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[1] The authors wish to thank colleagues from Danmarks Nationalbank for useful comments on preliminary versions of this paper. The authors alone are responsible for any remaining errors.

Abstract

We offer micro-econometric evidence on the relationship between the banks' loan rejection rates and the creditworthiness of the banks' corporate customers in 2007 and 2009/10 based on a unique Danish firm- and bank-level dataset. We find lower acceptance rates for applications for bank loans from firms with weak economic performance than for firms with strong economic performance. This was the case both prior to but especially during the financial crisis in 2009/10, where firms with higher profit ratios, solvency ratios and liquidity ratios had a significantly higher probability of having their loan application accepted than firms with poor economic performance. The banks tightened their credit standards during the financial crisis. However, banks with low capital adequacy ratios during the crisis did not have lower loan acceptance rates than banks with high capital adequacy ratios. This indicates that it has not been the banks' own capitalisation, which has been the decisive factor for the decline in the banks' loan acceptance rates during the financial crisis but rather the deterioration of the credit quality of the banks' corporate customers, which made it necessary for prudent banks to tighten their credit standards.

Key words: Banking and financial crises; Financial frictions; Survey data; Bank-firm relationships; Loan rejection rates; Firm credit score; Probit models; Sample selection.
JEL Classification: C25; C42; E44; E51; G21; G30; O16.

Resumé (Danish summary)

Vi foretager en økonometrisk analyse af sammenhængen mellem bankernes afslag på låneansøgninger og kundernes kreditværdighed i 2007 og 2009/10 på basis af mikrodata for danske virksomheder og banker. Vi finder lavere acceptprocenter for låneansøgninger fra virksomheder med dårlige regnskabsresultater end for virksomheder med stærke økonomiske nøgletal. Dette var tilfældet både før, men især under finanskrisen 2009/10, hvor virksomheder med høj overskudsgrad, høj solvens og god likviditet havde en signifikant højere sandsynlighed for at få deres ansøgning om banklån accepteret end virksomheder med svage økonomiske nøgletal. Bankerne har strammet deres kreditstandarder under finanskrisen. Der er dog ikke tegn på, at banker med en lav solvensprocent har haft lavere acceptprocenter for låneansøgninger end banker med høje solvensprocenter. Dette indikerer, at det ikke har været bankernes kapitalforhold, som har været den afgørende faktor for faldet i bankernes acceptprocenter for låneansøgninger under finanskrisen, men snarere den forringede kreditkvalitet af bankernes erhvervskunder, som gjorde det nødvendigt for bankerne at stramme deres kreditstandarder.

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1. Introduction

In the wake of the international financial crisis since 2008, the real effects of banking crises have once again been among the top issues on the research agenda. One of the topical issues is the access to credit for Small and Medium-sized Enterprises (SMEs). It has been discussed if the recent financial crisis caused a "credit crunch" and especially whether SMEs were subject to a "credit squeeze" due to a dysfunctional banking sector during the crisis.

A "credit squeeze" is usually defined as a situation in which the supply of credit is reduced considerably more than the weak economic development would normally warrant, making it difficult for creditworthy borrowers to obtain sufficient financing, cf. Stiglitz and Weiss (1981) and Bernanke and Gertler (1989). It has been a common finding in surveys on SMEs self-reported access to bank credit that the rejection rates for loan applications were markedly higher during the financial crisis than prior to the crisis, cf. e.g. McCann (2011). This might reflect that the financial crisis implied an extraordinarily large shock to the banks' capital which was followed by a period of tight credit standards and reduced loan supply in order to maintain or re-establish a sufficient capital ratio. However, it could also merely reflect that the economic downturn during the crisis reduced the creditworthiness and repayment capability of the corporate clients, which made it necessary for prudent banks to tighten their credit standards.

In the paper at hand we offer micro-econometric evidence on the relationship between loan acceptance rates and the creditworthiness of the banks' corporate customers based on a unique firm- and bank-level dataset which combine "soft" survey data on SMEs self-reported access to credit with "hard" accounting data and information on bank-firm relationships. The data set contains information on around 2,000 Danish SMEs' access to credit in 2007 and 2009/10, the economic performance of the firms and the key performance indicators of the firms' main bank relationship.

We find lower acceptance rates for applications for bank loans from firms with weak economic performance than for firms with strong economic performance. This was the case both prior to but especially during the financial crisis 2009/10, where firms with higher profit ratios, solvency ratios and liquidity ratios had a significantly higher probability of having their loan application accepted than firms with poor economic performance. The banks tightened their credit standards during the financial crisis. However, banks with low capital adequacy ratios during the crisis did not have lower loan acceptance rates than banks with high capital adequacy ratios. This indicates that it has not been the banks' own capitalisation, which has been the decisive factor for the decline in the banks' loan acceptance rates during

the financial crisis but rather the deterioration of the credit quality of the banks' corporate customers, which made it necessary for prudent banks to tighten their credit standards.

2. A brief review of related literature

The paper relates most closely to the strand of the micro-econometric literature that analyses credit rationing using survey data on SMEs self-reported access to credit. Recent papers within this line of research include Canton *et al*. (2010), Artola and Genre (2011), Ferrando and Griesshaber (2011) and Ferrando and Mulier (2011).

Canton *et al*. (2010) analyse the determinants of firms' perceived financing constraints on the basis of firm-level Eurobarometer survey data from 2005-2006 covering around 4,500 SMEs in the European Union. Using logit regressions they find that older firms perceive external financing as being less difficult than younger firms. Furthermore, turnover appears to relax the firms' perceptions in the "new" EU 10 countries, but not in the "old" Member States. There also appears to exist significant cross-country differences that might partly be explained by cross-country differences in the structure of the banking sector.

Artola and Genre (2011) analyses firm-level replies to the ECB/European Commission euro area SME survey on access to finance 2009-2010. More than 5,000 firms participated in the survey. Using probit and multinomial regression models the authors find that perceptions of financing constraints were broadly based across firms. However, the authors conclude that those firms who actually experienced credit restrictions tended to be small and young.

Ferrando and Griesshaber (2011) also analyse around 5,000 firm-level responses to the ECB/European Commission euro area SME survey on access to finance in 2009. Using probit regression analysis they find that age and ownership structure are important explanatory variables for firms' perceived financing obstacles across countries, whereas mixed results are found regarding the effect of firm size and industry.

The same survey data has been used by Ferrando and Mulier (2011). However, this study goes beyond the firm-level information contained directly in the survey and analyses whether the firms' financial conditions derived from balance sheet information help to explain financing obstacles as perceived by firms across euro area countries. Firms that have less working capital, cash and marketable securities, finance a higher share of their assets with short term loans, have a higher leverage, pay more interest on their debt and are less profitable are more likely to suffer from financial constraints. However, since the identity of the firms in the ECB/European Commission euro area SME survey is confidential, the financial accounts information used in the study by Ferrando and Mulier, *op. cit*., has been imputed from firms in the Bureau van Dijk Amadeus database with similar characteristics via

a matching procedure. Naturally, this introduces an extra element of uncertainty in the analysis.

A few studies have been based on datasets which combine "soft" firm-level information from SMEs self-reported access to finance with "hard" firm-level accounting information or other statistics for the same firms. Included in the group of studies is Lawless and McCann (2011), Danish Ministry of Economic and Business Affairs (2011) and Confederation of Danish Industry (2011).

Lawless and McCann (2011) combine firm-level information from the Access to Finance survey 2007/10 carried out by the Central Statistics Office of Ireland with firm-level from the Census of Industrial Production or the Annual Services Inquiry. The latter two data sources provide quantitative data on production, productivity, employment and international trade. Around 600 Irish SME are covered by the analysis, which did not indicate any significant differences between firms that were successful and those that were unsuccessful in their credit applications.

Danish Ministry of Economic and Business Affairs (2011:8-9) presents a summary descriptive analysis of applications for bank loans in 2009/10 based on firm-level survey data reported by around 2,000 Danish SMEs combined with firm-level accounting statistics. The analysis showed that the firms, whose credit applications were granted in full, were characterised by higher profit ratios, higher solvency ratios, higher returns on equity and lower gearing than the firms which obtained only part of the credit they applied for or whose loan application were rejected.

Confederation of Danish Industry (2011) found similar results in a survey among around 500 members in the spring of 2011. 43 per cent of the companies that had suffered a loss in the previous year had applied for debt financing. The corresponding ratio for firms that had profits in the previous year was only 31 per cent. Nearly 40 per cent of the companies that had applied for debt financing had a debt ratio amounting to at least 50 per cent of total liabilities. Among the companies that had not applied for debt financing the corresponding ratio was only around 17 per cent.

The paper at hand adds to this strand of the literature by offering a comprehensive analysis of a unique firm-level data set on economic performance and access to finance in 2009/10 for around 2,000 Danish SMEs. This data set was first studied by Danish Ministry of Economic and Business Affairs, *op.cit*. However, we enlarge the data set by adding information on the same firms' access to finance in 2007, which allow us to study potential differences in the SMEs' access to finance prior to and during the financial crisis. Further, we enrich the data set by adding information on the firms' main bank relationship and a range of key performance

indicators for each bank. This enables us to assess whether the loan acceptance rate at a bank depends on the banks' own characteristics in addition to firm characteristics.

3. Data sources and sample selection

The core of our data set consists of 2,265 firm-level responses to a survey conducted by Statistics Denmark concerning Danish SMEs access to finance in 2007 and 2009/10 (April 2009 - March 2010), cf. Statistics Denmark (2010). The firms all had between 5 and 249 employees in 2005 (and at least 5 employees in 2009) and were located within manufacturing, building and construction, trade and transport etc., information and communication or other industries. The information regarding 2007 and 2009/10 was collected in the same questionnaire forwarded to the firms in 2010. One should therefore properly treat the information regarding 2007 with some caution and in general one has to keep in mind that survey responses are always subjective.

For most of the firms participating in the survey - around 2,240 firms - we were able to obtain firm-level information on employment from Statistics Denmark.

For the majority of the firms participating in the survey – around 2,000 firms – we were also able to get summary firm-level accounting data (including turnover, result before financial items, capital and reserves and total assets/liabilities) from Statistics Denmark's Accounts statistics. This information has been derived from the firms' reporting to the Danish tax authorities.

For around 1,000 firms we were furthermore able to obtain information regarding short-term debt, total debt, gross interest costs and liquid assets. The key financial ratios etc. used in the paper at hand are defined in Table 1.

DEFINITION OF KEY FINANCIAL RATIOS ETC. Table 1

Solvency ratio	Capital and reserves as a ratio of total liabilities end of year.
Profit ratio	Result before financial items as a ratio of turnover.
Short-term debt ratio	Short-term debt as a ratio of total liabilities end of year.
Liquidity ratio (narrow)	Cash and deposits etc. as a ratio of total assets end of year.
Liquidity ratio (broad)	Securities, other equity, cash and deposits etc. as a ratio of total assets end of year.
Implied interest costs on gross debt	Interest costs etc. relative to total gross debt end of year.
Number of employees	Number of full-time employees
Export share	Export turnover in per cent of total turnover.
Memo:	
Median	The middle observation in a series of numbers arranged according to size.

In addition, we were able to obtain information on export share for around 1,000 firms based on Statistics Denmark's Enterprise statistics.

For around 60-65 per cent of the firms in the data set that applied for bank loans we were also able to obtain information on the identity of the firms' main bank relationship. A private data vendor, EXPERIAN A/S provided this information, which only relates to firms organised as public or private limited liability companies. We thus have no information regarding bank relationship for sole proprietorships.

Finally, we collected a range of bank-level key performance indicators for all the firms' main bank relationships. This information has been published on the website of the Danish Financial Supervisory Authorities (FSA).

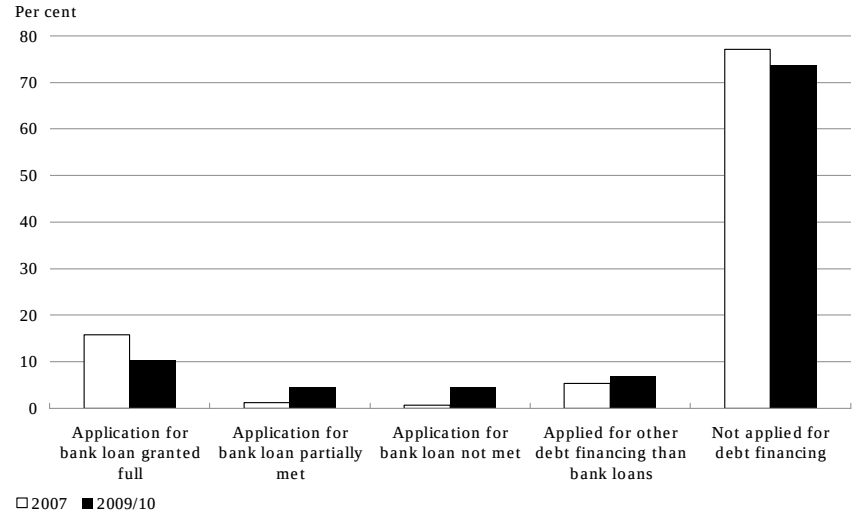
4. Descriptive statistics and exploratory data analysis

As a starting point, we offer a descriptive statistical overview of the data set. For each of the two data points (2007 and 2010) we divide the companies into five main groups:

- Companies whose application for a bank loan has been granted full.
- Companies whose application for bank loan has been partially met.
- Companies whose application for bank loan have not been met.
- Companies which have applied for other debt financing than bank loans.
- Companies which have not applied for debt financing.

Figure 1.a shows the percentage distribution of the firms into the 5 categories. The majority of the firms did not apply for any debt financing, neither in 2007 nor in 2009/10. It can also be noted from Figure 1.a that around 10 per cent of the companies experienced a total or partial refusal of their application for a bank loan in 2009/10 compared to only 2 per cent in 2007. Of the companies which applied for a bank loan in 2007, 90 per cent got their application fully approved. In 2009/10, the corresponding figure was only 54 per cent.

ALLOCATION OF FIRMS IN THE ANALYSIS - BANK LOANS Figure 1.a

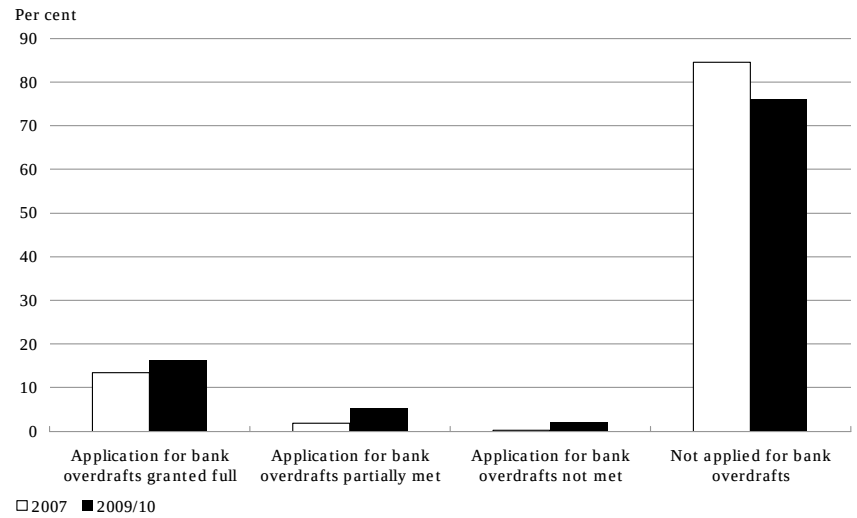


Source: Own calculations on the basis of the data listed in section 3.

It should be noted that overdrafts are not counted as debt financing in Statistics Denmark's survey. Bank overdrafts are included under other funding than debt financing, which also includes equity financing, trade credits, leasing, factoring, *etc*. Other debt financing than bank loans includes loans from mortgage banks and loans from the owners.

We are, however, also able to identify bank overdrafts in the data set, cf. Figure 1.b. Around 75 per cent of the firms did not apply for bank overdrafts in 2009/10, and the share was approximately similar in 2007. Around 7 per cent of the companies experienced a total or partial refusal of their application for bank overdrafts in 2009/10 compared to 2 per cent in 2007.

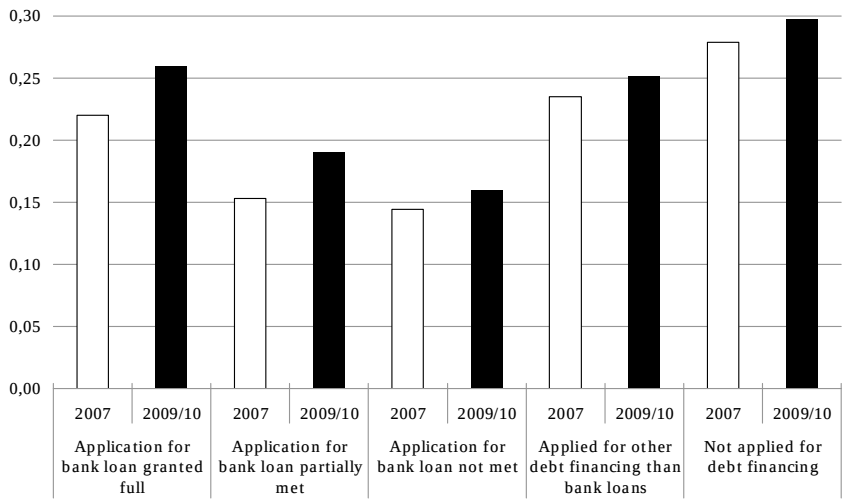
ALLOCATION OF FIRMS IN THE ANALYSIS - BANK OVERDRAFTS Figure 1.b



Source: Own calculations on the basis of the data listed in section 3.

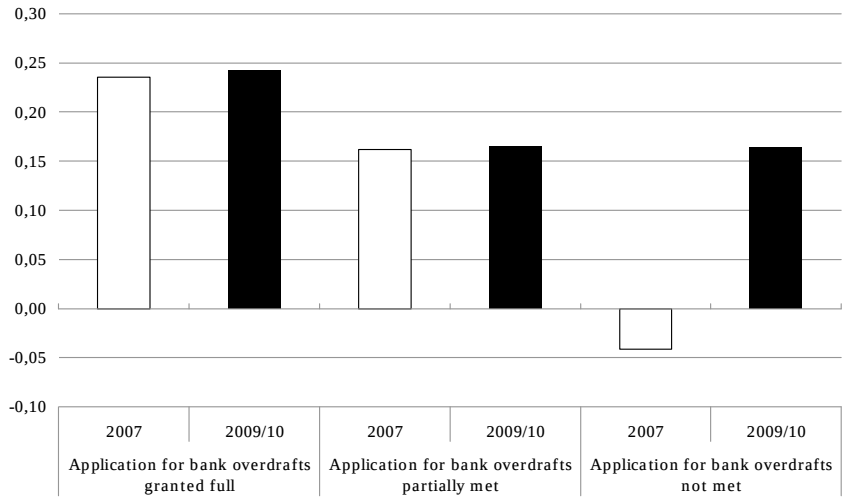
Figure 2.a illustrates the relationship between the outcome of a firm's applications for a bank loan in 2007 and 2009/10 and the firm's solvency ratio in the year preceding the loan application. As shown, the median of the solvency ratio in 2008 was significantly lower in the groups of firms, which got their application for bank loans in 2009/10 totally or partly rejected, than in the group of companies which got their application for bank loans fully accepted. It was also lower than in the groups of companies, that either did not seek debt financing or companies seeking other types of debt financing than bank loans. The same picture emerges regarding applications for bank loans in 2007 and for applications for bank overdrafts in 2007 and 2009/10, cf. Figure 2.b. The fact that the solvency ratio for the median company in all groups of enterprises in 2009/10 was higher than in 2007 should be seen in light of the general tendency towards consolidation in the business sector during the crisis.

FIRMS' APPLICATIONS FOR BANK LOANS IN 2007 AND 2009/10
- MEDIAN OF SOLVENCY RATIO YEAR BEFORE APPLICATION Figure 2.a



Source: Own calculations on the basis of the data listed in section 3.

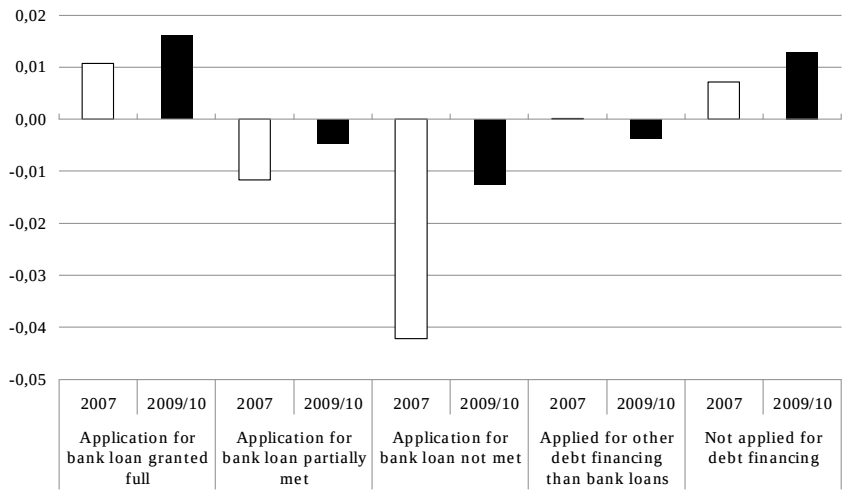
FIRMS' APPLICATIONS FOR BANK OVERDRAFTS IN 2007 AND 2009/10
- MEDIAN OF SOLVENCY RATIO YEAR BEFORE APPLICATION Figure 2.b



Source: Own calculations on the basis of the data listed in section 3.

It may also be noted that the median change in the firms' solvency ratio over the period 2006-2008 was negative in the groups of firms, which received full or partial refusal of their applications for bank loans in 2009/10, cf. Figure 3. In contrast, the median change in the firms' solvency ratio in the period 2006-2008 was positive in the group of companies whose applications for bank loans in 2009/10 were granted full. Similar observations can be made regarding loan applications in 2007.

FIRMS' APPLICATIONS FOR BANK LOANS IN 2007 AND 2009/10
- MEDIAN OF CHANGE IN SOLVENCY RATIO 2 YEARS PRIOR TO APPLICATION Figure 3

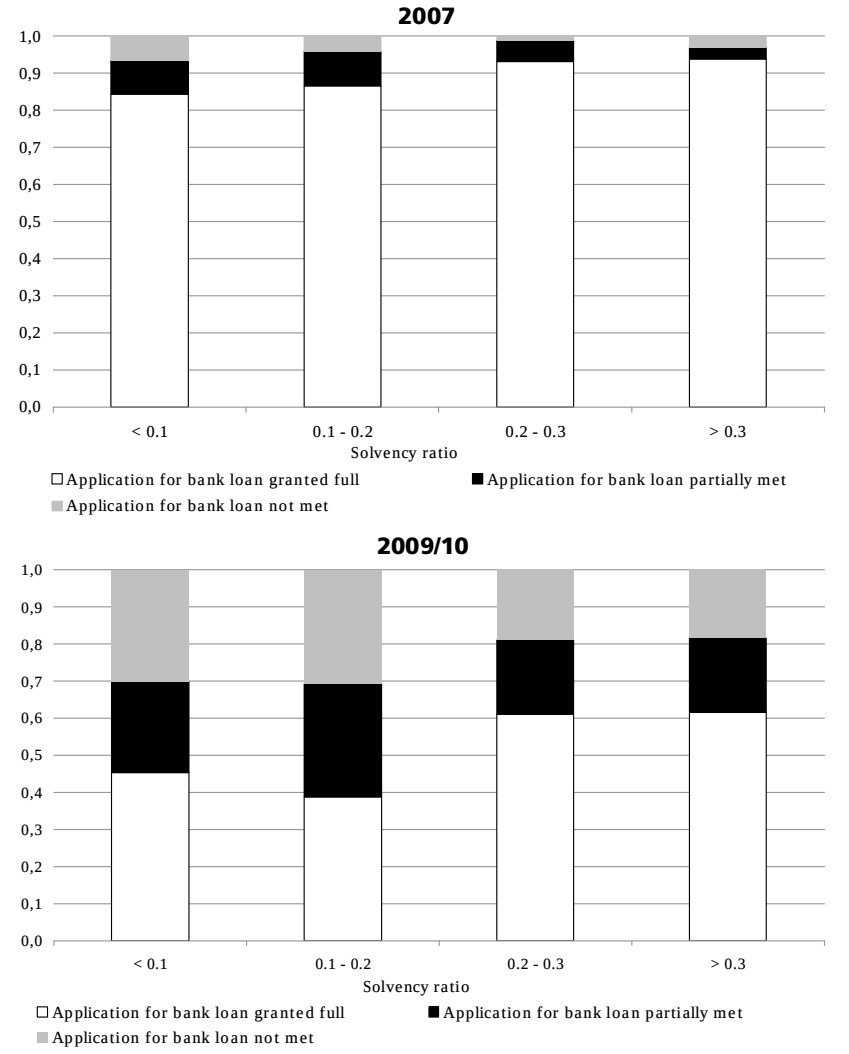


Source: Own calculations on the basis of the data listed in section 3.

Figure 4 shows the outcome of firms' application for bank loans distributed by the solvency ratio of the firms. Both in 2009/10 and in 2007, the most solid companies had higher acceptance ratios than firms with low solidity.

The refusal rates were significantly higher in 2009/10 than in 2007, which indicates that banks tightened their credit standards during the financial crisis. This reflect that the economic downturn during the crisis reduced the creditworthiness and repayment capability of the corporate clients. In 2007, companies found themselves at the end of a boom with the expectation of a "soft landing" while 2009/10 was at the bottom of the deepest recession since World War II.

OUTCOME OF FIRMS' APPLICATIONS FOR BANK LOANS - DISTRIBUTED BY THE SOLVENCY RATIO OF THE FIRMS Figure 4

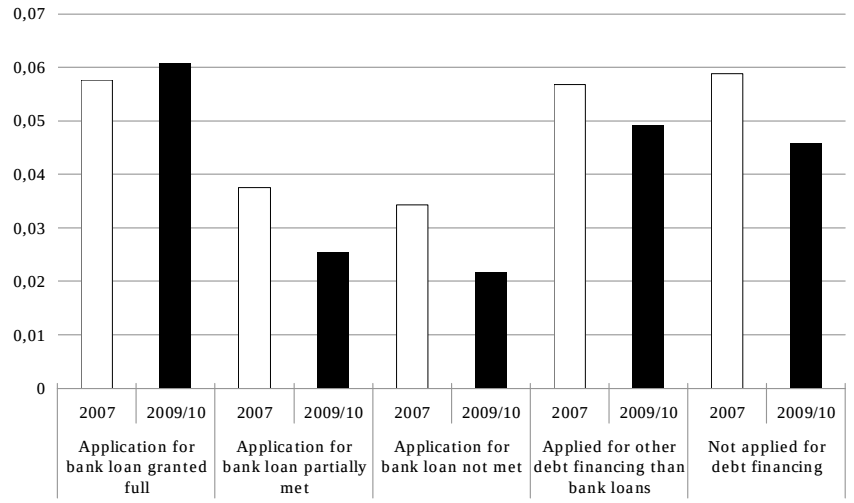


Source: Own calculations on the basis of the data listed in section 3.

The above analysis indicates that there has been a correlation between the firms' solvency ratio and the outcome of the banks' processing of loan applications as well during the financial crisis as before the financial crisis. A similar impression is obtained by considering companies' profit ratios, cf. Figure 5.a. The median of the profit ratio in 2008 was significantly lower in those groups of firms which got their application for bank loans in 2009/10 totally or partly rejected than in the group of companies, which got their application for bank loans fully accepted. The same was the case in 2007 and for applications for bank overdrafts, cf. Figure 5.b. It is also clear from Figure 6 that companies with high profit ratios experience lower rejection rates on their applications for bank loans than firms with low profit ratios.

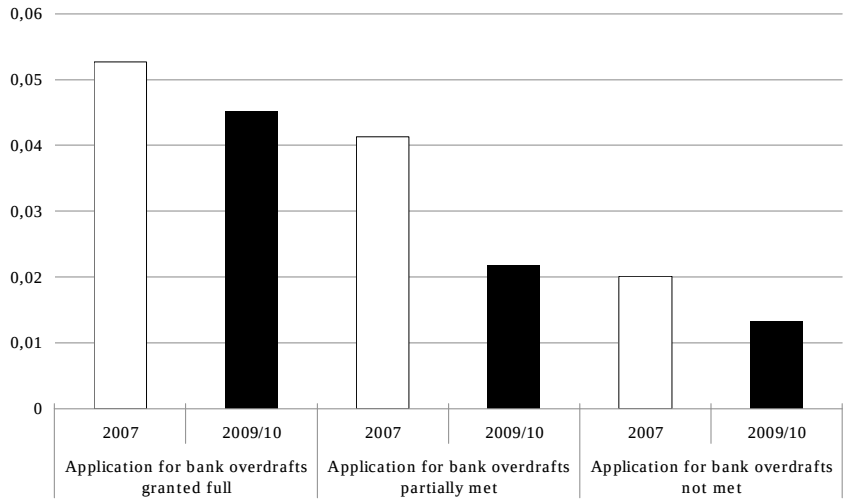
FIRMS' APPLICATIONS FOR BANK LOANS IN 2007 AND 2009/10
- MEDIAN OF PROFIT RATIO YEAR BEFORE APPLICATION

Figure 5.a



Source: Own calculations on the basis of the data listed in section 3.

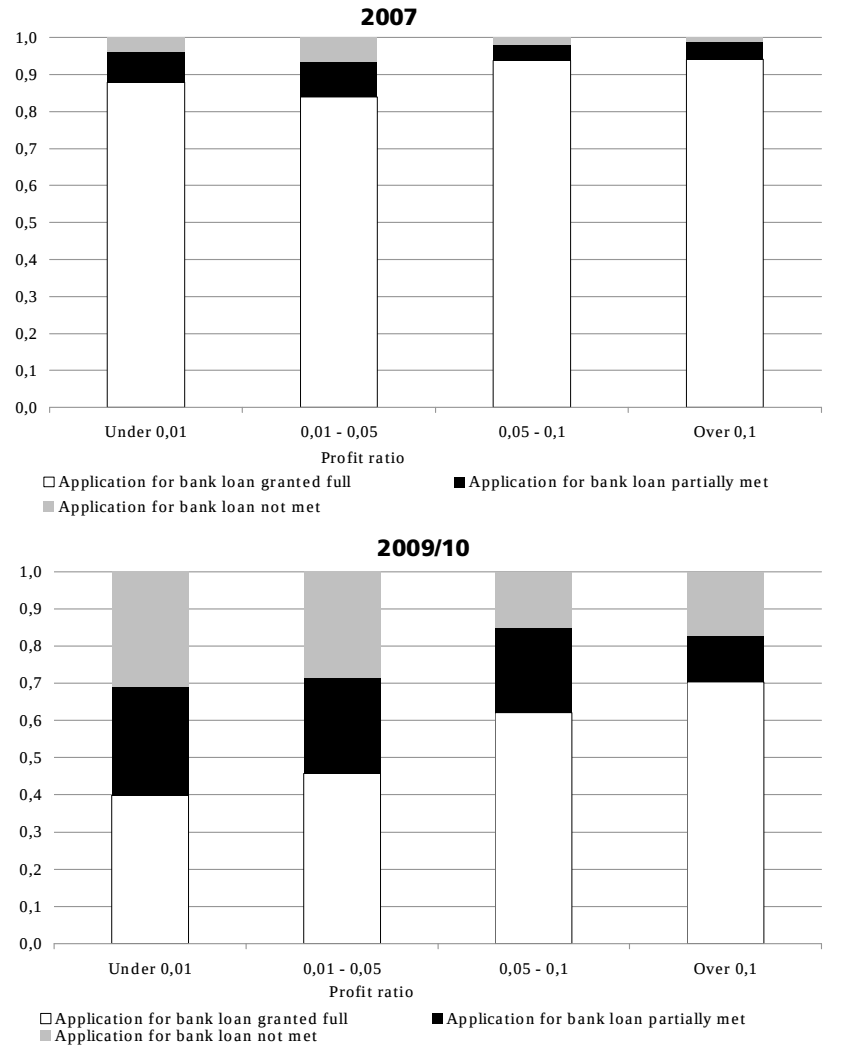
FIRMS' APPLICATIONS FOR BANK OVERDRAFTS IN 2007 AND 2009/10
- MEDIAN OF PROFIT RATIO YEAR BEFORE APPLICATION Figure 5.b



Source: Own calculations on the basis of the data listed in section 3.

OUTCOME OF FIRMS' APPLICATIONS FOR BANK LOANS - DISTRIBUTED BY THE PROFIT RATIO OF THE FIRMS

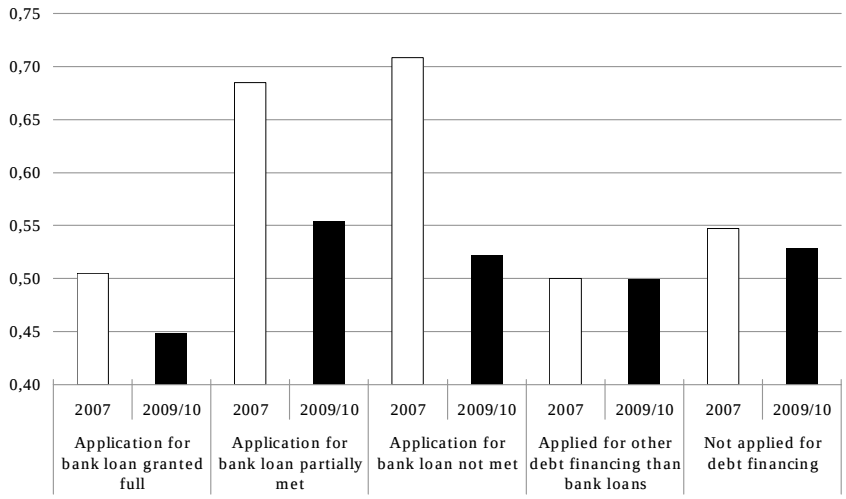
Figure 6



Source: Own calculations on the basis of the data listed in section 3.

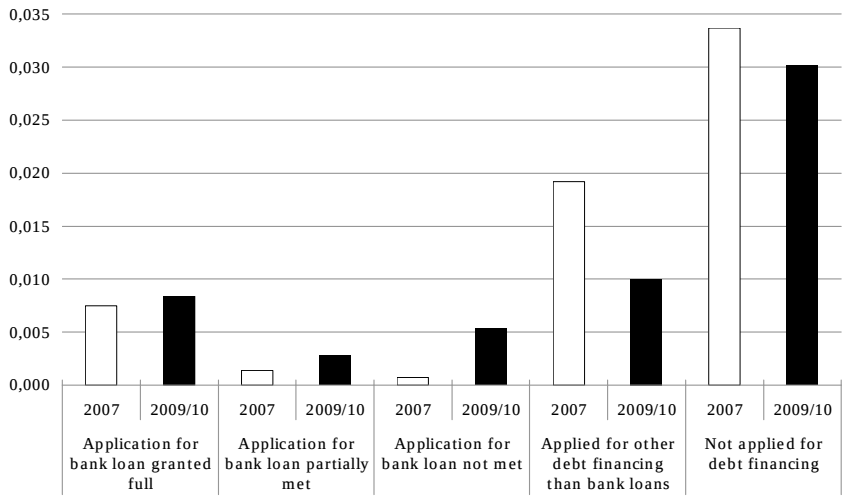
Furthermore, it is worth noting that the groups of companies which got their applications for bank loans in 2009/10 totally or partly rejected were characterized by a higher median short-term debt ratio and a lower median degree of liquidity than the other groups of firms, cf. Figures 7 to 9. Furthermore, the median of the implied interest costs on gross debt in the group of companies which got their applications for bank loans in 2009/10 totally rejected was higher than in the other groups of firms, cf. Figure 10. This also suggests that companies, whose application for a bank loan has not been met, were characterized by a lower credit score than other firms.

FIRMS' APPLICATIONS FOR BANK LOANS IN 2007 AND 2009/10
- MEDIAN OF SHORT-TERM DEBT RATIO YEAR BEFORE APPLICATION Figure 7



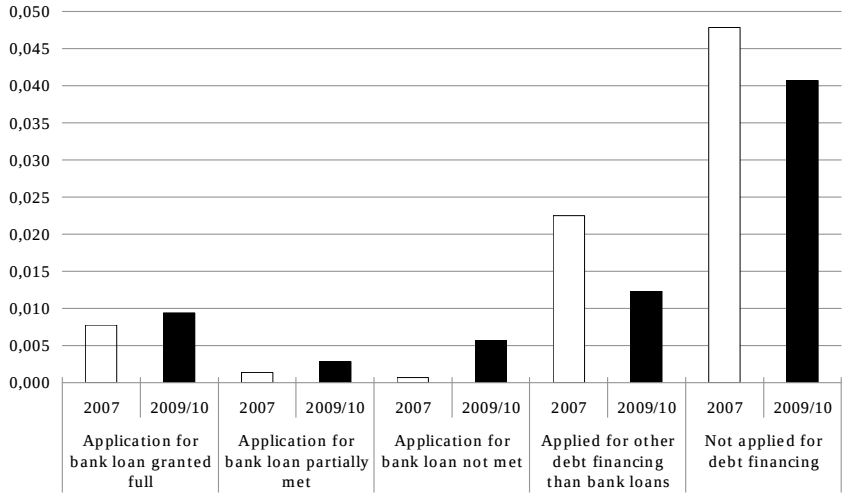
Source: Own calculations on the basis of the data listed in section 3.

FIRMS' APPLICATIONS FOR BANK LOANS IN 2007 AND 2009/10
- MEDIAN OF LIQUIDITY RATIO (NARROW) YEAR BEFORE APPLICATION Figure 8



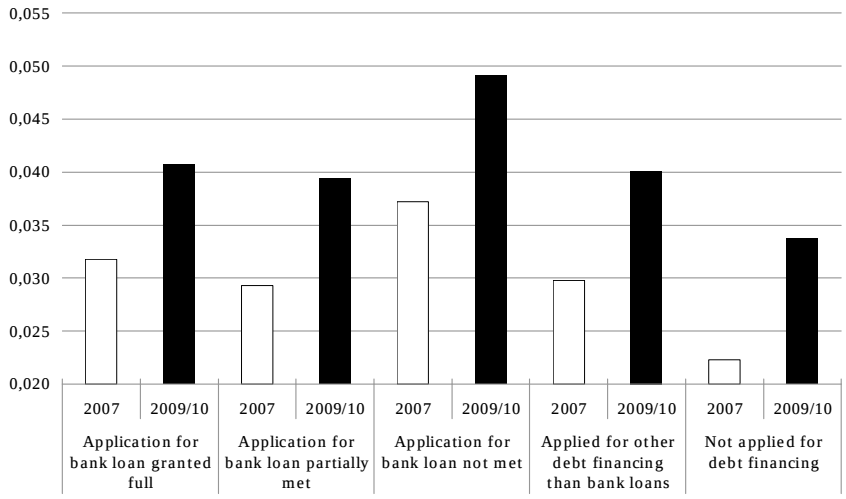
Source: Own calculations on the basis of the data listed in section 3.

FIRMS' APPLICATIONS FOR BANK LOANS IN 2007 AND 2009/10
- MEDIAN OF LIQUIDITY RATIO (BROAD) YEAR BEFORE APPLICATION Figure 9



Source: Own calculations on the basis of the data listed in section 3.

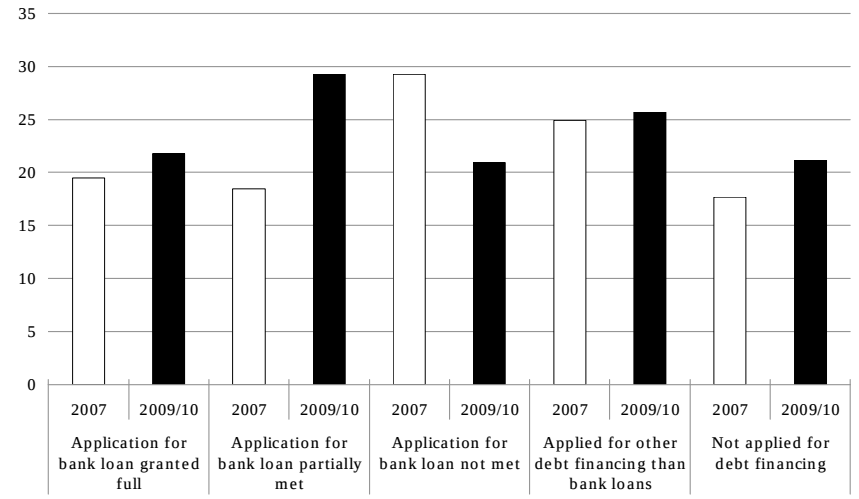
FIRMS' APPLICATIONS FOR BANK LOANS IN 2007 AND 2009/10
- MEDIAN OF IMPLIED INTEREST COSTS ON GROSS DEBT YEAR BEFORE APPLICATION Figure 10



Source:: Own calculations on the basis of the data listed in section 3.

Figure 11 shows the median of corporate employment in the various groups. There does not seem to be any systematic relationship between firm size and outcome of a loan application to a bank. This seems to be true for loan applications both in 2007 as well as in 2009/10.

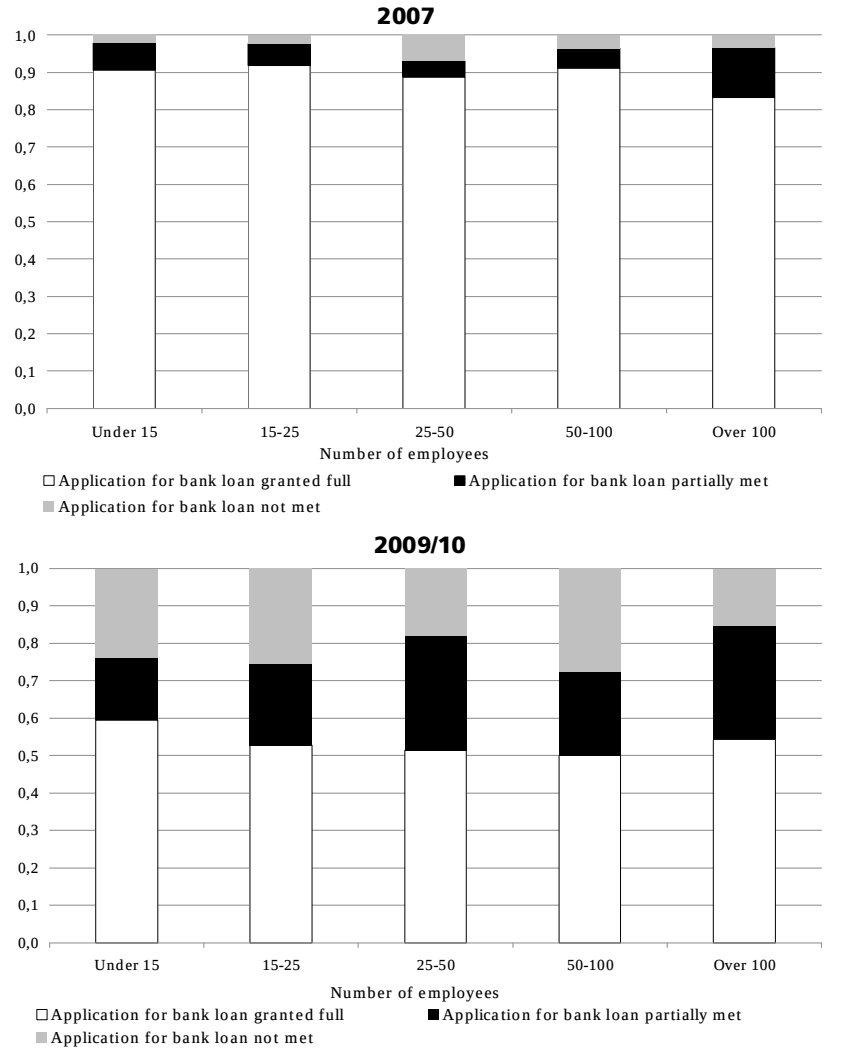
FIRMS' APPLICATIONS FOR BANK LOANS IN 2007 AND 2009/10
- MEDIAN OF NUMBER OF EMPLOYEES YEAR BEFORE APPLICATION Figure 11



Source:: Own calculations on the basis of the data listed in section 3.

This conclusion is supported by Figure 12 which shows the outcome of firms' application for bank loans distributed by the number of employees at the firm. However, it is worth noting that micro firms with fewer than 15 employees had the highest acceptance rates during the financial crisis in 2009/10. Although one has to keep in mind that survey responses are always subjective and subject to some uncertainty, there are at least no indications that very small firms should have been subjected to particularly high rejection rates for bank-loan applications during the financial crisis.

OUTCOME OF FIRMS' APPLICATIONS FOR BANK LOANS - DISTRIBUTED BY THE NUMBER OF EMPLOYEES AT THE FIRM Figure 12

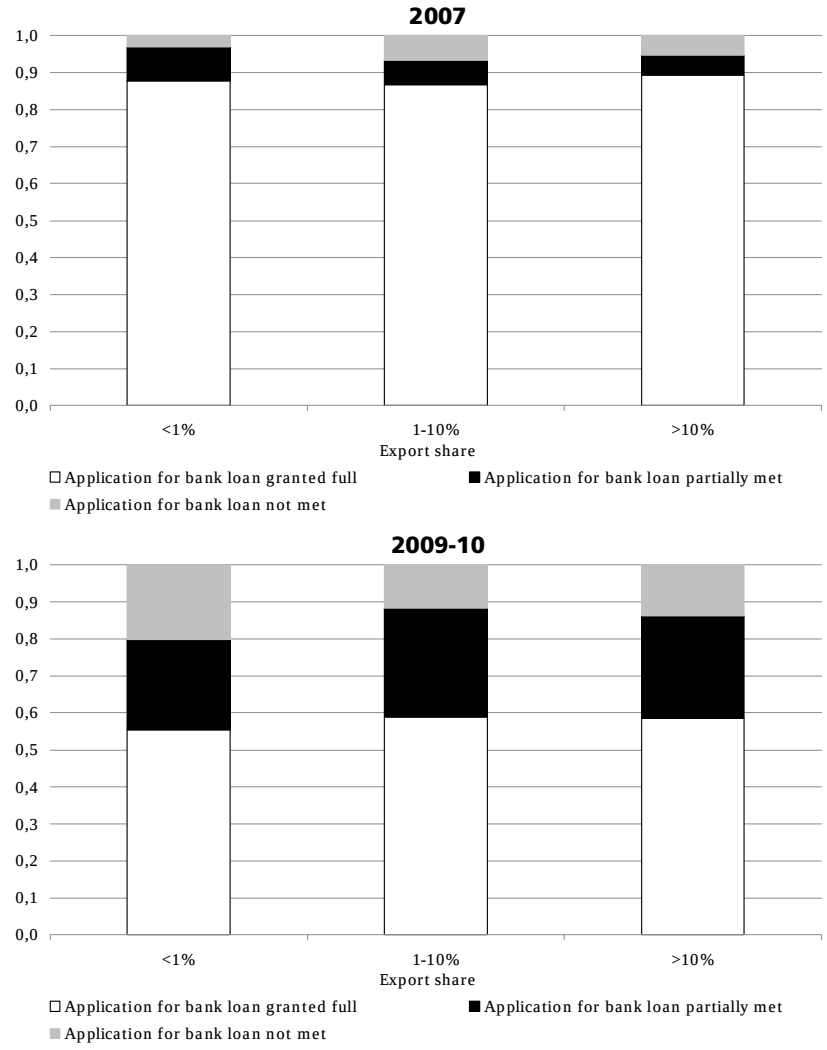


Source: Own calculations on the basis of the data listed in section 3.

Generally, SMEs are highly oriented towards the domestic market. Around 70 per cent of the firms in our analysis have an export share below 1 per cent. Figure 13 shows the outcome of the firms' application for bank loans distributed by the firm's export share. There does not seem to be any systematic relationship between export share and outcome of a loan application to a bank. This seems to be true for loan applications both in 2007 as well as in 2009/10.

OUTCOME OF FIRMS' APPLICATIONS FOR BANK LOANS - DISTRIBUTED BY EXPORT SHARE

Figure 13



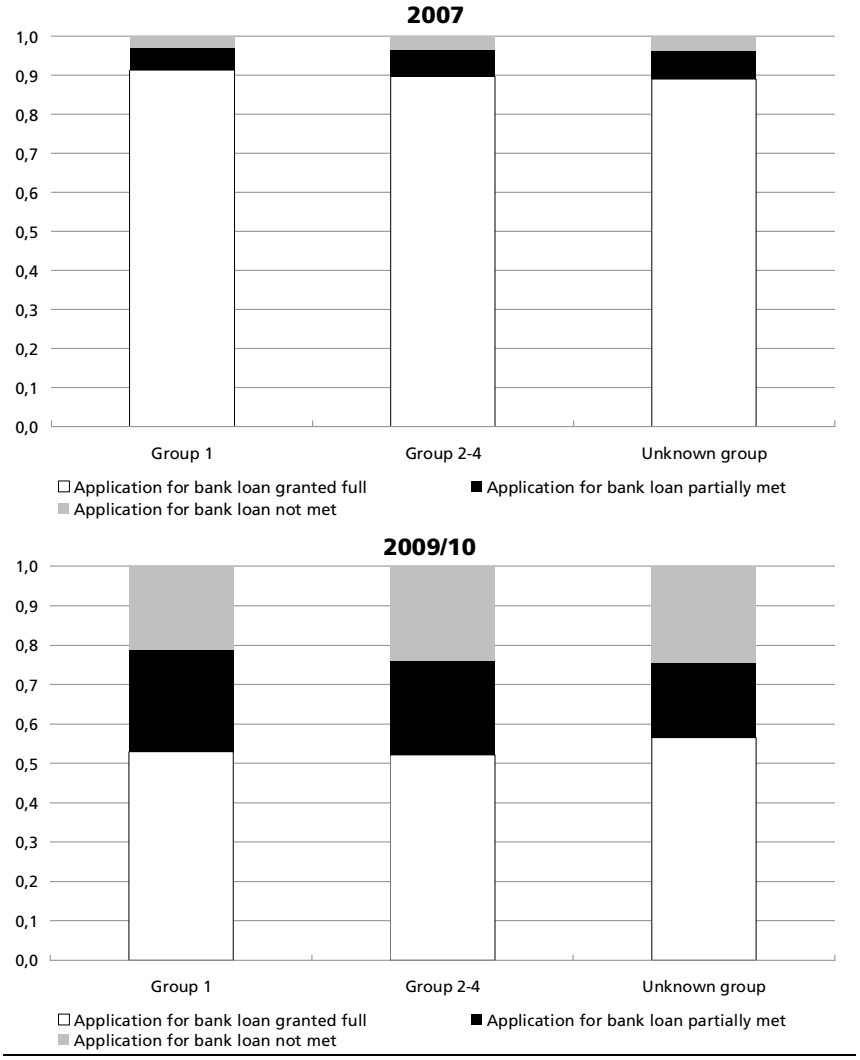
Source: Own calculations on the basis of the data listed in section 3.

For about 60-65 per cent of the companies, which have applied for bank loans, we have information about the company's principal banker, cf. Figure 14. There are no indications that the rejection rate for loan applications has been significantly higher for banks in the FSA group 2-4 (i.e. medium-sized and small banks) than for banks in the FSA group 1 (i.e. large banks), although banks in group 2-4 have generally had substantially larger loan impairment charge ratios than banks in group 1. The loan impairment charge ratio for banks in group 1 was 1.5 per cent in 2009, whereas the corresponding ratio for banks in group 2 and 3 was respectively 5.6 and 4.2, cf. Danish Financial Supervisory Authorities (2010). This indicates that it has not been the banks' own capitalisation, which has been the decisive factor for the decline in the banks' loan acceptance rates during the financial crisis but rather the

deterioration of the credit quality of the banks' corporate customers. This might reflect the comprehensive government interventions to safeguard financial stability during the crises, which included the opportunity for banks' to receive government capital injections.

OUTCOME OF FIRMS' APPLICATIONS FOR BANK LOANS - DISTRIBUTED BY THE FIRMS' BANK RELATIONSHIP

Figure 14



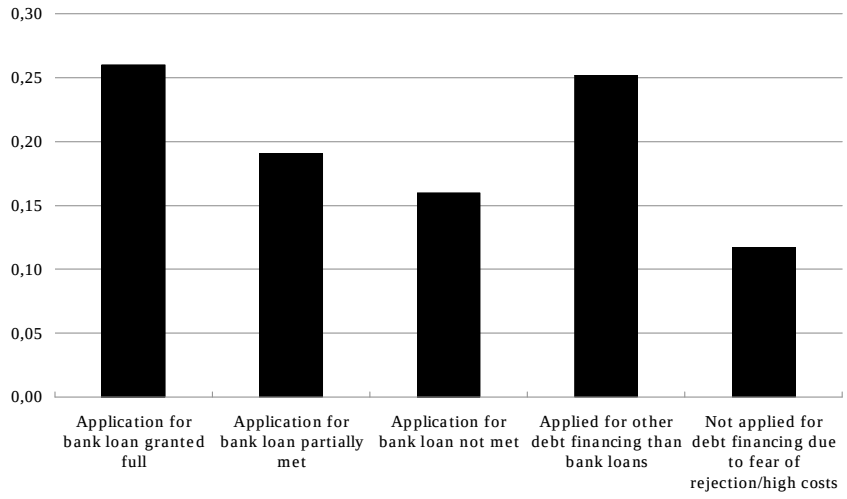
Source: Own calculations on the basis of the data listed in section 3.

Finally, our data set contains information that can illustrate the problem of self-selection. We have information which enables us to split the group of companies which have not applied for debt financing into two sub-groups:

- Companies which have not applied for debt financing due to self-selection because they expected that they would have their application for debt finance rejected or that debt financing would be too expensive for the firm.
- Other companies which have not applied for debt financing.

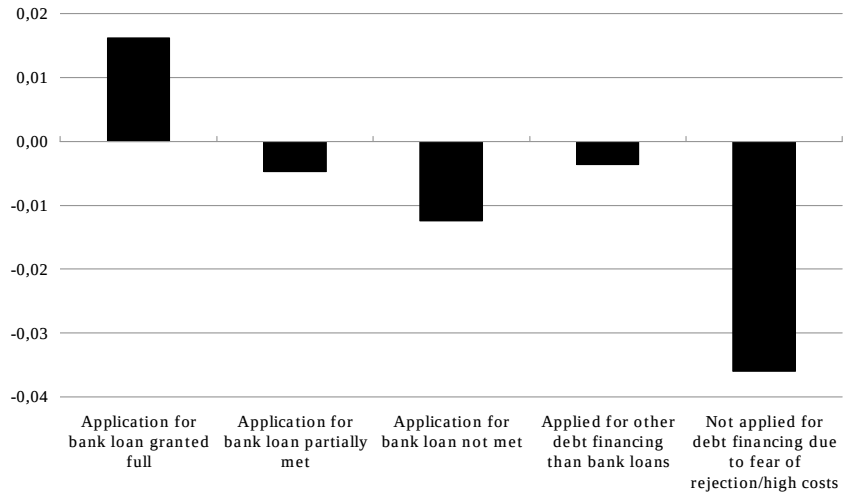
As can be seen from Figures 15-20, firms which have not applied for debt financing due to fear of rejection or high interest rates had weaker economic performance measured by solvency ratio, change in solvency ratio, profit ratio, short-term debt ratio and liquidity than firms which had applied for debt finance.

FIRMS' APPLICATIONS FOR DEBT FINANCING IN 2009/10
- MEDIAN OF SOLVENCY RATIO YEAR BEFORE APPLICATION Figure 15



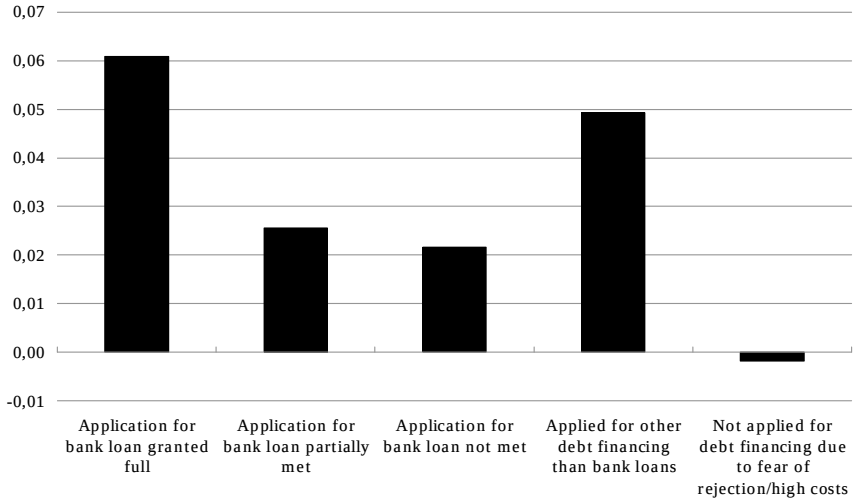
Source: Own calculations on the basis of the data listed in section 3.

FIRMS' APPLICATIONS FOR DEBT FINANCING IN 2009/10
- MEDIAN OF CHANGE IN SOLVENCY RATIO 2 YEARS PRIOR TO APPLICATION Figure 16



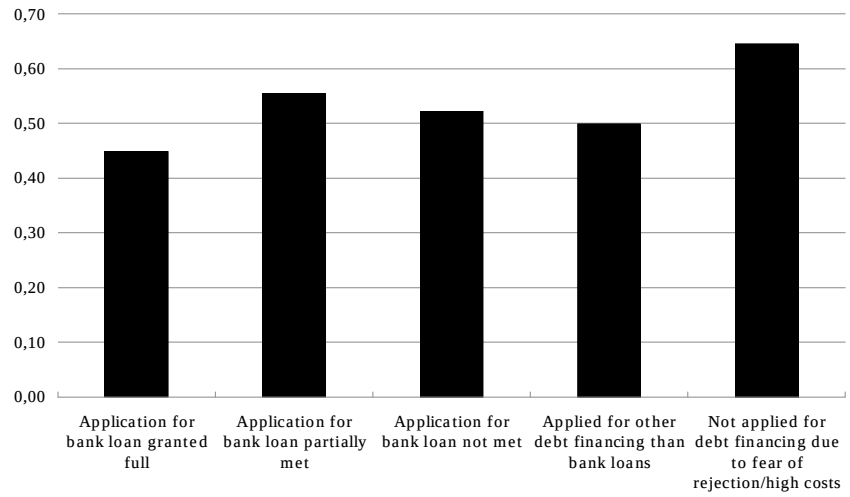
Source: Own calculations on the basis of the data listed in section 3.

FIRMS' APPLICATIONS FOR DEBT FINANCING IN 2009/10
- MEDIAN OF PROFIT RATIO YEAR BEFORE APPLICATION Figure 17



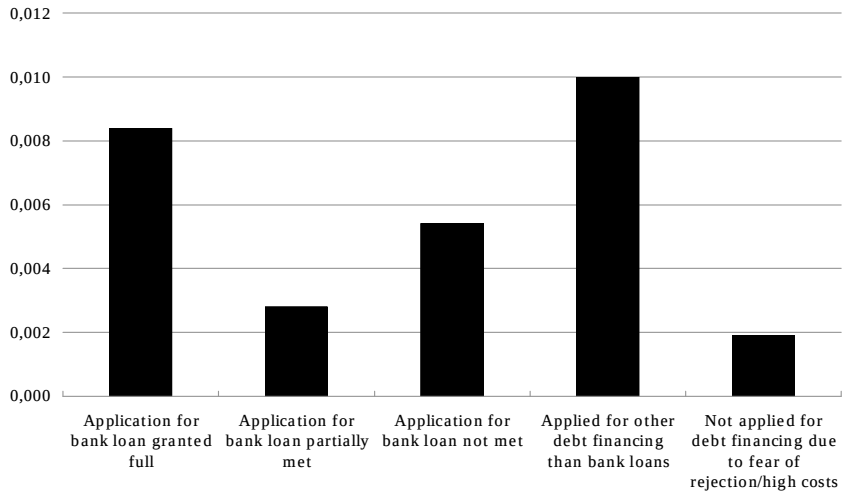
Source: Own calculations on the basis of the data listed in section 3.

FIRMS' APPLICATIONS FOR DEBT FINANCING IN 2009/10
- MEDIAN OF SHORT-TERM DEBT RATIO YEAR BEFORE APPLICATION Figure 18



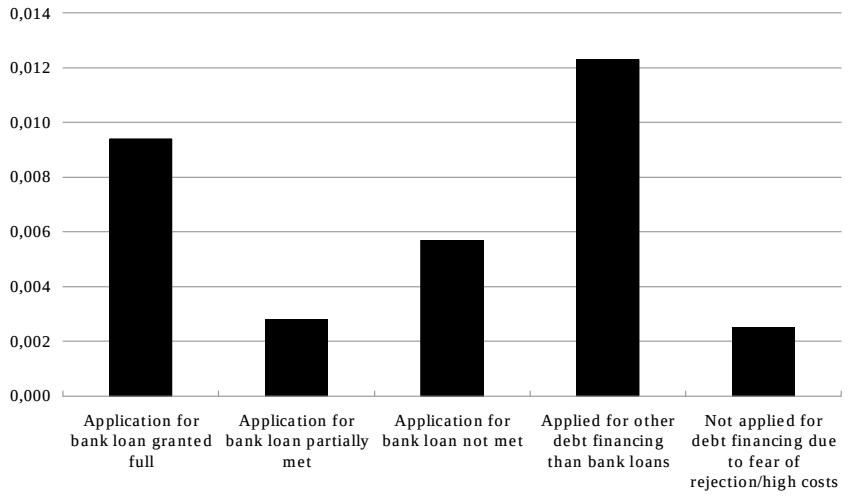
Source: Own calculations on the basis of the data listed in section 3.

FIRMS' APPLICATIONS FOR DEBT FINANCING IN 2009/10
- MEDIAN OF LIQUIDITY RATIO (NARROW) YEAR BEFORE APPLICATION Figure 19



Source: Own calculations on the basis of the data listed in section 3.

FIRMS' APPLICATIONS FOR DEBT FINANCING IN 2009/10
- MEDIAN OF LIQUIDITY RATIO (BROAD) YEAR BEFORE APPLICATION Figure 20



Source: Own calculations on the basis of the data listed in section 3.

5. Econometric analysis of the effect of firms' creditworthiness on the probability of loan acceptance

This section presents the results from a formal econometric analysis of the impact of firm characteristics on the probability of having an application for a bank loan accepted. We start by estimating a simple baseline model of the probability of loan acceptance, using the data on

solvency and profit ratio, which is available for most firms in the sample. The model is estimated separately for the years 2007 and 2009/2010. Subsequently, the model is extended to include additional firm-specific variables which are only available for roughly half of the firms in the sample. In addition, to take into account that firms, which do apply for bank loans, are not a random sample of all firms, we estimate a selection model. Finally, we include key performance indicators of the firm's principal bank connection to test whether loan rejection rates can be explained mostly by firm or bank characteristics.

For the basic model, we use a standard probit specification. The probit model is often formulated in terms of a latent variable model, which is also useful here to facilitate the description of the selection model used later. Assume that the underlying model has the following form:

$$y_1^* = x\beta + u_1 \tag{1}$$

where y_1^* can be thought of as the creditworthiness of the firm in the eyes of the bank, x is a vector of explanatory firm-specific variables and u_1 is an error term which is independent of x and which follows a normal distribution. However, we cannot observe y_1^*, all we observe is whether the loan application is accepted or not, that is:

$$y_1 = 1\left[y_1^* > 0\right] \tag{2}$$

where $1[\cdot]$ is an indicator function taking a value of 1 if the expression in the square brackets is true and 0 otherwise. This implies a scaling of y_1^* so that values of creditworthiness higher than 0 lead to acceptance of the loan application and values below 0 lead to rejection. The distribution of y_1^* conditional on x is therefore:

$$P(y_1 = 1 \mid x) = P(x\beta + u_1 > 0 \mid x) = \Phi(x\beta) \tag{3}$$

where Φ is the standard normal cumulative distribution function. This expression is used to generate the likelihood function in order for the probit model to be estimated by maximum likelihood.

ESTIMATED PROBIT MODELS OF ACCEPTANCE OF BANK LOAN APPLICATION — Table 2

	2007		2009-2010		2007		2009-2010	
	Coef.	M.E.	Coef.	M.E.	Coef.	M.E.	Coef.	M.E.
Solvency ratio	*0.751	0.130	*0.405	0.162	0.251	0.041	0.417	0.166
Profit ratio	-0.009	-0.002	**1.017	0.405	-0.018	-0.003	**1.698	0.674
Implied interest costs					-0.040	-0.007	-2.315	-0.919
Liquidity ratio (broad) ...					6.055	0.994	1.129	0.448
Short-term debt ratio.....					-0.880	-0.144	-0.162	-0.064
Constant	***1.132		-0.036		**1.49		0.040	
Observations.....	337		386		168		207	

Note: Coef. = Coefficient estimate; M.E. = Marginal Effect of a unit change in the explanatory variable on the probability of having the application for a bank loan accepted. Marginal effects are evaluated at the mean of the values of the explanatory variables. Only firms applying for bank loans are included. *** p<0.01, ** p<0.05, * p<0.1.
Source: Own calculations on the basis of the data listed in section 3.

Results from estimation of the baseline models are shown in Table 2. Decisions regarding loan applications in 2007 seem to be largely unrelated to the firm characteristics included in the models. During the strong credit growth prior to the financial crisis, around 90 per cent of the firms which applied for a bank loan got their application fully approved. The firms which did not have their loan application approved may have some special characteristics which we do not have any information on in the data.

In 2009-2010, the acceptance rate is substantially lower, namely 54 per cent. The outcome of a loan application is significantly related to the profitability of the firm, cf. Table 2. A firm which has a profit ratio corresponding to the 75^{th} percentile has a 6 percentage points higher probability of having its loan application accepted than a firm with a profit ratio corresponding to the 25^{th} percentile, all other variables held constant.

Only those firms, which applied for bank credit, are included in the models in Table 2. From the descriptive analysis in the preceding section, it is clear that there is an issue of self-selection. Firms which do not apply for a bank loan may have a number of reasons why they do not do so. Some firms do not need to take out any loans during the given year, for example because they finance their activities by retained earnings. Other firms evidently applied for debt financing other than bank loans, while some firms did not apply for debt financing at all, because they expected that their application would be rejected or that debt financing would be too expensive. Hence, there is heterogeneity in the group of firms which do not apply for debt financing; and the firms which do apply differs from the group of firms which do not apply. Furthermore, the selection effect need not be the same in the two time periods, so that characteristics of firms which apply for a bank loan in the two periods may differ; a fact which may impact the results based only on the firms which do apply for a bank loan.

An additional self-selection issue arises because of the fact that a seemingly weak firm (by the measures used in the analysis) which do apply for a bank loan may in fact be less weak than a firm with similar observed characteristics which do not apply for a bank loan – the difference may just not be captured by the explanatory variables. Because of the presence of self-selection, we also estimate a model which takes selection into account, namely the bivariate probit model with sample selection.

To be more specific, the basic model of interest is represented by equations 1-3. However, it is clear that y_1 is only observed when a firm has applied for a bank loan. Let y_2 be a dichotomous variable taking the value 1 when a firm in the given year has applied for a bank loan and 0 otherwise. We then have that y_1 is observed if and only if y_2=1. We model this selection process by a probit model as well:

$$y_2 = 1[z\delta + u_2 > 0] \qquad (4)$$

where z is a vector of firm-specific variables which determine selection and u_2 is a normally distributed error term. The selection issue means that u_1 and u_2 may be correlated, i.e. $\text{corr}(u_1, u_2) = \rho$. Van de Ven and Van Pragg (1981) derive the likelihood function under these assumptions.

Proper identification of the model requires at least one exclusion restriction, that is, at least one explanatory variable which is included in z (the selection equation) but not in x (the outcome equation)[2]. As we found in section 4 that the size of the firm was largely unrelated to the outcome of a credit application, we include two measures of firm size in the selection equation, namely the logarithm of number of employees and the logarithm of total assets. We also include a variable indicating if the firm has applied for debt financing from other sources than a bank (i.e. from the firm's owner / manager, employees of the firm, family / friends, other non-financial firms, mortgage banks or other sources). If a firm has applied for debt financing from other sources than a bank, it may be more likely to also apply for a bank loan, since it is in need of external financing[3]. Hence, we hypothesise that there is a relation between the extent to which a firm applies for debt financing from other sources than banks, and whether the firm applies for debt financing from a bank. However, the number of sources from which the firm applies for credit should not be related to the bank's decision to accept or reject the loan application. The bank's decision should in principle be based on the creditworthiness of the firm (and the firm's ability to pose collateral) and not whether it has applied for other types of financing.

[2] If no exclusion restrictions are used (that is, if $x=z$), identification of the model is possible through the functional form. However, in such cases, collinearity between the selection equation and the outcome equation means that estimates have no structural interpretation.

[3] This relation is likely to be less apparent if firms successfully apply for debt financing from other sources. If successful in attracting other types of financing, firms may be less interested in bank financing. In the empirical models that follow, we find a significant positive relation between applications for loans from other sources than banks, and bank loan applications.

RESULTS: BIVARIATE PROBIT MODELS WITH SAMPLE SELECTION Table 3

	2007		2009-2010		2007		2009-2010	
	Coef.	M.E.	Coef,	M.E.	Coef.	M.E.	Coef.	M.E.
PROBABILITY OF ACCEPTANCE OF BANK LOAN APPLICATION								
Solvency ratio	*0.766	0.106	**0.453	0.135	0.214	0.022	*0.797	0.186
Profit ratio	-0.009	-0.001	**0.897	0.268	-0.018	-0.002	**1.534	0.357
Implied interest costs					-0.103	-0.011	-1.986	-0.463
Liquidity ratio (broad)					6.035	0.618	**1.830	0.426
Short-term debt ratio					-0.906	-0.093	0.337	0.079
Constant	***1.253		***0.614		**1.474		0.491	
SELECTION EQUATION								
Solvency ratio	***-0.214		***-0.346		**-0.693		***-1.005	
Profit ratio	0.002		*-0.138		0.001		*-0.209	
Implied interest costs					*1.863		0.314	
Liquidity ratio (broad)					***-2.123		***-1.302	
Short-term debt ratio					*-0.497		**-0.630	
LN(No. of employees)	-0.060		-0.074		-0.048		0.027	
LN(Total assets)	**0.081		**0.077		0.070		0.048	
Applied for loan (other source)	***1.155		***1.083		***1.058		***0.865	
Constant	***-1.631		***-1.044		**-1.072		-0.671	
ρ	-0.095		***-0.511		0.040		**-0.688	
Observations	1,917		1,996		927		1,035	

Note: Coef. = Coefficient estimate; M.E. = Marginal Effect of a unit change in the explanatory variable on the probability of having the application for a bank loan accepted. Marginal effects are evaluated at the mean of the values of the explanatory variables. The selection equation models the probability that a company applied for a bank loan. ρ is not directly estimated in the ML-estimatiion; the significance test reported is a test for atanh(ρ) = 0. *** p<0.01, ** p<0.05, * p<0.1.

Source: Own calculations on the basis of the data listed in section 3.

Table 3 reports the results from estimation of the bivariate probit models with sample selection. As a first observation, results of the estimation of the main outcome equation produces largely similar results to those from the standard probit model reported in Table 2, in particular for the models relating to 2007. In addition, the value added of using a selection model for 2007, compared to the standard probit model in Table 2, is limited, as the estimate of ρ is not significantly different from zero. On the other hand, it is clearly important to take selection into account when estimating the models based on data from 2009-2010.

Table 3 underlines the previously found weak relation between firm characteristics and outcome of loan applications in 2007. We find only a marginally significant impact of the solvency ratio of the firm on the outcome. Only relatively few firms, which did apply for bank loans in 2007, had their application rejected.

However, for 2009-2010, there is a clear relation between firm characteristics and the probability of having a loan application accepted. Firms with higher profit ratios, solvency ratios and liquidity ratios have a significantly higher probability of having their loan application accepted. Consider for example two otherwise identical firms which differ with an interquartile range (based on the sample values) on each of these variables, all other things equal. Our results imply that the probability of having a loan application accepted for the firm

with high profit, solvency and liquidity ratios is 2.9, 5.1 and 6.2 percentage points higher, respectively, than for the firm with low values on each of these dimensions (evaluated at the mean of the other explanatory variables).

The descriptive analysis in section 4 indicated that a smaller group of firms did not apply for debt financing, since they believed that they would have their application rejected or that a loan would be too expensive. These firms had weaker economic performance. However, the selection equations indicate that most firms, which do apply for a bank loan, have poorer performance than firms which do not. Overall, this might reflect that the group of firms which do not apply for a bank loan is dominated by well-performing firms, although a minority is so poorly performing that they choose not to apply in expectation that their application would be rejected.

RESULTS: IMPACT OF BANK AND FIRM CHARACTERISTICS ON OUTCOME OF LOAN APPLICATIONS

Table 4

	2007		2009-2010	
	Coef.	M.E.	Coef.	M.E.
PROBABILITY OF ACCEPTANCE OF BANK LOAN APPLICATION				
Solvency ratio	1.263	0.059	***1.789	0.424
Profit ratio	-0.039	-0.002	**1.758	0.416
Implied interest costs	-4.588	-0.215	0.583	0.138
Liquidity ratio (broad)	6.233	0.293	**2.555	0.605
Short-term debt ratio	-0.769	-0.036	0.616	0.146
Bank: Group 1	0.517	0.033	-0.036	0.009
Bank: Loan impairment charge ratio	0.001	0.000	*-0.054	-0.013
Bank: Solvency ratio	9.685	0.455	-0.405	-0.096
Constant	0.056		0.037	
SELECTION EQUATION				
Solvency ratio	*-0.751		***-1.037	
Profit ratio	0.001		-0.354	
Implied interest costs	1.742		-0.914	
Liquidity ratio (broad)	***-2.362		***-2.091	
Short-term debt ratio	-0.286		-0.406	
Bank: Group 1	-0.090		**-0.324	
Bank: Loan impairment charge ratio	0.266		0.009	
Bank: Solvency ratio	-5.786		*-2.774	
LN(No. of employees)	-0.015		-0.038	
LN(Total assets)	0.057		0.052	
Applied for loan (other source)	***0.983		***0.923	
Constant	-0.378		0.070	
ρ	-0.201		**-0.670	
Observations	695		713	

Note: Coef. = Coefficient estimate; M.E. = Marginal Effect of a unit change in the explanatory variable on the probability of having the application for a bank loan accepted. Marginal effects are evaluated at the mean of the values of the explanatory variables. The selection equation models the probability that a company applied for a bank loan. ρ is not directly estimated in the ML-estimatiion; the significance test reported is a test for atanh(ρ) = 0. *** p<0.01, ** p<0.05, * p<0.1.

Source: Own calculations on the basis of the data listed in section 3.

As noted in section 3, we are able to identify the principal bank connection of the firms for slightly less than two-thirds of the firms that applied for bank loans. To assess the impact of

the bank connection, we include a dummy for large banks, as well as the loan impairment charge ratio and the solvency ratio of the bank in 2007 and 2009, respectively.

Due to the significant reduction in the number of observations when bank connection is included in the models, we choose to report results including bank connection variables separately, cf. Table 4. Though the number of observations is reduced, results for firm characteristics are qualitatively similar to those reported in Table 3. The size of the bank does not have an impact on the outcome of an application for a bank loan; although in 2009-2010, banks which have as their main bank connection one of the large banks are found to be less likely to apply for a bank loan. The interpretation of this is not clear, however, since firms choice of bank connection may be impacted by unobserved firm characteristics which impact the availability of alternative funding sources. In 2009-2010, we find a marginally significant relation between higher loan impairment charge ratios at the bank, and lower probability of loan acceptance. The solvency ratio of the bank has no impact on the outcome of the firm's credit application. This suggests that it has not been the banks' own capitalisation, which has been the decisive factor for the decline in the banks' loan acceptance rates during the financial crisis but rather the deterioration of the credit quality of the banks' corporate customers.

6. Concluding remarks

In the paper at hand we have offered micro-econometric evidence on the relationship between loan rejection rates (loan acceptance rates) and the creditworthiness of the banks' corporate customers based on a unique firm-level data set which combine "soft" survey data on SMEs self-reported access to credit with "hard" accounting data and information on bank-firm relationships. The data set contains information on around 2,000 Danish SMEs' self-reported access to credit in 2007 and 2009/10, the economic performance of the firms and a range of key performance indicators of the firms' main bank relationship.

We have found lower acceptance rates for applications for bank loans from firms with weak economic performance than for firms with strong economic performance. This was the case both prior to but especially during the financial crisis 2009/10, where firms with higher profit ratios, solvency ratios and liquidity ratios had a significantly higher probability of having their loan application accepted than firms with poor economic performance.

The banks tightened their credit standards during the financial crisis. However, banks with low capital adequacy ratios during the crisis did not have lower loan acceptance rates than banks with high capital adequacy ratios. This indicates that it has not been the banks' own capitalisation, which has been the decisive factor for the decline in the banks' loan acceptance rates during the financial crisis but rather the deterioration of the credit quality of the banks'

corporate customers, which made it necessary for prudent banks to tighten their credit standards.

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