The effect of collateral on small business rationing of term loans and lines of credit

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Abstract

Theories of loan contracting in the presence of asymmetric information highlight the key role of collateral in mitigating against credit rationing. Loan applications that are secured against collateral are viewed positively by banks as a sign of entrepreneurial commitment and as a means of de-risking lending which ends in default. However, theory also allows for the use of collateral by 'bad' borrowers who are pretending to be 'good' borrowers in order to receive a better loan contract offer. In this paper we explore the extent to which collateral can reduce the incidence of absolute loan denial and partial rationing associated with smaller loans than requested being offered. Where we differ from other work is in our ability to allow for collateral to act differently in respect of lines of credit and term loans. Using a large UK data set we find that this distinction is important, and that the presence of collateral is associated with reductions in partial rationing for lines of credit but increases in rationing for term lending. We argue that even the request (or offer) of collateral for a term loan indicates that either the bank or the firm believes it is a risky bet.

Key Words: Collateral; SME lending; Lines of credit; Term Loans; Credit rationing

1. Introduction

Credit rationing in the presence of asymmetric information inspired a wave of theoretical thinking and development which sought to define and underpin the conditions under which banks might reach a state where equilibrium credit rationing would be a common feature of debt capital markets (Jaffe and Russell, 1976; Stiglitz and Weiss, 1981; 1983). Building directly from this work, a second wave of theoretical work sought to address the issue of what credit rationed borrowers could do about this (Chan and Kanatas, 1985; Bester, 1985; 1987; Besanko and Thakor, 1987; Chan and Thakor, 1987). This body of theory focused on means by which borrowers could send a positive signal to the lender that they were fully committed to a projects success and hence the successful repayment of the debt. More than that, by placing collateral against borrowing, the bank reduced its expected loss in default. What is particularly intriguing is that these huge theoretical advances in our understanding of the conditions under which credit rationing might be most severe, and the types of firms it would impact on more, continued in parallel with the increasing prevalence of loan guarantee schemes across the developed and developing world. By design the policy problem that a loan guarantee scheme seeks to address is credit rationing, and the policy instrument is the guarantee which can be viewed as approximating collateral, although it is actually more akin to underwriting potential losses (Cowling, 2010). However, it is less clear about whether a government guarantee to a lending bank would exert the same disciplining effect as entrepreneurs' collateral.

Despite placing collateral at the forefront of the credit rationing literature, albeit alongside relationship lending and other mechanisms by which borrowers and banks can reduce the level of asymmetric information (Jiminez and Saurina, 2004), it was recently observed by Chala and Forssbaeck (2018: Pages 1-2) that, "empirical evidence on the link between collateral and rationing remains scarce and essentially only indirect. The empirical literature is also mixed on exactly why collateral is used and by which firms." The authors recognised that there are some practical issues in estimating these relationship empirically given that typically the presence or not of collateral in a lending contract is only observed for issued, not offered, contracts. That is to say more precisely in the context of this paper that collateral is only observed when a loan offer has been approved with or without collateral, hence absolute rationing (full loan denial) is not possible to estimate. We can shed some light on this by looking at rejected loan proposals and the reasons for them, but our ability to bring these data formally into our analysis is limited.

The aim of this paper is to build on the procedure adopted by Chala and Forssbaeck (2018) using US data to estimate the explicit relationship between collateral and credit rationing defined by partial or volume rationing (the loan amount advanced potentially being a fraction less than 1 of the amount requested by the borrower). However, due to the richness of our data we are able to establish whether or not different relationships exist for lines of credit and term loans, a feature that was not possible in their work. However, it is the case that our UK results can be meaningfully compared to the US results for term loans which might help establish how unique different national debt markets are in the context of small business lending. It is also the case that our data is for a much more recent, and post-GFC, time period, and a total sample in excess of 30,000 UK SMEs.

Given the prominence of selection issues all the way through the entire process from having a demand for finance, to making an application, to initial application screening and the potential for absolute rationing, and finally to partial rationing in respect of the amount advanced, we follow the trivariate probit procedure of Chala and Forssbaeck (2018) to jointly estimate the three-step process from demand for finance to potential loan approval (or absolute rationing). Obviously, passing on to the next stage of the process is conditional on reporting a positive response to the stage before. In respect of potential endogeneity issues around collateral, we choose to estimate it within the system of equations as it is embedded in the decision-making at each stage of the process, rather than assume it is exogenously determined.

The rest of the paper is set out in the following order. In Section 2 we review the theoretical and empirical literatures which relate collateral to credit rationing. Section 3 outlines our methodology and how we approach our two stages of estimation. In Section 4 we describe the nature of the data we have available to us and define our key estimating variables. Our key results for all stages of the process are reported and discussed in Section 5. Conclusions are drawn in the final section.

2. Literature Review

2.1. Credit rationing and collateral

Credit rationing has been the focus of a considerable body of theoretical work over several decades (Keeton, 1979). Its presence in credit markets captures a situation where there is an excess demand for bank funds (i.e more firms seek loans than banks are willing to supply at the market interest rate) that is driven by an unwillingness for banks to raise the interest rate

to clear the market. The empirical evidence on small firm loan refusal rates shows that in this excess demand for loans is quite common (Levenson and Willard, 1997; Shen, 2002; Fairlie and Robb, 2007; Fraser, 2009), and these problems are exacerbated in periods of economic and financial crisis (Cowling, Liu, and Ledger, 2012; Lee, Sameen, and Cowling, 2015).

The role that asymmetric information plays in the small firm - bank relationship is central to our understanding of why banks ration credit (Berger and Udell, 1998; Behr and Guttler, 2007; Petersen and Rajan, 1994; Cole, 2013; 1998). The seminal paper on credit rationing paper (Stiglitz and Weiss, 1981) has at its heart the fact that borrower quality is *ex ante* undetectable by the lending bank (adverse selection). This gives the firm an information advantage compared to the bank. The *ex post* problem information problem (moral hazard) accounts for the potential that a borrower responds to a rise in interest rates by switching her loan funds to a riskier project with a higher expected default probability. This leaves the bank at a point where its expected profits are lower than before it raised the interest rate. It is thus optimal for the bank not to raise its interest rate to clear the credit market as it suffers from lower expected profits as firms switch into higher risk projects. In a follow-on paper Stiglitz and Weiss (1983) allow for a more dynamic relationship between the firm and bank in which banks deny future credit applications to borrowers who have defaulted on a previous loan. If borrowers know that banks have adopted this strategy it follows that borrowers are induced to always choose the safest project with the lowest probability of failure.

A significant number of theoretical papers (Besanko and Thakor, 1987; Bester, 1985), and the exhaustive review of collateral by Coco (2000), have argued that collateral can act as a sorting device as only good risk borrowers will be willing to put up collateral against a loan as they feel more confident that they will not default and forego their securitised assets. Low quality borrowers are very unwilling to place collateral against borrowing due to their higher probability of losing it. Offering collateral also has an effect on the cost of borrowing, the interest rate offered by the bank. Good borrowers who are willing to offer collateral are compensated with a lower interest rate. Bad borrowers, who are less willing to offer collateral will receive a higher interest rate offer. In this regime banks separate out borrowers by risk type by the nature of the contracts they accept, even in the presence of asymmetric information (Leeth and Scott, 1989). This is a separating equilibrium where each firm receives a loan offer that reflects it individual risk.

But significant debates remain about who offers collateral and what the implications are for credit rationing. Bester *op cit* argue that bringing collateral into the credit market can eliminate credit rationing which contrasts with Besanko and Thakor *op cit* who argue the opposite. Their case is founded upon the possibility that in cases where good (low default probability) and bad (high default probability) borrowers are tangibly different in terms of their riskiness, the amount of collateral required from good borrowers may well exceed their collateralisable wealth endowment. This leads to a market equilibrium where a proportion of genuinely good and low risk borrowers are unfairly credit rationed. This sort of 'unfair' credit rationing would be supportive of public intervention in the debt market in the form of loan guarantee schemes.

Coco (2000), adds an interesting nuance to the collateral issue by pointing out that often the entrepreneur's marginal valuation of collateral in terms of interest rates may be lower than the rate at which the bank is willing to exchange collateral for interest rate in its zero profit contract. The valuation of collateral is not costless to the bank and it often takes a cautious approach to this in the sense that it is interested in the value of the asset offered if foreclosure forced it to sell that asset quickly. Here the optimal contract always requires full collateralisation. If banks only compete on collateral (assuming competition drives down a common loan rate), an increase in collateral requirements (adverse selection) drives the safest entrepreneurs out of the market. In addition, whilst collateral, by increasing the losses of the entrepreneur in default, increases effort, a higher interest rate, by reducing the surplus of the entrepreneur in successful states, induces lower effort. In a multi-period setting, the bank will design a contract in which the borrower obtains cheap credit (both lower interest rates and collateral) late in the relationship conditional on successful repayment in early periods.

2.2. Collateral and the empirical evidence

Direct empirical evidence on how collateral interacts with the pricing of loans and other contract terms is relatively sparse. There are two major studies that have tackled this empirically using large data sets to explore how specific loan contract terms alter the relative stickiness of bank interest rates. The earlier US study of Berger and Udell (1992: Page 1065), found some very clear and precise results and concluded that, "borrowers who pledge collateral have more information problems than other borrowers (consistent with their greater risk discussed above) and that the process of pledging collateral does not fully offset these problems." The Cowling (2010) UK study which replicated the earlier study at a later time

period and in the UK, arrived at the same conclusions. Further, this study found that collateral was more associated with term lending and floating rate loans. This suggests that where information problems are a concern to the bank, it is particularly concerned when the repayment horizons extend into the distant future. Banks are also reluctant to lock themselves into a fixed interest rate contract which contractually insures the borrower against future interest rate shocks.

Two recent studies looked at the collateral coverage rate for bundles of loans issued in the UK which included a government backed loan guarantee. Given known total lending, and the proportion of total lending covered by collateral (firm and government), Ughetto, Scellato, and Cowling (2017) found that an increase in the guaranteed coverage leads to a contraction in the interest rate spread but only for loans aimed at covering working capital needs rather than longer term investments. In a later UK paper, Cowling, Ughetto, and Lee (2018) explored the effect of collateral coverage on loan default, again on bundles of small business loans and found that the relationship between the guarantee coverage and subsequent default was not statistically significant.

Other Japanese empirical work has used land assets to separate firms into constrained and unconstrained borrowers (Ogawa and Suzuki, 2000) based on the ability of firms with land assets to offer these assets as security against loans. Arising out of this asset based borrowing constraint, constrained firms tended to have a more direct and stronger relationship between cash-flow and investment. This study emphasises the role of collateral in resolving the loan access problem. Atanasova and Wilson (2004) arrived at similar conclusions in their UK study spanning a decade of firm borrowing conditions. They identified the key role of collateral in mitigating against transitory credit rationing conditions imposed during periods of tight prevailing monetary conditions. Over a decade from 1989-1999 they found that only 11.5% of firms had never experienced any credit constraints and that the median number of periods when an individual firm suffered from credit constraints was 5. These two studies together highlight the key role of collateral in access to borrowing, particularly in periods of economic instability. However, contrary evidence was reported in Shen (2002) who used Taiwanese data to examine differences in lending behaviour and credit rationing at the firm and bank level in ‘good’ and ‘bad’ years. The base data showed that only minute differences in the share of unsecured lending were apparent between ‘good’ and ‘bad’ firms and between ‘good’ and

'bad' years. This non-result was reinforced in their econometric estimates of bank loan supply which found no collateral effect in any macroeconomic circumstance.

Carbo-Valverde et al. (2015) using Spanish data matching the firm to the bank investigate bank securitisation and its effect on loan supply. They find that in normal economic circumstances banks who are able to transfer portfolio risk through asset and mortgage securitisation issue more loans as their need for screening out lower quality applicants is reduced. However, this finding is overturned in periods of economic crisis when they ration credit more severely than banks that use covered bonds. Their work broadens the context under which we normally consider collateral and lending as it also impacts on the supply-side of the credit market via bank operations.

These findings suggest that there are very precise and specific nuances that need to be considered when investigating the role of collateral in lending contracts. Our separation of lines of credit and term loans directly tackles the issue of different loan contract and supply effects for different types of borrowing. We are not able to address the bank securitisation issue as bank characteristics were not available in the data set available to us.

3. Method and Estimation

Here we outline the method which will guide our empirical analysis and the precise estimation steps. Our main focus is on the degree of partial, or quantity, credit rationing defined as a firm whose loan was approved, but who potentially received a lower amount than they requested. We are also able to identify absolute credit rationing, defined as making a loan application that was refused, although this is not the central focus of our paper. Partial credit rationing is a very precise way of understanding credit rationing in the context of good quality borrowers as they have passed the initial bank screening process which eliminates low quality borrowers. In a sense it establishes how banks differentiate across their pool of good quality borrowers in a very nuanced and precise way. What is different about a firm offer 75% of the funds they requested and one who was offered 100%? This is very important in the context of 'true' credit rationing which only has relevance to firms and entrepreneurs who are constrained that are good quality.

From a data perspective, this measure of partial rationing makes it much easier to estimate as collateral is usually only observed when a contract offer has been made by the bank and a

loan accepted by the firm. We are actually not as constrained by data in this respect as most as we do have some evidence on reasons for rejection of funding applications with lack of security being a potential response. But the general point holds. It is also the case that the general characteristics that influence each step of the process from having a project that needs external funding through to partial rationing may be influenced by the availability of collateral. The final set of firms that potentially suffer from partial rationing is likely to be a non-random subset of the initial population of firms which implies that simply estimating what is our final model of partial credit rationing would be subject to selection bias or endogeneity. We are also guided by the knowledge that a bank lending contract contains a bundle of terms within it that are offered and negotiated simultaneously (Melnik and Plaut, 1986; Cowling, Matthews, and Liu, 2017). To address these issues, and to respect the work of Chala and Forssbaeck (2018) which inspired our efforts, we adopt their sequential approach of estimating a series of equations that are conditional on progressing from each prior equation. The sequence broadly follows that developed by Cole and Sokolyk (2016) and adopted in Cowling et al (2016), with some minor modifications. The main differences between our approach and the afore-mentioned studies which adopted a two-step Heckman-style probit model with selections (Van de Ven and Van Praag, 1981), are that (a) the selection process includes a system of equations representing each of the steps of the sequential loan demand/approval process (step 1 to 3, Figure 1) and (b) the outcome equation (step 4, Figure 1) also takes into account the endogeneity of independent variables, in our case collateral availability and interest rate.

[Insert Figure 1 Here]

By construction, each step of the selection process is nested in the previous step, and is identified by one or more exclusion restrictions, or instruments. The first step is to estimate the core model for whether or not a firm has a demand for finance. From the overall UK small business population, firms with an underlying need for external finance are a subset comprised of those who have no projects or working capital requirements that require long or short term funding or those firms that can fully fund their activities from internal resources. This model for the latent demand for finance has its estimable variable as demand for finance expressed through a binary variable where yes indicates that the firm makes a loan application or classes itself as a discouraged borrower, and a no indicates that the firm is neither a loan applicant nor a discouraged borrower. We model the demand for finance as a function of a set of core firm demographic characteristics, some spatial indicators, and a set of specific indicators of

business operation (e.g. export and innovation activities) and this model uses the maximum (full) sample. These core variables are all described in Section 4. The exclusion restriction for the credit demand equation is an indicator variable equal to one if the survey respondent reported cash flow problems as one of the main obstacles to business growth, and zero otherwise. The rationale for this variable stems from the pecking order theory (Myers and Majluf, 1984), that firms will only seek finance externally if internal sources of finance have been exhausted.

From having an underlying demand for funds, there is a subset of firms who choose not to make applications even when they have a need for finance. This unique set of firms are called discouraged borrowers from the original Kon and Storey (2003) theoretical model. A discouraged borrower is unwilling to make an application, even if it has a good project, as it fears rejection by the bank and does not want to incur the fixed costs of applying. The firms who enter (select into) this model, which is conditional on reporting a positive response to our demand for finance model, are then separated into those who formally make an application for finance and those who are discouraged borrowers. This is when human capital, or entrepreneur-level characteristics, stars to play a role in forming the *ex ante* expectation on finance application outcomes. Measures of entrepreneurial growth objective are usually used as the exclusion restrictions for the loan application or credit discouragement model in early research (c.f. Cowling, Liu and Minniti, 2016), as they are obviously unobservable by the lenders but found to be significant in explaining the finance-seeking behaviour by individual businesses (Michaelas et al. 1999; Psillaki and Daskalakis, 2008). In this study, entrepreneurial growth objective is proxied by a dummy variable indicating whether or not the owner-manager aims to grow the business over the next year.

The third step in this sequential process is to estimate whether or not the firm's loan application is approved or denied. Again this is a binary outcome with a positive response indicating the application was approved and a negative response indicating that the firm is absolutely rationed in the lending market, i.e it gets no money at all. This of course is conditional on having a demand for finance and not being discouraged from applying. The exclusion restriction used in the loan approval equation is the Experian risk rating, which is commonly used by commercial banks to make lending decisions but usually not easily accessible by borrowing SMEs. Further, measures of firm-bank relationship add another layer

of identification for this equation, drawn from the extant relationship lending literature (Berger and Udell, 1995 and 2002).

This step-by-step selection process is estimated as a trivariate probit process where there is truncation as not all firms progress successfully through each stage. It assumes correlated and jointly normal distributions of errors. We explicitly account for the process of selection through the sequence of equations by calculating the inverse Mills ratio for each model. Importantly, as we progress through each step of the sequential process the inverse Mills ratios enter the next step equation as explanatory variables.

The second strand, or the outcome process of our analysis is to estimate a simultaneous equation system where the endogenous variables are the partial rationing measure, which is non-negative and has a maximum of unity (all the loan request amount was met in full), and our collateral indicator. The collateral measure enters the main (partial rationing) equation as an endogenous variable from the underlying model. Following Chala and Forssbaeck (2018), we also include the interest rate risk premium of loan (over BoE base rate or LIBOR for fix- and floating-rate finance, respectively) as an endogenous variable. Both variables are instrumented and the credit rationing equation is estimated using a multi-level IV estimator.

A common instrument used by the collateral and risk premium equation is firm-bank relationship. It is defined as an indicator variable equal to one if a survey respondent reported either "satisfied" or "very satisfied" with his/her main bank, and zero otherwise. Conventionally, favourable lending relationship helps to overcome information asymmetries between banks and borrowing SMEs (Petersen and Rajan, 1994; Berger and Udell, 1995), resulting in the decline of both finance cost and collateral requirement (Chakraborty and Hu, 2006; Jiménez et al., 2006; Brick and Palia, 2007). However, it is argued that banks could exploit the proprietary information about the borrower from longer and closer relationships, essentially creating a "lock-in problem (Degryse and Van Cayseele, 2000)" where banks are free to seek rent by charging a higher loan rate (Greenbaumet al, 1989; Sharpe, 1990; Rajan; 1992; von Thadden;1998) or require more collateral (Lehmann and Neuberger, 2001; Menkhoff et al., 2006; Voordeckers and Steijvers, 2006), because it is too costly for the borrowers to switch banks. The variable is also a natural candidate for instrument, because it is likely to affect firms' subjective willingness to provide collateral and/or assessment of lending cost (risk premium). In addition, we use several unique instruments for the collateral

and risk premium equation. For collateral, it is instrumented by a dummy variable measuring whether the overdraft/term-loan application was a renewal or new application.The rationale for this choice is that (collateralised) outstanding debt exhausts the firm's capacity to pledge further assets to the current application, but is supposed to have no (direct) effect on the bank's decision in rationing credit. Further, if an outstanding loan is collateralised, this can be regarded as a signal of the firm's willingness to securitise future loans. For risk premium, there are two unique instruments. The first is whether the interest rate is floating or fixed, which is found to be significant in explaining loan rate (Berger and Udell, 1990; Brick and Palia, 2007; Chakravarty and Yilmazer, 2009; Cowling, 2010) but should have no effect on the credit risk of the business and the rationing decisions. The second instrument for risk premium is the yiled of the10-year UK Treasury Gilt (quarterly average) at the time of finance application.

4. Data and Measures

We collect the data from six waves of the SME Finance Monitor surveys conducted by BDRC Continental for UK SMEs between July 2011 and September 2012. This sample period was chosen because the information on collateral is no longer collected in subsequent surveys. In total, the data set contains 30,183 completed surveys with SMEs. In order to qualify for interview, SMEs had to meet the following criteria in addition to the quotas by size, sector, and region:

- not 50%+ owned by another company
- not run as a social enterprise or as a not for profit organisation
- turnover of less than £25m
- The respondent was the person in charge of managing the business's finances.
- No changes have been made to the screening criteria in any of the waves conducted to date.

Quotas were set overall by turnover and the number of employees. The classic B2B sample structure over-samples the larger SMEs compared to their natural representation in the SME population, in order to generate robust sub-samples of these bigger SMEs. Fewer interviews were conducted with zero employee businesses to allow for these extra interviews. Each quarter's sample matched the previous quarter's results as closely as possible. Quotas were set overall to reflect the natural profile by sector, but with some amendments to ensure that a robust sub-sample was available for each sector. Thus, fewer interviews were conducted

in Construction and Property/Business Services to allow for interviews in other sectors to be increased, in particular for Agriculture and Hotels. The weighting regime was initially applied separately to each quarter. The six waves were then combined and grossed to the total of 4,548,843 SMEs, based on BIS SME data. This ensured that each individual wave is representative of the whole SME population.

The firm-level data was further matched with the firms' Dun & Bradstreet and Experian credit risk ratings. The survey uses a complex weighting system which includes: (a) a general weighting to reflect the actual UK SME population by size, sector and region; (b) an additional size class weight; and (c) a rim weight for region. Further a start-up weighting is also calculated based on UK SME age structure statistics. In our analysis we use the weighted data so that our findings are representative of the whole UK SME population.

4.1. Dependent variables

The survey recorded information on the amount of finance applied for and if approved, the amount approved by the lending bank. Based on this information, we construct our quantity rationing measure as two variables. The first is a continuous variable defined as the ratio between applied and approved amount, which has an upper bound of 1, meaning the firm got all the finance applied for. The second is a binary variable that equals one if the loan was fully approved and zero otherse.

4.2. Explanatory variables

Independent variables in this study can be classified into three groups: firm characteristics, owner characteristics and credit risk indicators, which are commonly used in previous studies on small business finance to proxy for the development stage of the firm and the degree of information opacity between the firm and its finance suppliers.

Firm characteristics include size, legal status, sector, firm age, and performance. Firm size is measured by sales turnover. Legal status is defined by four categories including sole trader, partnership, LLP and Limited liability. Sector is defined as nine one-digit SIC codes. Age is defined in six categories from <12 months old to >15 years old. Performance is measured by the profitability of a business, defined as a binary variable as whether or not the firm generated a surplus (profit) over the past 12 months. We also consider additional firm-level control variables regarding the firm's, business activities and possible credit support

provided for finance application. Business activities concern firms' operating behaviours including innovation, the development of new process and products, and the degree of internationalisation (whether the firm exports products overseas). Credit support is proxied by the availability of formal business plans.

Owner characteristics or human capital measures consist of gender, (highest) formal educational qualification, prior business experience, and whether or not the owner holds a financial qualification. We use Experian risk classification to measure credit risk. Financial delinquency measures include non-payment of loans, unauthorised overdraft borrowing, bouncing cheques, County Court Judgements, late payment of tax, and trade credit restrictions, are direct reflection of credit history and are also used as proxies for credit risk. The detailed variable definitions are shown in Table 1.

[INSERT TABLE 1 HERE]

5. Results

5.1. Descriptive statistics

Table 2 reports the descriptive statistics of dependent and independent variables over the full sample, and in each of the stages during the finance demand/supply process shown in Figure 1, by alternative types of bank finance. Sample weights are applied so that the statistics are representative of the UK SME population.

An 'average' firm in our sample is a 10-year old, male-led, non-exporting business with less than £200,000 annual turnover and reporting a profit in the previous year. About two in five (40%) of the firms were involved in innovation activities either through developing new process or product. On average the owner of the firm holds at least one academic qualification and has around ten years of experience in managing or owning a business, and around a quarter of entrepreneurs have financial qualifications. Regarding more direct credit risk indicators, more than two thirds (71%) of the firms have average or above average risks according to the Experian risk rating, and about a quarter (24%) of the firms have had at least one incidence of financial delinquency.

About one in five (18%) SMEs had shown demand for overdraft facilities, but less than half (46%) actually approached a bank to apply for any. 72% of the applicants ended up with

at least part of the overdraft sought, amongst whom nearly 87% got the full amount they asked for. For the remaining 13% that were partially credit rationed, they only managed to secure around half (55%) of the required finance. Both the demand for and supply of term loans were generally lower according to the summary statistics. Only around one in ten (11%) were in need of the finance, a third of whom (36%) eventually applied. The approval rate was also lower at 56%, although the percentage of partially rationed firms (10%) was slightly smaller than that of overdraft (13%). In case of partial rationing, banks were only willing to provide an average of 62% of the requested loan amount. On aggregate level, 23% of SMEs showed demand for external finance (either overdraft or term loan), 48% of which actually applied to a bank with an approval rate of 70%. The average approved finance was 95% of the applied amount, with 89% receiving fully what they applied for. A univariate mean comparison between partial- and non-rationed SMEs show limited difference between the two groups, regarding both the provision of collateral and other control variables. The only common factors that differentiate the two groups seem to be firm-bank relationship, and credit history measures. The lack of collateral effect from the univariate analysis justifies our choice of the empirical model by considering the conditionality during the financing process, and the potential endogeity of the collateral measure.

[INSERT TABLE 2 HERE]

5.2. Tri-variate selection model: credit demand, application and approval

The purpose of the model is to address the potential selection biases because of sequential and conditional nature of each stage in a firm's financing activity. The predicted inverse Mills ratios from each of the credit demand, application and approval equations will later enter the outcome, quantity rationing, equation. The coefficient estimates are reported in Table 3. It is shown that for both types of finance, the correlations between the error terms of the equations are all significant, suggesting the existence of selection bias. Therefore, our approach to correct for this endogeneity problem using a multi-stage, Heckman-style process is justified. It is interesting to note that the correlation between overdraft application and approval equation is negative (ρ = -0.45, $p < 0.01$). Assuming the decision to apply for finance is based on the entrepreneur's expected loan approval odds determined by various firm- and individual-level factors, which are also used by banks to make lending decisions, a negative correlation suggests that the borrower may have misjudged the true approval probability and therefore

made the wrong application decision. Such miscalibration of expectated and true odds of credit approval may result in high-quality borrower becoming mistakenly discouraged and self-rationed (and vice versa), which is a sign of inefficient market (Cowling et al., 2016). Although not the focus of this paper, there is an increasing number of studies investigating the mechanism of such irrationality from a behavioural perspective (e.g. Cole et al., 2018).

Regarding the demand for overdraft facilities, more profitable firms have a lower demand (β = -0.11, $p < 0.01$), which is consistent with the pecking order theory as more profitable firms are more likely to satisfy their financing need internally. Similarly the exclusion restriction, the existence of cash flow problems, is positively related to the external finance need (β = 0.56, $p < 0.01$). Overdraft demand is also positively related to firm size, measured by the logarithm of sales (β = 0.07, p = 0.01) and negatively related to firm age, both in line with previous research. SMEs involved in innovation activities have higher demand as well (β = 0.20, $p < 0.01$), as they are likely to be early-stage and/or high-tech businesses less able to generate a steady stream of cash flows to satisfy their capital requirement.

Once the demand is established, the application decision will be made based on the borrower's *ex-ante* assessment of loan approval odds. In the case of overdraft, we conclude that the expectation formed upon proxies for firm risk and resource availability is reasonably unbiased compared to the actual application outcome, where larger, older and better performed (more profitable) firms are more likely to apply. Entrepreneurial human capital also plays an important role in overdraft application, as seen in the positive effect of owner experience. There is mixed evidence regarding the effect of credit track record: county court judgement and trade credit restrictions reduce, while unauthorised overdraft and late tax payment increase the likelihood of application. The exclusion restriction, entrepreneurial growth objective, is significantly but negatively related to overdraft application (β = -0.06, $p < 0.1$), implying that firms with a vision of long-term growth are less likely to turn to short-term finance.

When it comes to the decision whether or not to approve an overdraft application, banks primarily rely on credit-risk indicators, except for a few firm-level characteristics. Notably, larger firms with higher sales are more likely to be approved (β = 0.04, $p < 0.1$), which is consistent with the resource-based view that firm size is a proxy for resource availability. Entrepreneur-level characteristics have little explanatory power on overdraft approval,

including gender. Firms with a history of financial delinquency are more likely to be turned down. As for the exclusion restrictions, Experian risk rating has no, whilst lending relationship has a siginificantly positive effect on approval.

The results for term loan are in general similar to those for overdraft, with a few exceptional differences. Firstly, female-ownded businesses are more likely to be discouraged, but there is no evidence of gender discrimination in loan approval. This finding is similar to Cowling, Miniti and Liu (2016) which used a different UK data set but mainly considered commercial bank loans, and is consistent with feminised risk aversion. Secondly, term loan application seems to follow a more 'random' process according to our estimation, than overdraft. Here both entrepreneurial human capital and credit history measures have smaller explanatory power compared to the other type of bank finance.

[INSERT TABLE 3 HERE]

5.3. Instumental variable model with selection effect

The outcome, partial credit rationing, equation needs to address two types of endogeneity concerns. The first is the non-random sample selection arising from the sequential nature of credit demand, application and approval, and this is addressed by including three inverse Mills ratios inferred from the tri-variate selection model in the outcome equation. The second is the endogeneity of the explanatory variables, collateral and risk premium in our case, and this is addressed using instrumental varialbles (IVs). The key to the validity of the IV estimation is that the instruments are uncorrelated with (exogenous to) the dependent variable (partial rationing), but sufficiently related to the endogenous variables. We formally test the validity of the instruments using a series of standard diagnostics, using robust GMM estimators[1], and the results are reported in Table 4.

Since there are more instrumental variables than endogenous variables, our model is by construction overidentified. For overdraft (χ^2 = 2.19, p = 0.34) and term loan equation (χ^2 = 0.45, p = 0.80) individually and aggregately ((χ^2 = 0.01, p = 0.99), the Hansen J statistics are insignificant, suggesting that the null hypothesis that the overidentifying restrictions are valid

[1] Estimation using GMM allows us to examine more IV test diagnostics and is a common approach in prior research. However, we do compare where applicable the diagnostics with those derived from IV tobit regressions, which we use as our primary empirical model.

cannot be rejected. Next, the Kleibergen-Paap underidentification test shows that the null hypothesis that the instruments are (individually and jointly) uncorrelated with the endogenous variables is rejected at 5 percent level or less, implying the relevance of the instruments. Third, we test the statistical strength of the endogenous variables but with mixed results. The Montiel-Pflueger F-statistics show that the null hypothesis that the endogenous varialbes are jointly weakly identified is strongly rejected at 5 percent level. However, the null cannot be rejected according to the Anderson-Rubin Wald and Stock-Wright LM tests[2]. For individual endogeneous variables, the weak instrument tests using the Sanderson-Windmeijer F-statistics are passed for risk premium at 10 percent level, but for collateral it is only passed on aggregate level. Finally, we test whether the collateral variable in our regressions is actually exogenous. According to the difference-in-Sargan statistic for GMM estimators, the null hypothesis of exogeneity is rejected at 1% level for overdraft, 5% for aggregate and 10% for term loan. To summarise, although our estimation may be suscitible to weak instrument, endogeneity problem is not trivial, justifying the validity and relevance of the instrumental variable approach for the partial rationing equation.

[INSERT TABLE 4 HERE]

Table 5 reports the coefficient estimates of the partial rationing equation. Since the dependent variable, the proportion of finance applied that was approved by the bank, is truncated between 0 and 1 by definition, tobit model will be used. Our analyses will be based on the robust IV tobit estimators with inverse Mills ratios from the selection process, but we also include two benchmark specifications using a single-equation tobit model by treating collateral as an exogenous variable and ignoring sample selection. It can be seen that for overdraft and aggregate bank finance(Models I and V), the effect of collateral is marginally significant (β = -0.13 and -0.10 respectively, $p < 0.05$) and for term loan (Model III), the coefficient estimate is insignificant. However, for all three types of finance, collateral is negatively related to the proportion of finance approved, or positively related to the degree of partial rationing. In order to establish a more definitive and robust link between collateral and quantity rationing, we need to remove the influences of the potential biases discussed earlier in the paper. The afore-mentioned IV test statistics implies the presence of endogeneity, and

[2] The Anderson-Rubin Wald weak instrument tests are passed at 5% level for both types of finance if we use IV tobit estimators.

the coefficient estimates on the inverse mill's ratios indicates that sample selection bias is non-trivial as well[3]. For all three IV models, the inverse mill's ratio of credit approval equation is strongly significant, although those of the credit demand and application equation are not, probably because the selection effect has already been considered by the credit approval equation in the tri-variate probit model.

For those offered overdraft facilities, the coefficient estimate on the collateral dummy is significantly negative (β = -0.18, $p < 0.01$). In marginal terms, it means that firms that were required to pledge collateral on their overdraft received nearly twenty percentage points of the applied finance less than those wth no collateral requirement. Regarding the control variables, limited liability companies (β = 0.03, $p < 0.05$) and exporters (β = 0.03, $p < 0.01$) are more likely to get an amount closer or equal to their requested finance, while those with poorer credit record, particularly bounced cheques (β = -0.03, $p < 0.05$), are more likely to be quantity rationed. Experienced owner-mangers are less likely to have their financing needs fully satisfied. A potential explanation is that firms with an unchanged ownership are deemed as less viable (Levenson and Willard, 2000), and thus treated by the banks as a signal of inferior borrower quality.

With respect to term loans, the first observation we draw from the IV tobit regression is that similar to the likelihood of loan approval, banks mostly would resort to the clearly observable and direct indicators of credit risk, than other firm- and individual-level characteristics. Here, SMEs with a lower credit rating and incidences of late payment (on both outstanding loan and tax) are more likely to be quantity rationed. However, there is still a strongly negative effect of collateral (β = -0.16, $p < 0.01$) with similar magitute to the overdraft equation, on the actual loan approved compared to the applied amount. The overall evidence suggests that even after controlling for the fact that the use of collateral signals riskier borrowers, banks are still cautious in making the lending decision by imposing further rationing mechanism besides the collateral requirement.

[INSERT TABLE 5 HERE]

[3] The coefficient estimates for the first-stage regressions on the two endogenous variables, collateral and risk premium, are reported in the online Appendix to save space.

5.4. Robustness tests

We test the robustness of our findings using alternative measures of quantity rationing, and the results are reported in Table 6. The first measure is an indicator variable, equal to one if the firm got all the finance required (and zero otherwise), as the dependent variable (Models I and II). We adopt the same treatment of selection bias and endogeneity as our primary regressions, expect for that we use the IV probit estimator instead because the dependent variable is binary. The findings from the overdraft equation are qualitatively similar, with collateral negatively associated (β = -0.88, $p < 0.01$) with the probabily of full approval (100 percent of all the finance applied for). On marginal terms, collateralisation reduce the likelihood of no rationing, or increase the likelihood of quantity rationing, by twenty percentage point. However, we do not find a significant effect of collateral on term loans, implying that our model is perhaps better in explaining the degree of quantity rationing for term loans, not the yes/no decision of quantity rationing.

In order to derive a 'cleaner' effect of collateral by considering the above difference between the decision and degree of quantity rationing, we re-run the IV tobit regression without the firms whose application were fully approved (Models III and IV, Table 6). This means that our sample size will be reduced by around 90 percent, so caution should be taken when interpreting the results. Further, we did not supper-impose the selection between partial- and non-rationed firms, because a quard-variate probit selection model is hard to reach convergence mathematically given the sample size. We find that collateral has a significantly positive effect on the percentage of overdraft approved (β = 0.52, $p < 0.01$), which is contrary to our full-sample result. However, the coefficient estimate of collateral on term loan has not changed dramatically (β = -0.15, $p < 0.01$). This suggests that once the bank has decided to limit the provision of overdraft to a viable but risky business, collateral is used as a gurantee against credit risk and a mechanism to narrow the funding gap. However, for credit with longer terms and larger amounts, collateral alone is not sufficient to justify the risks a lender must bear given the returns.

[INSERT TABLE 6 HERE]

6. Conclusions

We have used a large UK data set to trace out the effects of collateral in debt markets in the context of small business lending. Collateral has been traditional seen as a screening device that is used to reduce credit rationing, but evidence from previous empirical studies seems inconclusive. The aim of this study is to reconcile this gap using a noval process to investigate SME access to finance taking into account the temporal sequence, and thus the conditionality, during different stages of the financing activity. In particular, we estimatate a tri-variate selection model taking into account credit demand, application and initial approval. Conditional on an observation being selected in the afore-mentioned process, we then estimate the effect of collateral on the degree of quantity rationing, treating the former as an endogenous variable in a two-stage IV system. Moreover, we are able to separately examing the potential difference in the collateral-rationing relationship between short-term (overdraft) and long-term (term loans) debt finance.

We find that collateral has a generally negative relationship with the percentage of originally applied finance that is approved, or is positively related to quantity rationing, regardless of the types of credit. This suggests that banks use collateral as a means of securitisation against lendings, but at the same time realise that borrowers facing collateral requirement have higher credit risks in the first place. Therefore, even if a firm passes the initial application screening based on an evaluation of business and operational characteristics, without any collateral the bank may still find the investment risk unjustified, which in turn reduce the amount of credit approved compared to the applied amount.

Further decomposing the approved credit applicants into those subject or not subject to quantity rationing shows that the mechanism through which collateral functions may differ depending on the riskiness of the loan type concerned. For shorter term and thus less risky overdraft, collateral is evidently more likely to be required for a firm recognised by the lender as not credit-worthy enough to justify full approval. For this subgroup of quantity-rationed overdraft applicants, their chance of getting the finance closer to their initial application is increased in the presence of collateral. The same is not true for the relatively riskier term lonas, collateral requirement applies universally to all approved applicants and increases quantity rationing even if we remove the non-rationed firms out of the sample.

Our findings provide empirical support to the de-incentivise view of collateral, which is theoretically modelled by Niinimäki (2018). Here we show that the inclusion of collateral in

a loan application may create negative incentives especially for the more expensive credit such as term lonas. In order to compensate the high financing cost and to save the collateral asset, the borrower may resort to excessive risk-taking by gambling with the value of the collateral. To avoid such moral hazard problem, credit rationing becomes an optimal decision for the lenders. This study also further justifies the public loan guarantee scheme to address credit rationing in the small business financing market, which serves as a substitute, or approximation, of collateral but without introducing the moral hazard problem. Last but not least, this paper calls for future research on the appropriate design of collateral requirement, so as to bring about the positive incentives for both borrowers and lenders.

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Table 1: Variable definitions

Panel A: Dependent variables

Group	Variable Name	Definition
Demand for finance		
	DEMAND	= 1 if firm had demand for overdraft or term loan; 0 otherwise
	APPLY	=1 if firm applied for overdraft or term loan; 0 otherwise
Supply of finance		
	APPROVE	= 1 if firm received at least part of the finance applied for; 0 otherwise
	*PERCENTGOT**	For *APPROVE* = 1, % of original applied amount that was offered (max = 1)
	*NORATION (NR)***	= 1 if firm received all of the finance applied for (*PERCENTGOT* = 1); 0 otherwise

Panel B: Independent variables

Group	Variable Name	Definition
Collateral	*COLLATERAL*	= 1 if security was required to obtain the offered finance; 0 otherwise
Firm characteristics		
Size	*SALES*	Annual turnover (£Mil)
Legal status	*LEGAL*	1= Sole Proprietor, 2=Partnership, 3= Limited Liability Partnership, 4= Limited Liability
Industry sector	*SECTOR*	1=Primary, 2= Manufacturing, 3=Construction, 4=Wholesale/Retail, 5=Hotels/Catering, 6=Transport & Communications, 7=Business Services, 8=Health, 9=Other Community
Age	*FIRM_AGE*	1= <12 months, 2= 1-2 years, 3= 2-5 years, 4=6-9 years, 5=10-15 years, 6=>15 years
Performance	*PROFIT*	=1 if firm broke even or made a profit
Owner characteristics		
Gender	*WLED*	= 1 if firm is a women-led business; 0 otherwise
Education	*ONWER_EDU*	1=None, 2=GCSE, 3= A level, 4= HNC, 5=BTEC, 6=Professional, 7=Degree, 8=Post-graduate Degree, 9=Other
Prior experience	*OWNER_EXP*	1= <12 months, 2= 1-3 years, 3= 4-6 years, 4=7-9 years, 5=10-15 years, 6=>15 years
Qualification	*FIN_QUAL*	=1 if owner has a financial qualification; 0 otherwise
Risk indicators		
Experian Credit Rating	*RISK*	= 1if minimal, 2 if low risk, 3 if average risk and 4 if above average risk
Financial Delinquency		
Missed loan repayment	*FD_LR*	= 1 if missed loan repayment; 0 otherwise
Unauthorised overdraft	*FD_OD*	= 1 if had unauthorised overdraft facility; 0 otherwise
Bounced cheques	*FD_BC*	= 1 if bounced cheques; 0 otherwise
County court judgement	*FD_CCJ*	= 1 if had county court judgement; 0 otherwise
Late tax	*FD_TAX*	= 1 if missed tax payments; 0 otherwise
Trade credit constraints	*FD_TCR*	= 1 if had Trade credit constraints; 0 otherwise
Credit terms		
Risk premium	*RISKPREMIUM* (%)	Spread between loan rate and reference rate (BoE base rate or LIBOR)
Additional control variables		
Business activities	*INNOVATOR*	= 1 introduced market-level new process or product; 0 otherwise
	EXPORTER	= 1 if business exports products or services overseas; 0 otherwise
Credit support	*BUSINESS PLAN*	= 1 if firm has a formal written business plan; 0 otherwise
Exclusion restrictions	*FINPROBLEM*	= 1 if firm sees cash flow and/or external finance as main growth obstacle; 0 otherwise
	OBJECTIVE	= 1 if firm aims to grow substantially over the next year; 0 otherwise
	BRELATION	= 1 if respondent fairly or very satisfied with the main bank; 0 otherwise
	RENEW	= 1 if the application was to renew current overdraft/term loan; 0 otherwise
	FIXRATE	= 1 if interest rate on overdraft/term loan was fixed rate; 0 otherwise
	GILTYIELD	Quarterly average yield of UK 10-year Treasury Guilt at time of application

***:** For firms applying for both overdraft and term loan, *PERCENTGOT* is the average of the two.

**: For firms applying for both overdraft and term loan, *NORATION* = 1 only if *PERCENTGOT* = 1 for both overdraft and term loan.

Table 2: Variable Descriptive Statistics (Weighted)

Panel A: Access to finance measures

	Overdraft			Term Loan			Overdraft and/or Term Loan		
Variable Name	# Obs	Mean	Std Error	# Obs	Mean	Std Error	# Obs	Mean	Std Error
Demand for finance									
DEMAND	25,769	0.185	0.002	25,769	0.110	0.002	25,769	0.233	0.003
APPLY	5,733	0.459	0.007	3,615	0.357	0.008	7,466	0.476	0.006
Supply of finance									
APPROVE	3,566	0.724	0.007	1,848	0.561	0.012	4,734	0.705	0.007
PERCENTGOT	2,604	0.939	0.003	1,150	0.964	0.004	3,383	0.947	0.003
NORATION (NR)	2,604	0.866	0.007	1,150	0.904	0.009	3,383	0.887	0.005

Panel b: Independent variables

	Full Sample		Overdraft			Term Loan		
	(N = 25,769)		(1) NR=1 (N=2,330)	(1) NR=0 (N = 274)	t-test	(3) NR=1 (N=1,040)	(4) NR=0 (N = 110)	t-test
Variable Name	Mean	Std Err	Mean	Mean	(1) = (2)	Mean	Mean	(3) = (4)
COLLATERAL			0.266	0.244		0.234	0.285	
Firm-characteristics								
SALES (£Mil)	0.212	0.006	0.413	0.268	***	0.459	0.575	
PROFIT	0.647	0.003	0.721	0.507	***	0.643	0.569	
LEGAL								
Sole proprietorship	0.680	0.003	0.540	0.568		0.508	0.399	
Partnership	0.048	0.001	0.082	0.080		0.117	0.066	
Limited liability partnership (LLP)	0.012	0.001	0.020	0.001	**	0.027	0.012	
Limited liability (LTD)	0.260	0.003	0.357	0.351		0.348	0.522	
SECTOR								
Primary	0.044	0.001	0.085	0.055		0.099	0.001	
Manufacturing	0.066	0.002	0.069	0.020	***	0.048	0.078	
Construction	0.225	0.003	0.174	0.203		0.180	0.240	
Wholesale / retail	0.122	0.002	0.188	0.186		0.179	0.183	
Hotels / catering	0.032	0.001	0.035	0.045		0.054	0.057	
Transport & communications	0.069	0.002	0.063	0.023	**	0.101	0.020	***
Business services	0.263	0.003	0.251	0.276		0.196	0.347	
Health	0.062	0.002	0.032	0.037		0.080	0.050	
Other community	0.117	0.002	0.101	0.156		0.064	0.024	*
FIRM_AGE								
<12 months	0.094	0.002	0.046	0.097		0.089	0.112	
1-2 years	0.108	0.002	0.077	0.112		0.092	0.072	
2-5 years	0.253	0.003	0.195	0.160		0.230	0.141	
6-9 years	0.166	0.002	0.159	0.185		0.141	0.139	
10-15 years	0.138	0.002	0.211	0.137		0.131	0.209	
15+ years	0.240	0.003	0.312	0.308		0.318	0.328	
Owner characteristics								
WLED	0.266	0.003	0.265	0.273		0.322	0.148	***
ONWER_EDU								
None	0.120	0.002	0.141	0.204		0.141	0.064	
GCSE	0.137	0.002	0.169	0.174		0.183	0.180	
A level	0.081	0.002	0.123	0.064	*	0.117	0.075	
HNC	0.064	0.002	0.073	0.084		0.071	0.026	*
BTEC	0.192	0.002	0.151	0.186		0.137	0.245	
Professional qualification	0.114	0.002	0.101	0.087		0.090	0.098	
Degree	0.141	0.002	0.147	0.094		0.156	0.271	
Post graduate degree	0.095	0.002	0.096	0.108		0.105	0.041	*
OWNER_EXP								
<12 months	0.055	0.001	0.017	0.035		0.071	0.112	
1-2 years	0.155	0.002	0.112	0.099		0.114	0.097	
2-5 years	0.149	0.002	0.123	0.138		0.092	0.077	
6-9 years	0.099	0.002	0.101	0.067		0.071	0.095	
10-15 years	0.156	0.002	0.208	0.170		0.201	0.138	
15+ years	0.378	0.003	0.440	0.491		0.451	0.480	
FIN_QUAL	0.234	0.003	0.271	0.255		0.260	0.425	
Risk indicators								
RISK								
Minimal risk	0.041	0.001	0.076	0.033		0.053	0.066	
Low risk	0.097	0.002	0.143	0.128		0.163	0.200	
Average risk	0.269	0.003	0.285	0.202		0.271	0.328	
Above average risk	0.441	0.003	0.375	0.483		0.389	0.371	
Financial Delinquency								
Missed loan repayment	0.016	0.001	0.017	0.073		0.035	0.020	
Unauthorised overdraft	0.070	0.002	0.134	0.225		0.120	0.068	
Bounced cheques	0.056	0.001	0.088	0.102		0.106	0.051	*
County court judgement	0.013	0.001	0.015	0.005		0.021	0.013	
Late tax	0.051	0.001	0.118	0.153		0.110	0.158	
Trade credit constraints	0.032	0.001	0.036	0.105	*	0.054	0.028	
Credit terms								
RISKPREMIUM (%)			1.367	2.591		2.021	3.153	
Additional control variables								
INNOVATOR	0.402	0.003	0.505	0.583		0.546	0.488	
EXPORTER	0.070	0.002	0.110	0.118		0.077	0.063	
BUSINESS PLAN	0.327	0.003	0.377	0.475		0.452	0.618	
FINPROBLEM	0.104	0.002	0.127	0.182		0.132	0.127	
OBJECTIVE	0.457	0.003	0.491	0.523		0.607	0.538	
RELATION	0.805	0.002	0.827	0.662	***	0.786	0.585	*
RENEW	0.016	0.001	0.733	0.622	*	0.404	0.426	
FIXRATE			0.094	0.082		0.235	0.393	
GILTYILED (%)			2.946	3.077		2.984	2.901	

Table 3: Selection Models – Tri-Variate Probit Regressions

		Overdraft			Term Loans			Overdraft and/or Term Loan	
Group/Variable Name	*DEMAND*	*APPLY*	*APPROVE*	*DEMAND*	*APPLY*	*APPROVE*	*DEMAND*	*APPLY*	*APPROVE*
Firm-characteristics									
ln(*SALES*)	0.074***	0.139***	0.037*	0.064***	0.119***	0.131***	0.064***	0.132***	0.062***
	(0.007)	(0.014)	(0.023)	(0.008)	(0.018)	(0.019)	(0.006)	(0.012)	(0.017)
PROFIT	-0.105***	0.120***	-0.065	-0.141***	0.129**	-0.040	-0.072***	0.099***	-0.038
	(0.022)	(0.045)	(0.060)	(0.025)	(0.055)	(0.068)	(0.019)	(0.035)	(0.044)
LEGAL									
Partnership	0.120***	0.228***	0.299***	0.113***	0.457***	0.314***	0.167***	0.314***	0.241***
	(0.035)	(0.070)	(0.101)	(0.039)	(0.086)	(0.098)	(0.032)	(0.059)	(0.076)
Limited liability	0.099*	0.261**	0.421**	0.041	-0.012	0.173	0.104*	0.158	0.461***
partnership (LLP)	(0.060)	(0.117)	(0.193)	(0.067)	(0.138)	(0.154)	(0.054)	(0.096)	(0.144)
Limited liability (LTD)	-0.008	-0.009	0.038	-0.022	-0.003	0.005	-0.010	0.005	0.026
	(0.028)	(0.053)	(0.072)	(0.031)	(0.066)	(0.069)	(0.025)	(0.044)	(0.056)
SECTOR									
Manufacturing	-0.296***	-0.389***	-0.275**	-0.140***	-0.143	-0.305***	-0.316***	-0.257***	-0.303***
	(0.047)	(0.094)	(0.134)	(0.052)	(0.111)	(0.110)	(0.041)	(0.076)	(0.096)
Construction	-0.134***	-0.319***	-0.113	-0.169***	-0.311***	-0.399***	-0.195***	-0.269***	-0.181**
	(0.040)	(0.078)	(0.115)	(0.046)	(0.100)	(0.105)	(0.036)	(0.066)	(0.087)
Wholesale / retail	-0.122***	-0.326***	0.009	-0.082	-0.317***	-0.240**	-0.199***	-0.187**	-0.095
	(0.045)	(0.088)	(0.130)	(0.051)	(0.108)	(0.119)	(0.040)	(0.073)	(0.096)
Hotels / catering	-0.180***	-0.461***	-0.319**	0.039	-0.126	-0.270**	-0.164***	-0.293***	-0.347***
	(0.047)	(0.090)	(0.132)	(0.051)	(0.107)	(0.108)	(0.042)	(0.074)	(0.095)
Transport &	-0.196***	-0.318***	-0.325**	-0.052	-0.157	-0.243**	-0.197***	-0.168**	-0.317***
communications	(0.046)	(0.091)	(0.128)	(0.051)	(0.108)	(0.111)	(0.041)	(0.075)	(0.094)
Business services	-0.192***	-0.255***	-0.238**	-0.249***	-0.285***	-0.403***	-0.267***	-0.189***	-0.222**
	(0.040)	(0.080)	(0.115)	(0.046)	(0.101)	(0.101)	(0.036)	(0.068)	(0.087)
Health	-0.348***	-0.303***	-0.281**	-0.110**	-0.144	-0.114	-0.295***	-0.158**	-0.264***
	(0.047)	(0.100)	(0.142)	(0.052)	(0.114)	(0.116)	(0.042)	(0.080)	(0.101)
Other community	-0.236***	-0.405***	-0.145	-0.204***	-0.196*	-0.336***	-0.289***	-0.180**	-0.246**
	(0.046)	(0.090)	(0.132)	(0.052)	(0.112)	(0.113)	(0.041)	(0.075)	(0.096)
FIRM_AGE									
1-2 years	-0.156***	0.162	-0.087	-0.145**	0.127	0.229	-0.141***	0.176*	-0.008
	(0.054)	(0.103)	(0.150)	(0.060)	(0.133)	(0.158)	(0.051)	(0.092)	(0.127)
2-5 years	-0.345***	0.148	0.110	-0.209***	0.057	0.137	-0.263***	0.123	0.129
	(0.046)	(0.098)	(0.150)	(0.052)	(0.121)	(0.146)	(0.044)	(0.084)	(0.120)
6-9 years	-0.395***	0.323***	0.257	-0.229***	0.165	0.267*	-0.283***	0.293***	0.285**
	(0.049)	(0.109)	(0.174)	(0.054)	(0.130)	(0.154)	(0.045)	(0.091)	(0.132)
10-15 years	-0.343***	0.414***	0.279	-0.272***	0.229*	0.276*	-0.268***	0.373***	0.259*
	(0.049)	(0.108)	(0.178)	(0.055)	(0.133)	(0.155)	(0.045)	(0.091)	(0.133)
15+ years	-0.420***	0.543***	0.271	-0.321***	0.342***	0.298*	-0.354***	0.495***	0.212
	(0.046)	(0.111)	(0.178)	(0.052)	(0.131)	(0.155)	(0.043)	(0.091)	(0.132)
Owner characteristics									
WLED		0.048	0.049		-0.155***	0.026		-0.046	0.062
		(0.044)	(0.061)		(0.054)	(0.066)		(0.036)	(0.045)
ONWER_EDU									
GCSE		0.029	0.079		0.091	0.097		0.006	0.062
		(0.071)	(0.094)		(0.086)	(0.085)		(0.062)	(0.075)
A level		-0.066	0.431***		-0.121	0.051		-0.081	0.292***
		(0.080)	(0.122)		(0.099)	(0.107)		(0.070)	(0.092)
HNC		0.105	0.072		0.087	-0.018		0.097	0.013
		(0.086)	(0.113)		(0.106)	(0.106)		(0.077)	(0.090)
BTEC		-0.071	0.015		-0.030	-0.076		-0.060	-0.032
		(0.074)	(0.098)		(0.092)	(0.092)		(0.064)	(0.078)
Professional qualification		-0.049	0.156		0.196**	0.108		0.018	0.047
		(0.075)	(0.101)		(0.091)	(0.091)		(0.065)	(0.078)
Degree		-0.104	0.196**		0.107	0.117		-0.021	0.135*
		(0.072)	(0.099)		(0.089)	(0.087)		(0.063)	(0.077)
Post graduate degree		-0.129	0.255**		0.003	-0.041		-0.127*	0.133
		(0.080)	(0.112)		(0.096)	(0.094)		(0.069)	(0.086)
OWNER_EXP									
1-2 years		0.376***	-0.356		-0.020	-0.264		0.221*	-0.425**
		(0.144)	(0.243)		(0.175)	(0.202)		(0.121)	(0.177)
2-5 years		0.366**	-0.243		-0.041	-0.207		0.214*	-0.273
		(0.144)	(0.243)		(0.176)	(0.205)		(0.121)	(0.178)
6-9 years		0.325**	-0.314		-0.121	-0.331		0.201	-0.450**
		(0.148)	(0.249)		(0.181)	(0.209)		(0.124)	(0.182)
10-15 years		0.287**	-0.181		0.026	-0.164		0.263**	-0.292*
		(0.140)	(0.240)		(0.172)	(0.197)		(0.118)	(0.174)
15+ years		0.316**	-0.142		-0.097	-0.184		0.192*	-0.248
		(0.137)	(0.238)		(0.169)	(0.196)		(0.115)	(0.173)
FIN_QUAL		0.033	0.043		0.049	0.067		0.024	0.021
		(0.042)	(0.058)		(0.052)	(0.050)		(0.034)	(0.042)
Risk indicators									
Low risk			-0.124			0.067			-0.030
			(0.106)			(0.075)			(0.072)
Average risk			-0.025			0.032			-0.015
			(0.104)			(0.073)			(0.070)

Above average risk			-0.069			-0.027			-0.057
			(0.107)			(0.077)			(0.073)
Financial Delinquency									
Missed loan repayment		-0.108	-0.123		-0.015	0.003		-0.090	-0.077
		(0.114)	(0.149)		(0.122)	(0.126)		(0.093)	(0.112)
Unauthorised overdraft		0.312***	-0.109		-0.022	0.045		0.167***	0.000
		(0.067)	(0.083)		(0.077)	(0.077)		(0.055)	(0.063)
Bounced cheques		0.021	-0.121		0.014	-0.111		0.002	-0.153**
		(0.069)	(0.083)		(0.079)	(0.083)		(0.057)	(0.064)
County court judgement		-0.244**	-0.189		0.067	-0.153		-0.136	-0.264**
		(0.110)	(0.152)		(0.128)	(0.143)		(0.092)	(0.114)
Late tax		0.214***	-0.040		0.008	0.140*		0.097*	0.005
		(0.069)	(0.084)		(0.078)	(0.079)		(0.056)	(0.064)
Trade credit constraints		-0.152**	-0.277***		-0.142*	-0.253***		-0.195***	-0.246***
		(0.071)	(0.093)		(0.080)	(0.085)		(0.058)	(0.072)
Additional controls									
INNOVATOR	0.199***	0.126***	0.058	0.264***	-0.025	0.067	0.251***	0.062*	0.084*
	(0.021)	(0.043)	(0.060)	(0.023)	(0.056)	(0.057)	(0.018)	(0.037)	(0.045)
EXPORTER	0.001	-0.024	-0.077	0.041	-0.121*	-0.110	-0.006	-0.038	-0.135**
	(0.031)	(0.059)	(0.079)	(0.035)	(0.071)	(0.073)	(0.027)	(0.047)	(0.057)
BUSINESS PLAN	0.104***	0.077*	-0.003	0.127***	0.180***	0.147***	0.115***	0.099***	-0.014
	(0.021)	(0.041)	(0.056)	(0.023)	(0.050)	(0.054)	(0.018)	(0.033)	(0.042)
Exclusion Restrictions									
FINPROBLEM	0.564***			0.724***			0.708***		
	(0.027)			(0.028)			(0.025)		
OBJECTIVE		-0.064*			0.039			-0.023	
		(0.040)			(0.046)			(0.032)	
RELATION			0.824***			0.438***			0.699***
			(0.089)			(0.079)			(0.055)
CONSTANT	-0.277***	-0.507***	-0.055	-0.819***	-0.375	-1.364***	-0.212***	-0.254	0.124
	(0.064)	(0.197)	(0.365)	(0.072)	(0.238)	(0.254)	(0.064)	(0.165)	(0.268)
Region effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N Obs	25,769	5,773	3,566	25,769	3,615	1,848	25,769	4,734	3,383
Likelihood ratio χ^2	2,882.55***			2,279.83***			3,800.45***		
Log-likelihood	-15,107.356			-5,395.842			-20840.731		
ρ (*DEMAND&APPLY*)	0.272**			0.188**			0.249***		
ρ (*DEMAND&APPROVE*)	0.573***			0.772***			0.794***		
ρ (*APPLY&APPROVE*)	-0.454***			0.675**			-0.407***		

NOTES: * $p < .10$; ** $p < .05$; *** $p < .01$. Asymptotic robust standard errors reported.

Table 4: Instrumental Variable Tests

	Overdraft		Term loan		Overdraft and/or term loan	
	Test statistic	P-value	Test statistic	P-value	Test statistic	P-value
Overidentification test						
Hansen J statistic $\chi^2(1)$	2.19	0.34	0.45	0.80	0.01	0.99
Underidentification test						
COLLATERAL: Sanderson-Windmeijer	13.58	0.00	9.63	0.02	33.24	0.00
RISKPREMIUM: Sanderson-Windmeijer	31.06	0.00	36.72	0.00	193.38	0.00
Kleibergen-Paap rank LM $\chi^2(2)$	13.27	0.00	9.45	0.02	32.24	0.00
Weak instrument test						
COLLATERAL: Sanderson-Windmeijer F	4.43	< 0.30	3.06	< 0.30	10.83	<0.10
RISKPREMIUM: Sanderson-Windmeijer F	10.13	< 0.10	11.65	< 0.10	63.00	<0.05
Montiel-Pflueger F	2.90	< 0.05	2.732	< 0.05	8.17	<0.05
Anderson-Rubin Wald $\chi^2(4)$	4.28	0.37	2.42	0.66	2,88	0.58
Stock-Wright LM	5.83	0.21	6.02	0.20	4.15	0.38
Endogeneity test						
GMM C (difference-in-Sargan) statistic $\chi^2(1)$	8.34	0.00	5.06	0.07	5.22	0.02

Table 5: Tobit and IV Tobit Regressions on Quantity Rationing with Selection Effect

	DV = *PERCENTGOT*					
	Overdraft		Term Loan		Overdraft and/or Term Loan	
	Model I	Model II	Model III	Model IV	Model V	Model VI
Group/Variable Name	Tobit	IV Tobit	Tobit	IV Tobit	Tobit	IV Tobit
COLLATERAL	-0.127**	-0.182***	-0.102	-0.157***	-0.103**	-0.171***
	(0.057)	(0.012)	(0.075)	(0.014)	(0.047)	(0.011)
Firm-characteristics						
ln(*SALES*)	0.030	0.002	0.018	0.005	0.019	0.006
	(0.021)	(0.009)	(0.027)	(0.013)	(0.017)	(0.010)
PROFIT	0.165***	-0.003	0.239***	0.024	0.171***	0.006
	(0.061)	(0.011)	(0.085)	(0.017)	(0.051)	(0.011)
LEGAL						
Partnership	0.047	-0.020	0.012	0.014	0.087	-0.004
	(0.099)	(0.022)	(0.153)	(0.045)	(0.081)	(0.025)
Limited liability partnership (LLP)	0.414**	0.008	0.087	0.000	0.292**	0.013
	(0.195)	(0.027)	(0.242)	(0.029)	(0.144)	(0.022)
Limited liability (LTD)	-0.019	0.025**	-0.113	0.003	-0.005	0.023**
	(0.082)	(0.011)	(0.122)	(0.015)	(0.067)	(0.010)
SECTOR						
Manufacturing	0.106	0.010	-0.658***	-0.052*	0.002	-0.016
	(0.126)	(0.030)	(0.235)	(0.027)	(0.107)	(0.024)
Construction	0.133	0.010	-0.466**	-0.018	-0.007	-0.012
	(0.110)	(0.024)	(0.232)	(0.040)	(0.094)	(0.023)
Wholesale / retail	0.029	-0.012	-0.541**	-0.037	-0.088	-0.032*
	(0.113)	(0.023)	(0.231)	(0.033)	(0.097)	(0.019)
Hotels / catering	0.095	0.006	-0.543**	-0.008	-0.025	-0.007
	(0.128)	(0.032)	(0.232)	(0.023)	(0.107)	(0.025)
Transport & communications	0.093	0.012	-0.471**	-0.017	-0.006	-0.008
	(0.127)	(0.025)	(0.237)	(0.025)	(0.107)	(0.020)
Business services	0.066	-0.003	-0.538**	-0.021	-0.043	-0.019
	(0.106)	(0.022)	(0.226)	(0.037)	(0.091)	(0.019)
Health	0.074	-0.011	-0.645***	-0.043*	-0.097	-0.032*
	(0.132)	(0.025)	(0.231)	(0.022)	(0.107)	(0.019)
Other community	0.008	-0.020	-0.394	-0.004	-0.081	-0.033*
	(0.118)	(0.024)	(0.243)	(0.029)	(0.103)	(0.019)
FIRM_AGE						
1-2 years	0.144	0.032	-0.343	-0.002	0.081	0.027
	(0.227)	(0.038)	(0.421)	(0.042)	(0.183)	(0.033)
2-5 years	0.159	0.046	-0.446	0.000	0.056	0.031
	(0.199)	(0.034)	(0.421)	(0.037)	(0.164)	(0.029)
6-9 years	0.163	0.033	-0.607	-0.016	0.089	0.033
	(0.202)	(0.043)	(0.428)	(0.041)	(0.169)	(0.038)
10-15 years	0.241	0.034	-0.710*	-0.020	0.052	0.028
	(0.202)	(0.047)	(0.427)	(0.044)	(0.167)	(0.043)
15+ years	0.240	0.035	-0.582	0.002	0.079	0.040
	(0.199)	(0.053)	(0.426)	(0.050)	(0.165)	(0.050)
Owner characteristics						
WLED	0.026	0.006	0.160*	0.007	0.040	0.009
	(0.063)	(0.008)	(0.093)	(0.018)	(0.052)	(0.008)
ONWER_EDU						
GCSE	0.049	0.001	-0.061	0.015	0.022	0.007
	(0.107)	(0.014)	(0.152)	(0.020)	(0.083)	(0.012)
A level	0.161	-0.003	0.124	0.025	0.141	0.003
	(0.122)	(0.016)	(0.189)	(0.025)	(0.096)	(0.014)
HNC	0.125	0.006	-0.010	0.029	0.111	0.018
	(0.127)	(0.018)	(0.191)	(0.024)	(0.101)	(0.015)
BTEC	-0.040	-0.012	-0.210	-0.008	-0.048	-0.004
	(0.112)	(0.015)	(0.165)	(0.022)	(0.088)	(0.013)
Professional qualification	0.011	-0.006	0.103	0.035	0.034	0.002
	(0.108)	(0.014)	(0.152)	(0.026)	(0.084)	(0.012)
Degree	0.138	0.013	-0.014	0.026	0.128	0.018
	(0.112)	(0.015)	(0.153)	(0.021)	(0.086)	(0.012)
Post graduate degree	-0.076	-0.023	0.117	0.022	0.020	-0.005
	(0.116)	(0.017)	(0.172)	(0.021)	(0.092)	(0.016)
OWNER_EXP						
1-2 years	-0.032	-0.077	0.004	-0.009	-0.341	-0.059
	(0.366)	(0.055)	(0.440)	(0.051)	(0.282)	(0.042)
2-5 years	-0.052	-0.090	0.074	0.011	-0.336	-0.062
	(0.358)	(0.055)	(0.450)	(0.052)	(0.279)	(0.041)
6-9 years	0.079	-0.080	0.352	0.044	-0.213	-0.046
	(0.366)	(0.054)	(0.462)	(0.054)	(0.285)	(0.042)
10-15 years	-0.158	-0.091*	0.526	0.055	-0.280	-0.049

	(0.353)	(0.052)	(0.447)	(0.051)	(0.275)	(0.043)
15+ years	-0.073	-0.078	0.371	0.046	-0.278	-0.042
	(0.350)	(0.053)	(0.442)	(0.051)	(0.273)	(0.040)
FIN_QUAL	0.009	-0.004	-0.189**	-0.012	-0.065	-0.006
	(0.059)	(0.007)	(0.081)	(0.010)	(0.048)	(0.007)
Risk indicators						
Low risk	-0.138	-0.015	0.130	0.007	-0.034	-0.008
	(0.093)	(0.011)	(0.126)	(0.014)	(0.077)	(0.010)
Average risk	-0.054	0.005	-0.089	-0.026*	-0.033	-0.001
	(0.095)	(0.011)	(0.115)	(0.014)	(0.077)	(0.010)
Above average risk	-0.224**	-0.017	-0.120	-0.015	-0.161**	-0.017
	(0.099)	(0.012)	(0.126)	(0.016)	(0.080)	(0.011)
Financial Delinquency						
Missed loan repayment	-0.087	-0.017	-0.236	-0.056*	-0.122	-0.032
	(0.194)	(0.029)	(0.208)	(0.031)	(0.148)	(0.026)
Unauthorised overdraft	-0.081	-0.030	-0.014	0.018	-0.044	-0.005
	(0.094)	(0.024)	(0.140)	(0.018)	(0.079)	(0.017)
Bounced cheques	-0.243**	-0.034**	-0.145	0.028	-0.171**	-0.010
	(0.100)	(0.015)	(0.146)	(0.020)	(0.083)	(0.013)
County court judgement	0.304	0.020	0.153	0.002	0.146	0.014
	(0.244)	(0.034)	(0.310)	(0.038)	(0.186)	(0.029)
Late tax	-0.070	-0.019	-0.350**	-0.041**	-0.110	-0.016
	(0.097)	(0.018)	(0.147)	(0.018)	(0.080)	(0.014)
Trade credit constraints	-0.221*	-0.004	0.155	0.028	-0.125	0.002
	(0.116)	(0.022)	(0.166)	(0.028)	(0.094)	(0.021)
Credit terms						
RISKPREMIUM (%)	-0.025***	-0.003	-0.018*	0.003	-0.023***	-0.002
	(0.008)	(0.003)	(0.010)	(0.002)	(0.006)	(0.002)
Additional controls						
INNOVATOR	-0.084	-0.009	0.024	0.005	-0.067	-0.002
	(0.058)	(0.011)	(0.081)	(0.011)	(0.048)	(0.009)
EXPORTER	0.163*	0.031***	0.122	0.001	0.105	0.015
	(0.084)	(0.010)	(0.111)	(0.018)	(0.070)	(0.010)
BUSINESS PLAN	-0.086	-0.012	-0.033	0.007	-0.089*	-0.004
	(0.057)	(0.009)	(0.079)	(0.023)	(0.048)	(0.010)
Inverse Mill's ratios						
Lambda (*DEMAND*)		-0.005		0.015		-0.010
		(0.025)		(0.024)		(0.019)
Lambda (*APPLY*)		-0.107		0.027		-0.019
		(0.104)		(0.153)		(0.126)
Lambda (*APPROVE*)		-0.062***		-0.075**		-0.077***
		(0.021)		(0.032)		(0.019)
CONSTANT	1.963***	1.249***	2.867***	1.002***	2.061**	1.137***
	(0.374)	(0.153)	(0.517)	(0.194)	(1.009)	(0.141)
Region effect	Yes	Yes	Yes	Yes	Yes	Yes
N Obs	2,604	2,604	1,150	1,150	3,383	3,383
Likelihood ratio χ^2	108.34***	1,144.36***	83.30***	738.13***	115.83***	1,493.74***
Log-likelihood	-849.22	-6218.01	-314.66	-2,636.52	-946.88	-6,960.12

NOTES: * $p < .10$; ** $p < .05$; *** $p < .01$. Asymptotic robust standard errors reported.

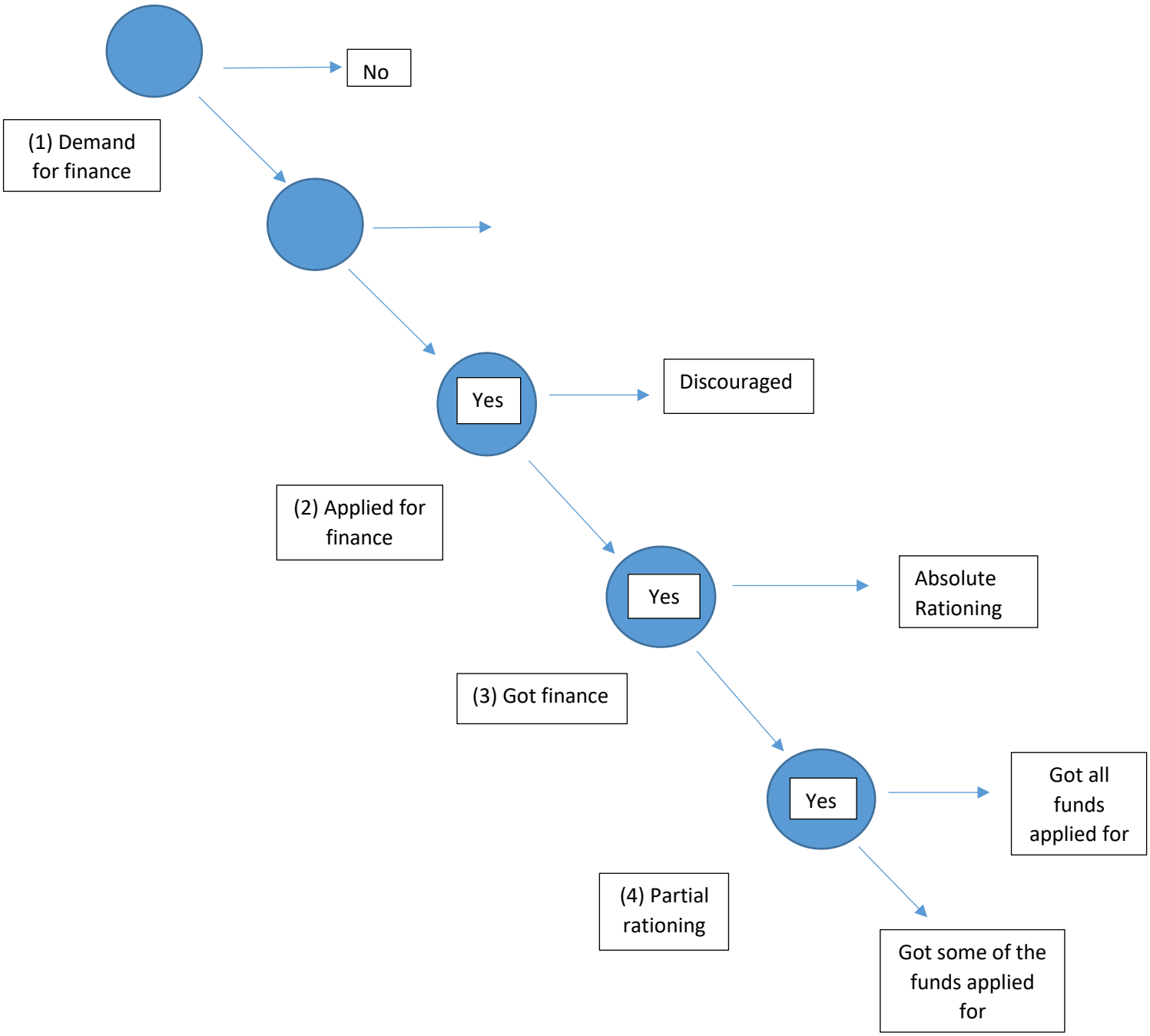
Table 6: Robustness Checks Using Alternative Quantity Rationing Measures

	DV = *NORATION*		DV = *PERCENTGOT* (if *NORATION* = 0)	
	Overdraft	Term loan	Overdraft	Term loan
	Model I	Model II	Model III	Model IV
Group/Variable Name	IV Probit	IV Probit	IV Tobit	IV Tobit
COLLATERAL	-0.881**	-0.010	0.521***	-0.152***
	(0.439)	(0.838)	(0.040)	(0.043)
Firm-characteristics				
ln(*SALES*)	-0.026	0.189	-0.036	-0.005
	(0.087)	(0.171)	(0.048)	(0.034)
PROFIT	0.089	0.545**	0.049	-0.011
	(0.110)	(0.236)	(0.053)	(0.065)
LEGAL				
Partnership	-0.189	0.592	-0.093	0.132
	(0.218)	(0.616)	(0.119)	(0.124)
Limited liability partnership (LLP)	0.258	0.056	-0.234	-0.396**
	(0.316)	(0.420)	(0.199)	(0.179)
Limited liability (LTD)	0.067	-0.181	-0.097	-0.256***
	(0.127)	(0.238)	(0.059)	(0.082)
SECTOR				
Manufacturing	0.395	-1.061**	-0.039	0.512**
	(0.304)	(0.486)	(0.149)	(0.261)
Construction	0.338	-1.057*	0.073	0.471*
	(0.245)	(0.597)	(0.126)	(0.278)
Wholesale / retail	0.140	-1.225**	0.092	0.337
	(0.234)	(0.525)	(0.126)	(0.256)
Hotels / catering	0.379	-0.799**	0.133	0.529**
	(0.335)	(0.398)	(0.178)	(0.239)
Transport & communications	0.283	-0.764*	0.146	0.432*
	(0.255)	(0.431)	(0.135)	(0.256)
Business services	0.184	-1.202**	0.036	0.588**
	(0.224)	(0.564)	(0.111)	(0.273)
Health	0.179	-1.037**	-0.045	0.360
	(0.256)	(0.404)	(0.132)	(0.227)
Other community	0.118	-0.760	0.036	0.635**
	(0.251)	(0.470)	(0.127)	(0.268)
FIRM_AGE				
1-2 years	-0.107	-0.405	0.219	0.550*
	(0.336)	(0.690)	(0.180)	(0.306)
2-5 years	-0.149	-0.719	0.263*	0.468
	(0.301)	(0.677)	(0.151)	(0.296)
6-9 years	-0.385	-0.800	0.241	0.480*
	(0.403)	(0.706)	(0.210)	(0.285)
10-15 years	-0.344	-0.858	0.202	0.531**
	(0.444)	(0.734)	(0.223)	(0.268)
15+ years	-0.400	-0.457	0.239	0.730***
	(0.505)	(0.804)	(0.260)	(0.269)
Owner characteristics				
WLED	-0.015	-0.073	0.044	0.051
	(0.084)	(0.249)	(0.047)	(0.066)
ONWER_EDU				
GCSE	0.013	0.022	-0.063	0.052
	(0.140)	(0.269)	(0.074)	(0.098)
A level	0.094	-0.092	-0.038	0.033
	(0.161)	(0.377)	(0.090)	(0.137)
HNC	0.027	0.161	-0.007	0.331**
	(0.180)	(0.322)	(0.101)	(0.146)
BTEC	0.006	-0.237	-0.139*	0.022
	(0.148)	(0.270)	(0.079)	(0.109)
Professional qualification	0.004	0.503	-0.109	-0.006
	(0.140)	(0.347)	(0.074)	(0.098)
Degree	0.178	0.094	0.013	-0.042
	(0.151)	(0.300)	(0.082)	(0.094)
Post graduate degree	-0.177	0.259	0.000	0.058
	(0.164)	(0.281)	(0.092)	(0.115)
OWNER_EXP				
1-2 years	-0.313	0.143	-0.376	0.078
	(0.560)	(0.738)	(0.310)	(0.226)
2-5 years	-0.454	0.231	-0.229	-0.080
	(0.555)	(0.737)	(0.300)	(0.201)
6-9 years	-0.187	0.668	-0.547*	0.065
	(0.555)	(0.763)	(0.299)	(0.217)
10-15 years	-0.547	1.045	-0.328	-0.038

	(0.527)	(0.735)	(0.287)	(0.202)
15+ years	-0.463	0.576	-0.368	-0.116
	(0.529)	(0.715)	(0.291)	(0.176)
FIN_QUAL	-0.003	-0.278**	-0.034	0.084
	(0.075)	(0.134)	(0.040)	(0.053)
Risk indicators				
Low risk	-0.124	0.150	-0.115*	0.269***
	(0.118)	(0.196)	(0.068)	(0.081)
Average risk	0.008	-0.058	-0.116*	-0.004
	(0.123)	(0.190)	(0.068)	(0.080)
Above average risk	-0.167	-0.104	-0.135**	0.143*
	(0.130)	(0.205)	(0.068)	(0.083)
Financial Delinquency				
Missed loan repayment	0.004	-0.198	-0.180	-0.050
	(0.258)	(0.349)	(0.120)	(0.132)
Unauthorised overdraft	-0.300	-0.061	0.048	0.001
	(0.234)	(0.228)	(0.118)	(0.140)
Bounced cheques	-0.256*	-0.036	0.060	0.071
	(0.133)	(0.245)	(0.066)	(0.106)
County court judgement	0.530	0.332	0.044	0.025
	(0.384)	(0.512)	(0.184)	(0.219)
Late tax	-0.215	-0.455*	0.029	-0.177
	(0.175)	(0.238)	(0.091)	(0.134)
Trade credit constraints	0.115	0.113	0.078	0.122
	(0.209)	(0.365)	(0.108)	(0.133)
Credit terms				
RISKPREMIUM (%)	-0.030	-0.006	-0.008	0.038***
	(0.031)	(0.033)	(0.006)	(0.008)
Additional controls				
INNOVATOR	-0.097	0.018	-0.027	-0.018
	(0.110)	(0.142)	(0.061)	(0.053)
EXPORTER	0.274**	0.075	0.015	-0.105
	(0.109)	(0.243)	(0.061)	(0.084)
BUSINESS PLAN	-0.116	0.234	0.004	0.066
	(0.089)	(0.312)	(0.047)	(0.060)
Inverse Mill's ratios				
Lambda (*DEMAND*)	0.351	0.151	-0.061	0.051
	(0.266)	(0.301)	(0.107)	(0.100)
Lambda (*APPLY*)	-1.272	2.472	0.146	-0.074
	(1.042)	(2.068)	(0.559)	(0.323)
Lambda (*APPROVE*)	-0.762***	-1.238***	-0.110	-0.443***
	(0.235)	(0.407)	(0.099)	(0.141)
CONSTANT	3.381**	0.558	0.584	0.147
	(1.561)	(2.643)	(0.821)	(0.754)
Region effect	Yes	Yes	Yes	Yes
N Obs	2,604	1,150	274	110
Wald χ^2	1106.01***	708.00***	299.11***	301.00***
Log-likelihood	-8,330.99	-3,721.50	-706.48	-199.86

NOTES: * $p < .10$; ** $p < .05$; *** $p < .01$. Asymptotic robust standard errors reported.

Fig 1: Sequential process from demand for finance to partial rationing



Appendix 1: First-Stage Estimations for IV Tobit Regressions

	Overdraft		Term loan		Overdraft and/or term loan	
Group/Variable Name	*COLLATERAL*	*RISKPREMIUM*	*COLLATERAL*	*RISKPREMIUM*	*COLLATERAL*	*RISKPREMIUM*
Firm-characteristics						
ln(*SALES*)	0.009	-0.052	-0.046	-0.203	0.069	0.009
	(0.067)	(0.122)	(0.116)	(0.229)	(0.081)	(0.166)
PROFIT	-0.223***	-0.045	-0.195	0.466	-0.171*	0.265
	(0.085)	(0.157)	(0.160)	(0.317)	(0.092)	(0.189)
LEGAL						
Partnership	-0.249	-0.177	-0.161	-0.331	-0.178	0.036
	(0.191)	(0.361)	(0.406)	(0.795)	(0.218)	(0.452)
Limited liability partnership (LLP)	-0.059	0.383	0.261	0.779	0.028	0.762
	(0.233)	(0.437)	(0.262)	(0.525)	(0.234)	(0.517)
Limited liability (LTD)	0.486***	-0.059	0.409***	0.097	0.475***	0.087
	(0.087)	(0.156)	(0.138)	(0.261)	(0.081)	(0.163)
SECTOR						
Manufacturing	0.096	-0.050	-0.342	-0.190	-0.181	-0.391
	(0.239)	(0.438)	(0.250)	(0.497)	(0.217)	(0.455)
Construction	-0.123	-0.128	0.072	0.016	-0.281	-0.506
	(0.185)	(0.339)	(0.371)	(0.732)	(0.193)	(0.395)
Wholesale / retail	-0.129	0.281	-0.283	0.080	-0.323**	0.012
	(0.179)	(0.328)	(0.295)	(0.579)	(0.159)	(0.320)
Hotels / catering	-0.148	0.354	-0.013	-0.222	-0.245	-0.295
	(0.258)	(0.473)	(0.218)	(0.442)	(0.236)	(0.496)
Transport & communications	0.004	0.022	0.018	-0.518	-0.179	-0.384
	(0.205)	(0.383)	(0.230)	(0.461)	(0.195)	(0.418)
Business services	-0.125	0.005	0.222	0.289	-0.225	-0.201
	(0.173)	(0.317)	(0.345)	(0.689)	(0.168)	(0.350)
Health	-0.174	0.138	-0.275	-0.109	-0.360**	-0.117
	(0.203)	(0.374)	(0.199)	(0.392)	(0.179)	(0.378)
Other community	-0.243	0.024	0.279	0.354	-0.260	-0.133
	(0.191)	(0.350)	(0.279)	(0.570)	(0.176)	(0.368)
FIRM_AGE						
1-2 years	-0.054	-0.314	0.211	0.473	0.048	0.306
	(0.323)	(0.547)	(0.406)	(0.737)	(0.290)	(0.553)
2-5 years	0.139	-0.354	0.472	-0.269	0.177	-0.163
	(0.290)	(0.494)	(0.367)	(0.658)	(0.257)	(0.492)
6-9 years	0.130	-0.040	0.346	-0.187	0.227	0.426
	(0.366)	(0.643)	(0.399)	(0.729)	(0.341)	(0.675)
10-15 years	0.002	-0.487	0.384	-0.176	0.225	0.136
	(0.395)	(0.699)	(0.422)	(0.774)	(0.372)	(0.738)
15+ years	0.077	-0.270	0.382	-0.241	0.369	0.389
	(0.434)	(0.769)	(0.475)	(0.887)	(0.421)	(0.833)
Owner characteristics						
WLED	0.011	-0.114	0.057	-0.216	0.050	-0.168
	(0.066)	(0.120)	(0.167)	(0.331)	(0.073)	(0.151)
ONWER_EDU						
GCSE	0.035	-0.398*	0.117	-0.154	0.076	-0.352*
	(0.111)	(0.206)	(0.179)	(0.351)	(0.098)	(0.202)
A level	-0.183	0.055	0.292	-0.094	-0.132	-0.196
	(0.183)	(0.362)	(0.232)	(0.455)	(0.177)	(0.389)
HNC	-0.123	-0.130	0.227	-0.141	0.043	0.003
	(0.139)	(0.259)	(0.215)	(0.427)	(0.122)	(0.251)
BTEC	0.010	-0.188	-0.042	-0.400	0.038	-0.336
	(0.121)	(0.218)	(0.200)	(0.383)	(0.111)	(0.223)
Professional qualification	-0.021	-0.039	0.253	-0.231	0.083	-0.108
	(0.120)	(0.228)	(0.229)	(0.449)	(0.098)	(0.201)
Degree	-0.004	0.477*	0.312*	-0.103	0.052	0.211
	(0.135)	(0.258)	(0.185)	(0.364)	(0.114)	(0.243)
Post graduate degree	-0.223	0.265	0.206	-0.069	-0.116	-0.159
	(0.156)	(0.299)	(0.184)	(0.365)	(0.149)	(0.313)
OWNER_EXP						
1-2 years	-0.727	0.211	-0.213	0.131	-0.392	0.548
	(0.488)	(0.850)	(0.521)	(0.927)	(0.437)	(0.874)
2-5 years	-0.874*	0.787	-0.197	-0.123	-0.475	0.681
	(0.470)	(0.809)	(0.523)	(0.932)	(0.398)	(0.776)
6-9 years	-0.780*	0.493	-0.051	0.247	-0.312	0.688
	(0.470)	(0.817)	(0.550)	(0.994)	(0.438)	(0.883)
10-15 years	-0.743*	0.986	-0.142	0.153	-0.396	1.006
	(0.445)	(0.762)	(0.515)	(0.916)	(0.415)	(0.814)
15+ years	-0.639	0.970	0.056	0.036	-0.271	0.841
	(0.446)	(0.763)	(0.509)	(0.902)	(0.381)	(0.740)
FIN_QUAL	-0.053	0.075	-0.022	0.056	-0.028	0.041
	(0.059)	(0.110)	(0.093)	(0.184)	(0.056)	(0.116)
Risk indicators						

Low risk	-0.021	0.016	-0.018	0.236	-0.050	0.090
	(0.088)	(0.168)	(0.125)	(0.251)	(0.081)	(0.168)
Average risk	0.104	0.146	-0.215*	0.250	-0.001	0.155
	(0.084)	(0.156)	(0.125)	(0.248)	(0.082)	(0.168)
Above average risk	0.081	0.270	-0.022	0.248	0.011	0.249
	(0.094)	(0.173)	(0.141)	(0.279)	(0.092)	(0.189)
Financial Delinquency						
Missed loan repayment	0.101	0.093	0.031	-0.483	0.067	-0.396
	(0.243)	(0.443)	(0.265)	(0.541)	(0.213)	(0.436)
Unauthorised overdraft	-0.375**	0.240	0.128	-0.012	-0.118	0.390
	(0.191)	(0.352)	(0.157)	(0.309)	(0.143)	(0.290)
Bounced cheques	-0.172	-0.256	0.221	0.004	0.004	-0.202
	(0.124)	(0.232)	(0.188)	(0.373)	(0.135)	(0.287)
County court judgement	-0.302	0.660	-0.140	1.631**	-0.066	1.357**
	(0.278)	(0.504)	(0.347)	(0.686)	(0.269)	(0.570)
Late tax	-0.159	0.073	-0.242	-0.227	-0.093	0.109
	(0.144)	(0.263)	(0.159)	(0.314)	(0.118)	(0.239)
Trade credit constraints	0.201	0.059	0.141	0.133	0.086	-0.012
	(0.211)	(0.388)	(0.259)	(0.514)	(0.208)	(0.434)
Credit terms						
RISKPREMIUM (%)	-0.030	-0.006	-0.008	0.038***		
	(0.031)	(0.033)	(0.006)	(0.008)		
Additional controls						
INNOVATOR	-0.070	0.032	-0.119	-0.147	-0.047	0.034
	(0.084)	(0.155)	(0.104)	(0.210)	(0.077)	(0.162)
EXPORTER	0.182**	0.091	0.128	0.146	0.078	-0.022
	(0.087)	(0.164)	(0.166)	(0.332)	(0.094)	(0.204)
BUSINESS PLAN	-0.074	-0.190	-0.101	-0.037	0.001	0.001
	(0.071)	(0.130)	(0.208)	(0.409)	(0.079)	(0.161)
Inverse Mill's ratios						
Lambda (*DEMAND*)	-0.657***	0.133	-0.433**	-0.336	-0.741***	-0.093
	(0.192)	(0.348)	(0.213)	(0.422)	(0.153)	(0.307)
Lambda (*APPLY*)	-1.226	-0.358	-0.883	0.065	-0.118	1.791
	(0.819)	(1.484)	(1.384)	(2.683)	(1.062)	(2.135)
Lambda (*APPROVE*)	-0.576	1.051	-0.998	-1.104	-0.995	-0.100
	(0.760)	(1.552)	(0.620)	(1.378)	(0.861)	(1.981)
CONSTANT	3.381**	0.558	0.584	0.147	-0.741***	-0.093
	(1.561)	(2.643)	(0.821)	(0.754)	(0.153)	(0.307)
Instruments						
RELATION	-0.476	-0.014	-0.509**	-1.193**	-0.588*	-0.682
	(0.327)	(0.678)	(0.218)	(0.498)	(0.351)	(0.816)
RENEW	0.042		0.064	0.042	0.143***	
	(0.059)		(0.069)	(0.059)	(0.046)	
FIXRATE		3.039***		3.993***		3.612***
		(0.140)		(0.184)		(0.131)
GILTYIELD		0.153**		0.038		0.142*
		(0.074)		(0.120)		(0.075)
Region effect	Yes	Yes	Yes	Yes	Yes	Yes
N Obs	2,604	2,604	1,150	1,150	3,383	3,383

NOTES: * $p < .10$; ** $p < .05$; *** $p < .01$. Asymptotic robust standard errors reported.

Appendix 2: Regression results using extended data period to Q4 2015: IV probit with selection adjustment

	DV = Prob (*NORATION*)					
	Overdraft			Term loan		
Group/Variable Name	Q1 11 – Q3 12	Q4 12 – Q4 15	Q1 11 – Q4 15	Q1 11 – Q3 12	Q4 12 – Q4 15	Q1 11 – Q4 15
COLLATERAL	-1.541***	0.873***	1.159***	-1.554***	-0.582	-1.270***
	(0.105)	(0.190)	(0.103)	(0.261)	(0.631)	(0.208)
Firm-characteristics						
ln(*SALES*)	-0.037	-0.029	0.095	-0.044	0.080	0.049
	(0.196)	(0.275)	(0.185)	(0.059)	(0.062)	(0.040)
PROFIT	0.062	0.056	0.111	-0.031	0.060	0.055
	(0.076)	(0.175)	(0.081)	(0.097)	(0.102)	(0.071)
LEGAL						
Partnership	-0.221	-0.061	0.189	-0.121	0.015	0.031
	(0.446)	(0.558)	(0.404)	(0.196)	(0.149)	(0.116)
Limited liability partnership (LLP)	-0.195	-0.143	-0.024	-0.333	0.073	-0.029
	(0.584)	(0.496)	(0.380)	(0.244)	(0.180)	(0.134)
Limited liability (LTD)	0.046	-0.065	-0.149	-0.006	0.109	0.091
	(0.092)	(0.372)	(0.159)	(0.140)	(0.130)	(0.086)
SECTOR						
Manufacturing	0.334	-0.027	-0.269	-0.396**	-0.261	-0.410***
	(0.751)	(0.718)	(0.569)	(0.198)	(0.235)	(0.154)
Construction	0.118	-0.088	-0.213	0.033	-0.403	-0.327*
	(0.465)	(0.525)	(0.384)	(0.250)	(0.263)	(0.183)
Wholesale / retail	0.055	-0.060	-0.268	-0.274	-0.599***	-0.544***
	(0.451)	(0.557)	(0.398)	(0.220)	(0.228)	(0.163)
Hotels / catering	0.035	0.379	-0.069	-0.307	-0.475**	-0.493***
	(0.664)	(0.658)	(0.517)	(0.191)	(0.197)	(0.139)
Transport & communications	0.165	0.312	-0.076	-0.214	-0.154	-0.300*
	(0.539)	(0.743)	(0.504)	(0.187)	(0.259)	(0.161)
Business services	-0.029	0.077	-0.176	-0.090	-0.379*	-0.398**
	(0.471)	(0.609)	(0.424)	(0.218)	(0.227)	(0.162)
Health	0.127	-0.113	-0.252	-0.462***	-0.336	-0.492***
	(0.612)	(0.621)	(0.479)	(0.177)	(0.213)	(0.141)
Other community	-0.145	0.163	-0.086	-0.107	-0.458**	-0.412***
	(0.428)	(0.459)	(0.341)	(0.213)	(0.207)	(0.149)
FIRM_AGE						
1-2 years	-0.168	0.133	0.279	-0.205	-0.180	-0.192
	(0.545)	(0.315)	(0.200)	(0.338)	(0.275)	(0.197)
2-5 years	-0.325	0.177	-0.127	-0.154	0.208	0.010
	(0.218)	(0.376)	(0.164)	(0.306)	(0.231)	(0.174)
6-9 years	-0.352	-0.090	-0.196	-0.205	0.171	-0.053
	(0.318)	(0.242)	(0.154)	(0.308)	(0.234)	(0.166)
10-15 years	-0.335	-0.128	-0.221	-0.200	0.270	0.035
	(0.437)	(0.321)	(0.159)	(0.308)	(0.220)	(0.166)
15+ years	-0.285	-0.139	-0.258	-0.127	-0.102	-0.114
	(0.419)	(0.255)	(0.170)	(0.304)	(0.208)	(0.164)
Owner characteristics						
WLED	0.055	-0.118	-0.001	0.205*	-0.054	0.071
	(0.163)	(0.092)	(0.052)	(0.121)	(0.085)	(0.068)
Risk indicators						
Low risk	0.145*	-0.248***	-0.044	0.076	0.029	0.038
	(0.086)	(0.084)	(0.057)	(0.114)	(0.101)	(0.072)
Average risk	0.168*	-0.164*	-0.049	-0.157	0.077	-0.047
	(0.086)	(0.087)	(0.059)	(0.112)	(0.110)	(0.074)
Above average risk	0.129	0.123	0.113*	0.044	0.099	0.058
	(0.095)	(0.095)	(0.064)	(0.128)	(0.124)	(0.084)
Additional controls						
INNOVATOR	-0.027	0.007	0.221	-0.117	-0.143*	-0.109**
	(0.322)	(0.242)	(0.221)	(0.099)	(0.077)	(0.055)
EXPORTER	0.109	-0.122	-0.040	0.185	-0.175*	-0.036
	(0.078)	(0.080)	(0.059)	(0.122)	(0.102)	(0.072)
BUSINESS PLAN	-0.056	0.035	0.101	-0.030	0.135	0.108*
	(0.118)	(0.228)	(0.130)	(0.109)	(0.083)	(0.065)
Inverse Mill's ratios						
Lambda (*DEMAND*)	0.435**	1.056***	1.004***	0.155	0.564***	0.402***
	(0.175)	(0.133)	(0.102)	(0.229)	(0.170)	(0.130)
Lambda (*APPLY*)	-1.010	-0.158	2.329	0.863*	1.539**	1.295***
	(3.321)	(4.257)	(2.958)	(0.521)	(0.674)	(0.455)
Lambda (*APPROVE*)	-1.435***	-3.134***	-2.579***	-1.266***	-1.481***	-1.245***
	(0.156)	(0.229)	(0.144)	(0.306)	(0.246)	(0.163)
CONSTANT	2.718	0.373	-2.467	2.056**	0.353	0.781
	(4.025)	(4.033)	(3.195)	(0.861)	(0.798)	(0.537)
Region effect	Yes	Yes	Yes	Yes	Yes	Yes
N Obs	3,002	4,144	7,159	1,342	2,159	3,501
Wald χ^2	767.52***	919.26***	1,591.98***	284.53***	372.91***	587.86***
Log-likelihood	-2,977.600	-4,047.108	-7,096.028	-1,482.437	-2,372.721	-3,892.984

NOTES: * $p < .10$; ** $p < .05$; *** $p < .01$. Asymptotic robust standard errors reported.