Got rejected? Real effects of *not* getting a loan

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Abstract

Using a lender cut-off rule that generates plausibly exogenous variation in credit supply, I analyze the real effects of loan rejections. At the bank at hand, loan applications with a rating better than the cut-off are accepted, while loan applications with a rating worse than the cut-off rating are subject to an additional review, leading to a sharp drop in the acceptance rate at the cut-off rating. Using almost 15,000 loan applications by small and medium-sized enterprises, I show that loan rejections lead to lower investments and a decrease in revenues and employment at the affected firms. The effects are concentrated among firms with low liquidity, measured as the ratio of current assets to current liabilities. High liquidity firms are able to absorb the credit supply shock by cutting down their current assets, without a significant effect on investments, revenues, and employment. To the contrary, low liquidity firms cut down on investments, leading to lower revenues and lower employment. Overall, the paper adds to the understanding of firms' liquidity holdings in the transmission of credit supply shocks.

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1. Introduction

It is important to understand the real effects credit access. As an example, assume that company A and company B are very similar and both apply for a new loan. Company A's loan application is accepted, while company B's loan application is rejected. How are investments, sales and employment going to differ between company A and company B in subsequent years? While there is ample research about the determinants of bank lending per se, much less is known about the real effects of lending.

A empirical analysis of the real effect of credit access faces one key challenge: A researcher needs to identify two *similar* sets of firms, one set of firms that have been denied credit and one set that has been granted credit. For obvious reasons, banks try to provide credit to high-quality firms while denying credit to poor-quality firms. Therefore, in any real-life data set, firms that have been denied credit are on average of worse credit quality than firms that have been granted credit.

I overcome this challenge by using internal data from a major German bank where loan decisions are governed by a sharp cut-off. The data set comprises almost 15,000 loan applications from small and medium size enterprises (SMEs). Loan applications with a rating better than the cut-off are accepted, while loan applications with a rating worse than the cut-off are subject to an additional review, leading to a sharp drop in the acceptance rate at the threshold. Thus, firms *just* below and *just*

above the cut-off are very similar in terms of credit quality, yet one group of firms has access to credit while the other group of firms does not.

Using a fuzzy regression discontinuity design, I document the following findings: First, while large firms (revenues above EUR 3mn) are able to substitute the loss in funding from the sample bank, small firms (revenues below or equal to EUR 3mn) are not. As a consequence, small firms lose approximately 10 percent of their debt funding and need to cut their assets by 7 percent relative to firms whose loan applications have been accepted. Second, the effect of the cut in assets crucially depends on the firms' liquidity (ratio of current assets to current liabilities): firms with high liquidity reduce their current assets (cash, inventory, and trade receivables), without any effect on investments, revenues, and employment. On the other hand, firms with low liquidity predominantly reduce their investment assets (such as property, plant, and equipment). As a consequence, revenues of low liquidity firms whose loan applications have been rejected decrease by 14 percent and employment decreases by 10 percent.

The regression discontinuity design relies on a no-manipulation assumption of the running variable, i.e., the internal rating. Economically, manipulation is not an issue here, as the rating is purely based on hard information. Furthermore, loan officers are incentivized based on ex-post performance so that any incentives to manipulate hard information as documented in Berg, Puri, and Rocholl (2014) are muted. A formal McCrary density test confirms the no-manipulation assumption.

The paper adds to several strands of the literature. First, the paper contributes to our understanding of the credit channel that transmits banking shocks to the real economy (Bernanke, 1983). Early empirical studies have focused on a simple comparison of small versus large firms (Gertler and Gilchrist, 1994). Subsequent research has looked at survey-based measures (Campello, Graham, and Harvey, 2010; Balduzzi et al., 2014), event studies and natural experiments (Gan, 2007; Almeida et al., 2012), or the dispersion in lender health following the financial crisis (Chodorow-Reich, 2014, Acharya et al., 2014, Cingano, Manaresi, and Sette, 2013, Bentolila et al., 2014). Using dispersion in lender health to identify real effects of credit supply relies on the assumption that the bank-firm matching is exogenous, and thus on the assumption that any cross-sectional variation in bank lending can be attributed to supply factors.

This paper adds to the literature in several ways. Most importantly, the set-up allows to distinguish between credit demand and credit supply effects. The sample contains only firms that have applied for a loan. Therefore, the effects observed can clearly be attributed to differences in credit supply. The set-up at hand also avoids the challenges associated with endogenous borrower-lender matching. The simple cut-off rule applied by the bank at hand provides plausibly exogenous variation in the supply of bank loans and thus offers a compelling environment to identify the real effects of credit access. Last but not least, most prior studies have predominantly looked at a sample of relatively large firms. Acharya et al. (2014) and Chodorow-

Reich (2014) analyze firms active in the syndicated loan market, with average sales of more than USD 1bn while Gan (2008) and Almeida (2012) focus on publicly listed firms with regulatory filings. This paper adds to this literature by using bank-internal data on lending to small and medium size enterprises. The mean revenues of the firms in the sample are EUR 10mn (median: EUR 6mn). The credit channel is likely to be most important for these small firms, as larger firms may be able to access alternative sources of funding (Becker and Ivashina, 2014).

Second, the paper adds to the growing literature on the role of banks as providers of monitored liquidity insurance (Boot, Greenbaum, and Thakor, 1993; Thakor and Udell, 1987; Shockley and Thakor, 1997; Acharya et al., 2014). In particular, Acharya et al. (2014) propose a theory that links firms' liquidity risk and the choice between bank loans (credit lines) versus cash holdings. This paper demonstrates that the real effects of credit access are most pronounced for firms that rely on banks for liquidity provision.

The rest of the paper is organized as follows. Section 2 describes the loan origination process and the cut-off rule used for accept/reject decisions. Section 3 provides descriptive statistics. Section 4 explains the empirical strategy and provides the empirical results. Section 5 concludes.

2. Institutional set-up

2.1 Loan granting process

I access data on 14,524 SME loan applications between 2009 and 2012 from a major German bank with a maximum loan amount of EUR 1mn. For loan applications up to EUR 1mn, loan granting decisions are governed by a cut-off regime that creates plausibly exogenous variation in the likelihood of receiving a loan.

In the first step, the bank aggregates hard information from various sources (account activity, balance sheet and profit and loss data, firm type/age/location, and information from a private credit registry) into a continuous internal rating. This continuous internal rating ranges from 0.5 (best) to 11.5 (worst) and is mapped into rating grades ranging from 1 (best) to 11 (worst). A distribution of rating grades for all loan applications is depicted in Figure 1.

[Figure 1]

In the second step, loan applications are grouped into three distinct buckets. Loan applications with a rating grade of 1-7 can be granted by the loan officer without consent from the risk management department. Loan applications with a rating grade of 8-9 are subject to further review by the risk management department

which then takes the final accept/reject decision. The risk management department bases their decisions on an analysis of the available data sources and can also request further details or clarification on some of the inputs. This set-up induces a discontinuity in the likelihood of am acceptance of the loan application. As can be seen from Figure 2, the likelihood of an accept-decision is larger than 80% for rating grades between 1 and 7, and it precipitously drops to 50% for rating grades 8 and 9.

[Figure 2]

Finally, loan applications with a rating grade of 10-11 are directly rejected without further considerations. Thus, there is another discontinuity in the likelihood of acceptance between rating grades 9 and 10. However, as the number of loan applications with a rating of 10-11 is very low (see Figure 2), the following analysis will predominantly focus on the discontinuity between rating grades 7 and 8.

2.2 Measuring real effects after the accept/reject decision

To measure real effects of the accept/reject decision ─ such as the development of investments, sales, and employment ─ I rely on the DAFNE data base provided by Bureau van Dijk. The DAFNE data base collects information on the balance sheet, profit and loss statement and number of employees from all

German companies. In Germany, all incorporated enterprises are required to disclose their annual reports within 12 months after the end of the fiscal year. The granularity of the disclosure requirement varies by size of the corporation. Corporations are defined as "very small enterprises", "small enterprises", "medium enterprises", and "large enterprises" based on their revenues, total assets, and number of employees. In the following, for simplicity reasons, I report the categorization by revenues.

Very small enterprises, representing 4% of the sample, are defined as firms with less than EUR 700,000 in revenues. Very small enterprises are only required to disclose basic items of their balance sheet. On the asset side, these basic items include investments, working capital, accruals and deferred tax assets. On the liability side, these basic items include equity capital, provisions, liabilities, accruals and deferred tax liabilities.

Small enterprises, representing 68% of the sample, are defined as firms with more than EUR 700,000 but less than EUR 9.68mn in revenues. Small enterprises are required to further decompose the balance sheet items discussed above. In particular, investments have to be decomposed into intangible assets, tangible assets, and financial assets; working capital has to be decomposed into inventory, trade receivables, securities, and cash holdings; and liabilities have to be decomposed into bonds, bank loans, trade payables, and other liabilities.

Medium sized enterprises, representing 24% of the sample are defined as firms with more than EUR 9.68mn in revenues and less than EUR 38.5mn in revenues wile

large enterprises, representing 4% of the sample are defined as firms with more than EUR 38.5mn in revenues. Medium and large enterprises face further disclosure requirements. In particular, these firms also need to disclose the profit and loss statement and provide a further breakdown of asset and liability positions.

I collect data on these items for the year directly preceding the loan application and two subsequent years. For example, for a loan application from May 2010 we collect data from the annual reports 2009, 2010, and 2011. In some cases, data is not available in the DAFNE database. This can be due to one of the following reasons: First, the firms is not active any more, either due to insolvency or because it was discontinued for a different reason. These firms can be clearly identified as any discontinuation and the respective cause has to be reported to the public register of corporations. I discuss in more detail how these companies are treated in the empirical section. Second, in a few cases, data is not available even though companies are legally required to file the data. I thoroughly check that instances of missing data are not systematically related to a reject/accept decision in the Online Appendix Table 2.

3. Data and descriptive statistics

I obtain data on 14,524 loan applications at a major German bank from small and medium sized enterprises between January 2009 and December 2012. The data set comprises detailed information on the loan and firm characteristics. Table 2 presents descriptive statistics on the loan application level. All variables are explained in Table 1.

The average rating is 5.80 (median: 5.64), i.e., below the cut-off rating of 7.5 that defines risk management involvement. A detailed rating distribution is provided in Figure 1. The proportion of loan applications with a rating above the cut-off rating of is 81%, with 19% being below the cut-off rating. The average loan volume is EUR 521,000 (median: EUR 500,000) with 55% of the loans being collateralized. The mean loan volume comprises slightly less than 10% of the mean balance sheet size of EUR 4.8mn (median: EUR 2.5mn). The mean firms is 21 years old (media: 17 years), has a relationship with the bank since 8.4 years (median: 4 years) and is a limited liability firm. It has EUR 9.7mn in revenues (median: EUR 5.5mn) and 49 employees (median: 29 employees). According to German Federal Statistical Office, the mean revenue of all German firms in 2012 (excluding self-employed workers) was EUR 5.0mn. Thus, the mean firm size is largely representative of the average German firm and significantly smaller than samples of listed firms or firms active in the syndicated loan market.

The average equity-to-asset ratio is 28% (median: 26%), the mean liquidity ratio (current assets divided by current liabilities) is 2.14 (median: 1.47). The mean profitability, measured as the EBITDA-margin (EBITDA divided by revenues) is 6% (median: 5%).

[Table 1 and 2]

4. Empirical strategy and results

4.1 Empirical strategy

The lender cut-off rule provides plausibly exogenous variation in loan supply. Thus, the cut-off rating can be used in a (fuzzy) regression discontinuity design (Thistlewaite and Campbell, 1960, Lee and Lemieux, 2009) to estimate the treatment effect:

$$y_{i,t} = \beta \cdot BelowCutOff(0/1) + g_1(DifferenceToCutOff) + g_2(DifferenceToCutOff) \cdot BelowCutOff(0/1) + \gamma \cdot Controls + \varepsilon \quad (1)$$

where $y_{i,t}$ is the variable of interest (e.g., change in loan volume, investments, employment), *BelowCutOff(0/1)* is a dummy equal to one if the rating is below the

cut-off rating (i.e., a rating of 7.5 or worse), *DifferenceToCutOff* is the difference between the continuous internal rating and *g1* and *g2* are polynomials fitted to the right and left-hand side of the cut-off rating. The key coefficient of interest, β, identifies the impact of the an exogenous change in loan supply on the outcome variable of interest (e.g., loan volume, investment, employment).

Controls is a set of loan and firm characteristics as well as fixed effects. Loan controls include the loan amount and a collateral dummy which is equal to one if the loan is collateralized. Firm characteristics include the logarithm of the firm age (measured in years), the logarithm of 1 plus the length of the relationship with the bank (defined as the number of years that the firm has had an account at the bank without interruption), the logarithm of the firm revenues (measured in EUR mn), the number of employees, the equity-to-asset ratio, the EBITDA margin (defined as earnings before interest and taxed, depreciation and amortization divided by firm revenues, the liquidity ratio (measured as current liabilities divided by current assets), and a dummy of whether the firm is incorporated as a limited liability firm. All firm characteristics are determined as of the fiscal year prior to the date of the loan application. Fixed effects include industry fixed effects, one-digit zip code fixed effects and year fixed effects. Equation (1) is estimated using a linear model and all standard errors are clustered at the firm level.

The regression discontinuity design relies on a no-manipulation assumption of the running variable, i.e., the rating. Economically, manipulation is not an issue

here, as the rating is purely based on hard information. Furthermore, loan officers are incentivized based on ex-post performance so that any incentives to manipulate hard information as documented in Berg, Puri, and Rocholl (2014) are muted. A formal McCrary density test (McCrary, 2008) does not reject the no-manipulation assumption (see Appendix Table 1).

4.2 The impact of the lender cut-off rule on firm's funding

In the first step, I estimate equation (1) using the acceptance dummy as the dependent variable. The acceptance dummy is equal to 1 if a loan application is accepted by the bank. The test thus fulfils a simply purpose, that is, confirming that the cut-off rule as described in section 2.1 is indeed reflected in the data. Results are presented in column (1) of Table 3.

[Table 3]

Reassuringly, the cut-off rule is indeed borne out in the data: The coefficient on the cut-off dummy is equal -0.26 (t-stat < -10), suggesting that the likelihood of an accept-decision drops by 26 percentage points at the cut-off rating.

How does the cut-off rating affect a firm's loan volume at the bank? Column (2) of Table 3 looks at the change in loan volume from one month prior to three

months after the loan application. Two points are worth mentioning here: First, the loan volume only constitutes the loan volume with the sample bank, i.e., the results are uninformative as to whether the firm is able to substitute any funding shortfall by applying for a loan at another bank. Second, the change is measured relative to the firm's total assets in the fiscal year prior to the loan application. Therefore, the results directly shed light on the economic importance, that is, on the loss in funding relative to the size of the firm's balance sheet. The coefficient on the cut-off dummy is -0.074 and highly statistically significant. The coefficient is also economically significant: Firms below the cut-off end up with a lower amount of funding from the sample bank equal to 7.4% of their total balance sheet size. With an average balance sheet size of EUR 4.8mn, this amounts to approximately EUR 350,000.

The prior analyses looked at a rather short time window, i.e., one months prior to three months after the loan application. It is important to analyze whether the same results carry over to longer time horizons, for example one or two years after loan application. It is conceivable that a firm just below the cut-off rating migrates to a rating above the cut-off rating after a while; and is thus able to successfully reapply for a loan. For the identification of real effects, which are measured using annual report data, it is important that the discontinuity in the loan supply is non-transient. I thus repeat the regression using the change in loan volume from one month prior to 12 months (column (3) of Table 3) and 24 months (column (4) of Table 3) after the loan application. Results are very similar to column (2), with the coefficient on the

cut-off dummy ranging from -6.0% to -8.4% (significant at the 1 percent level in all specifications). I conclude that being below the cut-off rating at the time of a loan application has indeed a longer-lasting effect on loan availability from the sample bank.

Are firms able to substitute funding from the sample bank via other funding sources such as loan from other banks or equity capital? Table 4 sheds light on this question. In column (1)-(3), the dependent variable is the change in total debt from the fiscal year prior to loan application to the fiscal year in the year following the loan application (i.e., the change is measured over two years). Again, the change is measured relative to the firm's balance sheet size in the fiscal year prior to the loan application. Column (1) reports results for the total sample. The coefficient on the cut-off dummy is -4.8%, suggesting that firms are not fully able to substitute from other banks. Column (2) and (3) split the results by firm size, with small and large firms being split at the median of the balance sheet size in the fiscal year prior to the loan application. Consistent with prior literature (Gertler and Gilchrist, 1994), the effects are concentrated in the sample of small firms (coefficient of -9.5%).

[Table 4]

As an alternative to debt funding, firms might also choose to increase equity capital. Columns (4)-(6) of Table 4 show that this is not the case. Using the change

in equity capital as the dependent variable gives insignificant results both for the total sample as well as for the subsamples of small and large firms. As a consequence of the drop in debt funding without a corresponding increase in equity funding, firms that are below the cut-off are subject to a negative shock on their total assets (see column (7) of Table 4). Again, the effect is most pronounced for small firms (see column (8) versus column (9) of Table 4).

4.3 The impact of the lender cut-off rule on real effects

The prior analysis has demonstrated that the lender cut-off rule restricts firms' overall availability of funding, in particular for small firms. Thus, the crucial questions are: How does the loss in funding transmit to the asset side, that is, which assets are reduced as a response to the limits in funding availability? And how does this affect revenues and employment at the firms? Table 5 sheds light on the first of these questions. Given that funding effects are concentrated in the sample of small firms, I focus on small firms only in the following analysis.

[Table 5]

Faced with constraints on their available funds, firms can either reduce their current assets (cash, trade receivables, inventory) or reduce their investment assets (such as property, plant, and equipment). Overall, firms seem to follow both

strategies, with the coefficient on current assets (-6%, $p<0.05$) being somewhat larger than the coefficient on investment assets (-2%, $p<0.10$), see column (1) and (2) in Table 5.

However, pooling all firms together provides an incomplete picture of the adjustment process. This adjustment process crucially depends on the liquidity ratio, measured as current assets divided by current liabilities, of the firm in the fiscal year prior to the loan application. Firms with a liquidity ratio above one ("high liquidity firms") predominantly reduce their current assets (coefficient of -8.5%, $p<0.01$) without a significant reduction in investment assets. The opposite effect can be observed for firms with a liquidity ratio below one ("low liquidity firms"). These firms are not able to cushion the loan rejection by a further cut into their liquidity (coefficient of -0.7%, $p>0.10$) and therefore have to reduce their investment assets (coefficient of -5.2%, $p<-0.10$).

As a consequence of this behavior, the negative effects on employment and revenues are fully concentrated among low liquidity firms. While there is no discontinuity in the change in revenues and employment at the cut-off rating for high liquidity firms (see column (3) and (4) of Table 6), low liquidity firms below the cut-off rating incur a significant reduction in both employment (-10.0%, $p<0.05$, see column (5) of Table 6) and revenues (-13.7%, $p<0.05$, see column (6) of Table 6).

[Table 6]

These results suggest that liquidity of a firm plays a key role in the transmission of funding shocks to the real economy and therefore add to the liquidity insurance theory brought forward by Acharya et al. (2014).

5. Conclusion

Using exogenous variation induced by a lender cut-off rule, I analyze the real effects of loan rejections. Loan applications with a rating better than the cut-off are accepted, while loan applications with a rating worse than the cut-off are subject to an additional review, leading to a sharp drop in the acceptance rate at the threshold. Using almost 15,000 loan application by small and medium-sized enterprises at a major German bank, I compare the development of firms *just* above the cut-off rating to those firms that are just *below* the cut-off rating using a fuzzy regression discontinuity design.

The results convey two simple messages: First, firms just below the cut-off exhibit a worse economic performance (in terms of investments, sales, and employment) than firms just above the cut-off. The effect is concentrated among small firms with a balance sheet size of less than EUR 3mn. Second, the liquidity of firms ─ measured as the ratio of liquid assets to liquid liabilities ─ plays a major role

in the transmission of credit supply shocks. Firms with a high liquidity are able to cut down their current assets (cash, inventory, and trade receivables) while firms with a low liquidity have to cut down their investment assets as a response to the rejection of their loan application. As a consequence, only firms with low liquidity suffer decreases in sales and employment. These decreases are significant, with a drop of 10-15% in revenues and employment at small firms with low liquidity. These results add to our understanding of the real effects of bank lending, and support recent theories (Acharya et al., 2014) about the importance of banks in the liquidity provision of the real sector.

References

[1.] Acharya, V., H. Almeida, F. Ippollito, and A. Perez (2014): "Credit lines as monitored liquidity insurance: Theory and evidence," *Journal of Financial Economics*, 112, 287-319.

[2.] Acharya, V., T. Eisert, C. Eufinger, and C. Hirsch (2014): "Real effects of the sovereign debt crisis in Europe: Evidence from syndicated loans," Working Paper.

[3.] Almeido, H., M. Campello, B. Laranjeira, and S. Weisbenner (2012): "Corporate debt maturity and the real effects of the 2007 credit crisis," *Critical Finance Review*, 1, 3-58.

[4.] Balduzzi, P., E. Brancati, and F. Schiantarelli (2014): "Financial markets, banks' cost of funding, and firms' decisions: lessons from two crises", Working Paper.

[5.] Becker, B. and V. Ivashina (2014): "Cyclicality of credit supply: Firm level evidence," *Journal of Monetary Economics*, 62, 76-93.

[6.] Bentolila, S., M. Jansen, G. Jiminéz, and S. Ruano (2014): "When credit dries up: Job losses in the great recession, Working paper.

[7.] Berg, T., Puri, M., and Rocholl, J. (2014): "Loan officer incentives, internal ratings and default rates," Working Paper.

[8.] Bernanke, B. (1983): "Non-monetary effects of the financial crisis in the propagation of the Great Depression," *American Economic Review*, 73(3), 257-276.

[9.] Boot, A.W.A., S.I. Greenbaum, and A.V. Thakor (1993): "Reputation and Discretion in Financial Contracting," *American Economic Review* 83, 1165-1183.

[10.] Campello, M., Graham, J. R., and Harvey, C. R. (2010): "The real effects of financial constraints: Evidence from a financial crisis," *Journal of Financial Economics, 97*(3), 470-487.

[11.] Chodorow-Reich, G. (2014): "The employment effects of credit market disruptions: Firm-level evidence from the 2008-2009 financial crisis," *The Quarterly Journal of Economics*, 129(1), 1-59.

[12.] Cingano, F, Manaresi, F., and E. Sette (2013): "Does credit crunch investments down?", Working Paper.

[13.] Gan, J. (2007): "The real effects of asset market bubbles: Loan- and firm-level evidence of the a lending channel," *Review of Financial Studies*, 20, 1941-1973.

[14.] Gertler, M., and Gilchrist, S. (1994): "Monetary policy, business cycles, and the behavior of small manufacturing firms," *The Quarterly Journal of Economics*, *109*(2), 309-340.

[15.] Lee, D. S., and Lemieux, T. (2009): "Regression discontinuity designs in economics," NBER Working Paper No. 14723.

[16.] McCrary, J. (2008): "Manipulation of the running variable in the regression discontinuity design: A density test," *Journal of Econometrics*, *142*(2), 698-714.

[17.] Thistlewaite, D. and D. Campbell, (1960): “Regression-discontinuity analysis: an alternative to the ex-post facto experiment,” *Journal of Educational Psychology, 51*, 309-31.

[18.] Thakor, A.V., and G.F. Udell (1987): "An Economic Rationale for the Pricing Structure of Bank Loan Commitments," *Journal of Banking and Finance* 11, 271-289.

Figure 1: Distribution of ratings

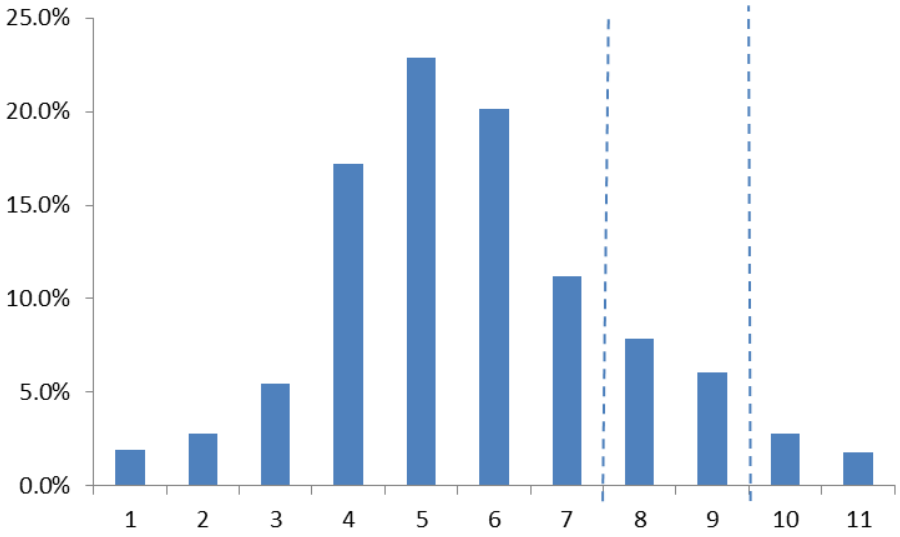

Figure 2: Loan acceptance rates by rating grade

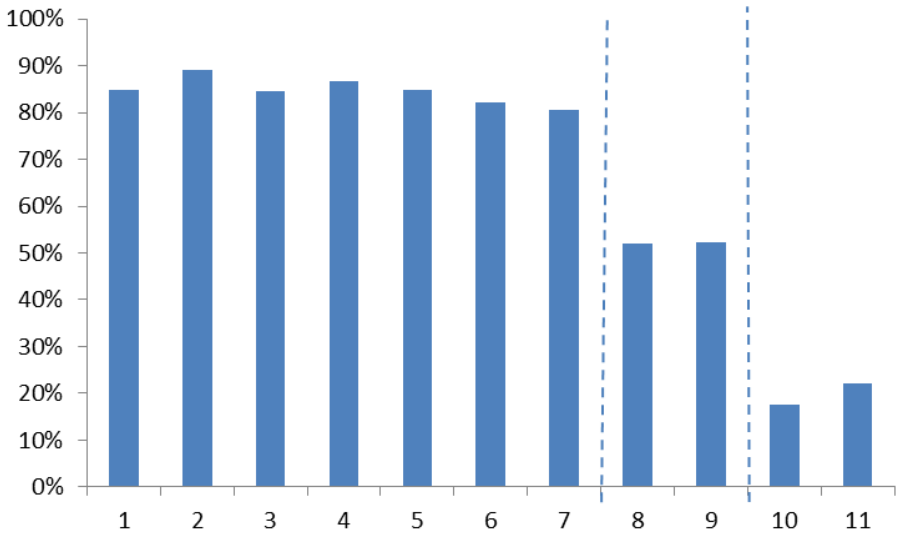

Table 1: Explanation of variables

Name	Description
Ratings and cut-off	
Rating	Internal continuous rating ranging from 0.5 (best) to 12.5 (worst).
Rating grade	Mapping of the continuous rating to rating grades, ranging from 1 (continuous rating from 0.5 to 1.5) to 12 (continuous rating from 11.5 to 12.5).
Cut-off (0/1)	Dummy variable equal to one if a loan application has a rating grade of 8 or worse, i.e., cannot be directly accepted by the loan officer.
Loan characteristics	
Loan amount	Notional amount of the loan application in EUR '000.
Collateralized (0/1)	Dummy equal to one if a loan is collateralized (either by a physical collateral or a third party guarantee).
Firm characteristics	
Firm age	Age of the firm in years since incorporation.
Relationship age	Number of years that the firm has had an account at the bank without interruption.
Legal form = Limited liab. (0/1=	Dummy equal to one if the firm is incorporated as a limited liability firm.
Revenues	Revenues of the firm in EUR mn according to its financial statement in the fiscal year prior to the loan application (based on German accounting standards).
Total assets	Total assets of the firm EUR mn according to its financial statement in the fiscal year prior to the loan application (based on German accounting standards).
Number of employees	Number of employees of the firm in the fiscal year prior to the loan application.
Equity-to-assets	Equity-to-asset ratio of the firm according to its financial statement in the fiscal year prior to the loan application.
EBITDA-Margin	Ratio of EBITDA (earnings before interest, taxes, depreciation, and amortization) to revenues of the firm according to its financial statement in the fiscal year prior to the loan application.
Liquidity	Ratio of current assets to current liabilities of the firm according to its financial statement in the fiscal year prior to the loan application.

Table 2: Descriptive statistics

This table presents summary statistics for the sample of all loan applications between January 2009 and December 2012. For variable definitions see Table 1.

		N	Mean	Median	Std.Dev.
Ratings and cut-off					
Rating grade	Number (1=Best, 11=Worst)	14,524	5.83	6.00	2.00
Rating (continuous)	Number (0.5=Best, 11.5=Worst)	14,524	5.80	5.65	1.98
Cut-off	Dummy (0/1)	14,524	0.81	1.00	0.39
Loan characteristics					
Loan amount	EUR '000	14,524	521.10	500.00	318.69
Collateralized	Dummy (0/1)	14,524	0.55	1.00	0.50
Firm characteristics					
Firm age	Years	14,524	21.02	17.00	17.68
Relationship age	Years	14,524	8.40	4.00	10.63
Legal form = Limited liab.	Dummy (0/1)	14,524	0.98	1.00	0.12
Revenues	EUR mn	14,524	9.76	5.52	13.40
Total assets	EUR mn	14,524	4.79	2.53	7.23
Number of employees	Number	14,524	48.98	29.00	66.63
Equity-to-asset ratio	Number	14,524	0.28	0.26	0.23
EBITDA-Margin	Number	14,524	0.06	0.05	0.08
Liquidity	Number	14,524	2.13	1.47	2.12

Table 3: The effect of the cut-off on acceptance rates and loan volumes

This table estimates the effect of the cut-off on acceptance rates and loan volumes using a regression discontinuity design. Column (1) provides results using the acceptance dummy as the dependent variable. The acceptance dummy is equal to 1 if the bank makes a loan offer to the firm, it is equal to 0 if the bank does not make a loan offer to the firm. Column (2) provides results using the subsequent change in loan volume as the dependent variable. The subsequent change in the loan volume is measured as the logarithm of the ratio of the loan volume of the firm at the bank 3/12/24 months after the loan application divided by the loan volume of the firm at the bank 1 months prior to the loan application. All models are estimated using a linear model. For variable definitions see Table 1. T-values based on standard errors clustered at the firm level are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 % level respectively.

	Acceptance dummy		Subsequent change in loan volume					
	(1)		(2)		(3)		(4)	
Dependent	Acceptance dummy (0/1)		Change in loan volume in % of total assets Time horizon: 3 months		Change in loan volume in % of total assets Time horizon: 12 months		Change in loan volume in % of total assets Time horizon: 24 months	
Model	Linear		Linear		Linear		Linear	
Methodology	Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off	
Parameter	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
INFERENCE								
BelowCutOff (0/1)	-0.260***	(-10.57)	-0.074***	(-6.63)	-0.060***	(-4.06)	-0.084***	(-2.95)
TRENDS BELOW/ABOVE CUT OFF								
(Rating-CutOff) x BelowCutOff (0/1)	-0.023**	(-2.28)	0.011	(1.58)	-0.005	(-0.62)	-0.022	(-1.29)
(Rating-CutOff) x (1- BelowCutOff (0/1))	-0.014	(-0.72)	-0.017**	(-2.43)	-0.024**	(-2.47)	-0.040**	(-2.39)
Firm controls	Yes		Yes		Yes		Yes	
Loan controls	Yes		Yes		Yes		Yes	
Industry fixed-effects	Yes		Yes		Yes		Yes	
Region-fixed effects	Yes		Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes		Yes	
Diagnostics								
Pseudo. R^2 / Adj. R^2	11.48%		9.79%		7.71%		7.84%	
N	7,075		7,075		7,075		7,075	

Table 4: Are firms able to substitute from other funding sources?

This table estimates the effect of the cut-off on the change in firm debt (from all banks), firm equity, and the change in firm assets using a regression discontinuity design. Change in firm debt (firm equity, firm assets) is measured as the difference between firm debt (firm equity, firm assets) in the fiscal year one year after the loan application and the firm debt (firm equity, firm assets) in the fiscal year one year prior to the loan application. Columns (1), (4), and (7) provide results for all firms. Columns (2), (5) and (8) provide results for small firms and columns (3), (6), and (9) for large firms. Small/Large firms are split at the median of total assets in each year. All models are estimated using a linear model. For variable definitions see Table 1. T-values based on standard errors clustered at the firm level are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 % level respectively.

Dependent	Change in firm debt						Change in firm equity					
	(1)		(2)		(3)		(4)		(5)		(6)	
Firm size	All firms		Small firms		Large firms		All firms		Small firms		Large firms	
Model	Linear		Linear		Linear		Linear		Linear		Linear	
Methodology	Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off	
Parameter	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
INFERENCE												
BelowCutOff (0/1)	-0.048**	(-2.56)	-0.095***	(-3.27)	-0.002	(-0.07)	-0.001	(-0.13)	-0.002	(-0.20)	0.003	(0.25)
TRENDS BELOW/ABOVE CUT OFF												
(Rating-CutOff) x BelowCutOff (0/1)	-0.015	(-1.54)	-0.003	(-0.18)	-0.026**	(-2.16)	-0.009**	(-2.35)	-0.012*	(-1.82)	-0.009*	(-1.90)
(Rating-CutOff) x (1- BelowCutOff (0/1))	0.024	(1.71)	0.039*	(1.79)	0.012	(0.70)	-0.010*	(1.80)	-0.014*	(-1.76)	-0.003	(-0.45)
Firm controls	Yes		Yes		Yes		Yes		Yes		Yes	
Loan controls	Yes		Yes		Yes		Yes		Yes		Yes	
Industry fixed-effects	Yes		Yes		Yes		Yes		Yes		Yes	
Region-fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
Diagnostics												
Pseudo. R^2 / Adj. R^2	4.66%		4.62%		2.48%		5.02%		5.39%		4.60%	
N	5,667		2,857		2,810		5,667		2,857		2,810	

Table 4 (continued)

Dependent	Change in firm assets					
	(7)		(8)		(9)	
Firm size	All firms		Small firms		Large firms	
Model	Linear		Linear		Linear	
Methodology	Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off	
Parameter	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
INFERENCE						
BelowCutOff (0/1)	-0.039**	(-2.18)	-0.068***	(2.58)	-0.008	(-0.36)
TRENDS BELOW/ABOVE CUT OFF						
(Rating-CutOff) x BelowCutOff (0/1)	-0.023***	(-2.61)	-0.018	(-1.36)	-0.029**	(-2.52)
(Rating-CutOff) x (1- BelowCutOff (0/1))	0.017	(1.28)	0.023	(1.17)	0.016	(0.93)
Firm controls	Yes		Yes		Yes	
Loan controls	Yes		Yes		Yes	
Industry fixed-effects	Yes		Yes		Yes	
Region-fixed effects	Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes	
Diagnostics						
Pseudo. R^2 / Adj. R^2	6.56%		6.81%		4.15%	
N	5,667		2,857		2,810	

Table 5: How do firms shrink their assets?

This table estimates the effect of the cut-off on the change in current assets and the change in fixed assets using a regression discontinuity design. Change in current assets (fixed assets) is measured as the difference between a firm's current assets (fixed assets) in the fiscal year one year after the loan application and the firm's current assets (fixed assets) in the fiscal year one year prior to the loan application. Columns (1) and (2) provide results for all small firms. Columns (3) and (4) provide results for small firms with high liquidity, columns (5) and (6) provide results for small firms with low liquidity. Low liquidity firms are defined as firms with a ratio of current asset to current liabilities of less than one in the fiscal year prior to loan origination. All models are estimated using a linear model. For variable definitions see Table 1. T-values based on standard errors clustered at the firm level are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 % level respectively.

	All small firms				Small firms with high liquidity				Small firms with low liquidity			
	(1)		(2)		(3)		(4)		(5)		(6)	
Dependent	Change in current assets		Change in investments (fixed assets)		Change in current assets		Change in investments (fixed assets)		Change in current assets		Change in investments (fixed assets)	
Model	Linear		Linear		Linear		Linear		Linear		Linear	
Methodology	Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off	
Parameter	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
INFERENCE												
BelowCutOff (0/1)	-0.060**	(-2.23)	-0.020*	(-1.85)	-0.085***	(-2.67)	-0.013	(-1.09)	-0.007	(-0.14)	-0.052*	(-1.82)
TRENDS BELOW/ABOVE CUT OFF												
(Rating-CutOff) x BelowCutOff (0/1)	-0.002	(-0.15)	-0.008	(-1.34)	-0.005	(-0.33)	-0.012*	(-1.91)	0.015	(0.53)	0.009	(0.48)
(Rating-CutOff) x (1- BelowCutOff (0/1))	0.018	(0.87)	0.005	(0.56)	0.050*	(1.95)	0.005	(0.58)	-0.055	(-1.52)	0.006	(0.30)
Firm controls	Yes		Yes		Yes		Yes		Yes		Yes	
Loan controls	Yes		Yes		Yes		Yes		Yes		Yes	
Industry fixed-effects	Yes		Yes		Yes		Yes		Yes		Yes	
Region-fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
Diagnostics												
Pseudo. R^2 / Adj. R^2	7.50%		6.13%		8.60%		6.56%%		4.90%		6.47%	
N	2,857		2,857		2,264		2,264		593		593	

Table 6: The effect on employment and revenues

This table estimates the effect of the cut-off on the change in employment and the change in revenues using a regression discontinuity design. Change in employment (revenues) is measured as the difference between a firm's number of employees (revenues) in the fiscal year one year after the loan application and the firm's number of employees (revenues) in the fiscal year one year prior to the loan application. Columns (1) and (2) provide results for all small firms. Columns (3) and (4) provide results for small firms with high liquidity, columns (5) and (6) provide results for small firms with low liquidity. Low liquidity firms are defined as firms with a ratio of current asset to current liabilities of less than one in the fiscal year prior to loan origination. All models are estimated using a linear model. For variable definitions see Table 1. T-values based on standard errors clustered at the firm level are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 % level respectively.

	All small firms				Small firms with high liquidity				Small firms with low liquidity			
	(1)		(2)		(3)		(4)		(5)		(6)	
Dependent	Change in employment		Change in revenues		Change in employment		Change in revenues		Change in employment		Change in revenues	
Model	Linear		Linear		Linear		Linear		Linear		Linear	
Methodology	Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off	
Parameter	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
INFERENCE												
BelowCutOff (0/1)	0.005	(0.19)	0.002	(0.06)	0.031	(1.00)	0.057	(1.58)	-0.100**	(-2.24)	-0.137**	(-2.21)
TRENDS BELOW/ABOVE CUT OFF												
(Rating-CutOff) x BelowCutOff (0/1)	-0.003	(-0.20)	-0.013	(-0.84)	-0.013	(-0.89)	-0.029*	(-1.70)	0.071**	(2.40)	0.045	(1.13)
(Rating-CutOff) x (1- BelowCutOff (0/1))	-0.019	(-0.99)	-0.032	(-1.45)	0.035	(-1.49)	-0.054**	(1.97)	0.016	(0.49)	0.002	(0.04)
Firm controls	Yes		Yes		Yes		Yes		Yes		Yes	
Loan controls	Yes		Yes		Yes		Yes		Yes		Yes	
Industry fixed-effects	Yes		Yes		Yes		Yes		Yes		Yes	
Region-fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
Diagnostics												
Pseudo. R^2 / Adj. R^2	3.99%		7.82%		3.82%		7.89%		8.91%		9.86%	
N	2,091		1,542		1,647		1,217		444		325	

Appendix Table 1: McCrary density test

This table provides results of a McCrary density test for the internal rating at the cut-off rating of 7.5. Panel I provides results for the sample of all loan applications. Panel II provides results for the sample of all loan applications with available balance sheet data. ***, **, * denote significance at the 1, 5 and 10 % level respectively.

	Bandwidth	Bin size	Jump estimate	(SE)
Panel I: Density at rating of 7.5				
Standard bandwidth	1.466	0.026	-0.030	(0.0537)
Undersmoothing	0.733	0.026	-0.024	(0.0753)
Panel II: Density at rating of 7.5, firms with available balance sheet data only				
Standard bandwidth	1.487	0.036	-0.096	(0.1091)
Undersmoothing	0.743	0.036	-0.084	(0.1048)

Appendix Table 2: Availability of data items – Test for discontinuity at the cut-off rating

This table estimates the effect of the cut-off on the availability of annual report data. Annual report data is culled from the DAFNE data base from Bureau van Dijk in the fiscal year prior to the loan application and the fiscal year following the year of the loan application. The dependent variables is equal to one if any of these two annual reports are missing or if the respective data item in any these two annual reports is missing. Column (1) provides results for firms' balance sheet items (equity, debt, assets, current assets, investment assets), column (2) provides results for firms' profit and loss items (revenues), column (3) provides results for the number of employees. Please note that either all items of a particular category (balance sheet, profit and loss, number of employees) are missing or none is missing. All models are estimated using a linear model. For variable definitions see Table 1. T-values based on standard errors clustered at the firm level are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 % level respectively.

	(1)		(2)		(3)	
Dependent	Change in firm balance sheet items is missing (0/1)		Change in firm profit and loss items is missing (0/1)		Change in the number of employees is missing (0/1)	
Model	Linear		Linear		Linear	
Methodology	Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off		Local regression +/- 2 notches around cut-off	
Parameter	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
INFERENCE						
BelowCutOff (0/1)	-0.012	(-0.54)	-0.015	(-0.80)	-0.022	(-0.89)
TRENDS BELOW/ABOVE CUT OFF						
(Rating-CutOff) x BelowCutOff (0/1)	0.012	(1.09)	0.009	(0.91)	0.013	(1.02)
(Rating-CutOff) x (1- BelowCutOff (0/1))	0.020	(1.21)	0.017	(1.14)	0.027	(1.51)
Firm controls	Yes		Yes		Yes	
Loan controls	Yes		Yes		Yes	
Industry fixed-effects	Yes		Yes		Yes	
Region-fixed effects	Yes		Yes		Yes	
Time fixed effects	Yes		Yes		Yes	
Diagnostics						
Pseudo. R^2 / Adj. R^2	2.96%		6.13%		2.31%	
N	7,075		7,075		7,075	