Collateralization, Bank Loan Rates and Monitoring: Evidence from a Natural Experiment

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Abstract

We identify the value of collateralization and its impact on borrower quality and bank monitoring exploiting a change in the Swedish law as a unique natural experiment that exogenously reduced the value of company mortgages, a special type of collateral comparable to the chattel pledge in the United States. Using a differences-in-differences approach, we study the impact on the entire business loan portfolio of a major Swedish bank. We find that collateral is valuable for the bank and that following a loss in collateral value the bank charges a higher interest rate on the loan, worsens its quality assessment of the borrower but also reduces its monitoring efforts of collateral and borrower.

Keywords: Collateral, monitoring, loan contracts, differences-in-differences

JEL Classification: D82, G21

1. Introduction

Collateralization of loans is widely observed around the world and although there is a substantial literature that investigates the important role of collateral in obtaining and managing credit, the precise workings of collateral as one the many features of a credit contract may still not be perfectly understood. Part of the difficulty resides in the joint determination of collateralization with many other loan contract terms (Brick and Palia (2007); Bharath *et al.* (2007); Vig (2009)) and its impact on borrower and bank behavior (Berglöf and von Thadden (1994); Rajan and Winton (1995); Repullo and Suarez (1998); Longhofer and Santos (2000); Gorton and Kahn (2000); Manove *et al.* (2001); Ono and Uesugi (2009)).

In this paper, we aim to take a step forward in identifying the value of collateralization and its impact on borrower quality and bank monitoring. As a unique natural experiment, we exploit a change in law implemented in Sweden on January 1st, 2004, which exogenously reduced the value of company mortgages, a special type of collateral widely used in Sweden that in many aspects resembles the chattel pledge in the United States.

Using a differences-in-differences approach, we study the impact of the change in law on the entire business loan portfolio of a major Swedish bank. We can assign the 3,537 business term loans (observed during 108,368 loan-months) in our sample to an affected, i.e., "treated", and a non-treated group depending on whether the borrower pledged the bank a company mortgage that is still outstanding around the change in law. Important for our purposes, all business term loans carry an adjustable interest rate and we observe the bank's own estimate of the assets pledged to secure each loan.

We establish three main findings. First, following the change in the law, the bank reduces the assessed value of collateral and contemporaneously increases the interest

rate on the same treated loan (and borrower). Second, the bank contracts its internal credit limit to the borrower by 13 percent and downgrades the borrower by almost two units on a 21-scale. Even after controlling for this reassessment of borrower quality by the bank, the decline in the collateral coverage ratio of four percentage points corresponds to a contemporaneous increase in the loan rate by around twenty basis points. Finally, following the change in the law, the bank reduces significantly the intensity and frequency of its monitoring of the condition of both the collateral and borrower.

Taken together these results suggest that collateral is valuable for the bank and that following a loss in collateral value the bank charges a higher interest rate on the loan, worsens its quality assessment of the borrower but also reduces its monitoring efforts of collateral and borrower.

Collateral is an important feature of debt contracts that has received much attention in the literature. However, the intricate nature of collateral imposes important econometric challenges, such as its joint determination with other contract terms and its impact on borrower and bank behavior. Moreover, accurate data on collateral values is typically lacking. Our empirical strategy combines two key ingredients that enable us to overcome these econometric difficulties. These ingredients are: (1) a unique experimental setting that exogenously reduced the value of a special type of collateral widely used in Sweden; and (2) a rich dataset from a major Swedish bank that contains detailed information about the loan contracts, including the estimated collateral values.

The remainder of this paper is organized as follows. Section 2 relates our paper to the literature. Section 3 describes the change in the company mortgage law. Section 4 describes the data, variables, and empirical methodology. Section 5 discusses the impact

of the change in the law on collateralization, loan rate, borrower limit and internal rating, and bank monitoring effort. Section 6 concludes.

2. Literature Review

a. Collateral and Loan Contracting

An extensive theoretical literature emphasizes the role of collateral as an effective loan-contracting tool aimed at ameliorating information asymmetries in the credit market.[1] Collateral may compensate either for *ex ante* adverse selection (e.g., Bester (1985); Chan and Thakor (1987); Boot *et al.* (1991)) or for *ex post* moral hazard problems (Boot and Thakor (1994)). The two sets of theories offer opposite predictions regarding the relation between collateral incidence and borrower observable quality. The empirical evidence is equally mixed in documenting a collateral – borrower quality correspondence. Overall, the available evidence seems more inclined towards the view that riskier borrower are more likely to pledge collateral (e.g., Berger and Udell (1990); Berger and Udell (1995); Harhoff and Körting (1998); Berger *et al.* (2010)).

A related empirical question that has received much attention is the relation between collateral and loan rates. This is a challenging empirical question, since loan contract terms may be determined simultaneously. Some studies have attempted to address this concern by estimating models of simultaneous equations (Brick and Palia (2007); Bharath *et al.* (2007)). However, the potential of this promising avenue may be limited by the lack of theoretical guidance on the precise empirical modeling of the system and the lack of detailed data. To the extent that both contract terms may be based on the same private information set (that is seldom fully observable to researchers), it is

[1] Freixas and Rochet (2008) and Degryse *et al.* (2009) review the theory and empirical evidence on collateral and bank-firm relationships. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) model the role of collateral for macro-economic credit cycles. Liberti and Mian (2010) document the importance of collateral for economic development.

unclear that one can easily find exogenous instruments to identify such a system. The richness of our dataset allied with the unique experimental setting enable us to overcome these important econometric problems faced by previous studies.

b. Collateral and Bank Monitoring

While collateral often is regarded as a contractual device that mitigates a borrower's adverse incentives, a recent literature deals with the agency problems on the lender's side. From the lender's perspective, collateral grants a higher position on the seniority ladder and therefore reduces the lender's expected losses given a borrower's default.

There is a substantial literature built around the idea that seniority improves a bank's incentives to monitor the firm and liquidate the firm if it gets in financial distress (e.g., Berglöf and von Thadden (1994); Repullo and Suarez (1998); Gorton and Kahn (2000)). Longhofer and Santos (2000) for example show that seniority encourages formation of banking relationships and improves banks' incentives to monitor the borrower. The intuition for their result is that in bad states the investment in monitoring yields higher returns when the lender is senior. Rajan and Winton (1995), on the other hand, argue that monitoring is valuable because it allows the lender to claim additional collateral if the firm is in distress. As a result, collateral improves a banks' ex post monitoring incentives. In contrast, Manove *et al.* (2001) argue that collateral can weaken the bank's incentive to evaluate the profitability of a planned investment project. In their model, collateral and screening are substitutes for bank's monitoring, although they are not equivalent from a social viewpoint.

To the best of our knowledge, Ono and Uesugi (2009) is the only other empirical study that attempts to test the relation between collateral and monitoring. Using a survey dataset of Japanese small and medium enterprises, Ono and Uesugi (2009) find that firms that more frequently submit documents to their main bank are less likely to

pledge collateral.[2] We aim to take a step forward in identifying the value of collateralization and its impact on borrower quality and bank monitoring by exploiting a change in the law affecting the value of collateral as a unique natural experiment and by using a differences-in-differences approach in analyzing a dataset containing all business term loans granted by a major Swedish bank.

3. The Swedish Company Mortgage

The company mortgage is a special type of collateral widely used in Sweden that in many aspects resembles the chattel pledge in the United States. Company mortgages enable firm owners to pledge certain personal assets related to their businesses as collateral, excluding assets that could be mortgaged otherwise, such as real estate, and excluding financial assets, such as cash, bank deposits, stock and bonds.

Before 2004, company mortgages were *special priority rights* claims that could be invoked by its holder not only in case of a bankruptcy – as is the case with any normal, not legally prioritized claim, as well as with many senior debt claims –, but also in the case of seizure of assets by a third party (distraint). Therefore this special priority right raised the value of the company mortgage versus claims that had: (1) only *normal priority rights* (and hence are ranked below special priority rights), such as costs incurred in bankruptcy or reconstruction procedures, taxes and most of the wage claims by employees (a limited part has special priority rights); and (2) *no priority rights*.

[2] Ono and Uesugi (2009) measure the incidence of collateral with an indicator variable. About 72 percent of the firms in their sample responded that they pledged collateral to their main bank. They measure monitoring with an ordinal variable that ranges from one (documents submitted to the borrower once every 1-2 months) to four (documents submitted on an annual basis). In a related study, Argentiero (2009) employs data from Italy to analyze the relation between collateral value and firm screening, measured as the number of bank employees in the lending branch scaled by the loan amount.

On January 1st, 2004, the Law on Company Mortgages that regulates the company mortgage (henceforth, "the Law") was changed.[3] The special priority rights of the company mortgage converted into normal priority rights and consequently the company mortgage could only be invoked in the case of bankruptcy. While the group of assets that could be pooled into a company mortgage now also included cash, bank deposits, financial assets, and real estate, the share of total eligible assets was reduced from 100% to 55%.[4] As a result, the company mortgage lost in value in most cases. In fact, the official records of the Parliamentary Committee on Civil Law mention that collateral of lower quality will provide better incentives to banks to assess the profitability of firms rather than the availability of collateral. .

Yet, lawmakers did not expect the change in law to result in higher collateralization requirements because these requirements were supposedly at their maximum already.[5] The Swedish Banking Association, however, commented when the proposed change in the law was referred to it for consideration that it expected collateralization requirements to increase given the key role played by collateral for Basel II capital requirements. The Association also expected interest rate margins to increase.

In principle, the change in the law mainly aimed at improving the possibilities for temporally troubled but essentially solvent and viable businesses to avoid inefficient liquidation by timely reorganization, and at weakening the lenders' incentives to secure collateral rather than to spend effort screening and monitoring the borrowers. However, while abolishing the special priority rights of the company mortgage meant that changes

[3] The "Lag (2003:528) om företagsinteckning" replaced the "lag (1984:649) om företagshypotek".

[4] Other elements of the change in the law were an abolishment of the normal priority rights of the taxes (to give government institutions incentives to cooperate in bankruptcies and reconstructions) and a quantitative reduction of the normal priority rights of wage claims. To compensate for the latter reduction, the government increased the wage amount it guaranteed with public funds.

[5] Lawmakers also did not expect any detrimental effects of the change in the law on start-up firms because primarily more mature businesses in their expansionary phase employ the company mortgage (Source: *Official Documents of the Parliamentary Committee on Civil Law* dealing with the change in the law, Sveriges Riksdag, Lagutskottets betänkande 2002/03:LU17).

in the composition of assets (during borrower distress for example) would matter less for lenders (by abating the borrowers' incentives to game the assets and assuring lenders their collateral value), any lenders' collateral claim would now require the borrower's actual bankruptcy.[6]

Given the nearly experimental setting this change in the law provides, involving an exogenous and rather sudden loss in the value of all company mortgages, we study its impact on all outstanding loans and a bank's collateralization requirements, loan rates and monitoring intensity.

4. Data, Variables, and Empirical Methodology

a. Data

For our analysis, we use a unique and comprehensive database containing all corporate accounts of a major Swedish commercial bank (henceforth, "the bank"). The database contains all loan files the bank maintains for each borrower at a monthly frequency between 2003:01 and 2006:12. From this database, we extract all business loans. Company mortgages can only be pledged to secure this type of loan. Business loans are term loans, with a fixed amount and a quarterly repayment schedule.

[6] The 2004 change in the law was mostly "reversed" on January 1st, 2009. Currently lacking the required data, we leave the study of this reversal for future research. Among the economic arguments put forward by the government for this reversal were anecdotic reports that companies found it more difficult to get credit, and that credit had become more expensive, especially in the less densely populated areas of Sweden. Many governmental agencies, industry lobbies and legal specialists on the other hand in their solicited written comments on the proposed reversal argued in vain that too little time had passed for a serious evaluation of the 2004 change in the law. The government pushed the reversal arguing that businesses would have more assets available as collateral and thus better access to credit. Worse incentives for lenders to monitor and for borrowers during bankruptcy received only short shrift this time. In fact, the government explicitly expected bankruptcy to become more likely and reorganization less likely. The 2009 change in the law did not only involve a reversal of the 2004 change as it also totally abolished the government's normal priority rights for paid-out guarantees on wage claims. A budget proposal to cover the expected reduction in government revenues in bankruptcy procedures, amounting to 298 million Swedish kroner (about 38 million U.S. dollars in 2009) per year therefore accompanied the change in the law.

Important for our purposes, business loans can be either secured or unsecured and carry a floating interest rate that is adjustable on a quarterly basis.

We supplement the bank's data with information from the Swedish Companies Registration Office. The Office maintains registered information on all company mortgages pledged in Sweden. The dataset we have access to tracks all company mortgages registered between 2000 and 2008. For each company mortgage, we obtain the date of registration and the amount. The identity of the holder of the mortgage letter is not always known because this information is not required by the Office. However, it is often voluntarily provided by its holder when the company mortgage is filed because it allows for notification when collateral becomes callable.

b. Variables

Table 1 describes the dependent variables used in this study and presents some descriptive statistics for each variable: its mean, standard deviation, and the number of observations. We analyze three sets of variables. First, we analyze some terms specified in each individual loan contract: the collateral value, the coverage ratio, and the loan rate. The collateral value is the bank's own estimate of the assets pledged to secure that particular loan. The collateral value is updated occasionally as a result of the bank's revaluation of the assets pledged. The coverage ratio is defined as the collateral value scaled by the exposure (i.e., the outstanding balance) of the loan. The coverage ratio measures the expected recovery rate upon a loan default. The loan rate is the annualized interest rate of the loan.

Second, we employ two measures of the bank's own assessment of the borrower's creditworthiness. The first is the internal credit rating of the borrower, which ranges from 0 (highest risk category) to 20 (lowest risk category). Only borrowers with

exposure levels above a certain threshold are assigned an internal rating.[7] To circumvent the problem that these ratings are missing for almost 40% of the borrowers in our sample, we also analyze the borrower's internal credit limit, i.e., the maximum exposure the bank is willing to have vis-à-vis each client. As with the internal ratings, this internal limit is reviewed periodically and is not directly observable by the borrower. In most cases, the borrower's total exposure is a fraction of this internal limit. However, in some cases the internal limit equals the borrower's current exposure.

Third, we study a number of alternative measures of the bank's monitoring activity. We separate these measures into collateral-based and borrower-based measures. Collateral-based monitoring relates to the revaluation of the assets pledged as collateral, while borrower-based monitoring pertains to the review by the bank of the borrower's condition. In the context of collateral-based monitoring, we distinguish between monitoring intensity and monitoring frequency. We measure monitoring intensity as the absolute value of the percentage change in the collateral value between two consecutive months. We presume that larger asset revaluations require more time spent by loan officers in evaluating the assets pledged as collateral (some infrequent additions or subtractions of collateral could also result in large changes in collateral value but may also be the consequence of loan officer monitoring and actions).

We also analyze the magnitude of changes in the collateral coverage ratio as an alternative measure of collateral monitoring intensity. If the bank's monitoring incentives of a particular loan are tied to its risk exposure, then monitoring incentives should be tied to the coverage ratio, rather than to the absolute collateral value.

[7] For confidentiality reasons, we cannot disclose what the threshold is. Clients with an exposure below this threshold are assigned a so-called "behavioral rating" which is based on account behavior. We do not have access to the behavioral ratings.

Besides considering the magnitude of the revaluations of the assets pledged as collateral, we also analyze the frequency with which loan officers undertake such revaluations. To this end, we calculate the number of collateral revaluations made per year. As before, we compute this measure for both the collateral value and the collateral coverage ratio.

Finally, we compute a measure of borrower monitoring based on the frequency with which the bank revises the client's situation. Specifically, we calculate the time to the next review as the number of months until the next planned review date. The frequency of revision varies largely across firms and the revision outcome may be a change in the collateral value, the loan rate, the internal limit, and/or the internal rating. The revision of the client's situation requires that the loan officer collects and processes new information about the customer. This leads us to hypothesize that more frequent revisions are consistent with a more intensive monitoring effort.

c. Empirical Methodology

We examine the effects of the change in law using a differences-in-differences approach. This methodology compares the effect of the change in law on two groups: the group that is affected by the event (the treated group) and the unaffected control group (the non-treated group). The differences-in-differences approach then relies on measuring the differential effect of the change in law across the two groups.

Our identification strategy exploits the change in law in 2004 that abolished the *special priority rights* of the company mortgage, and therefore decreased the value of this type of collateral. Accordingly, we define the treated group as all borrowers that pledged a company mortgage to the bank before 2004.[8] Since the change in law focused

[8] The company mortgages dataset we obtain from the Swedish Companies Registration Office starts in 2000.

only on this particular type of collateral, we presume that borrowers that never registered a company mortgage during our sample period should not have been directly affected by the new law. Therefore, we assign these borrowers to the control, non-treated group. We further require that the non-treated borrowers have loans outstanding that originate prior to the change in the law and mature thereafter (relaxing this requirement by including all loans that are outstanding during the sample period does not alter results). Borrowers that pledged a company mortgage either to any other identified entity or to an unidentified entity were dropped.

To evaluate the effect of the change in law, we estimate the following regression model:

$$y_{it} = \alpha_i + \lambda_t + \beta Treated_i \times After_t + u_{it},$$

where i indexes loans or borrowers (depending on the specification),[9] and t indexes time, i.e., year*month. The dependent variable is y_{it} and the error term is u_{it}.

The main explanatory variable of interest, $Treated_i \times After_t$, results from the interaction of two terms.[10] The first, $Treated_i$, defines the treated group (as opposed to the non-treated control group). Specifically, this dummy indicates whether the firm had a company mortgage pledged to our bank before the new law became effective on January 1st, 2004. This variable captures differences between the treated and non-treated groups before the change in the law.

The second term, $After_t$, equals one for the periods following the change in the law (i.e., 2004:01 to 2006:12), and equals zero otherwise (2003:01 to 2003:12). This variable captures differences for the non-treated group before and after the change in

[9] Some firms have more than one loan at the bank so we can use the loan as a cross-sectional unit. We then cluster the standard errors at the borrower level to address the potential correlation between loans belonging to the same borrower.

[10] We cannot estimate the two variables separately, because *Treated* is spanned by the individual fixed effects, while *After* is spanned by the time fixed effects.

law. To the extent that the change was anticipated and loan contracts and bank assessments were adjusted prior the effective implementation date we are likely to underestimate the impact of the change in the law (in unreported robustness checks we confirm this is to be marginally the case).

The variable resulting from interacting the two terms, $Treated_i \times After_t$, measures the differences-in-differences effect. Specifically, it measures the differential effect of the change in the law across firms that had pledged and firms that had not pledged company mortgages.

The model includes both individual fixed effects (α_i) and time fixed effects (λ_t). The inclusion of these fixed effects is crucial to absorb sources of heterogeneity. On the one hand, the individual fixed effects control for time invariant differences between the treated and non-treated groups. This ensures that our estimates are not plagued by bias due to nonrandom selection into treatment (i.e., a firm's decision to pledge a company mortgage on a particular loan). On the other hand, the time fixed effects control for aggregate fluctuations at the macro and at the bank level.

5. The Impact of the Change in the Law

a. Collateralization, Loan Rate, Borrower Limit and Internal Rating

We start by documenting the effect of the change in law on the borrowers' credit terms. Specifically, we analyze how the exogenous decrease in collateral value following the 2004 change in the law affects the loans' collateral value and coverage ratios, interest rate, as well as the borrowers' internal limits and ratings. Table 2 displays the averages for the non-treated and treated groups, before and after the change in law, for the five aforementioned variables. The table also provides differences of

means tests and differences-in-differences estimates.[11] We note that the estimates of these differences can also be obtained by replacing the individual and time dummies in the previous model by the $Treated_i$ and $After_t$ variables.

Before the change in the law, borrowers that had pledged company mortgages had credit terms that were virtually identical to those of borrowers in the non-treated group. We note that the only difference between the two groups is that the treated borrowers had significantly lower internal ratings.

The differences in means before and after the change in law are difficult to interpret because they are probably capturing economy or bank wide changes that affect both groups. Most interesting is the finding that the 2004 change in the law brought about a significant wedge between the two groups. Specifically, borrowers with outstanding pledged company mortgages experienced a sharp decrease in collateral value, a significant increase in the loan rate, and deterioration in their internal limits.

To further assess the significance of the change in law, we rely on the differences-in-differences estimates shown in Table 3. These estimates are obtained from the full-fledged model that includes sets of fixed effects for both the cross-sectional (i.e., loans or borrowers) and time (i.e., year*month) units. The results indicate that the value of the assets pledged as collateral by the treated group decreased by 75% on average. Part of this effect is due to a larger reduction in outstanding loan amount for the treated group. However, the decrease in collateral value is sharper than the decrease in the individual loan exposure for the treated group, which translates into a decline in their collateral coverage ratio of more than four percentage points after 2004. Hence, and not unexpectedly, the change in the law is perceived by the bank to result in a loss of collateral value.

[11] We cluster errors at the borrower level to address serial correlation (Bertrand *et al.* (2004)).

The decrease in the coverage ratio caused by the reduction in the value of outstanding collateral increases the bank's expected losses. Consistent with this view, the treated group also experienced an average 24 basis points increase in their loan rate, a reduction in their internal credit limit by 13 percent and a downgrade in their internal rating by almost two levels, vis-à-vis the untreated group.

Following the change in the law, we observe a contemporaneous decline in the collateral coverage ratio of about four percentage points and an increase in the loan rate by 24 basis points, for the same loan and borrower. However, the change in the value of the company mortgage also affects borrower limit and rating we found. Consequently, in Table 4 we introduce these internal bank measures of borrower risk in specifications for the 3,491 and 2,083 loans, respectively, for which we have these measures. Controlling for the deterioration in borrower quality ─ as assessed by the bank ─ slightly lowers the increase in the loan rate after the change in the law, but the impact remains statistically significant and economically relevant (the estimated coefficients on $Treated_i \times After_t$ "drop" from 19 to 18 and from 39 to 33 basis points, respectively).

These estimates suggest that for the same loan contract (and accounting for changes in borrower quality following the change in the law) the bank "charges" the borrower on average around six basis points for a percentage point decrease in collateral coverage ratio.[12] This finding is consistent with the observation that collateralization (and the degree of subordination) is a key determinant of recovery on defaulted debt (e.g., Khieu and Mullineaux (2009), Altman and Kalotay (2010)). Consequently, our results suggest that posting collateral may substantially reduce the loan rate at the individual loan contract level

[12] This finding is consistent with the observation that collateralization (and the degree of subordination) is a key determinant of recovery on defaulted debt (e.g., Khieu and Mullineaux (2009), Altman and Kalotay (2010)).

b. Unaffected Leasing Contracts

In order to test the robustness of our identification strategy, we propose a simple "placebo" test. Specifically, we investigate whether the change in the law has an impact on other loans in our sample that should not have been directly affected. We select all borrowers in our sample that have leasing contracts outstanding in 2004. Leasing contracts should not be affected by the change in the law, since a leased asset, and not a company mortgage, serves as its security. As a result, the change in the law should not have a differential effect on the loan rates charged to the leasing contracts of the non-treated control and the treated groups.

We estimate this premise using the differences-in-differences model presented before, which includes loan and year*month fixed effects. The estimates (not reported) corroborate our empirical strategy, as the differences-in-differences estimate is statistically insignificant and economically negligible.[13]

c. Bank Monitoring

We analyze how the change in a law, which weakened the value of company mortgages, affected the bank's monitoring activities. We analyze the effect of the change in law on the frequency and intensity of the loan officer's revaluation of the assets pledged as collateral and on the frequency of review of the borrower's condition.

Table 5 provides the comparison of the means for the non-treated control and treated groups, before and after the 2004 change in the law, for our monitoring variables. As before, we prefer to assess the economic effect of the change in law from a specification

[13] We do find, however, a differential increase in the exposure of these lease contracts for the treated group following the change in law. The decrease in the value of the company mortgages may have pushed some firms to obtain financing through lease agreements. This result corroborates the view that a lease contract is often considered to be a potential substitute for a secured loan (Eisfeldt and Rampini (2009)).

that controls simultaneously for individual- and time- heterogeneity. Table 6 displays the results of the full model.

The estimates in Table 6 show that following the 2004 change in the law that reduced the collateral value of company mortgages, the bank monitored this collateral less actively than other types of collateral. This conclusion holds for the two measures of monitoring proposed – frequency and intensity, and regardless of whether we look at collateral value or at the collateral coverage ratio.[14] On the one hand, the change in law led to a stronger reduction in the intensity of the revaluation of collateral for the treated group than for the control group. The estimated differences-in-differences effect suggests that the change in law decreased the magnitude of collateral revaluations by two and a half percent points.

On the other hand, we observe that the change in law was followed by a significant decrease in the frequency of the revaluation of the assets pledged as collateral. Moreover, the estimated differential decrease in frequency of 0.64 revaluations per year is economically meaningful, since the average number of collateral revaluations per year in our sample is two (Table 1). Next, we turn to the effect of the change in law on the bank's monitoring frequency of the borrower's condition. The relevant model estimates are shown in the last column of Table 6. After the change in law, the bank revised less frequently the condition of clients that had pledged company mortgages before 2004 than of clients who had not. On average, the bank revises a client's condition approximately every ten months (Table 1). Our differences-in-differences estimates indicate that after 2004 the bank increased the revision interval by about three weeks for the treated group, as opposed to the control group. This finding confirms a

[14] To the extent that the amortization schedule of our loan contracts is pre-determined, the decrease in loan exposure over time is mechanical. Moreover, we do not observe changes in amortization plans for the group of loans used in our analysis. Therefore the differential effects we obtain for the collateral coverage ratio cannot be attributed to differential changes in loan exposure across the two groups.

reduction in the bank's monitoring effort following an exogenous decrease in the value of the collateral.

In sum, the intensity and frequency of the bank's monitoring of the condition of the collateral and borrower is reduced as the value of the company mortgage drops. This result suggests that a part of a bank's monitoring activities may be collateral-related and that collateral posting not necessarily "makes a bank lazy."

6. Conclusion

We identify the value of collateralization and its impact on borrower quality and bank monitoring, exploiting as a unique natural experiment, a change in the Law on Company Mortgages implemented in Sweden on January 1st, 2004, that exogenously reduced the value of the company mortgage.

We study the impact of the change in law on the entire business loan portfolio of a major Swedish bank using a differences-in-differences approach. Following the change in the law, we find that the bank reduces the assessed value of collateral and contemporaneously increases the interest rate. The bank lowers its internal credit limit to the borrower and downgrades the borrower. However, the intensity and frequency of the bank's monitoring of the condition of the collateral and borrower is significantly reduced.

Taken together these results suggest that collateral is valuable for the bank and that following a loss in collateral value the bank charges a higher interest rate on the loan, worsens its quality assessment of the borrower but also reduces its monitoring efforts of the lower-valued collateral and borrower.

Collateral is an important feature of debt contracts that has received much attention in the literature. However, the intricate nature of collateral imposes important econometric difficulties, such as its joint determination with other contract terms and its

impact on borrower and bank behavior. Moreover, accurate data on collateral value is typically lacking. Our empirical strategy combines two key ingredients that enable us to overcome these econometric limitations. On the one hand, we exploit a change in a law that exogenously reduced the value of company mortgages, a special type of collateral widely used in Sweden. On the other hand, we exploit a rich dataset from a major Swedish bank that contains detailed information about the loan contracts, including the estimated collateral value.

Table 1 – Variable definitions and descriptive statistics

The table defines the variables used in the analysis and displays the summary statistics, i.e., the mean, standard deviation (Std. Dev.) and number of observations (Obs.).

Variable	Definition	Mean	Std. Dev.	Obs.
Loan contract				
Collateral value (€000)	Estimated value of assets pledged to secure the loan	49.95	184.15	108,368
Coverage ratio (%)	Collateral value / Loan exposure	46.60	46.54	108,368
Loan rate (%)	Annual interest rate of the loan	6.57	1.51	108,368
Borrower				
Internal rating	Internal rating assigned by the bank to the borrower (0-20)	9.29	3.23	56,696
Internal limit (€000)	Maximum exposure towards the borrower	499.09	2616.09	99,635
Monitoring intensity of collateral				
Change in collateral value (%)	Absolute value of the monthly percent change in collateral value	6.05	19.83	107,372
Change in coverage ratio (%)	Absolute value of the monthly change in coverage ratio	2.90	13.02	107,372
Monitoring frequency of collateral				
Nr. changes in collateral value	Number of yearly changes in collateral value	2.02	3.04	108,368
Nr. changes in coverage ratio	Number of yearly changes in coverage ratio	2.35	3.97	108,368
Monitoring of borrower				
Time to next review	Number of months to next review of the borrower’s situation	10.42	3.20	94,704

Table 2 – Change in law and credit terms: Comparison of means

For each dependent variable, the table displays the averages for the *non-treated* and *treated* loans or borrowers before and after the change in company mortgage law on January 1st, 2004. *Non-treated* refers to borrowers that never registered a company mortgage in the period 2000-2006. *Treated* indicates that the borrower had a company mortgage outstanding on January 1st, 2004. *After* refers to the period 2004-2006 and *Before* refers to the year 2003. Standard errors (clustered at the firm level) are provided in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Before	After	Difference
Ln(1 + Collateral value)			
Non-treated loans	5.96	5.52	-0.44***
	(5.25)	(5.25)	
Treated loans	6.29	5.05	-1.24***
	(4.95)	(4.94)	
Difference	0.33	-0.47	-0.80**
Coverage ratio (%)			
Non-treated loans	48.34	45.71	-2.63***
	(46.2)	(46.7)	
Treated loans	51.22	43.99	-7.23**
	(45.17)	(46.78)	
Difference	2.88	-1.72	-4.61
Interest rate (%)			
Non-treated loans	6.94	6.35	-0.59***
	(1.35)	(1.58)	
Treated loans	7.04	6.79	-0.25***
	(0.97)	(1.06)	
Difference	0.10	0.44***	0.34***
Ln(1 + Internal limit)			
Non-treated borrowers	11.74	11.71	-0.03
	(1.51)	(1.55)	
Treated borrowers	11.73	11.45	-0.28***
	(1.19)	(1.4)	
Difference	-0.01	-0.26**	-0.25***
Internal Rating			
Non-treated borrowers	9.67	9.41	-0.26***
	(2.71)	(3.15)	
Treated borrowers	7.08	6.08	-1.00**
	(4.14)	(4.58)	
Difference	-2.59***	-3.33***	-0.73

Table 3 – Change in law and credit terms: Panel analysis

The table reports the results for regressions of the form: $y_{it} = \alpha_i + \lambda_t + \beta Treated_i \times After_t + u_{it}$, where i indexes loans or borrowers, t indexes year*months, and β is the differences-in-differences estimate of the coefficient on the interaction term of *Treated* and *After*. The dependent variables are defined in Table 1. Robust t-statistics (standard errors are clustered at the borrower level) are provided in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Loan			Borrower	
Dependent Variable	Ln(Collateral)	Coverage ratio	Loan rate	Ln(Internal limit)	Internal rating
Treated x After	-0.75***	-4.15***	0.24***	-0.13***	-1.84***
	(-11.39)	(-6.73)	(18.37)	(-12.12)	(-32.28)
Loan fixed effects	Yes	Yes	Yes	No	No
Borrower fixed effects	No	No	No	Yes	Yes
Year*month fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.03	0.01	0.25	0.06	0.05
Number of loans	3,537	3,537	3,537	3,515	2,155
Number of observations	108,368	108,368	108,368	99,635	56,696

Table 4 – Change in law and loan rate controlling for borrower risk: Panel analysis

The table reports the results for regressions of the form: $y_{it} = \alpha_i + \lambda_t + \beta Treated_i \times After_t + u_{it}$, where i indexes loans or borrowers, t indexes year*months, and β is the differences-in-differences estimate of the coefficient on the interaction term of *Treated* and *After*. The dependent variables are defined in Table 1. Robust t-statistics (standard errors are clustered at the borrower level) are provided in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable	Loan rate			
Borrower Risk	Ln(Internal limit)		Internal rating	
Independent Variables	(I)	(II)	(I)	(II)
Treated×After	0.19***	0.18***	0.39***	0.33***
	(12.42)	(11.68)	(20.76)	(17.66)
Borrower Risk		-0.09***		-0.03***
		(-19.26)		(-21.87)
Loan fixed effects	Yes	Yes	Yes	Yes
Year*month fixed effects	Yes	Yes	Yes	Yes
R-squared (%)	0.24	0.24	0.33	0.34
Number of loans	3,491	3,491	2,083	2,083
Number of observations	99,635	99,635	56,696	56,696

Table 5 – Change in law and monitoring: Comparison of means

For each dependent variable, the table displays the averages for the *non-treated* and *treated* borrowers before and after the change in company mortgage law on January 1st, 2004. *Non-treated* refers to borrowers that never registered a company mortgage in the period 2000-2006. *Treated* indicates that the borrower had a company mortgage outstanding on January 1st, 2004. *After* refers to the period 2004-2006 and *Before* refers to the year 2003. Standard errors (clustered at the firm level) are provided in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Before	After	Difference
Absolute change in collateral value (%)			
Non-treated borrowers	5.58	5.98	0.40*
	(18.81)	(19.79)	
Treated borrowers	9.90	8.50	-1.40
	(25.39)	(23.73)	
Difference	4.32***	2.52***	-1.80
Absolute change in collateral coverage (%)			
Non-treated borrowers	2.65	2.87	0.22*
	(11.68)	(13.31)	
Treated borrowers	4.79	4.28	-0.51
	(15.31)	(16.22)	
Difference	2.14***	1.41***	-0.73
Number of changes in collateral value			
Non-treated borrowers	2.02	1.98	-0.04
	(3.05)	(3.03)	
Treated borrowers	2.68	2.27	-0.41
	(3.10)	(3.15)	
Difference	0.66***	0.29	-0.37
Number of changes in collateral coverage			
Non-treated borrowers	2.52	2.25	-0.27***
	(4.09)	(3.92)	
Treated borrowers	3.09	2.15	-0.94***
	(4.10)	(3.58)	
Difference	0.57**	-0.10	-0.67**
Time to next review			
Non-treated borrowers	11.05	10.22	-0.83***
	(2.71)	(3.30)	
Treated borrowers	9.26	9.61	0.35
	(4.03)	(3.61)	
Difference	-1.79***	-0.61***	1.18***

Table 6 – Change in law and monitoring: Panel analysis

The table reports the results for regressions of the form: $y_{it} = \alpha_i + \lambda_t + \beta Treated_i \times After_t + u_{it}$, where i indexes loans or borrowers, t indexes year*months, and β is the differences-in-differences estimate of the coefficient on the interaction term of *Treated* and *After*. The dependent variables are defined in Table 1. Robust t-statistics (standard errors are clustered at the borrower level) are provided in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Monitoring of collateral				Monitoring of borrower
	Change in value		Number of changes		Time to next review
Dependent variable	Ln(Collateral)	Coverage ratio	Ln(Collateral)	Coverage ratio	
Treated x After	-2.52***	-1.22***	-0.64***	-0.84***	0.62***
	(-5.04)	(-3.50)	(-13.75)	(-15.14)	(6.48)
Loan fixed effects	Yes	Yes	Yes	Yes	No
Borrower fixed effects	No	No	No	No	Yes
Year*month fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.001	0.001	0.01	0.04	0.08
Number of loans	3,537	3,537	3,537	3,537	3,406
Number of observations	107,372	107,372	108,368	108,368	94,704

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