but the path cannot be influenced by the duration of the spell. One can also assume that the conditional likelihood of ending a spell depend only on the value of an ancillary variable at time *t*, and not on past or future realizations of the variable. *Collateralization* for example is most probably not ancillary as a bank may increase collateral requirements when time to default would decrease.

Censoring is a crucial issue to be addressed when estimating a duration model. Not knowing when a loan starts, or after repayment when it would end, or both, means we are unable to observe the 'true' time to default for these observations. With no adjustment to account for censoring, maximum likelihood estimation of the proportional hazard models produces biased and inconsistent estimates of model parameters.

Accounting for right-censored observations can be accomplished by expressing the log-likelihood function as a weighted average of the sample density of completed duration spells and the survivor function of uncompleted spells (see Kiefer (1988)). Controlling for left censoring is less straightforward (Heckman and Singer (1984a)); hence, in economic duration analysis is often ignored. Our sample consists out of new loans granted from 1998:II onwards, which avoid the left censoring problem in our sample.

B. Variables

We are interested on the impact of monetary policy on the time to default of individual bank loans. The way in which we will express the coefficient will actually feature the equivalent hazard rate as the left hand side variable. The hazard rate is our main proxy for loan risk and has an intuitive interpretation as the per-period probability of loan default provided the loan 'survives' up to that period.

Suppose a loan l is granted in quarter τ. Let T denote the time to maturity or the time to default in case of an overdue repayment; hence, repayment or default would occur in quarter $\tau + T$. We differentiate between monetary policy conditions present in the quarter prior to the origination of the loan (at $\tau - 1$) and policy conditions prevailing during the life of the loan. In a non time-varying duration model the latter is measured at $\tau + T - 1$, while in a time-varying duration model all quarters between τ and $\tau + T - 1$ will contribute to the estimation. We index these periods $\tau + t$, with $t : 0 \rightarrow T - 1$. Figure 1 clarifies the timing of the variables within the context of a Non Time-Varying and Time-Varying Duration Analysis.

[Insert Figure 1 here]

We measure monetary policy conditions using the quarterly average of nominal German and, from 1999:I onwards, Euro overnight interbank interest rate. Consequently, we label the monetary policy measure prior to loan origination as INTEREST RATE$_{\tau\text{-}1}$, and the measures taken over the life of the loan as INTEREST RATE_{T-1} or INTEREST $\text{RATE}_{\tau+t}$, dependent on whether we use non time-varying or time-varying duration models.

We include dummies for the period of credit control, which ran from 1989:III to 1990:IV, and for the currency devaluations that took place during the quarters 1992:III, 1992:IV, and 1993:II. As the Spanish Peseta was solidly pegged to the German Mark, not surprisingly the correlations between Spanish and German interest rates are very high (depending on the rate and the period involved the correlations range between 70% and 90%). In addition to the measures of monetary policy conditions, an array of bank (*b*), firm (*f*), loan (*l*), and macroeconomic controls are included. Table 1 defines all the variables employed in the empirical specifications and provides their mean, standard deviation, minimum and maximum.

[Insert Table 1 here]

BANK $\text{SIZE}_{b\tau-1}$ measures the relative size of the bank vis-à-vis the other banks, OWN FUNDS/TOTAL $\text{ASSETS}_{b\tau-1}$ is the amount of bank equity over total bank assets, INTERBANK POSITION/TOTAL $\text{ASSETS}_{b\tau-1}$ is the net amount of interbank lending by the bank over total assets, and BANK $\text{NPL}_{b\tau-1}$-$\text{NPL}_{\tau-1}$ is the difference between the bank and the other banks level of non performing loans. All characteristics are measured prior to the loan origination quarter. We further include time-invariant dummies that equal one if the bank is a SAVINGS BANK_b (0/1) or a CREDIT COOPERATIVE_b (0/1).

Firm controls include a past default dummy, BORROWER $\text{RISK}_{f\tau-1}$ (0/1), that equals one if the borrower was overdue any time before on another loan, and zero otherwise. This variable is by definition left censored. Removing it does not alter our main results.

We do not have direct access to the actual date of registration of the firm, but we know when the firm borrowed for the first time during our long sample period. The variable LN(2+AGE AS BORROWER$_{f\tau-1}$) measures the age of the borrower in the credit register and for most firms will be highly correlated with actual age. This variable is also by construction left censored, but removing it or limiting its backward looking horizon to five years (older than five years or not) does not alter our main results. In addition to these firm variables we construct ten Industry dummies and fifty Province dummies.[7]

We include the log of the loan amount, LN(SIZE OF THE LOAN$_{l\tau}$), dated in the quarter of loan origination τ. A dummy variable COLLATERAL$_l$ (0/1) equals one if the loan is collateralized and equals zero otherwise. FINANCIAL CREDIT$_l$ (0/1) equals one if the loan is a financial credit and equals zero otherwise. Four MATURITY$_l$ dummies stand for the 0 to 3 month, 3 month to 1 year, 1 to 3 year, and 3 to 5 year classes.

We also feature the growth in real gross domestic product prior to the origination and during the life of the loan, GPDG$_{\tau-1}$ and GPDG$_{T-1}$ or GPDG$_{t-1}$. TIME TREND and TIME TREND^2 (as in Kashyap and Stein (2000)) or EFFICIENCY RATIO$_t$ (%) and FINANCIAL INCOME/ATA$_t$ (%) capture general economic, market and technological developments.[8]

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[7] Due to technical estimation constraints we only include firm fixed effects in a basic linear regression model. We feature the time to default as the dependent variable and attribute all right censored observations the value of double the length of the sample period. Results are unaffected.

[8] We also included various long-term interest rates, inflation and a time-varying International Country Risk Guide measure in some specifications. Results are unaffected and we opted to report the parsimonious models.

IV. Results

A. Cox (1972) Model

To keep estimations manageable, we randomly sample three percent of the loans in the Credit Register and work with 674,133 loans or 1,987,945 loan-quarters.[9] The full sample includes all commercial and financial loans (about the 80% of the total amount of credit in Spain) to non-financial firms granted by commercial banks, savings banks and credit cooperatives excluding non-Spanish subsidiaries and branches.

[Insert Table 2 here]

The estimates in Table 2 are based on ML estimation of the proportional hazard model using the Cox (1972) partial likelihood function in Model I or the Weibull distribution in Models II to VI as the baseline hazard rate. In Table 2 we estimate a non time-varying model; hence none of the variables vary over the periods. All estimates are adjusted for right censoring and standard errors are clustered by firm.

The estimated coefficients in Model I on INTEREST $RATE_{\tau-1}$ and INTEREST $RATE_{\tau+T-1}$ equal –0.069 and +0.207, respectively. Both coefficients are statistically significant at the 1% level and are economically relevant. These coefficients represent one of our key results. Lower interest rates increase the hazard rate on new loans but decrease the hazard rate on the outstanding loans. This finding suggests that lower short-term interest rates in the economy make banks take on new loans with higher credit risk while reduce the credit risk on outstanding loans.

The coefficients on the control variables are on the whole similar throughout the rest of the analysis; hence we briefly discuss them here. Most coefficients are statistically significant, except the coefficient on BANK $SIZE_{b\tau-1}$. The coefficients on OWN FUNDS/TOTAL $ASSETS_{b\tau-1}$ and INTERBANK POSITION/TOTAL $ASSETS_{b\tau-1}$ for example are negative indicating that, not surprisingly, banks with more own funds at stake or net lenders in the interbank market grant loans with lower hazard rates.[10] The coefficient on BANK $NPL_{b\tau-1}$-$NPL_{\tau-1}$ is positive suggesting that banks seemingly persist in hazardous lending. Savings Banks and Cooperatives grant more risky loans.

Borrowers that defaulted on their loan in the past, i.e. when BORROWER $RISK_{j\tau-1}$ (0/1) equals one, are more likely to have a higher hazard rate on their current loans and that 'older' borrowers have a lower one. Smaller, collateralized, financial, and shorter maturity loans are more risky, though the coefficient on $COLLATERAL_l$ (0/1) turns insignificant in some robustness checks.

Finally, our results on real GDP growth are also remarkable. The hazard rate on both new and outstanding loans is lower when GDP growth is higher. This result contrasts with, and further corroborates, the estimated effects of monetary policy on credit risk.

B. Weibull Specifications

Next we subject our results to a battery of robustness checks. Our main results remain mostly unaffected however. In Model II we employ the Weibull distribution as the baseline

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[9] We sample on the basis of certain index numbers in the database that were randomly assigned through time.

[10] In the first case, the higher the own funds at stake, the lower the incentive to take risk (as in Keeley (1990)). In the second case, interbank loans are usually less risky than loans to households and non-financial firms. Note

hazard rate because after one or two initial quarters overdue repayments could become conditionally more likely over the life of the loan. Indeed, the estimate of ln(α) suggests the existence of positive duration dependence. The coefficients on INTEREST RATE$_{\tau-1}$ and INTEREST RATE$_{\tau+T-1}$ equal -0.062*** and 0.299***, respectively (we will explore economic relevancy later).[11]

In Model III we replace the trend variables with the variables EFFICIENCY RATIO$_{\tau-1}$ and FINANCIAL INCOME/ATA$_{\tau-1}$ respectively. We introduce time trends or these specific variables to capture improvements in efficiency in the Spanish banking sector during the last 20 years. The percentage non-performing loans and the efficiency of the banking sector in general have dramatically improved in Spain, potentially biasing our results if we would not control for this effect.

Banks may shorten loan maturity to offset the increase in the hazard rate, thereby affecting the degree of right censoring. Despite the controls for loan maturity and the estimation procedure that adjusts for right censoring, we are still concerned about possible resulting spuriousness in our results. Consequently in Model IV we retain only loans with a maturity longer than one year, in effect removing more than three quarters of our observations. Results are mostly unaffected.

In Model V we interact INTEREST RATE$_{\tau-1}$ with GPDG$_{\tau-1}$. Results are unaffected. Finally, in Model VI we first-difference the interest rates and GDP growth variables, but

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that later we analyze how these net interbank lenders behave in periods of low interest rates and that results change significantly.

[11] As in the tables, we use stars next to the coefficients in the text to indicate their significance levels: *** significant at 1%, ** significant at 5%, and * significant at 10%.

leave the dependent variable in levels. Except for the sign on $GPDG_{T-1}$ - $GPDG_{\tau-1}$, which turns out to be positive, the results corroborate our earlier findings.

C. Time-varying Duration Models and Interactions

Next we allow interest rates and GDP growth to be time-varying and introduce interactions with bank characteristics. Bank susceptibility to monetary policy at loan origination may depend upon bank size and liquidity, as in Kashyap and Stein (2000) for example, on their set of lending opportunities, or on the bank's propensity to moral hazard when granting new loans may further depend on its net borrowing in the interbank market, its type or ownership structure. We report the estimates in Table 3.

[Insert Table 3 here]

We find that small banks, banks that are net lenders in the interbank market, and savings or cooperative banks take on more extra risk than other banks when interest rates are low. Hence, the strength of the balance sheet reduces the impact of monetary policy on risk-taking. Banks that borrow from other banks (and are therefore better controlled or/and have better investment opportunities) increase less their risk-taking when interest rates are lower. Finally, ownership clearly matters. We are currently working on generating more bank characteristics that can help us to disentangle whether lending opportunities or moral hazard are driving some of the results.

D. The Impact of the Path of Monetary Policy on Credit Risk

Before turning to alternative *ex ante* measures of risk, we investigate the economic relevancy of our results and also how the stance and the path of monetary policy affect bank credit risk.

We employ the coefficients of Model II in Table 2 to calculate an annualized hazard rate for a loan with an actual maturity of twelve months,[12] but otherwise mean characteristics, for various "paths of monetary policy" – i.e., for different combinations of on INTEREST $RATE_{\tau-1}$ and INTEREST $RATE_{\tau+T-1}$. For ease of exposition Figure 2 displays some of these combinations.

[Insert Figure 2 here]

For example, if the short-term interest rate in the economy is equal to its sample mean at loan origination and at maturity (4.13 % and 4.09 % to be exact), the annualized loan hazard rate is estimated to be 0.56 %. In sharp contrast, if the interest rate is equal to its sample minimum (2.16 %) at origination, but increases to its sample maximum (9.62 %) at maturity, the loan hazard rate increases more six-fold to 3.38 %. On the other hand, if the "path is reversed" and the funds rate drops from its maximum to its minimum, the hazard rate drops to 0.22 %.

The results suggest that during long periods of low interest rates banks may take on more credit risk and relax lending standards. Exposing the "hazardous" cohort of loans, granted when rates were low, to swiftly increasing policy rates dramatically exacerbates their risk, these estimates suggest. But while suggestive of the impact of changes in monetary policy on the loan hazard rates, the estimates so far are really only calculated for one loan cohort at a time. To obtain a correct assessment of a monetary policy path on the aggregate hazard rate, cohort size and timing needs to be properly accounted for (loans granted during the period of

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[12] The choice of the *actual* maturity matters because the estimated parameter of duration dependence does not equal one. As we annualize the hazard rate, a one-year maturity may facilitate interpretation. Employing other

the increase in the policy interest rate will have a lower and lower hazard rate for example). We leave such an exercise for future work.

E. *Ex Ante* Measures of Risk

Table 4 shows how short-term interest rates prior to loan origination affect *ex ante* lending standards and risk-taking. Model I shows that low interest rates imply than banks give more loans to borrowers that have a bad credit history, i.e., riskier borrowers that defaulted in the past.

[Insert Table 4 here]

We also construct the variable $NEW_{f\tau-1}$ (0/1), a dummy variable that equals 1 if the borrower is the first time that borrows from a bank, else 0. Model II shows that low interest rates correspond to banks giving more loans to borrowers that are new to the Spanish credit register. New borrowers have in general more uncertain cash flows and are therefore riskier.

All in all, these results show that banks lend to ex-ante riskier borrowers when interest rates are low prior to loan origination.[13]

V. Conclusions and Future Research

Controlling for macroeconomic conditions and for bank, loan, and firm characteristics, we find that prior to loan origination lower short-term interest rates may motivate banks in granting loans with higher credit risk. In addition, banks soften their lending standards; in

actual maturities does not qualitatively alter the results. The *contracted* maturity on the other hand is set equal to its sample mean.

[13] Jiménez and Saurina (2006) find that lending standards worsen during good times leading them to support countercyclical prudential norms.

particular, banks grant more loans to borrowers with a bad credit history and with higher uncertainty. These results suggest that bank risk-taking increases when interest rates prior to loan origination are low and that monetary policy affects the composition of credit in the economy as proposed by Matsuyama (2007), Dell'Ariccia and Marquez (2006) and Rajan (2006).

Conditioning on the loan being granted, lower interest rates imply lower credit risk – i.e., lower interest rates reduce the credit risk of outstanding loans. This is because refinancing costs are lower and, therefore, credit risk is lower. Consequently there is a completely different impact of lower interest rates on the credit risk of new vis-à-vis outstanding loans.

In the short-run lower interest rates reduce total credit risk of banks since the volume of outstanding loans is larger than the volume of new loans. In the medium term, lower interest rates, however, increase credit risk in the economy. In particular, a period of low interest rates followed by a severe monetary contraction maximizes credit risk, as the already "hazardous" cohort of new loans gets exposed to higher interest rates as outstanding loans. On the other hand, and asymmetrically, vertical declines in interest rates minimize total credit risk *ceteris paribus*.

The impact of monetary policy on risk-taking is not equal for all banks: small banks, banks that are net lenders in the interbank market, and savings or cooperative banks take on more extra risk than other banks when interest rates are low. Therefore, balance-sheet strength, investment opportunities, moral hazard and type of bank ownership shape the impact of monetary policy on bank risk-taking.

We also find that higher GDP growth both for new and outstanding loans reduce credit risk. Higher GDP growth or lower short-term interest rates imply higher borrower net worth and, therefore, fewer problems between lenders and borrowers. However, the effect of GDP growth on risk-taking is different from the effect of short-term interest rates on risk-taking. This result may imply that there may be other financial inefficiencies (Rajan (2006)) that explain the results of this paper.

We are currently working to extend our study in a number of directions. First, bank ownership, in particular public listing, and ownership dispersion may matter for risk taking incentives. Also the effect of monetary policy on risk-taking may depend on bank liquidity holdings, outstanding non-performing loans, and local banking competition. Second, we currently focus on the impact of monetary policy on the hazard rate of individual bank loans. We obviously overlook the correlations between loan default and the impact on each individual bank's portfolio or the correlations between all the banks' portfolios and the resulting systemic impact of monetary policy. Third, we have only studied the effects of monetary policy on the composition of credit in one dimension, i.e., risk. Industry affiliation and maturity of the funded projects for example may also change. Fourth, we choose *a priori* for a parsimonious empirical model, but one can further investigate the effects of other macroeconomic conditions such as the volatility of GDP growth, inflationary expectations or the term structure for example on the risk of new and outstanding loans. Finally, given the cohorts of loans and initial and ending policy rates for a time period, one can calculate on the basis of the estimated coefficients the path of monetary policy rates that would minimize the total amount of credit risk. It would be interesting to compare this path to the actual path that was followed. We leave all these extensions for future developments of this and other work.

FIGURE 1. NON TIME-VARYING AND TIME-VARYING DURATION ANALYSIS AND THE TIMING OF THE MONETARY POLICY VARIABLES

The figure clarifies the timing of the variables within the context of a Non Time-Varying and Time-Varying Duration Analysis.

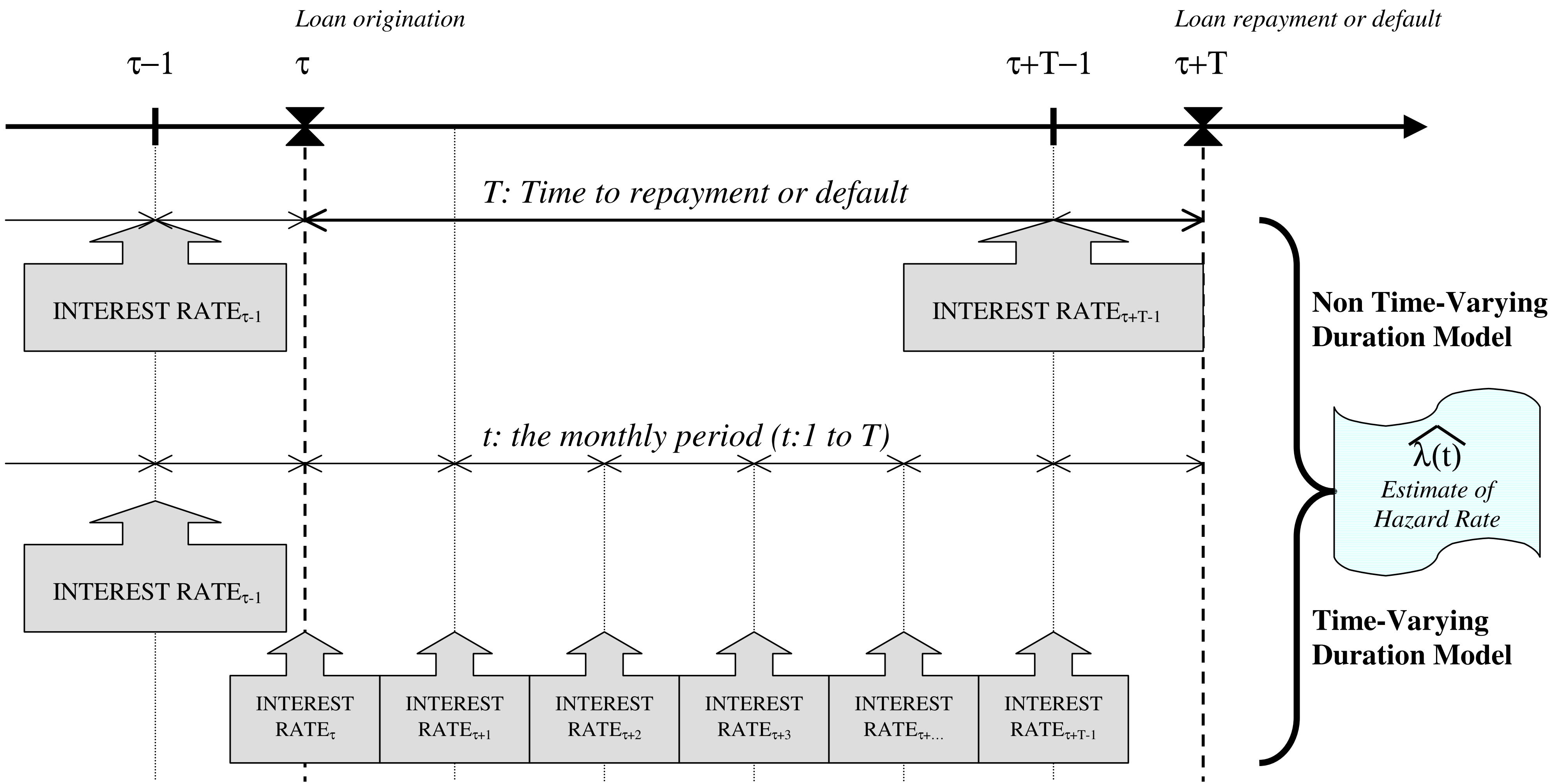

FIGURE 2. MONETARY POLICY PATHS AND LOAN HAZARD RATE

The figure displays various paths for the interest rate (in %) and the resulting annualized Loan Hazard Rate (in %) calculated for a loan with a maturity of four quarters but otherwise mean characteristics, based on the coefficients of Model II in Table 2.

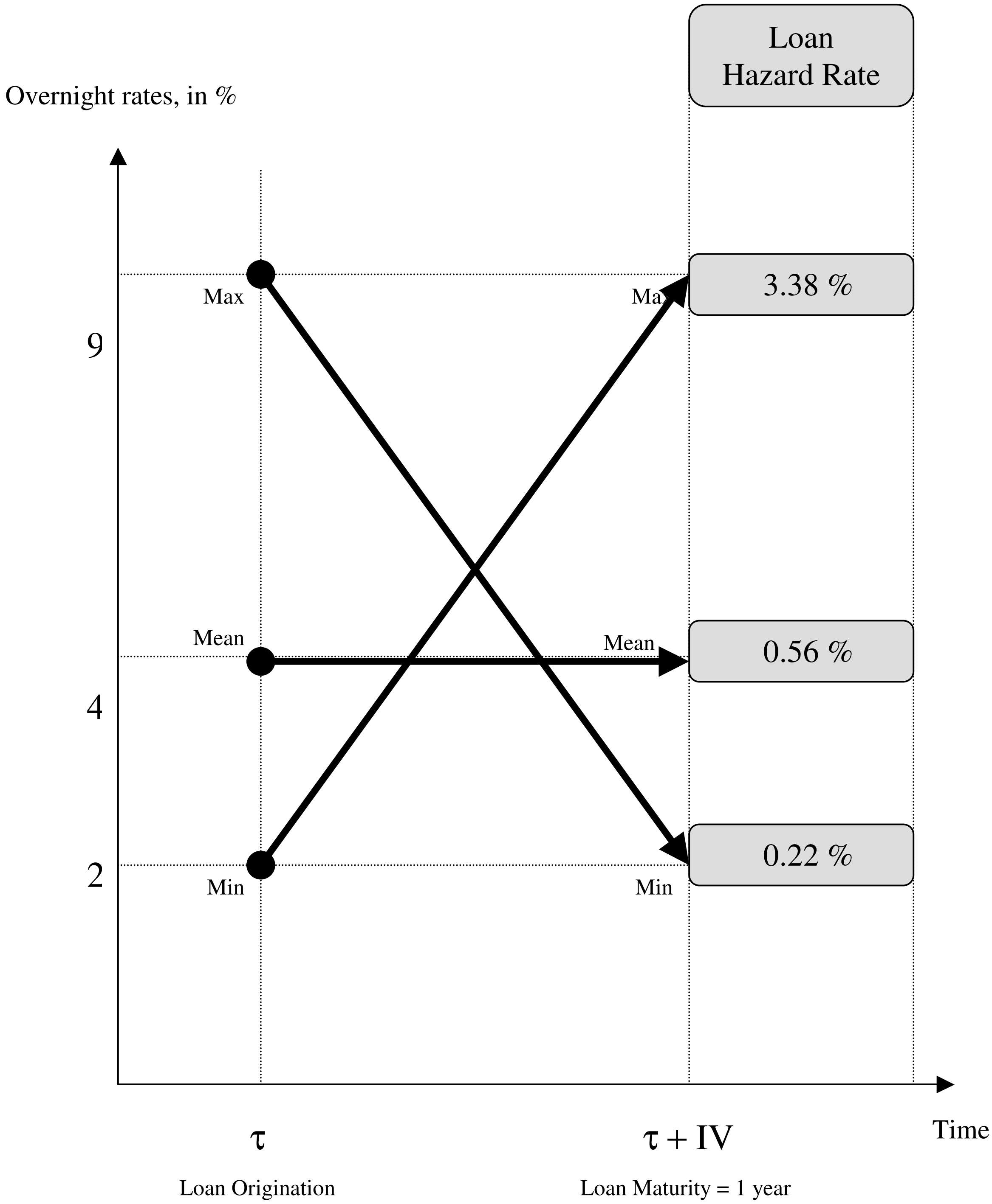

TABLE 1. DESCRIPTIVE STATISTICS

The table defines the variables employed in the empirical specifications and provides their mean, standard deviation, minimum and maximum.

Variables	Definition	Mean	Std. Dev.	Minimum	Maximum
DEFAULT$_l$ (0/1)	1 if there is default, i.e, if three months after the date of maturity or the date of an interest payment, the debt balance remains unpaid	0.005	0.068	0	1
INTEREST RATE$_{\tau-1}$ (%)	Quarterly averages of German and Euro overnight interest rates (the latter interest rate starts in 1999:I)	4.135	2.166	2.023	9.619
BANK SIZE$_{b\tau-1}$ (%)	Relative size of the bank vis-à-vis the other banks	3.827	3.800	0.000	15.122
OWN FUNDS/TOTAL ASSETS$_{b\tau-1}$ (%)	The amount of bank equity over total bank assets	6.324	2.470	-10.813	80.945
INTERBANK POSITION/TOTAL ASSETS$_{b\tau-1}$ (%)	The net amount of interbank lending by the bank over total assets	1.214	10.179	-92.746	91.561
BANK NPL$_{b\tau-1}$-NPL$_{\tau-1}$ (%)	The difference between the bank and the other banks level of NPLs	-0.013	1.793	-4.784	68.969
SAVINGS BANK$_b$ (0/1)	1 if the bank is a saving bank	0.319	0.466	0	1
CREDIT COOPERATIVE$_b$ (0/1)	1 if the bank is a credit cooperative	0.050	0.218	0	1
BORROWER RISK$_{f\tau-1}$ (0/1)	1 if the borrower was overdue any time before on another loan	0.111	0.314	0.000	1.000
LN(2+AGE AS BORROWER$_{f\tau-1}$)	Age is the number of years from the first time the firm borrowed from a bank	2.874	1.102	0.000	4.477
LN(SIZE OF THE LOAN$_{l\tau}$)	The log of the loan amount	4.175	1.376	1.792	15.061
COLLATERAL$_l$ (0/1)	1 if the loan is collateralized	0.077	0.267	0	1
FINANCIAL CREDIT$_l$ (0/1)	1 if the loan is a financial credit	0.457	0.498	0	1
MATURITY$_l$ 0m.-3m. (0/1)	1 if the loan matures before 3 months	0.421	0.494	0	1
MATURITY$_l$ 3m.-1y. (0/1)	1 if the loan matures between 3 months and 1 year	0.375	0.484	0	1
MATURITY$_l$ 1y.-3y. (0/1)	1 if the loan matures between 1 year and 3 years	0.099	0.298	0	1
MATURITY$_l$ 3y.-5y. (0/1)	1 if the loan matures between 3 year and 5 years	0.035	0.185	0	1
GPDG$_{\tau-1}$ (%)	Growth in real gross domestic product	3.032	1.312	-1.833	6.193
EFFICIENCY RATIO$_\tau$ (%)	Expenses and gross operating margin	60.189	4.011	49.087	65.964
FINANCIAL INCOME/ATA$_\tau$ (%)	Interest income plus dividends received over average total assets	3.905	1.721	2.033	7.162

TABLE 2. NON TIME-VARYING DURATION MODELS

The estimates this table lists are based on ML estimation of the proportional hazard model using the Cox (1972) partial likelihood function (Model I) or the Weibull distribution (Models II to VI) as baseline hazard rate. The parameter ln(p) measures the degree of duration dependence. The dependent variable is the hazard rate. The definition of the other variables can be found in Table 1. Subscripts indicate the time of measurement of each variable. τ is the month the loan was granted. T is the time to repayment or default of the loan. None of the variables vary over time. All estimates are adjusted for right censoring. Coefficients are listed in the first column, with z-statistics reported in italics in the second column. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Independent Variables	I Cox Coefficient	z-statistic	II Weibull Coefficient	z-statistic	III Weibull Coefficient	z-statistic	IV Weibull > 12 Months Coefficient	z-statistic	V Weibull Coefficient	z-statistic	VI Weibull Coefficient	z-statistic
INTEREST RATE$_{\tau-1}$	-0.069	*-3.200* ***	-0.062	*-3.250* ***	-0.086	*-3.680* ***	-0.058	*-2.080* **	-0.040	*-1.340*		
INTEREST RATE$_{\tau+T-1}$	0.207	*11.120* ***	0.299	*17.520* ***	0.291	*17.390* ***	0.378	*14.170* ***	0.299	*17.460* ***		
INTEREST RATE$_{\tau-1}$*GDPG$_{\tau}$									-0.007	*-1.020*		
ΔINTEREST RATE$_{\tau-1}$											-0.404	*-6.080* ***
ΔINTEREST RATE$_{\tau-2}$											-0.097	*-1.450*
ΔINTEREST RATE$_{\tau-3}$											-0.011	*-0.150*
INTEREST RATE$_{\tau+T-1}$-INTEREST RATE$_{\tau-1}$											0.095	*7.600* ***
BANK SIZE$_{b\tau-1}$	-0.005	*-0.690*	-0.003	*-0.410*	-0.004	*-0.580*	-0.035	*-2.740* ***	-0.003	*-0.380*	-0.002	*-0.280*
OWN FUNDS/TOTAL ASSETS$_{b\tau-1}$	-0.045	*-4.360* ***	-0.055	*-5.140* ***	-0.054	*-5.090* ***	-0.091	*-4.870* ***	-0.055	*-5.150* ***	-0.046	*-4.350* ***
INTERBANK POSITION/TOTAL ASSETS$_{b\tau-1}$	-0.016	*-8.900* ***	-0.017	*-9.310* ***	-0.017	*-9.330* ***	-0.008	*-3.090* ***	-0.017	*-9.210* ***	-0.019	*-9.970* ***
BANK NPL$_{b\tau-1}$-NPL$_{\tau-1}$	0.052	*9.020* ***	0.057	*9.130* ***	0.055	*8.910* ***	0.060	*7.540* ***	0.057	*9.190* ***	0.056	*8.940* ***
SAVINGS BANK$_{b}$ (0/1)	0.495	*10.170* ***	0.459	*9.070* ***	0.457	*9.000* ***	0.470	*5.560* ***	0.458	*9.050* ***	0.464	*9.140* ***
CREDIT COOPERATIVE$_{b}$ (0/1)	0.553	*5.200* ***	0.598	*5.520* ***	0.592	*5.460* ***	0.174	*0.980*	0.598	*5.510* ***	0.595	*5.510* ***
BORROWER RISK$_{f\tau-1}$ (0/1)	1.213	*18.630* ***	1.245	*18.740* ***	1.251	*18.840* ***	1.215	*13.370* ***	1.245	*18.740* ***	1.271	*18.670* ***
LN(2+AGE AS BORROWER$_{f\tau}$)	-0.187	*-10.810* ***	-0.185	*-10.520* ***	-0.188	*-10.730* ***	-0.056	*-2.160* **	-0.185	*-10.500* ***	-0.177	*-9.860* ***
LN(SIZE OF THE LOAN$_{l\tau}$)	-0.103	*-5.890* ***	-0.101	*-5.570* ***	-0.100	*-5.510* ***	-0.131	*-5.100* ***	-0.101	*-5.580* ***	-0.099	*-5.400* ***
COLLATERAL$_{l}$ (0/1)	0.180	*2.500* **	0.053	*0.680*	0.050	*0.640*	0.157	*1.730* *	0.053	*0.680*	0.050	*0.640*
FINANCIAL CREDIT$_{l}$ (0/1)	0.656	*9.590* ***	0.647	*9.770* ***	0.639	*9.630* ***	1.391	*4.050* ***	0.648	*9.790* ***	0.648	*9.650* ***
MATURITY$_{l}$ 0m.-3m. (0/1)	1.031	*10.770* ***	1.475	*14.180* ***	1.471	*14.150* ***			1.473	*14.150* ***	1.546	*14.810* ***
MATURITY$_{l}$ 3m.-1y. (0/1)	0.821	*10.380* ***	1.366	*15.350* ***	1.360	*15.290* ***			1.365	*15.330* ***	1.420	*15.900* ***
MATURITY$_{l}$ 1y.-3y. (0/1)	0.270	*3.220* ***	0.786	*8.610* ***	0.784	*8.610* ***	0.466	*4.790* ***	0.785	*8.600* ***	0.820	*8.930* ***
MATURITY$_{l}$ 3y.-5y. (0/1)	-0.035	*-0.380*	0.233	*2.380* **	0.236	*2.420* **	0.137	*1.420*	0.233	*2.380* **	0.236	*2.400* **
GPDG$_{\tau-1}$	-0.219	*-11.810* ***	-0.241	*-13.400* ***	-0.271	*-14.190* ***	-0.337	*-11.880* ***	-0.193	*-3.700* ***		
GPDG$_{\tau+T-1}$	-0.040	*-1.790* *	-0.018	*-0.880*	-0.022	*-1.080*	-0.030	*-0.950*	-0.016	*-0.800*		
ΔGPDG$_{\tau-1}$											-0.118	*-2.360* **
GPDG$_{\tau+T-1}$-GPDG$_{\tau-1}$											0.052	*3.370* ***
TIME TREND	0.193	*7.580* ***	0.186	*7.370* ***			0.124	*3.140* ***	0.185	*7.390* ***	0.075	*3.490* ***
TIME TREND^{2}	-0.001	*-8.570* ***	-0.001	*-7.940* ***			0.000	*-3.540* ***	-0.001	*-7.930* ***	0.000	*-4.900* ***
EFFICIENCY RATIO$_{f\tau}$					0.066	*7.700* ***						
FINANCIAL INCOME/ATA$_{f\tau}$					0.133	*3.770* ***						
CONSTANT			-22.291	*-10.990* ***	-13.825	*-21.470* ***	-17.100	*-5.500* ***	-22.366	*-11.100* ***	-12.105	*-7.630* ***
ln(α) (duration dependence)			0.657	*74.790* ***	0.658	*75.470* ***	0.489	*28.700* ***	0.657	*74.650* ***	0.588	*71.310* ***
Industry dummies (10)	yes		yes		yes		yes		yes		yes	
Province dummies (50)	yes		yes		yes		yes		yes		yes	
No. of Observations (Loans)	674,133		674,133		674,133		137,567		674,133		674,133	
Log pseudolikelihood	-34,559		-15,765		-15,773		-5,463		-15,764		-16,021	
χ^{2} (p-value)	0.00		0.00		0.00		0.00		0.00		0.00	

TABLE 3. TIME-VARYING DURATION MODELS INCLUDING INTERACTIONS WITH BANK CHARACTERISTICS

The estimates this table lists are based on ML estimation of the proportional hazard model using the Weibull distribution as baseline hazard rate. The parameter ln(p) measures the degree of duration dependence. The dependent variable is the hazard rate. The definition of the other variables can be found in Table 1. Subscripts indicate the time of measurement of each variable. τ is the month the loan was granted. T is the time to repayment or default of the loan. Variables that vary over time have a subscript $\tau+t$. All estimates are adjusted for right censoring. Coefficients are listed in the first column, with z-statistics reported in italics in the second column. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Independent Variables	I Coefficient	I *z-statistic*	II Coefficient	II *z-statistic*	III Coefficient	III *z-statistic*	IV Coefficient	IV *z-statistic*
INTEREST RATE$_{\tau-1}$	-0.102	*-6.350* ***	-0.133	*-7.650* ***	-0.097	*-5.950* ***	-0.070	*-3.840* ***
INTEREST RATE$_{\tau-1}$*BANK SIZE$_{b\tau-1}$			0.014	*4.590* ***				
INTEREST RATE$_{\tau-1}$*INTERBANK/TA$_{b\tau-1}$					-0.002	*-3.160* ***		
INTEREST RATE$_{\tau-1}$*SAVINGS BANK$_b$							-0.052	*-3.030* ***
INTEREST RATE$_{\tau-1}$*CREDIT COOPERATIVE$_b$							-0.208	*-4.320* ***
INTEREST RATE$_{\tau+t}$	0.064	*3.200* ***	0.061	*3.060* ***	0.062	*3.100* ***	0.056	*2.810* ***
BANK SIZE$_{b\tau-1}$	0.004	*0.510*	-0.061	*-3.650* ***	0.006	*0.690*	0.007	*0.870*
OWN FUNDS/TOTAL ASSETS$_{b\tau-1}$	-0.045	*-4.320* ***	-0.047	*-4.460* ***	-0.047	*-4.500* ***	-0.048	*-4.500* ***
INTERBANK POSITION/TOTAL ASSETS$_{b\tau-1}$	-0.021	*-11.290* ***	-0.021	*-11.290* ***	-0.009	*-2.280* **	-0.021	*-10.920* ***
BANK NPL$_{b\tau-1}$-NPL$_{\tau-1}$	0.052	*8.550* ***	0.054	*8.840* ***	0.051	*8.490* ***	0.052	*8.620* ***
SAVINGS BANK$_b$ (0/1)	0.519	*10.100* ***	0.540	*10.340* ***	0.523	*10.220* ***	0.814	*7.400* ***
CREDIT COOPERATIVE$_b$ (0/1)	0.712	*6.550* ***	0.717	*6.570* ***	0.704	*6.460* ***	1.677	*7.230* ***
BORROWER RISK$_{f\tau-1}$ (0/1)	1.227	*18.040* ***	1.223	*18.030* ***	1.223	*17.930* ***	1.222	*17.980* ***
LN(2+AGE AS BORROWER$_{ft}$)	-0.152	*-8.400* ***	-0.151	*-8.320* ***	-0.152	*-8.410* ***	-0.151	*-8.360* ***
LN(SIZE OF THE LOAN$_{l\tau}$)	-0.114	*-6.260* ***	-0.114	*-6.220* ***	-0.113	*-6.190* ***	-0.113	*-6.210* ***
COLLATERAL$_l$ (0/1)	0.068	*0.880*	0.070	*0.910*	0.068	*0.880*	0.074	*0.960*
FINANCIAL CREDIT$_l$ (0/1)	0.637	*9.370* ***	0.641	*9.450* ***	0.634	*9.340* ***	0.638	*9.410* ***
MATURITY$_l$ 0m.-3m. (0/1)	1.464	*14.290* ***	1.480	*14.470* ***	1.469	*14.310* ***	1.472	*14.390* ***
MATURITY$_l$ 3m.-1y. (0/1)	1.327	*15.330* ***	1.345	*15.530* ***	1.335	*15.460* ***	1.333	*15.420* ***
MATURITY$_l$ 1y.-3y. (0/1)	0.719	*8.060* ***	0.724	*8.120* ***	0.732	*8.220* ***	0.731	*8.200* ***
MATURITY$_l$ 3y.-5y. (0/1)	0.166	*1.710* *	0.176	*1.810* *	0.182	*1.880* *	0.182	*1.880* *
GPDG$_{\tau-1}$	-0.190	*-11.810* ***	-0.185	*-11.550* ***	-0.194	*-11.910* ***	-0.194	*-11.970* ***
GPDG$_{\tau+t-1}$	-0.095	*-5.340* ***	-0.096	*-5.360* ***	-0.095	*-5.300* ***	-0.094	*-5.290* ***
TIME TREND	0.053	*2.320* **	0.049	*2.160* **	0.045	*1.960* *	0.056	*2.430* **
TIME TREND^2	0.000	*-4.210* ***	0.000	*-4.030* ***	0.000	*-3.830* ***	0.000	*-4.380* ***
EFFICIENCY RATIO$_{\tau+t}$								
FINANCIAL INCOME/ATA$_{\tau+t}$								
CONSTANT	-8.982	*-4.870* ***	-8.578	*-4.670* ***	-8.413	*-4.520* ***	-9.235	*-4.990* ***
ln(α) (duration dependence)	0.699	*81.020* ***	0.699	*81.220* ***	0.699	*80.290* ***	0.701	*80.770* ***
Industry dummies (10)	yes		yes		yes		yes	
Province dummies (50)	yes		yes		yes		yes	
No. of Observations (Loan - Quarters)	1,987,945		1,987,945		1,987,945		1,987,945	
Log pseudolikelihood	-15,696		-15,684		-15,691		-15,681	
χ^2 (p-value)	0.00		0.00		0.00		0.00	

TABLE 4. PROBIT MODELS

The estimates this table lists are based on probit models. The dependent variable is indicated in the table. The definition of the other variables can be found in Table 1. Subscripts indicate the time of measurement of each variable. τ is the month the loan was granted. T is the time to repayment or default of the loan. Variables that vary over time have a subscript $\tau+t$. Coefficients are listed in the first column, with z-statistics reported in italics in the second column. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Dependent Variable	I BORROWER RISK=1 (0/1)			II NEW= 1 (0/1)		
Independent Variables	Coefficient	*z-statistic*		Coefficient	*z-statistic*	
INTEREST RATE$_{\tau-1}$	-0.029	*-3.890*	***	-0.047	*-11.470*	***
BANK SIZE$_{b\tau-1}$	-0.007	*-2.760*	***	0.004	*3.440*	***
OWN FUNDS/TOTAL ASSETS$_{b\tau-1}$	-0.011	*-3.940*	***	0.000	*0.120*	
INTERBANK POSITION/TOTAL ASSETS$_{b\tau-1}$	-0.001	*-2.030*	**	0.002	*5.260*	***
BANK NPL$_{b\tau-1}$-NPL$_{\tau-1}$	0.009	*3.220*	***	-0.007	*-4.330*	***
SAVINGS BANK$_b$ (0/1)	0.040	*2.140*	**	0.217	*28.530*	***
CREDIT COOPERATIVE$_b$ (0/1)	0.127	*2.980*	***	0.172	*11.080*	***
BORROWER RISK$_{f\tau-1}$ (0/1)						
LN(2+AGE AS BORROWER$_{fl\tau}$)	0.757	*23.110*	***			
LN(SIZE OF THE LOAN$_{l\tau}$)	0.053	*4.050*	***	-0.185	*-54.000*	***
COLLATERAL$_l$ (0/1)	0.172	*5.840*	***	0.227	*18.770*	***
FINANCIAL CREDIT$_l$ (0/1)	-0.044	*-2.060*	**	0.282	*41.700*	***
MATURITY$_l$ 0m.-3m. (0/1)	0.059	*1.970*	**	-0.513	*-38.250*	***
MATURITY$_l$ 3m.-1y. (0/1)	0.133	*5.240*	***	-0.382	*-30.460*	***
MATURITY$_l$ 1y.-3y. (0/1)	0.106	*4.300*	***	-0.314	*-23.420*	***
MATURITY$_l$ 3y.-5y. (0/1)	0.101	*3.840*	***	-0.151	*-9.890*	***
GPDG$_{\tau-1}$	-0.006	*-0.930*		0.005	*1.460*	
EFFICIENCY RATIO$_{\tau+t}$	0.013	*5.420*	***	-0.002	*-2.270*	**
FINANCIAL INCOME/ATA$_{\tau+t}$	0.161	*10.320*	***	0.158	*31.790*	***
CONSTANT	-4.726	*-13.980*	***	-1.134	*-12.180*	***
Industry dummies (10)	yes			yes		
Province dummies (50)	yes			yes		
No. of Observations (Loan - Quarters)	674,133			674,133		
Log pseudolikelihood	-198,206			-125,699		
χ^2 (p-value)	0.00			0.00		

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