Do Firms Get the Financing They Want? Measuring Credit Rationing Experienced by Small Businesses in the U.S.

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ABSTRACT. This paper measures the extent to which small businesses in the United States in the late 1980s were able to access the external credit finance they desired. We argue that a comprehensive definition of credit rationing must account for both (a) creditworthy firms that apply for and are denied financing, and (b) creditworthy firms that decide not to apply for desired external financing, given expectations about how long it may take to obtain financing and the evolution of investment opportunities.

Data from a national survey of small businesses shows that only 2.14 percent of firms did not obtain the funding for which they applied in 1987–88. Another 2.17 percent may have faced some short-run constraints on investment: they were initially denied by lenders but received the credit for which they applied by the end of the sample period. Finally, an additional 4.22 percent of firms are estimated to have been discouraged from applying because of expected denial.

Constrained firms are smaller, younger, and more likely to be owned by their founders than those firms that successfully applied for external finance. The total number of credit constrained firms seems quite small, particularly because we cannot distinguish empirically between creditworthy and non-creditworthy firms. Thus the extent of true credit rationing appears quite limited.

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1. Introduction

This paper measures the extent to which small businesses in the United States in the late 1980s were able to access the external credit finance they desired. Direct measures of firms' desire for credit have been unavailable previously. Consequently, the early empirical literature on credit constraints faced by firms looked for *indirect* evidence, examining the extent to which the interest rates charged for commercial loans responded to changes in open market interest rates. Goldfeld (1966) and Jaffee (1971) found that commercial loan rates were slow to adjust to changes in open market rates.[1] Similarly, Sealy (1979) found evidence that the commercial loan market is characterized by periods of disequilibrium, such that excess supply or demand are only partially reduced by interest rate changes.

More recently, Berger and Udell (1992), using data on individual commercial loan contracts, confirmed the finding of earlier macroeconomic studies that loan rates are "sticky," but questioned the economic significance of rationing in the U.S. because other features of loan contracts seem inconsistent with significant credit rationing: Specifically, loans issued under commitments are about as "sticky" as loans that are issued without a commitment, even though commitment loans are typically extended to clients about whom the issuer has extensive information. Perhaps more troublesome for the credit rationing story, Berger and Udell show that the fraction of loans issued under commitments (and therefore not "discretionary" for the issuer) does not rise during tight credit periods, as one would expect if financial institutions cut back discretionary lending during credit crunches.

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This paper contributes to the literature on credit constraints and credit rationing in two ways. First, we argue that in a dynamic economy where investment opportunities evolve, any discussion of firms' ability to access external capital markets must account explicitly for the time that it takes the firm to learn whether its applications are successful: that is, a firm may in some absolute sense have "access" to credit, but because of the duration of the application process, the firm is effectively prevented from investing in profitable projects due to a lack of financing. Second, we provide direct evidence on the availability of formal debt finance to small businesses in the U.S., and therefore an estimate of the number of firms facing implicit or explicit credit rationing.

We choose to focus on small businesses in part because accumulating evidence suggests that it is precisely these businesses that are responsible for much of the dynamism of the economy. In the United States, small firms are a major factor in both job creation and job destruction (Davis, Haltiwanger and Schuh, 1996), and account for about half of total business receipts and half of GDP.[2] Moreover, the prevailing wisdom holds that these small firms are primarily start-ups, exploring investment projects that are difficult for financial institutions to evaluate and monitor, and that the owners may have a limited credit history and few collateralizable assets. Consequently, potential lenders may ration credit to these borrowers rather than leave themselves open to the problems of adverse selection and moral hazard described by Stiglitz and Weiss (1981).

Many governments – both in the U.S. and elsewhere – believe that the risk that small firms may have particularly limited access to external finance, combined with the view that small firms are critical for economic growth, provides sufficient motivation to intervene in financial markets.[3] In the U.S., for example, the Small Business Administration (SBA) provided $2.8 billion in guaranteed loans to small firms in 1986 alone (Rhyne, 1988, p. 17). Nevertheless, there is no direct evidence that small firms are, in fact, credit rationed in formal capital markets.[4]

We use the National Survey of Small Business Finance (NSSBF) to analyze the credit history of small firms in 1987–88. We estimate that approximately 6.36 percent of U.S. small businesses had an unfulfilled desire for credit in 1987–88. Of these, one-third (2.14 percent of the sample) were denied funding for an extended period of time, while the remaining two-thirds (4.22 percent of the sample) were discouraged from applying by the prospect of being denied. Moreover, an additional 2.17 percent may have faced some short-run rationing of investment capital, as they were initially denied by lenders and only later received the credit for which they applied.

Firms with unmet credit needs in this sample are smaller and younger than the typical firm, and are more likely to be owned by their founder. In economic terms, although a maximum of 6.36 percent of firms were rationed, they accounted for an even smaller 3.22 percent of total sales and 3.46 percent of total employment among the firms in these data. Moreover, this figure provides an upper bound on the extent of true credit rationing, because both creditworthy and non-creditworthy firms are included in the group of rationed firms. Thus equilibrium credit rationing in the spirit of Stiglitz and Weiss (1981) appears to be economically unimportant for the small firms in these data. The fact that credit denial is negatively correlated with firm size suggests that credit rationing should be even less relevant for larger firms than those in the NSSBF sample.

The paper is structured as follows. The next section develops the framework used for the analysis, expanding the standard view of credit rationing to include the concept of duration; this section also details the estimation techniques. Section three describes the data and the duration-based definitions of credit rationing. Section four provides the estimates of credit rationing. Section five interprets the results.

2. Theoretical and empirical framework

The current literature on credit rationing follows the lead of Jaffee and Russell (1976) and Stiglitz and Weiss (1981), modeling credit rationing as an equilibrium phenomenon where asymmetric information between borrowers and lenders creates the potential for adverse selection. Consequently, lenders ration loans on some basis other than price, and there are firms who are unable to secure outside financing at any price.[5]

Because these models are static, the literature

does not address the concept of duration. Duration is a potentially important issue: if a firm is unable to get access to credit at time *t*, then we can call that firm credit rationed in principle. If the firm receives the credit after waiting a period of length δ, then it is not credit rationed from time $t + \delta$ onward. If δ is very small, then the firm is rationed for only a short period of time and the "real" effects of credit rationing are probably negligible. However, if δ is large, then the delay in credit acquisition can adversely affect the firm's ability to expand or even survive.[6] Moreover, firms that anticipate a large δ may be discouraged from applying for credit in the first place, further exacerbating the effect of credit rationing on economic activity.

We address the need for debt financing only; the data are not well-suited to determine whether equity finance is available to these firms. As debt finance has arguably been the sole focus of the literature on credit rationing, we are not overly concerned by this limitation of the data. Monetary policy and aggregate lending shocks are believed to cause cyclical credit rationing in large part through decreased lending by financial intermediaries. Debt financing is also central to models of equilibrium credit rationing: equity financiers have priority over debt financiers as residual claimants on the firm, and they share in the positive benefit from excessively good returns on exceptional investment projects – returns not shared with debt financiers. This makes debt financiers more susceptible to moral hazard in lending, and thus more likely to ration credit to otherwise worthy investment projects.

We want to estimate the probability that a firm wants debt financing at the prevailing interest rate and yet is denied that funding, either explicitly or implicitly, for reasons other than creditworthiness. This probability can be written as:

$$\begin{aligned}\Pr(\textit{Rationed}|\textit{Creditworthy}) = \\ \Pr(\textit{Apply} \cap \textit{Denied}|\textit{Creditworthy}) + \\ \Pr(\textit{Not Apply} \cap \textit{Denied}|\textit{Creditworthy}),\end{aligned} \tag{2.1}$$

the sum of the probability that a creditworthy firm applies for and is denied financing, and the probability that a creditworthy firm, with a project in need of finance, does *not* apply for credit yet expects to be denied if it were to do so. Firms in the latter group are "discouraged" credit applicants: given a low anticipated probability that its loan application will be approved, a firm may find that the cost of applying could exceed the expected benefit, i.e. the benefit of the capital injection weighted by the expected probability of acceptance. Because these firms would have applied for credit if the application cost were lower (or the expected approval were higher), it is appropriate to include these creditworthy but discouraged firms – the second component in equation (2.1) – in our measure of credit rationing.

We face two difficulties in estimating equation (2.1). First, in our data we observe credit denial, but not creditworthiness. This means that the pool of firms consists of both creditworthy and non-creditworthy firms. So in principle we can estimate only

$$\begin{aligned}\Pr(\textit{Rationed}) = \Pr(\textit{Apply} \cap \textit{Denied}) \\ + \Pr(\textit{Not Apply} \cap \textit{Denied}),\end{aligned} \tag{2.2}$$

which overstates the amount of rationing for creditworthy firms as follows:

$$\begin{aligned}\Pr(\textit{Rationed}|\textit{Creditworthy}) = \Pr(\textit{Rationed}) \\ - \Pr(\textit{Rationed}|\textit{Not Creditworthy}).\end{aligned}$$

Thus our measure of credit rationing from equation (2.2) is more properly a measure of credit constraint, and would be an upper bound on the desired measure from equation (2.1) if we were able to measure all the components from equation (2.2).

The second difficulty is that we only observe one component of Pr(*Rationed*) in our data: Pr(*Apply* ∩ *Denied*), i.e. the number of denied borrowers. Because we do not directly observe the number of discouraged borrowers – Pr(*Not Apply* ∩ *Denied*) – we estimate it using the procedures outlined below. If our estimate – E[Pr(*Not Apply* ∩ *Denied*)] – is accurate then equation (2.2) is indeed an upper bound on the true extent of credit rationing.

The empirical work below demonstrates that firms facing different *ex ante* probabilities of credit denial have markedly different loan application rates. Because no existing models of credit rationing have predictions about the expected duration of credit rationing and firm behavior, the Appendix provides a simple model that we use to

generate the estimation framework. The relevant points are:

- higher expected probabilities of eventual (long-run) loan denial lead a firm to be less likely to apply for a loan in the first place; thus
- population estimates of credit rationing must adjust for the presence of discouraged borrowers – those borrowers that choose not to apply because they expect to have their applications denied;
- the effect of a positive expected probability of short-run denial will have little or no deterrent effect on the application decision.[7]

Because the only clear theoretical prediction is that expected long-run denial will deter loan applications, we focus exclusively on long-run denial when estimating the discouraged firm effect.[8]

To proceed, we need to predict both the probability that a firm is denied credit, and the probability that a firm applies for credit at all. The first equation of interest describes the firm's decision to apply for outside financing:

$$\Pr(Apply) = X'\beta^{x} + \Pr(Deny)\beta_D + \varepsilon_1, \qquad (2.3)$$

where Pr(*Deny*) is the probability that the firm does not receive credit by the end of the sample period, X is a vector of explanatory variables related to other aspects of the firm's application decision, and ε_1 is an idiosyncratic error term. The null hypothesis is that $\beta_D \leq 0$.

The second equation describes the outcome of the application process, which is observed only for those firms that apply:

$$\Pr(Deny) = Z'\theta + \varepsilon_2, \qquad (2.4)$$

where Z is a vector of explanatory variables and ε_2 is an idiosyncratic error term. We want to know the value of Pr(*Deny*) (as a proxy for Pr(*Rationed*)) for the entire sample, yet we directly observe this only for the firms that apply.

A naïve – and the most conservative – estimate of Pr(*Deny*) for the whole sample is simply

$$\Pr(Deny) = \frac{(\#\text{ firms denied credit})}{(\#\text{ firms in the sample})}. \qquad (2.5)$$

However, this presumes that the demand for credit is and will be zero among the firms that do not apply. The main problem with this assumption is that, as hypothesized in equation (2.3), expectations of loan approval may influence a firm's likelihood of applying for external financing (i.e., $\beta_D < 0$) where the costs of applying are positive. This leads equation (2.5) to potentially understate the true Pr(*Deny*). We focus the empirical work on correcting equation (2.5) for the firms that want credit yet do not apply because they expect to be denied.

Before proceeding, it is worth noting that there is another naïve estimate of Pr(*Deny*) available:

$$\Pr(Deny) = \frac{(\#\text{ firms denied credit})}{(\#\text{ firms that apply for credit})}. \qquad (2.6)$$

There are two reasons why equation (2.6) is not useful for our purposes. First, and most important, equation (2.6) implicitly assumes that *all* firms have positive demand for credit *in all periods*: the only reason a firm would not apply for credit in any period is because it expects to be denied. This is obviously false: any firm with no positive expense shocks (e.g., no capital expansion plans) and no negative revenue shocks (e.g., stable demand) easily could have zero demand for external financing in a given period. Moreover, the determinants of the credit demand process are sufficiently complex that it is empirically intractable to fully identify the sources of such between-firm heterogeneity.

Second, even though firms with zero current demand might face credit rationing in future periods (when they have positive demand for external financing), what matters for our purposes is current demand for financing. This is the concept that concerns the literature on credit rationing, i.e. whether at the going interest rate there is a contemporaneous excess demand for financing among creditworthy firms. Estimating credit rationing over a longer interval than one period provides a measure of *cumulative* rationing, a concept not discussed by the literature.

Our task is to evaluate the downward bias in the estimate of Pr(*Deny*) from equation (2.5) by estimating β_D from equation (2.3). If we find $\widehat{\beta_D} < 0$, then expectations of credit denial lead to lower application rates. We call this the discouraged firm effect. To construct our best estimate of the extent of credit denial in the sample/

economy, we then add a term to equation (2.5) to correct for the bias induced by the negative feedback effect. Denoting a firm's application decision by A ($A = 1$ if a firm applies), our best estimate of the probability of denial is:

$$\Pr(Deny) = \frac{\sum_{i \in (A=1)} 1 \text{ (if denied)}_i}{(\#\text{ firms in the sample})} + \frac{\sum_{i \in (A=0)} \left[\frac{\widehat{\Pr}(A|\beta_D = 0) - \widehat{\Pr}(A|\beta_D = \widehat{\beta_D})}{\widehat{\Pr}(A|\beta_D = 0)} \right]}{(\#\text{ firms in the sample})}. \quad (2.7)$$

Equation (2.7) shows that the fraction of firms denied credit can be expressed as the sum of (a) the fraction of firms that applied for and were denied credit, plus (b) the fraction of firms discouraged from applying, where each firm that did not apply is assigned a weight between zero and one depending on the extent to which it is predicted to be discouraged from applying. A firm predicted to have zero chance of applying due to expected denial counts as one discouraged firm; a firm predicted to apply at half the sample-average rate counts as one-half of a discouraged firm; a firm predicted to apply at the same rate regardless of expected denial does not count as a discouraged firm.

We estimate β_D in two steps. First we estimate equation (2.4) using the set of firms that applied for credit. Then we use the estimated coefficients, $\hat{\theta}$, to calculate the predicted probability of denial for all firms in the sample. Finally, we use the predicted probability to estimate β_D in equation (2.3). In order for this procedure to properly identify β_D, at least one variable in Z must not be included in X, i.e. one variable must affect the probability of denial but not the probability of applying. The three variables we used all represent characteristics of the firm that were set prior to the current period:

- the amount of money originally put into the firm by the owner;
- a dummy indicating transfer of ownership since the firm was founded; and
- the age of the firm at the time the firm was acquired (equal to zero for those firms still owned by the original founder).

There are good reasons to believe *a priori* that these are valid instruments. For one, such "initial conditions" variables should be correlated with the underlying value of the firm, and thus are good predictors for whether the firm is denied a loan, conditional on applying: *ceteris paribus*, more highly capitalized firms are better credit risks; firms that have transferred ownership (and are still in business) should be more viable; and firms transferred at older ages should also be more viable.[9] Moreover, because these characteristics of the firm are not determined by current market conditions, they should not be correlated with the current loan application decision, except through their effect on the probability of acceptance. Indeed, the instruments passed standard tests of overidentifying restrictions.[10]

3. The data

The data used for this study are derived from the National Survey of Small Business Finances (NSSBF). The NSSBF surveyed a nationally representative sample of small businesses (500 employees or fewer) in the United States in 1988–89, collecting information on firms' use of financial institutions during 1987–88.[11] The questionnaire included a series of questions about loan application and denial. To our knowledge, this is the only representative data set of firms that includes such information. In particular, much research on firm borrowing has been done using data on the characteristics of completed loans (e.g. Berger and Udell, 1992). However, because such data sets contain no information on the firms that did not apply for loans, they cannot be used to determine the true extent of credit rationing in the economy at large.

We use the following series of questions from the NSSBF to construct the credit rationing measure (emphases below are taken verbatim from the questionnaire):

- "During 1987, did the firm *ever* apply for a line of credit, loan, or lease from *any* financial institution?"
- "Did *any* financial institution turn down the firm's request for financing or approve less than applied for?"
- "Did the firm eventually obtain *all* the financing that it initially applied for?"

We classify a firm as credit rationed if it was initially denied some or all of the credit for which it applied. Among the group of rationed firms, those firms that eventually obtained all the needed financing are classified as short-run credit rationed. The remainder, those that did not obtain the financing in the end, are classified as long-run credit rationed.

The unrationed firms are, under these criteria, firms that receive all of the credit they sought. This in no way implies that these firms are not paying a risk premium associated with imperfect information. So, even though these firms are not rationed, they may nevertheless be paying more for credit (and hence borrowing less) that they otherwise would have in a perfect capital market (with a perfectly elastic supply curve).

It should be noted that the term "financial institution" does not refer exclusively to banks. The range of possible answers includes everything from banks and thrifts to brokerages, leasing companies, insurance companies, finance companies, mortgage banks, the Small Business Administration, and other businesses. Thus a firm is considered credit rationed only if it was unable to obtain financing from *all* of these sources, which include many "non-traditional" debt sources.[12]

4. The availability of credit

Table I presents the mean characteristics of the firms in four different groups: (a) those that did not apply for credit, (b) those that applied for and received all the credit they sought, (c) those that applied, were initially denied and eventually received all the credit, and (d) those that did not receive all the credit in the end. The naïve estimate described in equation (2.5) suggests that 2.14 percent of the sample is "long-run rationed," because 73 out of 3404 firms applied for and were denied credit. If we focus instead on the firms who were initially denied credit but eventually received all the financing for which they applied, a total

TABLE I
Mean characteristics of firms that did and did not apply for credit

	Did not apply for credit	Applied and immediately received credit	Initially denied, eventually received all credit	Initially denied, did not get all financing in the end
Total assets	841,552	1,703,358	2,434,245	2,185,071
	(54,491)	(298,207)	(674,912)	(998,455)
Sales (1987)	2,229,816	3,836,089	4,510,722	3,728,019
	(151,678)	(429,914)	(1,278,724)	(1,160,810)
Ln(sales)	12.7	13.5	13.3	13.3
	(0.04)	(0.08)	(0.23)	(0.23)
Full-time employees (1987)	22.0	38.3	48.6	33.4
	(0.95)	(2.88)	(11.6)	(7.99)
Owners start-up capital	68,874	75,202	206,609	72,624
	(5,001)	(8,302)	(81,748)	(26,240)
Ln(Owners start-up capital)	9.44	9.75	10.3	9.62
	(0.05)	(0.10)	(0.23)	(0.30)
Imputed owners start-up capital	0.21	0.20	0.15	0.11
	(0.01)	(0.02)	(0.04)	(0.04)
Firm transferred ownership	0.31	0.32	0.31	0.19
	(0.01)	(0.02)	(0.05)	(0.05)
Age at acquisition	8.22	9.80	9.46	4.03
	(0.34)	(0.82)	(2.44)	(1.25)
Number of observations	2,683	574	74	73

Standard errors in parentheses.

of 74 firms, these measures would indicate similar percentages of firms were "short-run rationed." However, neither of these measures considers the possibility that some firms were discouraged from applying for credit in the first place.

A key comparison for our analysis is the difference in size between the firms that did not apply for financing and those that did. The firms that did not apply for credit are significantly smaller in terms of both sales and the number of full-time employees. While it may be true that smaller firms are worse credit risks, the fixed costs of granting and servicing loans lower profit margins on lending to smaller businesses. So financial intermediaries should be less willing to lend to the smallest firms, even if small firms' default rates are not higher than for larger firms. Because firms bear costs when they apply for credit, smaller firms facing high expected denial rates might select out of the pool of applicants. We have to account for these discouraged firms to get an accurate measure of the true level of credit denial.

To address this, Table II presents the probit regression results that allow us to calculate the broader measure of the probability of credit denial defined by equation (2.7). The first column contains the results from estimating equation (2.4), predicting the probability of denial among the subsample of firms that applied for credit. Of the three instruments for the probability of denial, the dummy for whether the firm is owned by its founder is the only one that is significant.[13] Firms owned by their founder are more likely to be denied credit.

The second and third columns contain the results from including the predicted denial probabilities in (2.3), the application equation. The long-run probability of denial is entered as a linear spline with three segments in the second column: one for the first decile of predicted denial proba-

TABLE II
Probit regression results

	First stage: Pr(long-run rationing)	Second stage: Pr(Apply)	Second stage: Pr(Apply)
Firm transferred ownership	–0.47**	–	–
	(2.12)		
Age at acquisition	0.001	–	–
	(0.25)		
Ln(Owners start-up capital)	–0.005	–	–
	(0.31)		
Pr(Long-run rationed) × 1(first decile)	–	1.57	–
		(0.33)	
Pr(Long-run rationed) × 1(second-ninth deciles)	–	0.40	–
		(0.39)	
Pr(Long-run rationed) × 1(tenth decile)	–	–2.09*	–2.39***
		(1.93)	(3.34)
Inputed owners start-up capital	–0.28	–0.19*	–0.20**
	(1.00)	(1.80)	(2.39)
Ln(sales)	–0.05	0.11***	0.11***
	(0.91)	(4.96)	(5.13)
Constant	–0.42	–2.28***	–2.21***
	(0.60)	(6.49)	(7.81)
Pseudo R^2	0.0292	0.0295	0.0294
Number of observations	721	3404	3404

Absolute value of z-statistics are in parentheses.
* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent.

bilities (1.8 through 4.3 percent), one for the second through ninth deciles (4.3 through 16.1 percent), and one for the tenth decile (16.1 through 23.7 percent). The spline terms for the first two segments are not significantly different from zero in the second column; they are constrained to be zero in the third column. Doing so does not appreciably affect the estimates for the other coefficients.[14]

The coefficient on predicted denial for the tenth decile is negative and statistically significant.[15] This indicates a negative feedback effect, i.e. those firms with the highest expected denial rates are less likely to apply. Hence the crude estimate of 2.14 percent probability of credit denial from equation (2.5) is an underestimate because it excludes the discouraged firms.

How large is the discouraged firm effect? The firms in the top decile are estimated to be 47.4 percent less likely to apply because they expect to be denied. They account for 8.9 percent of the sample.[16] So discouraged firms make up 4.22 percent of the total. Taking the two estimates together, 6.36 percent of all small firms in these data are either directly denied credit or are discouraged from applying because they expect to be denied.

Assuming that our estimate of the discouraged firm effect is accurate, we have calculated an upper bound on the extent of credit *rationing* in these data: the 6.36 percent credit *denial* figure includes both creditworthy and non-creditworthy firms. Only the former can be considered truly credit rationed. The latter are bad credit risks and are appropriately denied debt financing.

That the pool of denied firms likely contains both good and bad firms is bolstered by a comparison of the observable differences between denied and non-denied firms. As shown in Table II, denied firms are identified in these data primarily by ownership type. Firms owned by their founders are much more likely to be denied credit. These firms are substantially smaller and younger than the rest of the sample. The typical denied firm in 1987–88 was 13.5 years old, had $751,870 in sales, and 8 full-time employees; 96.3 percent of these firms were owned by their founders. In contrast, the typical non-denied firm was 23.5 years old, had $2,809,692 in sales, and 27.7 full-time employees; only 65.8 percent of these firms were owned by their founders. A pool of firms that is disproportionately small and young undoubtedly contains a disproportionate number of firms that are inefficient and more likely to go out of business. Only the creditworthy among such a group – the more efficient or those with longer expected life spans – are truly credit rationed.[17]

This analysis has ignored the issue of whether there are existing "relationships" between the firms and their potential creditors. Using the same NSSBF survey, Petersen and Rajan (1994) and Berger and Udell (1995) explored how the ties between a firm and its creditors are related to the quantity and price of debt transactions. Taken together, these papers demonstrate that small firms with longer relationships face cheaper terms and borrow greater quantities of credit than small firms with shorter relationships. Extrapolating from this result, we could argue that those firms that we classify as being rationed or discouraged in the NSSBF sample may be waiting until such time as they can establish a sufficiently strong relationship to receive credit from an institutional lender: those that prove creditworthy will be rewarded with a lending relationship and credit, so the rationing that we document here may be temporary.

5. The importance of credit rationing

In economic terms, although a maximum of 6.36 percent of firms were rationed, they accounted for an even smaller 3.22 percent of total sales and 3.46 percent of total employment in these data.[18] Thus, equilibrium credit rationing in the spirit of Stiglitz and Weiss (1981) appears to be economically unimportant for the small firms in these data. The fact that credit denial is negatively correlated with firm size suggests that credit rationing may be even less important for larger firms. Our estimate of credit rationing for the U.S. also is of comparable magnitude to Cressy's (1996) estimate for a sample of United Kingdom firms for a similar period.

Unfortunately, our data measure rationing over a relatively short time span in the late 1980s. McCallum (1991) claimed that credit rationing is an important channel through which monetary shocks affect output. Our finding that at most 6.36 percent of small firms are credit rationed might seem contradictory to McCallum's results.

However, the NSSBF data do not cover a recessionary period. Despite the stock market crash in October 1987, the period covered by these data was a relatively good one for U.S. businesses. There is no particular reason to believe that credit was scarce. In contrast, monetary tightening during recessions undoubtedly increases the number of credit rationed firms, and may also increase the duration of a firm's search for available credit.[19] Comparable data from recessionary periods should be analyzed before rejecting the findings of authors such as McCallum.

Moreover, some firms in these data could experience rationing in ways that we do not observe. In particular, we do not know whether a firm would like to issue its own stocks or bonds in order to raise money directly from the market. If a firm is unable to do so and does not apply for financing from a financial institution, we would misclassify that firm as not rationed.

We also find that an additional 2.17 percent of firms may have faced some short-run credit rationing. These firms' initial applications were at least partially denied by prospective lenders; only later in the sample time frame did they receive the credit for which they were denied initially. Whether this adversely affected their investment plans is unknown. However, applying for a business loan can be a long, drawn-out process. Recognizing this, the businesses may have applied for outside financing far in advance of the critical start date for their investment projects, anticipating such short-run rationing as a normal delay in obtaining financing. However, further research on such short-run delays is needed before reaching a conclusion on their true economic impact.

An additional consideration is the role of the Small Business Administration (SBA), an agency created for the express purpose of alleviating financing shortfalls for small businesses. The results presented here obviously are conditional on the existence of this institution, and must be tempered as such. Thus it is useful to document the overall role of SBA loan programs in the sample and in the economy at large.

In 1995, the SBA guaranteed approximately $7.8 billion in loans (Rhyne, 1988, p. 17), which accounted for about 3.5 percent of total funds raised by nonfarm businesses (Economic Report of the President, 1996). Of the firms in our data, very few – less than one percent – report that the SBA is one of their lending institutions. Loans guarantees are a separate matter – an SBA loan could be reported as granted from a bank. There is a separate sample of firms with SBA loans included in the NSSBF. Comparing them to the main sample shows an important contrast. We know from the empirical work that whether the firm is owned by the original founder is an important predictor of credit denial. Yet within the SBA sample a larger fraction of firms – 36 percent versus 31 percent for the main sample – were no longer held by the founder. This suggests that firms receiving SBA loans are *less* likely to need external financing in the first place. So the importance of the SBA in alleviating firms' demand for external financing appears to be quite limited.

6. Conclusion

Using new evidence on small business loan applications, we find that a maximum of 6.36 percent of firms were credit rationed in the U.S. in 1987–88; two-thirds of these, 4.22 percent of the total, were discouraged from applying by their expectations of denial. An additional 2.17 percent faced short-run delays in obtaining external finance. These firms account for even smaller fractions of total GDP. Because these figures include both creditworthy and noncreditworthy firms, the extent of true equilibrium credit rationing appears to be quite limited.

7. Appendix: A search model of external financing

Here we outline a simple model in which firms search for external financing. The main insight of the model is that credit rationing can be viewed as the outcome of an ongoing search process. Consequently, credit rationing has a duration dimension. Moreover, credit rationing may be a relevant phenomenon even for firms that do not apply for credit, if the prospects for acceptance so discourage the firms that they do not reach the stage where they might be denied.

Firm i learns at time t of an investment project that requires external financing of amount L. The total cost of borrowing over the life of the project is $R(L)$. The value of this externally funded investment (the present value of future cash flow from

the project, gross of financing costs) is $V_{i,t}$, which is drawn from an underlying distribution, V. The value of initiating this investment project decays at a rate λ each period that the firm delays the investment, as other firms enter the market and appropriate some of the available economic profit. Therefore, the value of an investment made at time $t + n$, $n \geq 0$, is $(1 - \lambda)^n V_{i,t} - R(L)$.

The cost of applying for credit is c_t and must be paid with each application, each period. For simplicity, we limit firms to filing one credit application per period. The firm will apply for credit in period $t + n$, if

$$[(1 - \lambda)^n V_{i,t} - R(L)] \times E[\Pr(Accepted)_i]_{t+n} - c_{t+n} \geq 0. \quad (7.1)$$

Hence, a low probability of the application being accepted may be sufficient to discourage the firm from applying in the first place.

Each bank observes its stock of loanable funds and its draw of new loan applications at the start of each period. From the application, the bank forms an estimate of the value of the investment project $\phi\,(1 - \lambda)^n V_{i,t}$, where ϕ is the signal to noise ratio, $\sigma_1^2/(\sigma_1^2 + \sigma_2^2)$, and σ_1^2 and σ_2^2 are the variances of the signal and noise, respectively. σ_2^2 is an inverse function of good reputation, which may be related to observable characteristics of the firm.

The bank rank orders the projects, based on the expected return to the bank of making each loan, and immediately denies any projects which do not yield an acceptable expected rate of return. The bank then approves applications from the highest return projects, working down the list of applications until its loanable funds are exhausted. If funds are exhausted before all worthy projects are funded, some creditworthy firms are denied credit. If, after all worthy projects are financed, the bank still has available funds, it invests the excess in risk-free securities. Thus, the probability that an application is denied is the combined probability that (1) the project passes the bank's minimum return criterion, and (2) the bank's loanable funds are not exhausted by higher quality projects.[20]

A firm denied credit in period $t + n$ will re-evaluate

$$[(1 - \lambda)^{n+1} V_{i,t} - R(L)] \times E[\Pr(Accepted)_i]_{t+n+1} - c_{t+n+1} \geq 0.$$

in the next period. If the expected net benefit of applying has decayed sufficiently, relative to the application cost, the firm will not apply again. Alternatively, the firm may re-apply for credit (from the same institution or another institution).

We define a firm as credit rationed if it has a project that satisfies $V_{i,t+n} - R(L) - c_{t+n} \geq 0$ (i.e., it has a positive net present value) but does not receive outside financing, either because it applies and is denied, or because it does not apply in the first place (due to the firm's perception that it has a low $E[\Pr(Accepted)_i]_{t+n}$). For the firms that do apply, we must also consider the duration of their search for credit as being an additional feature of rationing: if the firm receives the desired credit in a few periods, we could say that the firm was rationed only in the short run. However, if credit is not forthcoming in a timely matter (that is, before the project's value decays to the point where even certain acceptance would not induce the firm to apply for credit), the firm is permanently credit rationed.

Equation (7.1) can be used to show the relationship between the expected duration of credit rationing and the negative feedback on the decision to apply. *Ceteris paribus*, longer waiting periods – higher n – mean both a lower value of the investment project ($(1 - \lambda)^n V_{i,t}$ is smaller) and greater application costs ($\sum_{k=1}^{n} c_{t+k}$ is larger) for the firm. If the firm knows for sure that it will have to wait only a short time to obtain financing, say $n = 2$, this is equivalent to saying that the ex ante fixed cost of applying for and receiving credit is lower for that firm. Only those firms with the most marginally profitable investment projects will be deterred from applying by the prospect of having to wait a short time to receive financing. So an expected probability of short-run credit rationing will have little or no effect on the application decision for the typical firm. However, an expected probability of long-run credit rationing – for a period of time of duration N or longer – will have a deterrent effect on the application decision if

$$(1 - \lambda)^N V_{i,t} - R(L) < \sum_{k=1}^{N} c_{t+k}.$$

The length of the minimum expected duration, N, necessary to induce a discouraged firm effect is an empirical question.

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Notes

[1] Slovin and Shuska (1983) presented estimates that the commercial loan rate is more sensitive to changes in the open market rate than suggested by Goldfeld's and Jaffe's work; however, there are alternate interpretations of these regression results. See, for example, Berger and Udell (1992).

[2] Both figures are for firms with 500 employees or fewer, the standard definition used by the Small Business Administration. The business receipts figure (47 percent) is based on authors' calculations using data from the Census Bureau's Statistics of U.S. Businesses for 1993. GDP share estimates commonly cited by the SBA range around 50 percent; for example see textit *The State of Small Business* (1997).

[3] In the year that the data were collected for the NSSBF, the Office of Advocacy for the SBA remarked that "[M]any small businesses have difficulty in raising capital sufficient to open, operate, and grow. Commercial lenders often find it more profitable and secure to extend credit to a big firm in a single transaction than to originate many small loans. Other providers of capital find it more convenient and less risky to invest in well known, established businesses." (Office of Advocacy, U.S. Small Business Administration, 1988, p. 1).

[4] The literature on credit rationing for consumers is similar: there has been scant direct evidence beyond that provided by Jappelli (1990). Our approach in this paper is similar in spirit to Jappelli's.

[5] See Waller and Levine (1994) for a simple exposition of equilibrium credit rationing models. Jaffe (1971) reviews the early literature on credit rationing, starting with Hodgman (1959, 1960); papers in this tradition relied on ad hoc assumptions of interest rate rigidity to create credit rationing as a disequilibrium phenomenon. Freimer and Gordon (1965) set the stage for later advances by asking whether this sort of credit rationing was a rational strategy for bankers.

[6] The literature on unemployment deals with a similar issue. If the typical person is unemployed for only a short duration, say a couple of weeks, then unemployment most likely is not an economically devasting experience. However, durations of many months are an entirely different matter.

[7] If the firm knows it will have to wait only a short time to obtain financing, this is equivalent to saying that the the *ex ante* fixed cost of applying for and receiving credit (with complete certainty) is higher for that firm. Only those firms with the most marginally profitable investment projects will be deterred from applying by the prospect of having to wait a short time to receive financing.

[8] Consistent with the prediction that a positive expected probability of short-run denial will have little or no deterrent effect on the application decision, we found (results not reported) no negative feedback from predicted short-run denial to the application decision. This is not surprising because, in the absence of proper statistical controls for the firm's credit history/creditworthiness, a positive predicted probability of short-run denial may be *positively* correlated with loan demand: the best credit risks may be those that are *most* likely to apply (conditional on a given expected long-run denial probability).

[9] Motivation for the positive relationships between creditworthiness and both firm transfer and transfer age can be derived from Jovanovic (1982) and related approaches, which model firm death through an information revelation process. Young firms have higher probabilities of failure because they have not been around long enough to determine either their optimal size or whether they should be in business at all. In this class of models, an outsider will be willing to purchase the firm only after enough information has been collected to accurately predict that the firm will be viable in the long run. Firms transferred at older ages have had more uncertainty resolved through the collection of more information on the firms' operating performance.

[10] The test procedure is as follows: take the residuals from the second stage (loan application) equation and regress them on the instruments. The instruments are valid if they are not significantly correlated with the residuals.

[11] The reference period is either calendar year 1987 or fiscal year 1987. See Federal Reserve System (1992) for a detailed description of the survey.

[12] The White House Conference on Small Business recently remarked that small businesses were increasingly turning away from "the traditional sources of debt capital – banks, credit unions, and savings and loans," and choosing to rely instead on "non-traditional sources, such as finance companies, credit card agencies and private investment companies" for debt finance. (U.S. Small Business Administration, Office of Advocacy, 1994, p. 19)

[13] The results do not change if age at acquisition and start-up capital are excluded. The additional regressors include log sales and a dummy for whether startup capital was imputed (at the mean startup capital for the sample).

[14] We tried alternate spline specifications, including a separate spline term for each predicted denial decile. Only the tenth decile term was statistically significant. We also tried substituting polynomial for spline terms. The results did not differ appreciably.

[15] The standard errors have not been corrected to account for the estimation of the predicted denial probabilities in the first stage.

[16] This 47.4 percent discouraged firm effect applies only to the 303 firms in the top decile that did not apply for credit. The remaining firms that applied for credit are classified as 100 percent or 0 percent denied based on whether they obtained all the financing for which they applied.

[17] The positive relationship between firm size/age and

creditworthiness is easily derived within a Jovanovic (1982) type model. The good credit risks among a pool of small/young firms can suffer from a type of statistical discrimination: relatively high costs of screening good applicants from bad lead external financiers to decrease lending to the group as a whole. Instead, external financing is directed toward the pool of older/larger firms that has a higher probability of repayment as a whole. Within the context of our model (see Appendix) this is equivalent to saying that the signal to noise ratio is lower for smaller/younger firms.

[18] These are overestimates because they count all sales and employment at discouraged firms as rationed. Properly weighting by the degree of discouragement – 47.4 percent – would reduce these figures substantially.

[19] A common perception is that the most recent recession was induced at least partly by a "credit crunch." For differing evidence on this, see Berger and Udell (1994) and Peek and Rosengren (1995).

[20] This essentially assumes that there is some disequilibrium credit rationing at any given point in time (i.e., that markets don't clear instantaneously). It would be more appealing, theoretically, to embed this search structure in a model of equilibrium credit rationing, in which information asymmetries drive financial intermediaries to use non-price rationing, as in Stiglitz and Weiss (1981). We will pursue this in future work. However, we do not believe that this more complicated rationale for credit rationing would significantly change the fundamental view that credit rationing should be defined by duration, with attention to the possibility that some firms are discouraged from applying for credit at all.

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