

DISSERTATION

GENDER, RACE, AND CREDIT RATIONING OF SMALL BUSINESSES:
EMPIRICAL EVIDENCE FROM THE 2003 SURVEY OF SMALL BUSINESS
FINANCES

Submitted by

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In partial fulfillment of the requirements

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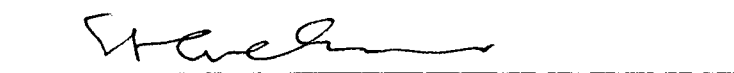
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ABSTRACT OF DISSERTATION

GENDER, RACE, AND CREDIT RATIONING OF SMALL BUSINESSES: EMPIRICAL EVIDENCE FROM THE 2003 SURVEY OF SMALL BUSINESS FINANCES

Rapid rates of growth of small business ownership among women and minorities have motivated research on issues related to small business performance. The importance of access to credit for the success of small businesses, as well as evidence that women and minorities have less access to credit than male and white business owners has led researchers to explore the reason for this. The purpose of this study is to determine whether credit rationing in the small business credit market is different based on gender and/or race of the business owner.

This study examines two types of credit rationing and uses a comprehensive measure that includes discouraged borrowers. In addition, we examine how loan amounts are determined. We utilize three different types of methodologies to analyze data from the 2003 Survey of Small Business Finances.

Our results are consistent with previous studies that have found higher loan denial rates and lower loan application rates among women and minority business owners. Testing the robustness of the results, we find an asymmetry in the response of women business owners compared with minorities. The results suggest that women tend to ration themselves in the credit market, whereas

minorities are rationed by banks through what appear to be prejudicial lending practices.

The results for discouraged borrowers that estimate joint decisions of lenders and borrowers suggest that among those who apply for a loan, minority-owners have a higher chance of approval. This indicates that only higher quality firms apply for a loan, confirming the discouraging effect of banks' probabilistic offers. We also find that women and minority owners are more likely to be given a smaller loan than they request (type 1 rationing) than men and white owners. In addition, women-owned firms receive significantly smaller loan amounts than men-owned firms. There is no difference, however, in the approved loan amount between minority and white-owned firms.

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I accept sole responsibilities for any errors and omissions in this work.

Dedication

In loving memory of my father Delegiin Mijid

TABLE OF CONTENTS

| | |
|---|-----------|
| CHAPTER ONE: INTRODUCTION | 1 |
| <i>SECTION 1.1 BACKGROUND.....</i> | <i>1</i> |
| <i>SECTION 1.2 FIRST PAPER OVERVIEW: TYPE 2 RATIONING AND FIRMS' CREDIT NEEDS</i> | <i>4</i> |
| <i>SECTION 1.3 SECOND PAPER OVERVIEW: DISCOURAGED BORROWERS? PERCEPTIONS OF WOMEN AND MINORITY-OWNED FIRMS.....</i> | <i>6</i> |
| <i>SECTION 1.4 THIRD PAPER OVERVIEW: LOAN SIZE AND TYPE 1 CREDIT RATIONING</i> | <i>7</i> |
| CHAPTER TWO: LITERATURE REVIEW | 9 |
| <i>SECTION 2.1 THEORETICAL STUDIES ON CREDIT RATIONING.....</i> | <i>9</i> |
| <i>SECTION 2.2 EMPIRICAL STUDIES ON CREDIT RATIONING</i> | <i>13</i> |
| <i>SECTION 2.3 CREDIT RATIONING AND THEORIES OF DISCRIMINATION.....</i> | <i>15</i> |
| <i>SECTION 2.4 EMPIRICAL STUDIES ON DISCRIMINATION IN THE SMALL BUSINESS CREDIT MARKET</i> | <i>16</i> |
| <i>SECTION 2.5 SUMMARY AND CONTRIBUTION TO THE EXISTING LITERATURE</i> | <i>21</i> |
| CHAPTER THREE: DATA AND DESCRIPTIVE STATISTICS | 24 |
| <i>SECTION 3.1 SUMMARY OF DATA.....</i> | <i>24</i> |
| <i>SECTION 3.2 DESCRIPTIVE STATISTICS.....</i> | <i>25</i> |
| CHAPTER FOUR: TYPE 2 RATIONING and FIRMS' CREDIT NEEDS | 30 |
| <i>SECTION 4.1 RESEARCH METHODOLOGY AND VARIABLE DESCRIPTIONS</i> | <i>30</i> |
| <i>SECTION 4.2 HYPOTHESES</i> | <i>36</i> |
| <i>SECTION 4.3 EMPIRICAL RESULTS.....</i> | <i>39</i> |
| <i>SECTION 4.3 CONCLUSIONS AND IMPLICATIONS</i> | <i>53</i> |
| CHAPTER FIVE: DISCOURAGED BORROWERS? PERCEPTIONS OF WOMEN AND MINORITY-OWNED FIRMS..... | 58 |
| <i>SECTION 5.1 INTRODUCTION.....</i> | <i>58</i> |
| <i>SECTION 5.2.RESULTS FOR TWO STAGE LOGISTICS ANALYSIS.....</i> | <i>61</i> |
| <i>SECTION 5.3 LENDER AND APPLICANT JOINT DECISION-MAKING.....</i> | <i>65</i> |
| <i>SECTION 5.4 CONCLUSIONS.....</i> | <i>73</i> |
| CHAPTER SIX: LOAN SIZE AND CREDIT RATIONING BY GENDER AND RACE..... | 74 |
| <i>SECTION 6.1 INTRODUCTION.....</i> | <i>74</i> |
| <i>SECTION 6.2 METHODOLOGY AND HYPOTHESES.....</i> | <i>76</i> |
| <i>SECTION 6.3 RESULTS</i> | <i>78</i> |
| <i>SECTION 6.4 CONCLUSIONS.....</i> | <i>91</i> |
| CHAPTER SEVEN: SUMMARY | 93 |

| | |
|-------------------------|------------|
| REFERENCES..... | 100 |
| APPENDIX A | 104 |
| APPENDIX B | 106 |
| ENDNOTES..... | 116 |

List of Tables

| | |
|--|----|
| Table 3.2.A Sample Means, Medians and Standard Errors of Selected Variables | 26 |
| Table 3.2.B Characteristics of Women, Men, Minority, and White-Owned Firms | 28 |
| Table 4.1 Variable Names and Descriptions | 33 |
| Table 4.3.A Logit Estimates of Probability of Loan Denial for Women and Men-owned firms | 39 |
| Table 4.3.B Logit Estimates of Probability of Loan Denial for Minority and White-owned firms ... | 41 |
| Table 4.3.C Logit Estimates of Probability of Loan Application for Women and Men-owned firms | 46 |
| Table 4.3.B Logit Estimates of Probability of Loan Application for Minority and White-owned firms | 47 |
| Table 4.3.C Summary of Hypothesis Tests for 5 Subsamples | 50 |
| Table 5.2.A Predicted Average Probability of Loan Denial and Loan Application for for Female- and Male-Owned Firms and Logit Estimates of Parameters | 61 |
| Table 5.2.B Predicted Average Probability of Loan Denial and Loan Application for for Minority- and White-Owned Firms and Logit Estimates of Parameters | 63 |
| Table 5.3.A Results from BiVariate Probit Regressions for Female and Male-owned firms | 68 |
| Table 5.3.B Results from BiVariate Probit Regressions for Minority and White-owned firms | 70 |
| Table 6.3.A Probit Estimates of Parameters of Probability of Type 1 Rationing | 79 |
| Table 6.3.B Result of 2SLS method for Women-owned firms | 81 |
| Table 6.3.C. Result of 2SLS method for Men-owned firms | 82 |
| Table 6.3.D Result of 2SLS method for Minority-owned firms | 85 |
| Table 6.3.E Result of 2SLS method for White-owned firms | 86 |
| Table 6.3.F 2SLS Result Comparison of All Firms with Services and Retail Industries only | 89 |
| Table 7.1. The Probability of Denial Using Median and Mean Values of Each Group | 95 |

CHAPTER ONE: INTRODUCTION

SECTION 1.1 BACKGROUND

Small firms are an integral part of an economy. The U.S. Small Business Administration (SBA)'s Office of Advocacy reports the following to summarize how important small firms are to the U.S. economy. "Small firms represent 99.7 percent of all employer firms, employ half of all private sector employees, pay more than 45 percent of the total U.S. private payroll, have generated 60 to 80 percent of net new jobs annually over the last decade, create more than 50 percent of non-farm private GDP..." (US Small Business Administration, FAQ). Based on 57 recent studies, vanPraag and Versloot (2007) contrast the contributions of entrepreneurs and non-entrepreneurs to the economy. They conclude that entrepreneurs play a very important and specific role in the economy. Entrepreneurs generate relatively high employment opportunities, provide higher productivity growth and produce and commercialize a high quality of innovation.

Evidence suggests strongly that small firms' access to external funding, which (among other factors) leads to a firm's success, is very important and somewhat unique. Unlike homogenous individual loans, which can be based on the credit score or the credit history of the individual, they are more heterogeneous in nature. Also unlike large businesses, small firms have information opacity problems (Berger & Udell, 1998) and the public market for

external equity almost does not exist for small firms. Therefore, small business owners face greater difficulty securing external funds.

Women and minority-owned businesses have grown rapidly in recent years. Between 1997 and 2002, the number of women-owned firms increased by 20 percent, Black-owned firms by 45 percent, Hispanic-owned firms by 31 percent and Asian-owned firms by 24 percent. In contrast, men-owned firms increased by 16 percent and white-owned firms by only 6 percent (Lowrey, 2006, 2007). Despite this fact, data from the 2003 SSBF displays significantly lower profitability and access to credit for women – and minority – owned firms compared to their male and white counterparts, respectively.

The existing literature on small business finance finds some evidence that women-owned firms have a higher loan denial rate (K. S. Cavalluzzo, Cavalluzzo, & Wolken, 2002) , a lower application rate (Carrington, 2006; Treichel & Scott, 2006), and if approved, they get a smaller loan amount (Treichel & Scott, 2006) than men-owned firms. Similarly, there is persistent evidence of discrimination against black-owned firms (Blanchflower, Levine, & Zimmerman, 2003; K. Cavalluzzo & Wolken, 2005; K. S. Cavalluzzo et al., 2002; Mitchell & Pearce, 2005).

These studies utilized methodology and/or data that include only firms that applied for credit. Firms which did not apply for a loan are also important. For example, many firms might not apply because of fear of rejection. In the credit rationing literature, these firms are rationed. The number of these discouraged borrowers is almost twice as large as that of those which were denied (Levenson

& Willard, 2000). These borrowers are considered to be rationed because they would have applied in the first best world (Mushinski, 1999a)

The purpose of this dissertation is to fill this gap and to study women and minority-owned firms using different measures of credit rationing. We use data from the 2003 Survey of Small Business Finances conducted by the Federal Reserve Board of Governors – the most recent dataset available to the public for small businesses. We utilize three different methodologies to measure credit rationing and examine both type 1 and type 2 credit rationing (defined below). Throughout this study, we compare women-owned firms with men-owned firms and minority-owned firms with their white-owned counterparts. Because of data limitations, we were unable make narrower distinctions such as different races or minority-women owners.

This study contributes to the existing literature by analyzing whether banks ration credit for women and minority-owned firms more than for men and white-owned firms, respectively, and how this credit rationing affects their probability of applying. Consequently, it will suggest whether or not credit rationing is neutral across businesses according to the gender and race/ethnicity of the business owners.

The rest of the study is organized as follows: the next three sections provide a brief overview of the findings. Chapter Two starts with a definition of credit rationing and reviews the relevant theoretical and empirical literature on credit rationing. It also summarizes theories of discrimination along with empirical studies on gender and/or racial discrimination in the small business credit

markets. Chapter Three discusses the data and descriptive statistics. In Chapter Four, we present the methodology developed by Levenson and Willard (2000), variables used throughout this study, our hypotheses testing and empirical results for type 2 credit rationing. The results for robustness check that extends the same analysis to certain subsamples of firms is presented in this chapter. Chapter Five examines discouraged borrowers more in detail. We present results from the above analysis for those firms that applied and were discouraged to apply. We also present here an empirical model adapted from Mushinski (1999a, 1999b) and show results from a bivariate probit model. In Chapter Six, we analyze type 1 credit rationing and loan amounts for those who received credit. Here we discuss the 2 Stage Least Square (2SLS) methodology to examine loan amounts and present the results. Chapter Seven concludes and summarizes our findings.

SECTION 1.2 FIRST PAPER OVERVIEW: TYPE 2 RATIONING AND FIRMS' CREDIT NEEDS

The purpose of this paper is first to explore whether banks ration credit to women and minorities more than men and whites, and second, to examine how credit rationing affects firms' likelihood for applying for credit. Using a measure developed by Levenson and Willard (2000), we estimate the extent to which small firms are credit constrained and how these constraints in turn affect their likelihood of requesting credit. This paper will address the following questions, among others. Are lenders rationing credit more for female-owned firms than male-owned firms in the small business credit market? Do banks ration minority

owners more than white owners? Are minority-owned firms more discouraged from applying for a loan than white-owned firms? Do women-owned firms differ from men-owned firms in their likelihood of applying for a loan?

We find that the women and minority business owners have higher denial rates and lower application rates than their counterparts. In addition, banks look for different characteristics in women than men, and minorities than whites when they evaluate loan applications. We also find that banks' rationing negatively affects women-owned firms' application decision in the lowest 10th percentile of the probability of denial and minority-owned firms' decision to apply for credit in the highest 10th percentile.

We extend the above analysis for certain subsamples of firms¹ that have similar characteristics for women- and minority-owned firms. More specifically, we examined 5 subsamples: a) service and retail industries, b) small firms by asset size, c) small firms by sales and profits d) small firms by number of employees and e) young (less than 10 year old) firms. The main idea is that the access to (and the need for) credit of women and minority-owned firms might differ from that of men and white-owned firms because their business characteristics differ. We investigate whether women and minority-owned firms' lower access to credit is due to certain less desirable characteristics. Our findings suggest that women owners still have higher denial rates in some subsamples,

¹ We also attempt to distinguish creditworthy and non-creditworthy borrowers (those with lower credit scores) to see if there is a difference in access to credit between women and men and between minority and white-owned firms. Unfortunately, due to data limitations, we were unable to perform such an analysis. That is, within creditworthy borrowers, there were too few women or minority-owned firms that were denied for credit.

while in other subsamples where they have the same denial rate as men-owned firms, women may be rationing themselves by not applying at the same rate as men-owned firms. The results for minority-owned firms are robust in a sense that they still face significantly higher loan denial rates even when applying for loans at the same rate as white-owned firms

SECTION 1.3 SECOND PAPER OVERVIEW: DISCOURAGED BORROWERS? PERCEPTIONS OF WOMEN AND MINORITY-OWNED FIRMS

This paper examines discouraged borrowers – firms that did not apply for credit because of fear of rejection – and their perceptions. First, by applying the same methodology for those firms that applied for a loan and those that did not apply because of fear of rejection, we investigate whether banks' rationing for women and minority owners is different than for their men and white-owned counterparts. We analyze whether banks' rationing affects their likelihood of applying as well. Our results show that women-owned firms have much higher denial rate than men-owned firms and the gap between women and men increased to 5.3 percent and remained significant. Minority-owned firms also face 12.3 percent higher probability of denial, on average, than white-owned firms. The higher probability of denial, though, does not negatively affect the probability of applying for women and minority-owned firms. Despite this fact, women and minority owners have significantly lower application rates.

Second, we utilize an econometric model developed by Mushinski (1999a, 1999b) which measures credit rationing that arises from the probabilistic nature of banks' loan offers. Here we first estimate the banks' conditional loan approvals

and use the predicted values of approval to estimate firms' likelihood to apply for a loan. We estimate the bank and the firm's joint decision using the bivariate probit model. Our regression results suggest that women-owned firms still have a lower loan approval than men-owned firms, but the difference is insignificant. Women-owned firms' decision to apply is positively affected by banks' rate of approval decisions, which indicates a discouraging effect: the lower the approval rate, the less likely women are to apply. Despite this fact, women-owned firms have four percent higher application rates, on average, than men-owned firms. On the other hand, minority-owned firms have a significantly higher approval rate than white-owned firms. That is, minority-owned firms that apply for a loan have a higher chance that the loan will be approved than white-owned firms. Banks' loan approval decisions seem to have a discouraging effect for minority-owned firms, however, we find that there is, on average, no difference in the application rate between minority and white-owned firms.

SECTION 1.4 THIRD PAPER OVERVIEW: LOAN SIZE AND TYPE 1 CREDIT RATIONING

The purpose of this paper is to investigate whether women and minority-owned firms obtain smaller loan amounts than men and white-owned firms and whether women and minority owners are more likely to receive smaller loan amounts than they request (type 1 credit rationing). First, we estimate the probability that firms are type 1 rationed and compare this probability for women and minority-owned firms with their counterparts. We find, on average, women owners have 3.2 percent higher probability of type 1 rationing than men, and

minority owners face an even higher, 14 percent, probability than white owners. This result confirms that there is strong evidence for prejudice against black-owned firms.

Then, we examine loan amounts using a simultaneous equation model developed by Hanley and Girma (2006). In this model, lenders' decisions to approve a loan, interest rate to be charged and loan amount are determined simultaneously. Our estimation results indicate that, for those who were approved, the amount of loan that women-owned firms obtain is half that of men-owned firms. The same result can be found when we examine the services and retail industries only. On the other hand, there is no significant difference in estimated loan amounts between minority and white-owned firms.

CHAPTER TWO: LITERATURE REVIEW

SECTION 2.1 THEORETICAL STUDIES ON CREDIT RATIONING

There are many definitions of credit rationing. Keeton distinguishes two types of credit rationing: type 1 rationing occurs when "...a customer receives a loan of smaller size than he would desire at the interest rate quoted by the bank." and type 2 rationing occurs "...when some firms are able to obtain loans while other, identical firms are not." (Keeton, 1979, p. 9). However, this definition excludes firms that did not apply for a loan because of fear of rejection. Non-application arising out of fear of rejection is a form of credit rationing because it has been shown to arise out of informational asymmetries in credit markets (Besanko & Thakor, 1987). Collateral requirements are also a product of a informational asymmetries (Bester, 1985). Firms which do not obtain a loan because of insufficient collateral are therefore rationed. The idea of non-application being a manifestation of credit rationing is embodied in Levenson and Willard (2000)'s "type 2 rationing":

"...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 the expectations about how long it may take to obtain financing ..."

The theoretical background for credit rationing is very well-developed.

"Economists have focused on the existence of market failures to explain why

creditworthy individuals are rationed in credit markets.” (Mushinski & Phillips, 2001, p. 4465). The main causes for credit rationing are adverse selection and incentive effects as outlined by Stiglitz and Weiss’s (1981) seminal work. They argue that credit rationing implies excess demand for funds that comes from information asymmetry. In a perfectly competitive world, where information can be obtained perfectly and without cost, there is no credit rationing. In such a world, everyone who applies for a loan gets one at a market interest rate because lenders are able to separate risky projects or borrowers from less risky ones, and therefore are able to assign separate loan contracts to each borrower.

Informational asymmetries prevent credit markets from being perfectly competitive. Stiglitz and Weiss (1981) have shown that because of moral hazard and adverse selection, a profit maximizing bank cannot increase the market interest rate. Profits are maximized at an interest rate which is below the competitive equilibrium. As a result, the equilibrium in the credit market is characterized by “an equilibrium excess demand”. Banks have to ration credit. For the same reason, banks cannot increase collateral requirements because it would cause less risky borrowers to opt out.

There are many reasons for rationing and many arguments on whether or not rationing occurs and under what conditions. First, we discuss arguments that say credit rationing does exist and then move on to claims that state that credit rationing does not exist under certain conditions or if it does, it is not an important phenomenon. Stiglitz and Weiss’s (1981) work is based on the assumption that borrowers are risk-averse. Wette (1983) extends the S-W model to risk-neutral

borrowers to investigate the role of collateral and finds that even when borrowers are risk-neutral, an increase in collateral requirements may lead to adverse selection effects. Therefore, lenders cannot use collateral to eliminate excess demand. Kon and Storey (2003) extended the S-W adverse selection model to “discouraged borrowers” to incorporate application costs for borrowers and screening errors made by banks. They first defined a discouraged borrower “...as a good firm, requiring finance that chooses not to apply to the bank because it feels its application will be rejected” (p. 47). They then showed that the number of discouraged borrowers is highest when there is imperfect information for both banks and firms. If banks and borrowers had perfect information, everybody would apply for a loan, and when there was no information, the number of discouraged borrowers would be minimal because increased information lowers banks’ screening errors and increases borrowers’ application costs.

Stiglitz and Weiss (1983) showed a dynamic model, wherein a lender and a borrower have developed a multi-period relationship, where credit rationing could involve experienced borrowers as well as inexperienced ones. Contingency contracts have some desirable incentive properties for banks, because they can simply threaten to terminate the contract if a borrower has a tendency to engage in risky activities. Once contracts are terminated, banks deny future loans to defaulters; therefore, the threat to terminate aligns the behavior of borrowers to those of lenders, and both types of borrowers can be rationed. They also showed that in a static model, where banks determine the interest rate, collateral and equity requirements simultaneously, every type of borrower could be rationed (J.

E. Stiglitz & Weiss, 1985). Therefore, Stiglitz and Weiss (1987) argue that even with a variety of types of borrowers, credit rationing still exists and is important.

We now turn to an argument stating why credit rationing does not exist. Bester (1985) shows a model in which banks determine the interest rate and the collateral requirement simultaneously, and finds that no borrower is denied credit in equilibrium. Low-risk borrowers have some observable characteristics to distinguish themselves from high-risk borrowers, so low-risk borrowers are willing to accept a higher collateral requirement in exchange for lower interest rates; therefore, rationing will not occur. He does show, however, that low-risk borrowers with limited wealth (the type of person who starts a small business) may still be rationed.

De Meza and Webb (2006) argue that the feature of market-clearing equilibria in the credit market is agency costs, but not credit rationing. That is, preference of a firm for internal over external finance is determined by agency costs; therefore, low-wealth types tend to delay or scale down their projects, or succeed less often. As a result, pure random rationing will not be observed. Riley (1987) argued that rationing disappears as the number of observationally distinguishable borrowers increases, and it can be observed only in a single, marginal pool of applicants. Parker (2002) argued that although credit rationing exists theoretically, its relevance is limited empirically. This is because as technology becomes more sophisticated, it is easier for banks to screen out borrowers and sign separate contracts; therefore, banks may not have to ration. De Meza and Southey (1996) found that, in fact, banks do have better

information about the prospects of a project and the likelihood that a loan will be paid off than borrowers do. This is especially true with start-up entrepreneurs, because borrowers tend to be overly optimistic about their projects, and therefore, a lenders' rejection of a loan does not necessarily mean that a borrower has been rationed.

SECTION 2.2 EMPIRICAL STUDIES ON CREDIT RATIONING

Now we turn to empirical literature testing these theories. A number of studies tested whether or not credit rationing is a significant phenomenon as well as what factors determine credit rationing and/or interest rates or interest rate premiums charged by banks. For example, in the commercial loan market, Sealey (1979) studied the existence and magnitude of credit rationing, while Berger and Udell (1992) examined the significance of credit rationing in the economy. For consumer loans, Chakravarty and Scott (1999) examined whether or not the borrower-lender relationship helps to lower credit rationing faced by households, whereas Jappeli (1990) studied who is credit rationed in the U.S.

In the small business credit market, Cowling and Mitchell (2003) investigated whether or not government loan guarantee schemes affect the availability of credit to small businesses whose credit needs had been denied previously. Freel (2007) examined how innovativeness affects credit rationing, while Blumberg and Letterie (2007) examined whether commitments and favorable signals such as previous income or career help to reduce rationing faced by start-up businesses. For family-owned businesses, Bopaiah (1998)

studied whether family ownership affects a firm's access to credit and the interest rate it has to pay.

In developing areas, the nature of credit rationing arises from collateral requirements and the higher transaction costs associated with loan applications and monitoring. This is because a creditworthy borrower may not have the collateral required by banks, and oftentimes the loan amount requested by a borrower is much smaller than these costs. Therefore, empirical studies in the development literature focus on how to reduce the informational asymmetry problem. For example, Zeller (1994) studied determinants of credit rationing for informal and formal lenders in Madagascar. Mushinski (1999a) analyzed how informal lenders such as credit unions mitigate credit rationing faced by households unserved by formal lenders such as banks. Mushinski and Pickering (2007) undertook an analysis of the extent to which Grameen Bank types of credit groups mitigate rationing. Petrick (2005) surveyed various methods used by researchers for measuring and testing credit rationing in rural or agricultural areas.

The main findings of the above studies show that credit rationing does exist both in commercial and consumer loans and the small business credit market. They also address what factors affect its existence and how the problem can be mitigated. Since small business owners face the most information asymmetry problems and minority and/or female business owners have increased difficulties securing the credit they need in the small business credit market, the purpose of this study is to explore the possible relationship between

credit rationing and discrimination based on the race and/or gender of the business owner.

SECTION 2.3 CREDIT RATIONING AND THEORIES OF DISCRIMINATION

Blau and Ferber defined labor market discrimination as “when two equally qualified individuals are treated differently solely on the basis of their gender (race, age, disability, etc.)” (2002, p. 202). Theories of discrimination originate in Becker (1971). He argued that various parties, employer, employee, and/or customers have “tastes for discrimination”. In a competitive economy, employer discrimination should be eliminated over time, but discrimination may persist when either employees or customers are prejudiced.

Another theory of discrimination referred to as “statistical discrimination” occurs when individuals are judged according to their membership in some social group such as women or a racial or ethnic minority rather than according to their individual attributes. Judgments are made based upon assumptions about the “group” instead of upon the qualifications of the individual.

Shulman (1996) outlines various political economy theories of discrimination. The one that seems most relevant to credit rationing is the idea of organizational adaptation. The term refers to “the tendency of firms and other organizations to adapt to the social conventions in their external environment.” (Shulman, 1996, p. 50). In the case of lending, this would result in banks internalizing existing social hierarchies of race and gender. They may judge women-owned and minority-owned businesses as less likely to succeed because

the business owners do not have established networks with suppliers, workers, customers, and neighbors (Weiler & Bernasek, 2001).

The idea that “one group has less power and control over decisions and resources than another group” (Riddell, Shackelford, & Stamos, 1998, p. 226) or “the perception of discrimination (whether accurate or not)” that may result in inequality (Albelda, Drago, & Shulman, 1997, p. 207) have serious policy implications. The direct application of this idea to the credit market implies that credit rationing may be a form of discrimination.

Some authors have explored the relationship between credit rationing and discrimination (Blanchflower et al., 2003). If credit is rationed more for women and minority business owners than it is for white male business owners, all other things equal, it has been argued that credit rationing is a form of discrimination.

SECTION 2.4 EMPIRICAL STUDIES ON DISCRIMINATION IN THE SMALL BUSINESS CREDIT MARKET

In gender research, several studies have found that there is no difference between men- and women-owned businesses in their access to the credit market for small firms. For example, using the 1998 SSBF data, which has over 3500 samples of U.S small firms, and employing multivariate analysis, Robb et al. (2002) studied characteristics of firms, owners and their finances. Their results showed that the observed differences between men and women-owned firms can be explained by differences in the business, credit history, and owner characteristics rather than gender. Therefore, they concluded that there are no

fundamental differences between female and male-owned businesses in terms of their access to credit. Mitchell and Pearce (2005) conducted an extensive study using the above data. By disaggregating the data by lender type (banks and non-banks) and by loan type (relationship loans and transaction loans), they tested five hypotheses for outstanding loans and four hypotheses for loan application denials on whether or not lenders have differential lending practices for female and minority business owners. They also tested whether lenders require superior attributes from female and ethnic minority owners on the subset of approved loans. In the case of gender differences, their results showed that lenders (both banks and non-banks) have no preferential lending practices on outstanding loans (both transaction and relationship loans) against women-owned firms. For loan denial rates, authors again failed to reject all null hypotheses (by lender type and loan type) that denial rates for loan applications for female- and male-owned firms are the same. Also, they found no evidence that lenders require superior attributes from female owners over male owners.

Similar results were found for small firms in the Netherlands (Verheul & Thurik, 2001), Canada (Carrington, 2006; Orser, Riding, & Manley, 2006), and Trinidad and Tobago (Storey, 2004). Using panel data of 2000 Dutch start up firms, Verheul and Thurik (2001) discovered that there is no difference on start up capital between women- and men-owned businesses. They showed that, on average, the proportion of equity and debt capital is the same for female and male entrepreneurs. Orser et al. (2006) examined gender differences among Canadian Small and Medium Enterprise (SME) owners using the 2001 Survey of

Financing of SME collected during 2002. Their results indicated that after controlling firm size and industry, women business owners were just as likely as men to seek external funds, except for equity capital, and to be approved once they applied. Carrington (2006), using the financing activities of Canadian small firms in 2000 and 2001, stated that there are no significant differences between women- and men-owned firms of similar size and age in access to credit. Although women entrepreneurs were less likely to apply for loans, once they applied for a loan, they were equally likely to be approved, and terms and conditions to the loan were the same as those for men. Storey (2004) examined the presence of racial and gender discrimination in the loan market in Trinidad and Tobago. He used a multivariate analysis of loan application and denial rates for small and micro enterprises using over 2000 samples from a survey conducted between 1995 and 1996, and concluded that neither loan application nor denial rates differ significantly by gender.

On the other hand, a few studies suggest that discrimination exists against women-owned businesses in the small business credit market. For example, Treichel and Scott (2006) used three surveys for U.S small firms and found that women-owned businesses are less likely to apply for a bank loan and if approved, they are more likely to receive a smaller loan. They found no evidence on loan turndown rates for women-owned businesses. Using the 1993 National Survey of Small Business Finances (NSSBF), K. S. Cavalluzzo et al. (2002) analyzed the following factors influencing observed differences in the credit market experiences of small businesses across demographic groups: credit

applications, loan denials, unmet credit needs and interest rates paid by small businesses across owner gender, race and ethnicity and how these can vary with banking market concentration. They found some evidence that female-owned firms have statistically significant higher loan denial rates than male-owned firms and this increases with lender market concentration. They could not conclude that the observed difference is due to “prejudicial discrimination”; instead it could be due to an omitted variable bias. There is no other evidence against women-owned firms on application rates, unmet credit needs (either they didn’t apply for credit because they feared rejection or were denied credit within 3 years), and interest rates charged.

Several studies examined the existence of racial discrimination in the credit market for small businesses. For example, K. S. Cavalluzzo et al. (2002) found evidence of significant differences in loan denial rates, application avoidance rates and unmet credit needs between African-American and white-owned firms after controlling for explanatory variables. Statistically significantly higher differences between Hispanic and white-owned firms on application avoidance rates and unmet credit needs were observed, and interest rates paid by Hispanic-owned firms were higher and they increased with lender market concentration. The authors concluded that these differences could be a result of omitted variable bias such as owner’s personal wealth. However, K. Cavalluzzo and Wolken (2005) studied the impact of personal wealth, such as home ownership, home equity, and personal net worth, on loan denial across demographic groups using the same dataset. They found that personal wealth,

especially homeownership decreases loan denial rate, but the difference between African-American and white-owned firms still remained large and statistically significant. Wealth only explained about one third of the difference. Similar results were found by Blanchflower et al. (2003) when they showed that black-owned firms were more likely to be turned down on loan applications and charged higher interest rates if approved. This is unlikely to be explained by the omitted variable bias (they used the 1993 and 1998 SSBF data, and minority-owned firms were over-sampled in the 1993 SSBF). However, they found neither difference on denial rates nor difference in interest rates charged across other demographic groups or for women-owned businesses. Mitchell and Pearce (2005) also found that African-American and Hispanic business owners face significantly higher loan denial probabilities for transaction loans from both banks and non-banks compared to white owners, but not for relationship loans. In addition, Storey's (2004) results also indicated that the denial rates for Africans were higher compared to other ethnic groups, suggesting the possible presence of discrimination.

All these studies suggest that racial discrimination exists against black-owned firms, and some studies find evidence of this against Hispanic-owned firms. None of them suggest that there is a difference between Asian and white-owned firms in the small business credit market.

SECTION 2.5 SUMMARY AND CONTRIBUTION TO THE EXISTING LITERATURE

Theories of credit rationing have not reached a consensus on whether credit rationing exists and if so, under what conditions. It is still an ongoing debate why rational banks have to ration. However, empirical studies strongly suggest that banks do ration credit, especially in developing areas and in the small business credit market, where borrowers do not have adequate collateral to secure the loan.

Various theories of discrimination suggest that women and minorities do face differential treatment either by society, norms, tastes, perception, etc. According to the Becker's theory of discrimination (1971), as competition increases, discrimination should be eliminated. Nevertheless, it has persisted in the small business credit market. The connection between discrimination and credit rationing is made by Blanchflower et al. (2003). They suggest that if credit is rationed more for women, for example, it is considered that credit rationing is a form of discrimination.

Most of the studies on gender indicate that there is no significant difference between women and men-owned businesses after controlling for an extensive set of explanatory variables. Exceptions include studies by K. S. Cavalluzzo et al. (2002), which suggested that denial rates for female-owned firms were higher, and by Treichel and Scott (2006), which indicated that application rates and loan amount granted for female-owned firms were lower than for their male counterparts. In contrast, studies on racial discrimination all

implied that African-American (or African) business owners experience systematically higher probabilities of loan denial rates than do white owners even after controlling explanatory variables, implying that there exists racial discrimination in the small business credit market. There was some evidence suggesting that Hispanic business owners face higher loan denial, and are charged higher interest rates if approved, than white owners..

The above studies on gender and/or racial discrimination use different econometric tools, including univariate and/or multivariate analysis on loan denial rates, application rates, application avoidance rates, interest rates charged, outstanding loans, unmet credit needs, or startup capital. A single probit or logit equation of these dependent variables was regressed on a set of explanatory variables, with the exception the studies of Mitchell and Pearce (2005) and K. Cavalluzzo and Wolken (2005). In both of these studies, the authors used the joint estimation of probability that a firm applies for a loan and probability that a lender denies for a loan. They used this method because a single probit or logit model would underestimate the probability of loan denial since it excludes firms that did not apply because of fear of rejection. Instead, they estimated the probability that a firm applies for a loan and then residuals from this equation were used in estimating the probability of denial.

To our knowledge, none of the above studies examined the effect of credit rationing on firms' need for credit and how this effect varies for men-owned businesses and women-owned firms (and white-owned firms as compared to minority-owned firms). Therefore, this study contributes to the existing literature

by analyzing the extent to which credit rationing occurs differently for men business owners than women and for white-owned firms than minority-owned ones. Consequently, it will suggest whether or not discrimination in the form of credit rationing exists in the credit market for small businesses.

CHAPTER THREE: DATA AND DESCRIPTIVE STATISTICS

SECTION 3.1 SUMMARY OF DATA

For research purposes, the US SBA defines a small business as an independent organization with 500 or fewer full-time employees. The data used for this study is the 2003 SSBF and is downloaded from the Federal Reserve Board of Governor's website². This survey has been collected every five years since 1987. There are 4,240 non-agricultural, non-financial non-governmental and for-profit firms that represent 6.3 million small businesses nationally. Missing values were imputed five times for each firm, so there are 21,200 firm-implicate observations. The original reported data values are the same across implicates and the only imputed data values differ. In order to avoid duplication, we have selected only one implicate (implicate1) because reported data values are the same for each implicate. This dataset is the most up-to-date and has extensive information about firms, their owners, financing characteristics, financial institutions, financial services used, balance sheet and income statement information, and most recently applied loan experiences.³

For this study, we have chosen 2,820 firms in which one owner has the majority (more than 50 percent) of the shares. Due to data limitations, we analyze differences between women and men-owned firms and between white

² Can be downloaded from the website:

<http://www.federalreserve.gov/pubs/oss/oss3/nssbftoc.htm>

³ For more information see (Mach & Wolken, 2006)

and minority-owned firms.⁴ The sample consists of 24 percent women-owned firms and 13 percent minority-owned firms. Minority-owned firms include Hispanic, Black, Asian, Hawaiian, and native-American-owned firms.

SECTION 3.2 DESCRIPTIVE STATISTICS

Descriptive statistics of selected variables are presented in Table 3.2.A. The mean values of these variables for non-rationed firms are compared to rationed firms as well as to discouraged borrower firms. Non-rationed firms include both firms that applied for credit and were approved and firms that did not apply for a loan in the last 3 years. Rationed firms are firms that applied for a loan and either always or sometimes got denied. Discouraged borrower firms are firms that did not apply for credit because of their fear of rejection.

For the purpose of this study, we define credit rationed firms as firms that applied for a loan and got denied (either always or sometimes) or firms that did not apply for a loan because they feared their request would be turned down. As we expect, non-rationed firms have on average significantly more assets and higher profits than rationed and discouraged borrower firms. In addition, these firms have been in their business longer and have higher credit scores and longer relationships with their primary financial institutions. Finally, the owners of these firms are more experienced and have higher rates of homeownership (in a primary residence).

⁴ Unlike the 1993 and 1998 SSBF, the 2003 SSBF did not over-sample minority-owned firms.

Table 3.2.A Sample Means, Medians and Standard Errors of Selected Variables

| Variables (1) | Not-rationed Firms | | | | Rationed Firms | | | Discouraged Firms | | | t-Tests for differences in means | | | |
|-------------------------|--------------------|---------------|-----------|-------------|----------------|-----------|-------------|-------------------|------------|-----------------|----------------------------------|-----------------|--|--|
| | Mean (2) | Median (3) | SE (4) | Mean (5) | Median (6) | SE (7) | Mean (8) | Median (9) | SE (10) | (2)-(5) (11) | (2)-(8) (12) | (5)-(8) (13) | | |
| Total Assets, in \$1000 | 1843.2 | 131.0 | 162.2 | 735.1 | 152.0 | 165.9 | 228.7 | 29.0 | 54.7 | 4.78 *** | 9.43 *** | 2.90 *** | | |
| Total Sales, in \$1000 | 3953.3 | 357.2 | 253.3 | 2520.9 | 320.0 | 1254.6 | 483.2 | 87.4 | 144.6 | 1.12 | 11.90 *** | 1.61 | | |
| Profit, in \$1000 | 476.3 | 35.0 | 82.2 | 186.1 | 24.0 | 82.6 | 18.0 | 9.0 | 25.0 | 2.49 ** | 5.33 *** | 1.95 * | | |
| Firm age, in years | 16.88 | 15 | 0.24 | 13.22 | 10 | 1 | 9.86 | 8 | 0.53 | 3.87 *** | 12.01 *** | 3.18 *** | | |
| Owner age, in years | 53.75 | 54 | 0.22 | 48.44 | 47 | 1 | 47.37 | 47 | 0.65 | 5.31 *** | 9.23 *** | 0.91 | | |
| Experience, in years | 22.19 | 21 | 0.24 | 18.82 | 18 | 0.95 | 15.30 | 14 | 0.63 | 3.43 *** | 10.20 *** | 3.08 *** | | |
| Return on Assets | 2.46 | 0.22 | 0.87 | 1.54 | 0.24 | 0.74 | 2.34 | 0.25 | 1.37 | 0.81 | 0.07 | -0.52 | | |
| Long Term Debt/Assets | 0.71 | 0.09 | 0.13 | 1.19 | 0.44 | 0.22 | 1.14 | 0.07 | 0.30 | -1.88 * | -1.33 | 0.13 | | |
| Short Term Debt/Assets | 0.22 | 0 | 0.01 | 0.48 | 0.11 | 0.12 | 0.94 | 0 | 0.58 | -2.22 ** | -1.25 | -0.78 | | |
| Relationship, in months | 141.40 | 108 | 2.59 | 107.17 | 72 | 9.52 | 78.13 | 48 | 4.56 | 3.47 *** | 12.07 *** | 2.75 *** | | |
| Family-owned, % | 0.92 | 1 | 0.01 | 0.94 | 1 | 0.02 | 0.96 | 1 | 0.01 | -0.65 | -3.05 *** | -1.08 | | |
| Credit score | 3.91 | 4 | 0.03 | 2.98 | 3 | 0.13 | 3.04 | 3 | 0.09 | 7.11 *** | 9.59 *** | -0.42 | | |
| Owens home, % | 0.92 | 1 | 0.01 | 0.84 | 1 | 0.03 | 0.76 | 1 | 0.03 | 2.58 *** | 5.89 *** | 1.89 * | | |
| No. obs. | 2422 | | | | 139 | | | | 259 | | | | | |

Column 11 presents the result of t-Tests for differences in the means between Not-rationed and Rationed firms

Column 12 presents the result of t-Tests for differences in the means between Not-rationed and Discouraged firms

Column 13 presents the result of t-Tests for differences in the means between Rationed and Discouraged firms

*, **, *** indicates that the differences in the means of the two groups are significant at 10%, 5%, and 1% level, respectively.

In Table 3.2.B, we show characteristics of women and men-owned firms as well as minority and white-owned firms. As described by Mach and Wolken (2006), the 2003 data displays that women-owned firms are significantly younger and smaller in terms of sales, assets and total number of employees, and tend to have lower credit scores than men-owned firms. Women-owned businesses are more likely to be organized as a proprietorship and less likely to be a corporation. Also, women-owned firms engage more in retail and services industries. In addition, women business owners have less experience (17 years on average) than men owners (23 years). Fifty-four percent of women-owned firms have outstanding loans, which includes line of credit, mortgages, motor vehicle loans, equipment loans, capital lease and any other type of loans. This number is 70 percent for men-owned firms, which is much higher than women-owned ones. The same is true for trade credit; 69 percent of men-owned firms have trade credit, whereas only 54 percent of women-owned firms do. Finally, 22 percent of women-owned firms reported that they did not apply for credit because of fear of rejection and only 15 percent of men-owned firms reported this. For those who applied for a loan, denial rate was much higher for women-owned businesses than for men-owned ones (13 percent vs. 7 percent). For those who were approved, interest rates charged were about 60 basis points higher for women-owned firms than for men-owned firms.

Similarly, descriptive statistics for white and minority-owned firms' display that minority-owned firms tend to be younger, have lower credit scores, and are more likely to be in the service industry than are white-owned

Table 3.2.B Characteristic of Women, Men, Minority, and White-Owned Firms

| Variable | Women-owned firms | | | Men-owned firms | | | Minority-owned firms | | | White-owned firms | | |
|--|-------------------|----------|--|-----------------|----------|--|----------------------|----------|--|-------------------|----------|--|
| | Mean | Median | | Mean | Median | | Mean | Median | | Mean | Median | |
| A. Firm Characteristics | | | | | | | | | | | | |
| Total sales (in \$1000s) | \$ 1,017.6 | \$ 106.4 | | \$ 4,277.6 | \$ 398.6 | | \$ 3,092.2 | \$ 216.5 | | \$ 3,555.1 | \$ 300.0 | |
| Total Assets (in \$1000s) | \$ 492.5 | \$ 46.2 | | \$ 1,959.2 | \$ 150.0 | | \$ 1,201.8 | \$ 82.4 | | \$ 1,668.2 | \$ 110.0 | |
| Total No. of employees | 14 | 3 | | 27 | 5 | | 21 | 4 | | 24 | 4 | |
| Age of firm (years) | 13 | 11 | | 17 | 15 | | 12 | 10 | | 17 | 14 | |
| D&B Credit Score | 3.6 | 4.0 | | 3.8 | 4.0 | | 3.4 | 3.0 | | 3.8 | 4.0 | |
| Type of Business (percentage of total) | | | | | | | | | | | | |
| Proprietorship | 54% | | | 39% | | | 45% | | | 42% | | |
| Partnership | 3% | | | 3% | | | 4% | | | 3% | | |
| C-corporation | 14% | | | 22% | | | 21% | | | 20% | | |
| S-corporation | 29% | | | 36% | | | 31% | | | 35% | | |
| Industry (percentage of total) | | | | | | | | | | | | |
| Retail industry | 19% | | | 17% | | | 18% | | | 17% | | |
| Services industry | 56% | | | 40% | | | 53% | | | 43% | | |
| Other industries | 25% | | | 43% | | | 29% | | | 40% | | |
| B. Owner Characteristics | | | | | | | | | | | | |
| Age of owner (years) | 52 | 51 | | 53 | 53 | | 50 | 50 | | 53 | 53 | |
| Owner's experience (years) | 17 | 15 | | 23 | 22 | | 17 | 15 | | 22 | 20 | |
| C. Financing Characteristics | | | | | | | | | | | | |
| Have loan | 54% | | | 70% | | | 63% | | | 66% | | |
| Have credit card | 79% | | | 80% | | | 71% | | | 81% | | |
| Have trade credit | 54% | | | 69% | | | 57% | | | 67% | | |
| Have additional equity | 4% | | | 5% | | | 5% | | | 5% | | |
| D. Most Recent Loan Experience | | | | | | | | | | | | |
| Didn't apply/fear rejection | 22% | | | 15% | | | 29% | | | 14% | | |
| Always Approved | 82% | | | 89% | | | 70% | | | 90% | | |
| Always Denied | 13% | | | 7% | | | 22% | | | 6% | | |
| Sometimes Approved | 5% | | | 4% | | | 7% | | | 4% | | |
| Requires collateral | 48% | | | 55% | | | 51% | | | 54% | | |
| Requires guarantee | 59% | | | 59% | | | 62% | | | 59% | | |
| Original interest rate, % | 6.441 | 6 | | 5.813 | 5.75 | | 7.314 | 7 | | 5.764 | 5.655 | |

firms. On average, minority business owners have less experience (17 years) than white business owners (22 years). Minority-owned businesses use credit cards and trade credit 10 percent less than so white-owned firms. Twenty-nine percent of minority owners report that they did not apply for credit because of fear of rejection, whereas this number is only 14 percent for white owners. The denial rate for minority-owned firms is much higher, 22 percent vs. 6 percent for white-owned firms. For most recently applied loan types, minority-owned businesses apply for considerably fewer capital leases, mortgages, motor vehicle loans and equipment loans than do white-owned firms. Interest rates charged for minority-owned firms, on average, were higher by about 50 basis points than the rates charged for white-owned firms.

CHAPTER FOUR: TYPE 2 RATIONING and FIRMS' CREDIT NEEDS

SECTION 4.1 RESEARCH METHODOLOGY AND VARIABLE DESCRIPTIONS

This chapter explores the extent to which credit rationing occurs in the small business credit market, whether or not there is any difference between women-and men-owned firms and between white- and minority-owned firms to this extent, and how it in turn affects a firm's credit need. More specifically, we examine here how the predicted probability of denial, which serves as a proxy for credit rationing, affects a firm's decision to apply for a loan.

Research methodology used in this study is directly based on a model developed by Levenson and Willard (2000). They first constructed a theoretical model for true measure of credit rationing, including short-run constraint (a firm which eventually obtains the needed credit), long-run constraint (a firm denied credit) and the duration aspect of credit rationing (a firm which gets credit after waiting for a period of time). Then, they calculated the extent of credit rationing experienced by small businesses in the US using the 1987 SSBF.

Their basic model can be written as follows. First, a firm's decision to apply for a loan is

$$\Pr(\text{Apply}) = X\beta^x + \Pr(\text{Deny})\beta_D + \varepsilon_1, \quad (4.1)$$

where $\Pr(\text{Deny})$ is the probability that a firm will be denied, X is set of explanatory variables related to a firm's decision to apply for a loan, β^x and β_D are

coefficients, and ε_1 is unobservable error terms. Then, the outcome of the application process – the probability of loan denial can be written as

$$\Pr(Deny) = Z'\theta + \varepsilon_2, \quad (4.2)$$

where Z is a vector of explanatory variables relevant to the loan denial decision, θ is a coefficient, and ε_2 is the random error term.

Using this model, we estimate the probability of applying in two stages.

Stage 1: Equation 4.2 is estimated for firms that applied for a loan. Then, using the estimated θ coefficients, the probability of denial is calculated for all firms, which includes firms that did not apply because of fear of rejection. This ensures that the need for credit of these “discouraged borrowers” is not zero and measures its effect on their application decision.

Stage2: The equation 4.1 is estimated using the predicted probabilities from the 1st stage.

The following modifications are made to Levenson and Willard’s (2000) model. First, we use logistic regressions for this two-stage model instead of probit since it is easier to interpret the results using logit estimates of parameters in terms of log-odds ratios. We run the above two-stage process for women-, men-, minority-, and white-owned firms separately and compare results for women-owned firms with men-owned and minority-owned firms with white-owned firms.⁵

⁵ To adequately account for the effects of race and gender we could run a single regression interacting all variables with a gender dummy variable, and another interacting all variables with a race dummy variable. Alternatively we could run separate regressions for males and females and for whites and minorities. We did both and the results of the separate regressions are reported here. The results were similar to those

Next, since the predicted values of $\text{Pr}(\text{Deny})$ are used in the 2nd stage equation as a regressor, the predicted values add extra randomness, which makes the calculation of analytical standard errors difficult. Therefore, we use the bootstrap method in all 2nd stage regressions in order to test the hypotheses. Following Efron and Tibshirani (1993: p. 52), we use 200 replications for estimating the standard errors of parameters.

In addition, we extend the Levenson and Willard (2000) model by adding more explanatory variables.⁶ Since informational asymmetries are an important reason for banks to ration creditworthy borrowers, we want to include as many variables as possible as suggested by theory. We assume these variables are available to banks because they require such information in their loan applications. We also assume these variables to be exogenous because even though some variables such as credit scores, sales, and equity are endogenous, at the time of application this information is given (fixed). Therefore, given the availability of such information in the data set, it is reasonable to add more variables to the model. In addition, these variables are drawn from theories of credit rationing and many have been used by researchers in other empirical studies. We include 16 control variables, and we classify these variables into four broad categories⁷ (see Table 4.1 for description of variables):

for the single regressions with interaction terms. A comparison of the results by gender and race is easier with the separate equations; therefore, we chose that approach.

⁶ We ran the above 2-stage process with similar variables to those Levenson and Willard (2000) used in their model. The main result did not vary from what is presented here.

⁷ We started with 29 control variables used by most recent empirical studies. Due to data limitations, we are unable to use the following variables because of too few responses in one category: market, 2-digit SIC industry classification, whether or not an owner manages the firm, whether or not an owner or a firm

Table 4.1. Variable Names and Descriptions⁸

| Variable Name | Variable Description |
|--|---|
| Dependent variables | |
| NotApply | A dummy variable NotApply equals to 1 if a firm applied for a loan or renewed the existing line of credit in the last 3 years, 0 otherwise |
| Approved | A dummy variable Approved equals to 1 if a firm is approved for these loans, 0 if a firm is always denied or sometimes denied for a loan |
| Independent variables | |
| A. Characteristics of a firm | |
| LogSales | LogSales equals natural log of a firm's total sales as of year ending 2003 |
| AgeFirm | A categorical variable AgeFirm equals 1 if a firm's age is 25 or older-"old", 2 if it is 5-24 years old-"middle age", 3 if it is 3-4 years old-"adolescent" and 4 if it is 0-2 years old-"infant" |
| Type | A categorical variable Type equals to 1 if type of a firm S Corporation, 2 if it is C corporation, 3 if it is Partnership and 4 if it is Proprietorship |
| Rural | A dummy variable Rural equals to 1 if a firm is located in rural area, 0 if it is in urban area |
| Industry | A categorical variable Industry equals to 1 if a firm is in the Services industry, 2 if it is in the Retail industry, 3 otherwise |
| B. Characteristics of an owner | |
| OwnerAge | OwnerAge equals to age of the principal owner, in years |
| Experience | Experience equals to the principal owner's experience, in years |
| Education | A categorical variable Education equals to 1 if the owner has degree, 2 if he/she has some college, 3 if he/she is high school graduate |
| C. Creditworthiness of a borrower | |
| CredScore | CredScore equals to 1 if a firm's D&B credit score is 0-10, 2 if it is 11-25, 3 if it is 26-50, 4 if it is 51-75, 5 if it is 76-90 and 6 if it is 91-100: 1 is most risky and 6 is least risky |
| OwnsHome | A dummy variable OwnsHome equals to 1 if a borrower owns home or primary residence, 0 otherwise |
| D. Characteristics of finances | |
| LogEquity | LogEquity equals natural log of a firm's equity capital |
| ROA | ROA is Return on Assets and equals to total profit divided by total assets |
| LongTD | LongTD is Long Term Debt and equals to Total loans divided by total assets |
| ShortTD | ShortTD is Short Term Debt and equals to Total short term obligations divided by total assets |
| Relation | Relation equals number of months a firm conducted business with a primary financial institution |
| FamOwned | A dummy variable equals to 1 if a firm is owned by the same family members |

declared bankruptcy, had any delinquency or judgment, whether a firm has a checking or savings account, application costs and collateral requirements.

⁸ Following Berger & Udell (1998), we classify the age of firms in the above four categories. We cannot use SIC 2-digit code for industry classifications because we do not have enough observations for women and minority-owned firms in certain industries such as construction, manufacturing, etc. Total loans is the combined amount of outstanding principal of loans, mortgages, notes, bonds, capital leases, or loans from partners/stockholders. Total short term obligations include accounts payable such as payables to suppliers and services, other current liabilities such as tax payable, accrued expenses and other liabilities.

- Characteristics of firms include asset size, age, type and industry of a firm, and whether a firm is located in a rural area. Firms' need for credit and financing options change as businesses grow (Berger and Udell 1998), thus we use asset size and age of a firm as control variables. The organizational type of a firm is also a factor in both lenders' and firms' decision making as postulated by the agency theory (Jensen & Meckling, 1976). Location and industry determine the riskiness of a loan as they indicate whether firm is in a growth oriented or high-paced industry or competitive urban district. Anna et al. (2000), who examine women owners in the traditional (female-dominated) industries such as retail and services and compared them with women owners in the non-traditional (male-dominated) industries such as construction, manufacturing and high technology, find that women-owned firms' success rates differ depending on different factors. Thus, industry is an important determinant for businesses success, which leads to an important factor in determining loan approval decisions by banks and application decisions by the owner.
- Characteristics of owners include age, education and experience of an owner. Education and experience of a business owner are considered determinants of human capital and therefore increases in these variables would decrease the probability of denial, a priori (Knaup & Piazza, 2007).
- Characteristics of creditworthiness presented by D&B credit score and whether an owner owns a home. A higher credit score is clearly important

to lenders¹ and more and more banks use credit scoring in their underwriting practices. Homeownership is an indicator of wealth which can be used as collateral for loans.

- Characteristics of finances include equity capital, return on assets (ROA) and leverage ratios (long and short term debt to assets), bank-borrower relationships and whether a firm is family-owned. Financial and income statement information helps lenders identify whether or not a loan applicant is financially sound. This is one way for lenders to overcome informational asymmetries. Another way is “relationship lending” based on how long the applicant has maintained a sound relationship with the lender.

Finally, the Levenson and Willard (2000) model analyzes the effect of long-run rationing (that is firms that are always denied) on firms’ decision to apply. The authors argue that if a firm gets a loan after waiting a certain period of time, it is considered non-rationed⁹. However, in this paper, we classify firms as rationed if they are always denied for a loan or sometimes denied and sometimes approved. Since our focus here is to determine if credit rationing is a form of discrimination based on owner’s race and/or gender, we are not concerned with measuring the extent of credit rationing at one point in time, and it allows us to include a larger number of firms in the sample.

⁹ See Levenson and Willard (2000) for a detailed discussion of duration effect of rationing on p.85.

SECTION 4.2 HYPOTHESES

In order to determine if there is any systematic difference between women- and men-owned firms and between white- and minority-owned firms in access to credit, we test the following hypotheses. It should be noted that we assume that information asymmetry exists in lending between borrowers and lenders, and because the lenders cannot raise the interest rate, they have to turn down some loans (type 2 credit rationing). If lenders ration credit purely on a random basis, then on average, we should have the same probability of denial regardless of business owners' gender and/or race.

The first test of neutrality involves looking at these average probabilities of loan denial by gender and by race/ethnicity. While we recognize that firms, their owners and their financing characteristics vary widely between women- and men-owned firms and between minority- and white-owned firms, after controlling for a set of explanatory variables that capture these differences, if we reject these two hypotheses, we have evidence that women and minority-owned firms have less access to credit than their male and white counterparts.

H1: Women-owned firms have same average probability of denial as men-owned firms.

$$\overline{\hat{\Pr}(D)}^{women} = \overline{\hat{\Pr}(D)}^{men}$$

H2: Minority-owned firms have the same average probability of denial as white-owned firms.

$$\overline{\hat{\Pr}(D)}^{minority} = \overline{\hat{\Pr}(D)}^{white}$$

The second test of neutrality examines the factors that are significant in banks' loan approval/denial decisions. After controlling for all available information, we look at whether banks' evaluation criteria are the same for all firms. This leads to testing the following hypotheses:

H3a: Banks use the same criteria to evaluate loan applications for women and men-owned firms.

$$\theta_i^{women} \neq 0 \text{ and } \theta_j^{men} \neq 0 \text{ and } i = j$$

H4a: Banks use the same criteria to evaluate loan applications for minority- and white-owned firms.

$$\theta_i^{minority} \neq 0 \text{ and } \theta_j^{white} \neq 0 \text{ and } i = j$$

This is a test of whether women- and minority-owned firms' probabilities of denial are affected by the same control variables as their male and white counterparts.

We can also see whether the economic significance of the variables used by banks to evaluate loan applications is the same for all firms. This suggests testing the following hypotheses:

H3b: The sizes of the coefficients of the control variables on the probability of denial for women-owned firms do not differ from their men-owned counterparts.

$$\theta_i^{women} = \theta_i^{men}$$

H4b: The sizes of the coefficients of the control variables on the probability of denial for minority-owned firms do not differ from their white-owned counterparts.

$$\theta_i^{minority} = \theta_i^{white}$$

In summary, Hypotheses H3-H4 are to determine if banks treat women and minority-owned firms less favorably when evaluating loan applications including whether the signs and magnitudes of the coefficients on variables used for evaluation are the same.

Business owners apply for loans and banks then either approve or deny their requests for credit. However, expectations about the probability of being denied a loan will affect the decision to apply. If a business owner thinks there is a significant probability that her loan will be denied, given the application costs associated with applying for a loan, she may choose not to apply. In order to examine the relationship between loan denial rates and loan application rates, we test the following hypotheses:

H5: Women-owned firms applied for credit at the same rate as men-owned firms.

$$\overline{\hat{\text{Pr}}(\text{Apply})}^{\text{women}} = \overline{\hat{\text{Pr}}(\text{Apply})}^{\text{men}}$$

H6: Minority-owned firms applied for credit at the same rate as white-owned firms.

$$\overline{\hat{\text{Pr}}(\text{Apply})}^{\text{minority}} = \overline{\hat{\text{Pr}}(\text{Apply})}^{\text{white}}$$

In order to see whether or not their relatively higher denial rate negatively affects their loan application rate, we test the following two hypotheses:

H7: Women's probability of denial does not negatively affect their probability of applying.

$$\beta_{Di}^{\text{women}} \geq 0$$

H8: Minority-owned firms' probability of denial does not negatively affect the probability of applying.

$$\beta_{Di}^{\text{minority}} \geq 0$$

These two hypotheses would also tell us whether or not being discouraged from applying for credit is related to the denial rate.

SECTION 4.3 EMPIRICAL RESULTS

Section 4.3.1 Stage 1 Results

The regression results from the 1st stage for women and men-owned firms are shown in Table 4.3.A and for minority and white-owned firms in Table 4.3.B. Bank loan decisions (either approved or denied) were regressed on control variables with intercepts. Then we use the estimated coefficient to calculate the probability of denial for all firms including firms that did not apply (whether or not they needed a loan). We perform a two-sample t-test for means to test whether women and men-owned firms have an equal probability of denial after controlling all explanatory variables¹⁰.

As shown in Table 4.3.A (in the top row) we reject the null hypothesis for H1 because the mean Pr(D) for women is 17.2% and for men is 13.5%. The difference between Pr(D) for men and women is statistically significant. Similarly, when we perform a two-sample t-test for means for minority and white-owned firms, mean Pr(D) are 35.1 % and 11.4% for minority and white owners, respectively (Table 4.3.B, in the top row). Again, we reject H2 because these mean probabilities of denial are not equal. Alternatively, we also apply the delta

¹⁰ We also apply logit transformation since the transformed values are a linear function of parameters which are distributed normally. The hypothesis test results for transformed values do not differ from results presented here.

Table 4.3.A Logit Estimates of Parameters on Probability of Loan Denial for Female and Male-Owned Firms

| Parameter | Female-owned firms | | Male-owned firms | |
|-----------------------------|--------------------|-----------|--------------------|-----------|
| | <i>Pr(D)=17.2%</i> | | <i>Pr(D)=13.5%</i> | |
| | Est. | Std.E. | Est. | Std.E. |
| Intercept | 1.30 | 1.996 | 2.73 | 1.070 *** |
| Log of Sales | -0.11 | 0.104 | -0.20 | 0.062 *** |
| Age of firm – old | 1.81 | 0.759 ** | 0.07 | 0.313 |
| Age of firm – middle | -0.33 | 0.394 | -0.17 | 0.192 |
| Age of firm - adolescent | -0.44 | 0.597 | 0.41 | 0.283 |
| Type - S Corporation | 0.14 | 0.490 | 0.03 | 0.232 |
| Type - C Corporation | -1.03 | 0.658 | 0.13 | 0.258 |
| Type – Partnership | 0.58 | 0.901 | -0.15 | 0.506 |
| Location-rural county | -0.28 | 0.368 | -0.01 | 0.157 |
| Industry – retail | -0.61 | 0.376 | -0.38 | 0.148 *** |
| Industry – services | -0.18 | 0.336 | -0.04 | 0.141 |
| Owner's educ - degree | 0.81 | 0.375 ** | -0.18 | 0.162 |
| Owner's educ - certificate | 0.38 | 0.393 | -0.01 | 0.211 |
| Owner's experience, years | 0.02 | 0.040 | 0.00 | 0.017 |
| Owner's age, years | -0.05 | 0.033 | -0.02 | 0.016 |
| Credit score – 1 | 1.32 | 0.628 ** | 0.97 | 0.247 *** |
| Credit score – 2 | 1.51 | 0.495 *** | 0.05 | 0.295 |
| Credit score – 3 | 0.38 | 0.555 | -0.08 | 0.255 |
| Credit score – 4 | -0.53 | 0.611 | 0.07 | 0.213 |
| Credit score – 5 | -2.11 | 0.972 ** | -0.67 | 0.302 ** |
| No homeownership | -0.21 | 0.415 | 0.35 | 0.184 * |
| Log of Equity | -0.03 | 0.032 | -0.04 | 0.015 ** |
| Return on Asset | -0.04 | 0.043 | 0.01 | 0.041 |
| Long-term debt to assets | 0.12 | 0.072 * | -0.07 | 0.062 |
| Short-term debt to assets | 0.71 | 0.325 ** | 0.04 | 0.173 |
| Relationship w/bank, months | 0.00 | 0.002 | 0.00 | 0.001 * |
| Non-family-owned firm | 0.48 | 0.550 | -0.35 | 0.240 |
| Log Likelihood | -63.96 | | -277.47 | |
| R-square | 0.25 | | 0.09 | |
| Df | 26 | | 26 | |
| Number of observations | 941 | | 202 | |

*, **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, **Bold**, *Bold and Italic* coefficients for women and men are statistically different from each other at the 10, 5, and 1% level.

method to test H1 and H2 since the predicted probabilities are a non-linear function of estimated parameters. In Appendix A, we show a derivation of the delta transformation. The probability of denial for women-owned firms after the

delta transformation would follow a normal distribution with mean of 0.17 and variance of 0.014. For men-owned firms, it is $N(0.13, 0.006)$ so when we perform the two-sample t-test for means, the difference in the probability is still significant. For minority and white-owned firms, the predicted probabilities would follow $N(0.11, 0.012)$ and $N(0.35, 0.006)$, respectively. Therefore, for simplicity, throughout this study we apply two sample t-test for means from the original estimates.

We reject H1 and H2 which indicates women and minority owners have a much higher probability of denial even after controlling all explanatory variables. This suggests our first test of whether or not credit rationing is neutral to gender and race of the business owner has failed. The second aspect of testing whether credit rationing is related to business owners' gender and race involves looking at the individual coefficients. This allows us to analyze what determines the probability of denial for women-owned firms versus men-owned firms, and similarly for minority-owned firms compared to white-owned firms. We perform this analysis in two ways:

- In terms of how parameters affect $\Pr(D)$ differently for women and men-owned firms (also for minorities and white-owned firms).
- In terms of differences on estimated coefficients between women and men-owned firms and between minority and white-owned firms. We used t-test on the estimated coefficients.

In Tables 4.3.A and 4.3.B, we analyze closely what determines banks' loan approval or denial decisions for each individual group of owners: women, men,

Table 4.3.B. Logit Estimates of Parameters on Probability of Bank Loan Denial for Minority and White-Owned Firms

| Parameter | Minority-owned firms | | White-owned firms | |
|-----------------------------|----------------------|----------|--------------------|-----------|
| | <i>Pr(D)=35.1%</i> | | <i>Pr(D)=11.4%</i> | |
| | Est. | Std.E. | Est. | Std.E. |
| Intercept | 4.03 | 2.665 | 2.28 | 0.975 ** |
| Log of Sales | -0.32 | 0.157 ** | -0.14 | 0.052 *** |
| Age of firm – old | 0.30 | 0.964 | 0.27 | 0.296 |
| Age of firm – middle | 0.05 | 0.467 | -0.31 | 0.187 * |
| Age of firm – adolescent | 1.60 | 0.703 ** | -0.02 | 0.297 |
| Type - S Corporation | -0.64 | 0.593 | 0.16 | 0.229 |
| Type - C Corporation | -0.35 | 0.653 | 0.02 | 0.260 |
| Type – Partnership | 0.88 | 1.318 | -0.13 | 0.505 |
| Location-rural county | 0.34 | 0.431 | -0.08 | 0.155 |
| Industry – retail | 0.11 | 0.442 | -0.43 | 0.143 *** |
| Industry – services | -0.05 | 0.330 | -0.01 | 0.143 |
| Owner's educ – degree | 0.11 | 0.386 | -0.03 | 0.160 |
| Owner's educ – certificate | 0.10 | 0.450 | 0.03 | 0.206 |
| Owner's experience, years | -0.02 | 0.041 | 0.01 | 0.017 |
| Owner's age, years | -0.02 | 0.034 | -0.04 | 0.016 ** |
| Credit score – 1 | 1.11 | 0.657 * | 0.95 | 0.252 *** |
| Credit score – 2 | 0.90 | 0.582 | 0.26 | 0.275 |
| Credit score – 3 | -0.65 | 0.600 | 0.18 | 0.245 |
| Credit score – 4 | -0.47 | 0.571 | 0.02 | 0.215 |
| Credit score – 5 | -0.96 | 0.699 | -1.04 | 0.346 |
| No homeownership | -0.64 | 0.416 | 0.50 | 0.174 *** |
| Log of Equity | -0.05 | 0.042 | -0.04 | 0.014 *** |
| Return on Asset | 0.06 | 0.113 | 0.02 | 0.023 |
| Long-term debt to assets | 0.04 | 0.143 | -0.02 | 0.040 |
| Short-term debt to assets | 0.41 | 0.284 | 0.02 | 0.182 |
| Relationship w/bank, months | 0.00 | 0.003 | 0.00 | 0.001 |
| Non-family-owned firm | -0.07 | 0.646 | -0.18 | 0.222 |
| Log Likelihood | -54.79 | | -277.85 | |
| R-square | 0.30 | | 0.08 | |
| Df | 26 | | 26 | |
| Number of observations | 1011 | | 132 | |

*, **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, Bold, Bold and Italic coefficients for women and men are statistically different from each other at the 10, 5, and 1% level.

minorities and white owners. Coefficients with asterisks (three, two or one)

indicate estimated coefficients are statistically different from zero at the 1%, 5%

and 10% level, respectively. In terms of economic significance, these coefficients

show how much log-odds of the probability of denial increase per one unit increase in a variable. For example, the coefficient on credit score of 1 is 1.32 for women-owned firms. This means the log-odds of being denied will increase by 1.32 if a women-owned firm has a credit score of 1 compared to the reference group which is firms with credit score of 6. For women-owned firms, seven variables significantly affect their probability of denial. Six of these seven increase their probability of denial while only one of them, credit score of 5, reduces the probability of denial. For men, it is the opposite: six of the seven variables that have a significant impact on the $\text{Pr}(D)$ and reduce male owners' probability of denial (except credit score of 1). Categorical or dummy variables, such as age of firm, owner's education, etc., indicate that lenders prefer a certain category of borrowers over another category. Therefore, they are not necessarily indicators of less favorable treatment by bank toward women or minority owners. However, increases in two continuous variables, short and long-term debt, will increase women-owned firm's $\text{Pr}(D)$ but not men's. Also, increased sales and equity will decrease men's $\text{Pr}(D)$ but not women's.

Similar asymmetry exists between minority and white-owned firms. In particular, the probability of denial increases for minority owners if a firm's age is 3-4 years old or a firm's credit score is 1, and the probability decreases with higher sales. For white-owned firms, again six out of seven variables reduce this probability, while a credit score of 1 is the only variable that increases the probability of denial. The results lead us to reject the null hypotheses H3a and

H4a, that banks evaluate loan applications in the same way for women and men as well as for minorities and white owners.

In terms of differences in coefficients between women and men and between minorities and white owners, coefficients in bold italic and bold only indicate that estimated coefficients between women and men-owned firms are statistically significantly different from each other at the 1 and 5% level, respectively. Coefficients on firms in the old category, on an owner with college degree, on a credit score of 2 and on long-term debt to assets ratio are significantly different for women-owned firms than men-owned ones. Coefficients on these four parameters are positive and significant for women, which indicates an increase in the denial rate, but this is not so for men.

What is the economic significance of this? For instance, firms with a credit score of 2 have a higher denial rate both for women and men compared to firms with a credit score of 6, which was the excluded group from the regression. However, the size of the coefficient for women is 1.51, which is much higher than men and significant at the 5% level. This means that the log-odds of loan denial increases by 1.51 units for women-owned firms with a credit score of 2 compared to those with a credit score of 6. In probability terms, a credit score of 2 increases the probability of denial by 32% for women-owned firms, given everything else is held constant. A coefficient of 0.05 for men-owned firms would be interpreted as 1% increase in probability of denial. This percentage increase is in relative terms. In other words, let's say the probability of denial were 10% for firms with credit

score 6. Then, all else equal, this probability would increase by 3.2% for women and 0.1% for men if a firm has a credit score 2.

In order to calculate economic significance, we take the exponentiation of log-odds and then convert it in terms of the probability¹¹:

$$\Pr(D) = \frac{e^{\log-odds}}{1 + e^{\log-odds}}.$$

The coefficient on long-term debt to assets ratio is 0.12 for women, which indicates that log-odds of denial would increase by 0.12 per one unit increase in this ratio. This would also mean that the probability of denial would increase by 3% per one percent increase in long-term debt to assets ratio. For men-owned firms, this coefficient is negative but insignificant, indicating a 2% decrease in the probability. In other words, all these differences in coefficients between women and men are statistically and economically significant. Therefore, we reject hypothesis H3b, that impact or the magnitude of a variable on the probability of denial for women and men-owned firms is the same.

In Table 4.3.B, we show the same comparison for minority and white-owned firms. Coefficients on adolescent firms and homeownership show significant differences between minorities and white owners at the 5% level. Minority-owned adolescent firms with an age of 3 to 4 years-old have a higher denial rate compared to their 0 to 2 year-old peers: the log-odds of being denied increases

¹¹ The Logit model calculates log-odds of the probability $D=1$:

$$\ln \frac{\Pr(D=1)}{[1 - \Pr(D=1)]} = \theta_0 + \theta_1 z_1 + \dots + \theta_n z_n + \varepsilon_2.$$

So if we call the right hand side as log-odds, then

we exponentiate both sides to get $\frac{\Pr(D)}{1 - \Pr(D)} = e^{\log-odds}$. This would give us $\Pr(D) = \frac{e^{\log-odds}}{1 + e^{\log-odds}}$

by 1.6. This would be interpreted in probability terms as the probability of denial being raised by 33%. This result is the opposite of what we would expect.

However, it may suggest that banks prefer to finance fresh starts than 3-4 year-old established firms, given everything else is equal. Another unexpected result is found for minority-owned firms. The coefficient on homeownership is negative but insignificant indicating that if a business owner does not own a home, the probability of denial decreases by 16%. For white owners, this coefficient is positive and significant and the difference in the coefficients between minority and white owners is 28%. Therefore, we reject H4b here as well.

Section 4.3.2 Stage 2 Results

For all hypotheses tested in the 2nd stage we use bootstrap standard errors instead of original standard errors. In Table 4.3.C, we see the mean probability of applying for loans for women and men is 32.2% and 44.6%, respectively. Using a two-sample t-test for means, we reject the null hypothesis H5, that female and male owners have the same probability of applying for credit. Similarly, we reject H6 as well because minority-owned firms do not apply for credit at the same rate that white-owned firms do. The mean application rate is 37% and 42.5% (see Table 4.3.D) for minority and white-owned firms, respectively.

Finally we test H7 and H8, to see whether or not a higher probability of denial has a discouraging effect on firms' application rates. In order to smooth out the effect of $Pr(D)$ on the probability of applying, following Levenson and

Table 4.3.C Logit Estimates of Parameters on Probability of Loan Application for Female- and Male-Owned Firms

| Parameter | Female-owned firms | | | Male-owned firms | | |
|---------------------------------|------------------------|--------|-----|------------------------|--------|-----|
| | 2nd stage ^a | | | 2nd stage ^a | | |
| | <i>Pr(A)=32.2%</i> | | | <i>Pr(A)=44.6%</i> | | |
| | Est. | Std.E. | | Est. | Std.E. | |
| Intercept | -4.24 | 0.09 | *** | -4.12 | 0.058 | *** |
| Log of Sales | 0.30 | 0.007 | *** | 0.38 | 0.003 | *** |
| Type - S Corporation | 0.45 | 0.023 | ** | 0.06 | 0.007 | |
| Type - C Corporation | 0.40 | 0.024 | | 0.23 | 0.008 | ** |
| Type – Partnership | -0.33 | 0.06 | | -0.23 | 0.014 | |
| Location-rural county | 0.24 | 0.009 | * | 0.15 | 0.005 | ** |
| Industry – retail | 0.24 | 0.012 | | 0.06 | 0.006 | |
| Industry – services | 0.17 | 0.009 | | 0.11 | 0.004 | * |
| Owner's educ - degree | -0.32 | 0.011 | ** | -0.08 | 0.005 | |
| Owner's educ - certificate | 0.18 | 0.014 | | 0.02 | 0.006 | |
| Owner's experience, years | 0.01 | 9E-04 | | -0.02 | 4E-04 | *** |
| Credit score – 1 | -0.17 | 0.026 | | 0.38 | 0.015 | ** |
| Credit score – 2 | 0.68 | 0.024 | ** | -0.11 | 0.01 | |
| Credit score – 3 | 0.19 | 0.016 | | 0.22 | 0.008 | * |
| Credit score – 4 | -0.11 | 0.015 | | 0.05 | 0.006 | |
| Credit score – 5 | 0.05 | 0.02 | | -0.29 | 0.009 | ** |
| Log of Equity | -0.01 | 0.001 | | -0.02 | 7E-04 | *** |
| Return on Asset | 0.00 | 0.001 | | -0.05 | 0.002 | *** |
| Long-term debt to assets | 0.02 | 0.004 | | 0.00 | 0.003 | |
| Short-term debt to assets | 0.21 | 0.013 | | -0.04 | 0.008 | |
| Relationship w/bank, months | 0.00 | 9E-05 | | 0.00 | 4E-05 | ** |
| Prob(D)-lowest 10th percentile | -256.60 | 10.58 | ** | -3.35 | 0.801 | |
| Prob(D)-middle 80th percentile | 0.10 | 0.099 | | -3.06 | 0.112 | ** |
| Prob(D)-highest 10th percentile | -0.07 | 0.063 | | -1.39 | 0.07 | * |
| Number of observations | 2111 | | | 627 | | |

*, **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, **Bold**, **Bold and Italic** coefficients for women and men are statistically different from each other at the 10, 5, and 1% level, respectively.

^a The bootstrap standard errors are used in all 2nd stage hypotheses.

Willard (2000), we divide the probability of denial into three groups: the lowest 10th percentile, the middle 80th percentile and the highest 10th percentile. A negative and significant coefficient is found for women-owned firms in the lowest 10th percentile, indicating that their higher probability of denial does indeed have a negative impact on their loan application decision. This is statistically significant at the 5% level but economically insignificant. The probability of denial would

Table 4.3.D Logit Estimates of Parameters on Probability of Loan Application for Minority and White-Owned Firms

| Parameter | Minority-owned firms | | | White-owned firms | | |
|---------------------------------|------------------------|--------|-----|------------------------|--------|-----|
| | 2nd stage ^a | | | 2nd stage ^a | | |
| | <i>Pr(A)=37.0%</i> | | | <i>Pr(A)=42.5%</i> | | |
| | Est. | Std.E. | | Est. | Std.E. | |
| Intercept | -3.33 | 0.087 | *** | -5.60 | 0.043 | *** |
| Log of Sales | 0.29 | 0.006 | *** | 0.43 | 0.003 | *** |
| Type - S Corporation | 0.19 | 0.027 | | 0.10 | 0.006 | |
| Type - C Corporation | -0.05 | 0.026 | | 0.25 | 0.007 | ** |
| Type – Partnership | 0.02 | 0.062 | | -0.22 | 0.014 | |
| Location-rural county | 0.25 | 0.019 | | 0.17 | 0.005 | *** |
| Industry – retail | 0.26 | 0.016 | | 0.14 | 0.006 | * |
| Industry – services | -0.15 | 0.012 | | 0.14 | 0.004 | *** |
| Owner's educ – degree | -0.52 | 0.016 | *** | -0.01 | 0.004 | |
| Owner's educ - certificate | 0.50 | 0.016 | ** | -0.02 | 0.006 | |
| Owner's experience, years | -0.03 | 0.001 | ** | -0.01 | 3E-04 | |
| Credit score – 1 | 0.53 | 0.031 | | 0.04 | 0.013 | |
| Credit score – 2 | 0.10 | 0.025 | | 0.11 | 0.009 | |
| Credit score – 3 | 0.20 | 0.022 | | 0.20 | 0.008 | * |
| Credit score – 4 | -0.54 | 0.022 | ** | 0.10 | 0.007 | |
| Credit score – 5 | -0.04 | 0.022 | | -0.18 | 0.01 | |
| Log of Equity | 0.00 | 0.002 | | -0.02 | 6E-04 | ** |
| Return on Asset | 0.00 | 0.004 | | -0.04 | 0.001 | *** |
| Long-term debt to assets | 0.05 | 0.008 | | 0.00 | 0.002 | |
| Short-term debt to assets | 0.30 | 0.018 | ** | -0.02 | 0.009 | |
| Relationship w/bank, months | 0.00 | 1E-04 | | 0.00 | 3E-05 | * |
| Prob(D)-lowest 10th percentile | 13.07 | 1.623 | | 11.98 | 0.928 | |
| Prob(D)-middle 80th percentile | -0.91 | 0.064 | | 0.64 | 0.088 | |
| Prob(D)-highest 10th percentile | -1.48 | 0.067 | * | 0.44 | 0.055 | |
| Number of observations | 2381 | | | 357 | | |

*, **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, Bold, Bold and Italic coefficients for women and men are statistically different from each other at the 10, 5, and 1% level, respectively.

^a The bootstrap standard errors are used in all 2nd stage hypotheses.

decrease by an infinitesimal amount. In other words, the scale for the lowest 10th percentile is very small; therefore, an increase in the Pr(D) by one percent would decrease log-odds of being denied by 256.6. However, the Pr(D) itself is very small -- almost close to zero. This result suggests that women in the lowest 10th percentile did not apply due to conservative behaviors. For minority-owned firms, the highest 10th percentile firms are discouraged from applying, which is what we

would expect a priori. This is statistically significant at the 10% level and is economically significant as well. Therefore, we reject the null hypotheses of H7-H8, that the probability of denial does not have negative impact on women and minority owners' loan application decision.

Section 4.3.3 Robustness Checks: Conditioning the Characteristics of Women-Owned Firms

Our results support what has been found in previous research that women and minority-owned firms have less access to credit, that is higher loan denial rates that in turn lower their loan application rates than do their white and male counterparts. Now we turn to an examination of the why those differences exist, and the extent to which they can be explained by decisions taken by business owners versus the lending practices of banksⁱⁱ.

Many studies (Loscocco, Robinson, Hall, & Allen, 1991; Robb et al., 2002) conclude that women-owned firms tend to be in the services and retail industry, which is less profitable, more competitive, and less growth oriented. Women-owned firms also tend to be younger and smaller than male-owned firms. Fairlie and Robb (2007) find that black-owned firms have less collateral and less wealth to start with when they form their businesses, both of which could account for their relative underperformance compared with white-owned firms. The central question then becomes "Do women and minority-owned firms have less access to credit because they have less desirable characteristics for lenders (smaller,

younger and service and retail oriented) or are they smaller and younger because they have less access to credit?"

We have established differences in access to credit by testing the above 8 hypotheses. In order to try to get at the central question above, we repeated the two-stage model for 5 different sub-samples based on characteristics of women-owned firms: the services and retail industry, young firms (10 years old or younger), small firms by number of employees (3 or fewer), sales (\$110,949.5 or smaller) or profits (\$13,357.5 or smaller) and by assets (\$50,750 or smaller). Each of these was determined by the median characteristics of women-owned firms in our sample¹².

The detailed regression results for these sub-samples are given in Appendices B.1 through B.10. We show the summary of hypotheses H1-H2 and H5-H8 for each sub-sample in Table 4.3.E¹³. Differences in parameters between women and men and between minority and white-owned firms diminish but do not completely disappear. Allison (2004) suggests solutions when the maximum likelihood cannot be reached because there are too few observations. We reclassified the following 3 variables in some sub-samples: age of firms, credit score, and owner's education. In some sub-samples where we cannot make reclassification (such as dummy variables or where reclassification makes no meaningful categories or continuous variables), we excluded the following

¹² Minority-owned firms share the same characteristics as women-owned firms: they tend to be younger and smaller in assets size and tend to concentrate in service and retail sales industries. Therefore, we use the median characteristics of women-owned firms as the cutting point and this enables us to pool 36% to 51% of our sample.

¹³ Note that Hypotheses H3 and H4 have mixed results and are therefore difficult to summarize in this table.

Table 4.3.E Summary of Hypotheses Tests for 5 Sub-Samples

| | H1: $\frac{\hat{Pr}(D)}{\hat{Pr}(D)}^{\text{women}} = \frac{\hat{Pr}(D)}{\hat{Pr}(D)}^{\text{men}}$ | H2: $\frac{\hat{Pr}(D)}{\hat{Pr}(D)}^{\text{min or}} = \frac{\hat{Pr}(D)}{\hat{Pr}(D)}^{\text{white}}$ | H5: $\frac{\hat{Pr}(A)}{\hat{Pr}(A)}^{\text{women}} = \frac{\hat{Pr}(A)}{\hat{Pr}(A)}^{\text{men}}$ | H6: $\frac{\hat{Pr}(A)}{\hat{Pr}(A)}^{\text{min or}} = \frac{\hat{Pr}(A)}{\hat{Pr}(A)}^{\text{white}}$ | H7: $\beta_{Di}^{\text{women}} \geq 0$ | H8: $\beta_{Di}^{\text{min or}} \geq 0$ |
|-----------------------------------|--|---|--|---|---|--|
| | (1) Reject | (2) Reject | (3) Reject | (4) Reject | (5) Do not reject | (6) Do not reject |
| Services and Retail Industry | Reject | Reject | Reject | Reject | Do not reject | Do not reject |
| Young firms (10 years or younger) | Do not reject | Reject | Reject | Do not reject | Reject | Do not reject |
| Small firms by employment | Do not reject | Reject | Reject | Do not reject | Do not reject | Do not reject |
| Small firms by sales or profits | Do not reject | Reject | Reject | Do not reject | Do not reject | Do not reject |
| Small firms by asset size | Reject | Reject | Reject | Do not reject | Do not reject | Reject |

variables: family ownership, type of a firm, whether a firm is located rural or urban area, and short term debt to assets.

From Table 4.3.E in column 1, we see that if a woman owns a firm in the services and retail industry or a smaller firm by asset size, then she has a higher denial rate than the men-owned firms in the same sub-sample. The difference in the denial rate is 5.2% and 3.4% respectively and they are statistically significant at the 1% and 10% levels, respectively. For other sub-samples, women-owned firms have the same denial rates as men-owned firms; therefore, we have mixed results for H1 hypothesis. On the other hand, minority-owned firms have systematically higher denial rates than white-owned firms in all sub-samples (see column 2 of Table 4.3.E). The differences in the average probability of denial between minority and white-owned firms range from 22.7% to 36.3% and these are all statistically and economically significant. Thus we reject H2, that minority-owned firms have the same denial rate as white-owned firms.

Women-owned firms are found to have consistently lower application rates despite the fact that in some cases they have the same denial rates as men. Thus we reject H5 in column 3 as well. Then we looked at whether lower application rates are affected by the denial rate. In column 5, this was not the case except for young firms in which case women actually had a lower denial rate. Therefore, we fail to reject H7 and conclude that women may be rationing themselves rather than being rationed by lenders. Minority-owned firms show the opposite result. Despite their high denial rates, they apply at the same rate as white-owned firms with the exception of the services and retail industry

(column 4). Their application rates are not affected by the denial rate (column 6). The exception includes small minority-owned firms measured by the size of their assets; therefore we reject both H6 and H8. In summary, using different subsamples, we look to see if the results we obtained in stages I and II continue to hold. The results show that in three out of five cases, women no longer have higher loan denial rates. Despite this fact, women consistently apply for credit at a lower rate than men, indicating that women may be rationing themselves. Minority-owned firms, however, have persistently higher loan denial rates than white owners but they apply for loans at the same rate as their white counterparts. This result is consistent with previous studies which find evidence that black-owned firms have less access to credit because of prejudicial lending practices of banks.

SECTION 4.3 CONCLUSIONS AND IMPLICATIONS

Recent rapid rates of growth of small businesses owned by women and minorities have focused the attention of researchers on gender and race issues in this sector. Recent research has shown that despite this rapid growth, women and minority-owned business tend to under-perform compared with their white and male counterparts on a number of traditional performance measures. They tend to be smaller (both in terms of sales and number of employees), more heavily concentrated in the less profitable sectors of the economy; services and retail sales, they experience slower growth, and they tend to be less profitable overall. These findings have prompted researchers to explore possible causes of this relative underperformance.

Given the importance of access to credit for small businesses, in particular bank credit, evidence that women and minority-owned business have less access to credit than their male and white counterparts has prompted some researchers to examine this as a possible factor in explaining their relative underperformance. Evidence suggests that women and minority-owned businesses have higher loan denial rates, lower application rates, and if approved for loans receive smaller loan amounts than male and white-owned businesses. In a world of asymmetric information and imperfect capital markets, where credit rationing is believed to exist, an important research question has been to determine whether banks ration credit on the basis of the gender and/or race of business owners, and if so, if this is the result of prejudicial lending practices on the part of banks. The purpose of this chapter is to contribute to the literature on this question.

This chapter extends a model of credit rationing developed by Levenson and Willard (2000) which includes discouraged borrowers in the study of credit rationing based on the gender and race/ethnicity of business owners. Including borrowers who don't apply for loans because they fear rejection is important because they are estimated to be a significantly large group and their exclusion from previous studies looking at gender and race/ethnic differences has been recognized as a source of sample selection bias. The inclusion of these borrowers in our analysis recognizes that their need for credit is not zero and the probability of loan denial can be used as a more reasonable proxy for (type 2) credit rationing.

Using data from the 2003 Survey of Small Business Finances we estimate the probability that a firm is credit rationed. Then using the estimated probability, we examine whether credit rationing is neutral with respect to the gender and/or race of the business owners. We also analyze whether or not credit rationing has a discouraging effect on women and minority owners' loan application decisions. We find women and minority-owned firms indeed have higher denial rates and lower application rates than their male and white-owned counterparts. This result suggests credit rationing is not gender and race neutral. This higher probability of rationing has a discouraging effect for women in the lowest 10th percentile and for minority owners in the highest 10th percentile. Furthermore, using the same procedure, we examine whether or not this non-neutrality of credit rationing is due to characteristics of a firm and owner rather than the owner's gender and race/ethnicity.

The results suggest that credit rationing for women-owned businesses may have more to do with the characteristics of these businesses and women business owners rationing themselves rather than the result of prejudicial lending on the part of banks. This is consistent with previous research. Future research will need to focus on why women choose not to apply for credit at the same rate as men. It is possible that they are more risk averse than their male counterparts (Jianakoplos & Bernasek, 1998) and this makes them less likely to want to take on debt in the financing of their businesses. A study by Sullivan et al. (1998) found that women were less interested than men in relationship banking as they faced such tight time constraints from home and family responsibilities in addition

to business responsibilities. They also found women were more likely to say they preferred using their credit cards to having to deal with a bank. From a public policy perspective, finding ways to improve women's access to business credit under reasonable terms and conditions could be important for improving the success and growth rates of those businesses.

The results for minority-owned businesses are also consistent with previous research and suggest that credit rationing has less to do with the characteristics of firms and more to do with prejudicial lending practices of banks. Despite their higher probability of loan denial, minority business owners applied for loans at similar rates to white business owners, suggesting that they were not self-rationing but rather were being rationed by lenders and the rationing was discriminatory. The magnitude of the difference in loan denial rates of minority-owned firms compared with white-owned firms is striking. This is consistent with the extensive literature on mortgage lending that finds evidence of discrimination by race. This research did not disaggregate bank lending practices. Future research could look at whether different types of lending such as relationship lending are associated with different probabilities of denial for minority business owners. From a public policy perspective understanding lending practices and whether or not some are more or less discriminatory could help increase access to credit for minority-owned businesses.

One of the limitations of our model is possible omitted variable bias as we have not included information on alternative sources of financing. Another limitation is that our measure of credit rationing will tend to be the upper bound of

true credit rationing for the following two reasons. First, as recognized by Levenson and Willard (2000), it includes both creditworthy and less creditworthy applicants. Second, it includes both “always denied” and “sometimes denied” applicants. Although the data collected through the SSBF are the most comprehensive available, resolving these issues will require access to a more comprehensive data source.

CHAPTER FIVE: DISCOURAGED BORROWERS? PERCEPTIONS OF WOMEN AND MINORITY-OWNED FIRMS

SECTION 5.1 INTRODUCTION

The results from Chapter Four suggest that banks do ration, on average, women and minority-owned firms more than men and white-owned firms. Bank rationing negatively affects the likelihood of applying for women-owned firms in the lowest 10th percentile of the probability of denial, and for minority-owned firms in the highest 10th percentile. The results also reveal that in general women and minority owners have lower application rates than their counterparts. In smaller subsamples, we find women owners may ration themselves by not applying at the same rate as men even when they face the same loan denial rates.

Conversely, we find no differences in the loan application rates between minority and white owners in the subsamples (except services and retail industries) Yet, interestingly, more and more women and minority-owned firms report that they did not apply because of fear of rejection. Thus the purpose of this chapter is to investigate these discouraged borrowers more closely. In both models, we test the above mentioned hypotheses H1-H2, that women and minority owners are rationed by banks at the same rate as men and white owners and H5-H8, the higher probability of denial has a discouraging effect on women and minority owners' decision to apply for a loan.

K. S. Cavalluzzo et al.(2002), using the 1998 SSBF, have found that almost half of the small businesses that needed credit did not apply because they feared rejection. For the 2003 SSBF, about 22 percent of women owners and 29 percent of minority owners reported this, but this number is only 14 percent for men- and white-owned firms. Similar to previous surveys, the 2003 SSBF asked respondents "During the last three years, were there times when [FIRM] needed credit, but did not apply because it thought the application would be turned down?" The total number of respondents who answered "Yes" was 459 of which 259 firms truly had not applied for credit during the last three years at all. This number is almost twice as large those who were denied, which is 139 firms total.

There are only a few studies on credit rationing that analyzed these discouraged borrowers. Kon and Storey (2003), who extend Stiglitz and Weiss's (1981) adverse selection model, develop a theoretical model where they incorporate application costs for borrowers and imperfect screening by banks. They conclude that discouragement is at its maximum when there is some but not perfect information and therefore, government policy should be directed to minimize the discouragement.

Levenson and Willard (2000), who developed this two-stage analysis, argued that the need for credit for these discouraged borrowers is not zero; therefore, it should be included in rationed borrowers as well. Mushinski (1999a) examined preemptively rationed borrowers who did not apply either because of fear of rejection, previous loan application denials, too high transaction costs, interest rates or insufficient collateral.

The literature on gender and /or race studies in the small business credit market excluded these discouraged borrowers with the exception of K.S. Cavalluzzo et al. (2002) who studied unmet credit needs and Robb et al. (2002) who used a dummy dependent variable “Fear” using multivariate analyses. Therefore, this chapter examines these discouraged borrowers to see if their fear was due to the degree of credit rationing practiced by banks. To investigate this we utilize the following two methodologies: first we apply the two-stage process for these discouraged borrowers and second we use a model that incorporates the probabilistic nature of credit rationing.

First, we run the two-stage analysis for a subgroup who expressed their needs for credit. This subgroup includes firms that applied for a loan and firms that answered “yes” to the above question. Basically, this subgroup excludes 1,410 firms (*exactly 50 percent of all firms*) that did not have need for credit perhaps because they had accumulated too much debt before or they were self-sustained.

Second, we adapt a model by Mushinski (1999a, 1999b) in which both banks and firms make joint decisions based on their utility maximization. He argued that in the first best world where there is no market failure, everybody who needs a loan will apply. However, small firms often face information and transaction costs that bar their credit needs, or banks simply turn down their application because of higher transaction and monitoring costs. Therefore, in the second best world or in the real world, these firms do not apply if they think their application will be turned down. Using this model, we estimate women and

minority-owned firms' application decisions and how they are affected by the probability of banks' approval.

SECTION 5.2.RESULTS FOR TWO STAGE LOGISTICS ANALYSIS

The results from the two-stage logit analysis are shown in Table 5.2.A for women and men-owned firms and in Table 5.2.B for minority and white-owned firms. The 1st stage estimated coefficients and their standard errors are exactly the same as they are in tables 4.3.A and 4.3.B and therefore are not shown here. This is because these coefficients are estimated using only firms which applied for a loan.

The only thing that changed here from the 1st stage is the average probabilities of denial. The average probability of denial for women increased to 18.4 percent compared to Chapter Four, whereas for men it decreased to 13.1 percent (see the top row of table 5.2.A). The difference in the mean probability between women and men is widened and it is statistically significant at the 1% level. We reject again the hypothesis H1 that women and men owners have the same average probability of denial.

In the 2nd stage, since the predicted probabilities of denial are skewed to the left, we divide it into three splines that are different from in Chapter Four¹⁴: the lowest 20 percentile, the middle 60 percentile and the highest 20 percentile. The main reason for dividing into three splines is that instead of drawing just one

¹⁴ With the lowest 10th, the middle 80th and the highest 10th percentile, we had non-convergence in the maximum likelihood function because the predicted probabilities are skewed to the left. So we tried splines with 15-35-50, 10-40-50, and 5-45-50 percentiles and had the same error message on non-convergences in maximum likelihood function.

Table 5.2.A. Predicted Average Pr(Deny) and Pr(Apply) for Female and Male-Owned Firms and Logit Estimates of Parameters for Pr(A)

| | Female-owned firms | | | Male-owned firms | | |
|---------------------------------------|--------------------------------|----------------------|-----|--------------------------------|----------------------|-----|
| 1st stage ^a | Pr(D)=18.4% | | | Pr(D)=13.1% | | |
| 2nd stage ^b | Pr(A)=69.4%^d | | | Pr(A)=85.4%^d | | |
| Parameter | Est. | Std. E. ^c | | Est. | Std. E. ^c | |
| Intercept | -4.304 | 0.216 | *** | -1.253 | 0.106 | |
| Log of Sales | 0.293 | 0.018 | *** | 0.221 | 0.007 | *** |
| Type - S Corporation | 0.862 | 0.030 | *** | 0.047 | 0.014 | |
| Type - C Corporation | 0.021 | 0.036 | | 0.801 | 0.022 | *** |
| Type - Partnership | -0.493 | 0.060 | | -0.384 | 0.027 | |
| Location-rural county | -0.003 | 0.021 | | 0.173 | 0.011 | |
| Industry – retail | 0.374 | 0.024 | | -0.187 | 0.013 | |
| Industry – services | 0.361 | 0.019 | * | 0.136 | 0.009 | |
| Owner's educ. – degree | 0.029 | 0.018 | | 0.223 | 0.011 | |
| Owner's educ. – certificate | -0.299 | 0.024 | | -0.275 | 0.013 | |
| Owner's experience, years | 0.016 | 0.002 | | 0.001 | 0.001 | |
| Credit score – 1 | -1.096 | 0.047 | ** | -0.168 | 0.040 | |
| Credit score – 2 | 0.264 | 0.052 | | -0.587 | 0.039 | *** |
| Credit score – 3 | 0.233 | 0.047 | | 0.324 | 0.038 | |
| Credit score – 4 | 0.028 | 0.046 | | -0.246 | 0.035 | |
| Credit score – 5 | 0.744 | 0.059 | | 0.069 | 0.035 | |
| Log of Equity | 0.023 | 0.003 | | 0.033 | 0.001 | ** |
| Return on Asset | 0.003 | 0.004 | | -0.041 | 0.003 | |
| Long-term debt to assets | 0.004 | 0.023 | | 0.101 | 0.007 | |
| Short-term debt to assets | 0.061 | 0.036 | | -0.074 | 0.011 | |
| Relationship w/bank, months | 0.008 | 0.000 | *** | 0.002 | 0.000 | * |
| Pr(D)-lowest 20th percentile | 13.986 | 5.305 | | 44.786 | 2.218 | |
| Pr(D)-middle 60th percentile | 2.228 | 0.552 | | 5.303 | 0.402 | |
| Pr(D)-highest 20th percentile | 0.855 | 0.108 | | -2.162 | 0.068 | *** |
| No. of obs. (Applied vs. discouraged) | 89 | 202 | | 161 | 941 | |

^a 1st stage: Obtained coefficients for 2 separate groups: Women-, and Men-owned firms who applied for bank loans. Then, Probabilities of Denial for all firms in each group are calculated using these coefficients for each group separately.

^b 2nd stage: These Probabilities of Denial are used to predict Probability of Applying for bank loans for each group separately.

^c The standard errors of the 2nd stage Logit parameters are replaced with the bootstrap standard errors with 200 replicates.

^d The standard errors of means of Prob(Apply) for the original sample were 0.015 and 0.005 for women and men-owned firms, respectively. Instead we use the bootstrap SE of 0.0019 and 0.0008, respectively.

***, **, * means that statistically significant at 1 percent, 5 percent and 10 percent, accordingly.

Bold Italic, **Bold** and *Italic* means significant at 1%, 5% and 10%, accordingly when comparing minority- to white-owned firms.

line as a fitted regression, we used three splines to smooth out the fitted regression. The probability of denial has no significant effect on the probability of applying for female-owned firms. Thus we fail to reject the hypothesis H7 that the effect of the probability of denial on the probability of applying is not negative.

Despite this fact, women who expressed their need for credit have, on average, 16 percent lower probability of applying than men. The average probability of applying for women is 69 percent, whereas for men it is 85 percent, and the difference is statistically significant¹⁵. Thus we reject H5 that women and men owners have the same probability of applying.

Table 5.2.B shows results for minority and white-owned firms. In the 1st stage, the average probability of denial for both minority and white-owned firms did not change much from the results in Chapter Four. It is 34.1 percent and 11.8 percent for minorities and whites, respectively. The gap between minority and white-owned firms in the loan denial remained different from zero at the 1% level. We reject hypothesis H2 that banks ration minority-owned firms at the same rate as white-owned firms.

In the 2nd stage, minority owners' decision to apply for a loan is not affected by the higher probability of denial. Therefore we fail to reject H8, that the probability of denial has no negative effect on the probability of applying for minority owners. The average probability of applying is 70.6 percent for minority owners and 83.8 percent for white owners. The difference is significant at the 1% level. This suggests that we reject the hypothesis H6 that minority and white-owned firms apply for a loan at the same rate.

In conclusion, when we exclude firms that did not apply for a loan but did not have fear of rejection, we have stronger evidence that women and minority-owned firms face significantly higher denial rate than their male and white

¹⁵ The predicted probability of applying is much higher than Chapter Four because we include all firms in Chapter Four whereas we exclude in this chapter firms that did not apply and did not have fear of rejection.

Table 5.2.B. Predicted Average Pr(Deny) and Pr(Apply) for Minority and White-Owned Firms and Logit Estimates of Parameters for Pr(A)

| | Minority-owned firms | | | White-owned firms | | |
|-------------------------------------|----------------------------------|----------------------|-----|----------------------------------|----------------------|-----|
| 1st stage ^a | <i>Pr(D)</i> =34.1% | | | <i>Pr(D)</i> =11.8% | | |
| 2nd stage ^b | <i>Pr(A)</i> =70.6% ^d | | | <i>Pr(A)</i> =83.8% ^d | | |
| Parameter | Est. | Std. E. ^c | | Est. | Std. E. ^c | |
| Intercept | -6.099 | 0.379 | *** | -2.421 | 0.092 | *** |
| Log of Sales | 0.465 | 0.027 | *** | 0.235 | 0.007 | *** |
| Type - S Corporation | 0.527 | 0.055 | | 0.281 | 0.014 | |
| Type - C Corporation | -0.128 | 0.082 | | 0.418 | 0.019 | * |
| Type - Partnership | -0.659 | 0.107 | | -0.096 | 0.030 | |
| Location-rural county | -0.032 | 0.049 | | 0.102 | 0.010 | |
| Industry - retail | -0.293 | 0.047 | | 0.017 | 0.012 | |
| Industry - services | -0.361 | 0.040 | | 0.314 | 0.009 | *** |
| Owner's education - degree | -0.132 | 0.047 | | 0.276 | 0.009 | ** |
| Owner's education - certificate | -0.249 | 0.039 | | -0.242 | 0.012 | |
| Owner's experience, years | -0.006 | 0.002 | | 0.019 | 0.001 | * |
| Credit score - 1 | -0.435 | 0.090 | | -0.373 | 0.021 | |
| Credit score - 2 | 0.646 | 0.088 | | -0.236 | 0.016 | |
| Credit score - 3 | 0.411 | 0.070 | | 0.243 | 0.015 | |
| Credit score - 4 | -0.833 | 0.064 | * | -0.033 | 0.014 | |
| Credit score - 5 | -0.189 | 0.079 | | 0.092 | 0.026 | |
| Log of Equity | 0.075 | 0.005 | ** | 0.024 | 0.001 | * |
| Return on Asset | -0.149 | 0.018 | | 0.000 | 0.001 | |
| Long-term debt to assets | 0.362 | 0.031 | * | 0.067 | 0.006 | |
| Short-term debt to assets | 1.044 | 0.071 | ** | -0.145 | 0.013 | |
| Relationship w/bank, months | 0.008 | 0.001 | ** | 0.004 | 0.000 | *** |
| Pr(D)-lowest 20th percentile | 35.475 | 3.669 | | 93.803 | 3.233 | *** |
| Pr(D)-middle 60th percentile | 1.100 | 0.380 | | 6.151 | 0.362 | |
| Pr(D)-highest 20th percentile | -1.092 | 0.116 | | -0.939 | 0.063 | |
| No of obs.(applied vs. discouraged) | 55 | 132 | | 195 | 1011 | |

^a 1st stage: Obtained coefficients for 2 separate groups: Minority and White--owned firms that applied for bank loans. Then, Probabilities of Denial for all firms in each group are calculated using these coefficients for each group separately.

^b 2nd stage: These Probabilities of Denial are used to predict Probability of Applying for bank loans for each group separately.

^c The standard errors of the 2nd stage Logit parameters are replaced with the bootstrap standard errors with 200 replicates.

^d The standard errors of means of Prob(Apply) for the original sample were 0.02 and 0.005 for minority and white-owned firms, respectively. Instead we use the bootstrap SE of 0.002 and 0.0008, respectively.

***, **, * means that statistically significant at 1 percent, 5 percent and 10 percent, accordingly.

Bold Italic, Bold and *Italic* means significant at 1%, 5% and 10%, accordingly when comparing minority- to white-owned firms.

counterparts. This again suggests the banks' credit rationing is not neutral to gender and race of the business owners since we reject both null hypotheses H1 and H2. We find the probability of denial has no significant effect on the probability applying for both women and minority-owned firms. Despite this fact they still have a significantly lower application rates when compared to men and white owners.

SECTION 5.3 LENDER AND APPLICANT JOINT DECISION-MAKING

Section 5.3.1 Empirical Model

This section examines credit rationing for discouraged borrowers using a model that captures joint decision making for firms and lenders. In other words, another way to analyze why borrowers with credit needs do not apply for credit is to distinguish the exact nature of credit rationing (Mushinski, 1999a, p. 89).

Mushinski referred to these borrowers as preemptively rationed (or absolutely rationed) borrowers and claimed that credit rationing arises in this case "because of the probabilistic nature of the loan offer process." His analysis is based on a model he developed (1999b) in which both borrower and lender make their decision based on their utility maximization. He first modeled an economic model that captures this probabilistic loan offer and then he developed an econometric model of such credit rationing.

In the first best world, where there are no information asymmetry and transaction costs, everybody who needs a loan will apply for credit. In the presence of such market failure (second best world), low-wealth applicants will

not apply because they fear that their applications will be rejected. Thus loan applicants consider this likelihood of rejection when they apply for a loan¹⁶. In this section, we adapt his empirical methodology to extend our analyses of credit rationing for women, men, minority and white-owned firms. Therefore, the purpose of this section is to identify if there are any significant differences on the conditional probability of loan offers, that is, banks' loan approval decisions given to firms that applied for credit, between women and men-owned firms and between minority and white-owned firms. This section also examines how this conditional probability affects firms' application decisions and if there is any difference in loan application between women and men and between minorities and white owners.

The econometric model can be written as follows¹⁷. First, firms apply for a loan if they expect a positive utility¹⁸:

$$\alpha \ln(P) + x_1\beta_1 + \varepsilon_1 \geq 0 \quad (5.3.1)$$

$$\text{Then, banks grant the loan if } x_2\beta_2 + \varepsilon_2 \geq 0 \quad (5.3.2)$$

where $P = \text{Prob}(\text{Accept/Apply})$ is the conditional probability of having the application accepted. x_1 and x_2 are firms' characteristics relevant to firms' application and banks' approval decisions, respectively. α, β_1 and β_2 are coefficients, ε_1 and ε_2 are error terms. We assume that ε_1 and ε_2 follow a

¹⁶ For more information, see Mushinski (1999a, 1999b).

¹⁷ For more detailed discussions about the econometric model presented here, see (Mushinski, 1999a, 1999b).

¹⁸ The exact form of the utility function is not important here. For simplicity, we use the above form of a utility function and threshold values.

bivariate normal distribution with correlation coefficient ρ : $(\varepsilon_1, \varepsilon_2) \sim BVN(\rho)$ and the Cumulative Distribution Function is $CDF = \Phi_2(\varepsilon_1, \varepsilon_2, \rho)$.

Then there are 3 possibilities:

1) Firms do not apply if $\alpha \ln(\hat{P}) + x_1\beta_1 + \varepsilon_1 < 0$, which is $\varepsilon_1 < -\alpha \ln(\hat{P}) - x_1\beta_1$ and the probability of not applying is

$$\Pr(\text{Don't Apply}) = \Phi(-\alpha \ln(\hat{P}) - x_1\beta_1) \quad (5.3.3)$$

2) Firms apply and the applications are accepted if $\alpha \ln(\hat{P}) + x_1\beta_1 + \varepsilon_1 \geq 0$ and $x_2\beta_2 + \varepsilon_2 \geq 0$, then the probability of applying and acceptance is

$$\Pr(\text{Apply, Accept}) = \Phi_2(\alpha \ln(\hat{P}) + x_1\beta_1, x_2\beta_2, \rho) \quad (5.3.4)$$

3) Firms apply and the applications are rejected if $\alpha \ln(\hat{P}) + x_1\beta_1 + \varepsilon_1 \geq 0$ and $x_2\beta_2 + \varepsilon_2 < 0$, then the probability of applying and rejection is

$$\Pr(\text{Apply, Reject}) = \Phi_2(\alpha \ln(\hat{P}) + x_1\beta_1, -x_2\beta_2, -\rho) \quad (5.3.5)$$

where \hat{P} is the predicted conditional probability, which we can estimate with

$$\text{probit model: } \hat{P} = \frac{\Pr(\text{Apply, Accept})}{\Pr(\text{Apply})} = \frac{\Phi_2(\alpha \ln(\hat{P}) + x_1\beta_1, x_2\beta_2, \rho)}{\Phi(\alpha \ln(\hat{P}) + x_1\beta_1)} \quad (5.3.6)$$

Then we can write the likelihood function as:

$$\prod_{Y_1} \Phi(-\alpha \ln(\hat{P}) - x_1\beta_1) \cdot \prod_{Y_2} \Phi_2(\alpha \ln(\hat{P}) + x_1\beta_1, x_2\beta_2, \rho) \cdot \prod_{Y_3} \Phi_2(\alpha \ln(\hat{P}) + x_1\beta_1, -x_2\beta_2, -\rho) \quad (5.3.7)$$

where $Y_1=1$, if a firm did not apply and $Y_1=0$ otherwise, $Y_2=1$ if applied and accepted and $Y_2=0$ otherwise; and $Y_3=1$ if applied and rejected and $Y_3=0$ otherwise.

Here we first estimate equation 5.3.6 for those firms that applied for a loan using the probit model. Then we insert the predicted conditional probabilities into equation 5.3.7 to estimate the likelihood function using the bivariate probit model with selection. Since we insert the predicted conditional probability back to the maximum likelihood function, this adds an extra randomness to the likelihood function. Therefore, we repeat bivariate probit regression using the bootstrap method with 200 replications.

Section 5.3.2 Empirical Results

The regression results are shown in Tables 5.3.A and 5.3.B. First we explain results for women and men-owned firms and compare them. Signs and significance levels of the estimated coefficients of the original sample are very similar to the results presented in Chapter Four (not shown here). However, in Table 5.3.A we use the bootstrap standard errors. Most coefficients are statistically significantly different from zero; therefore, we do not explain the individual coefficients. Instead, here we focus on the estimated probability of approval and how it affects the probability of applying.

On average, women have a 79 percent approval rate whereas men have 80 percent, and the difference is insignificant. The higher the probability of approval, the higher the application rate for women. This means also that the lower probability of approval decreases women's application rate, which is a discouraging effect. Despite the fact that the higher denial rate has a discouraging effect on women's likelihood of applying, women owners have 64

Table 5.3.A Results from Bivariate Probit Regressions for Female and Male-Owned Firms

| Parameter | Female-owned firms | | | Male-owned firms | | |
|----------------------------------|---|-----------------|-----|---|-----------------|-----|
| | Estimate | SE ^a | | Estimate | SE ^a | |
| A. Dependent Variable-Apply | <i>Pr(Apply)=0.64^b</i> | | | <i>Pr(Apply)=0.60^b</i> | | |
| Intercept | -2.370 | 0.047 | *** | -3.566 | 0.028 | *** |
| Log of Prob(Approve) | 0.054 | 0.014 | *** | -0.632 | 0.027 | *** |
| Log of Sales | 0.111 | 0.004 | *** | 0.231 | 0.002 | *** |
| Log of Equity Capital | -0.011 | 0.001 | *** | -0.007 | 0.000 | *** |
| ROA | -0.009 | 0.001 | *** | -0.029 | 0.001 | *** |
| Long term debt | 0.008 | 0.002 | *** | 0.003 | 0.002 | |
| Short term debt | 0.134 | 0.007 | *** | -0.022 | 0.004 | *** |
| Type-S Corporation | 0.600 | 0.012 | *** | 0.129 | 0.007 | *** |
| Type-C Corporation | 0.469 | 0.014 | *** | 0.219 | 0.007 | *** |
| Type-Partnership | 0.221 | 0.088 | ** | 0.053 | 0.011 | *** |
| Rural county | 0.300 | 0.010 | *** | 0.161 | 0.006 | *** |
| Industry-Retail | 0.248 | 0.012 | *** | 0.233 | 0.007 | *** |
| Industry-Services | 0.201 | 0.011 | *** | 0.144 | 0.005 | *** |
| B. Dependent Variable-Approve | <i>Pr(Appr/Apply)=0.79^b</i> | | | <i>Pr(Appr/Apply)=0.80^b</i> | | |
| Intercept | 1.068 | 0.188 | *** | -2.666 | 0.099 | *** |
| Log of Sales | -0.056 | 0.007 | *** | 0.152 | 0.006 | *** |
| Age of firm-old (>24 year old) | -1.088 | 0.085 | *** | -0.187 | 0.027 | *** |
| Age of firm-middle age (5-24) | -0.164 | 0.075 | ** | -0.082 | 0.023 | *** |
| Age of firm-adolscnt (3-4 year) | -0.092 | 0.136 | | -0.367 | 0.028 | *** |
| Type-S Corporation | -0.189 | 0.031 | *** | -0.014 | 0.011 | |
| Type-C Corporation | 0.318 | 0.100 | *** | -0.043 | 0.014 | *** |
| Type-Partnership | -0.183 | 0.133 | | 0.098 | 0.089 | |
| Rural county | 0.140 | 0.038 | *** | 0.061 | 0.011 | *** |
| Industry-Retail | 0.328 | 0.032 | *** | 0.430 | 0.011 | *** |
| Industry-Services | 0.176 | 0.027 | *** | 0.064 | 0.011 | *** |
| Owner's Education (degree) | -0.706 | 0.104 | *** | 0.165 | 0.011 | *** |
| Owner's Education (some college) | -0.635 | 0.104 | *** | 0.094 | 0.013 | *** |
| Owner's Experience | -0.010 | 0.001 | *** | 0.000 | 0.001 | |
| Owner's age | 0.021 | 0.001 | *** | 0.009 | 0.001 | *** |
| D&B Credit Score | 0.309 | 0.011 | *** | 0.131 | 0.003 | *** |
| No homeownership | 0.178 | 0.036 | *** | -0.362 | 0.015 | *** |
| Log of Equity Capital | 0.016 | 0.002 | *** | 0.016 | 0.001 | *** |
| ROA | 0.022 | 0.005 | *** | -0.008 | 0.001 | *** |
| Long term debt | -0.065 | 0.015 | *** | 0.034 | 0.002 | *** |
| Short term debt | -0.330 | 0.027 | *** | -0.025 | 0.008 | *** |
| Bank-borrower relationship | 0.000 | 0.000 | | 0.001 | 0.000 | *** |
| Family-owned firm | -0.375 | 0.111 | *** | 0.306 | 0.018 | *** |
| _Rho | -0.99999 | 0.000 | . | 0.294 | 0.560 | |

^a The standard errors are from bootstrapping after 200 replications.

^b For the t-test of means of Prob(Apply) and Prob(Approve/Apply) for women and men-owned firms, we used the bootstrap standard errors.

***, **, * means that statistically significant at 1 percent, 5 percent and 10 percent, accordingly

Bold Italic, Bold and *Italic* means significant at 1%, 5% and 10%, accordingly when comparing minority- to white-owned firms

percent application rate compared to 60 percent for men owners, and this difference is significant at the 1% level.

Now we turn to the results for minority and white-owned firms presented in Table 5.3.B. Similar to table 5.3.A., most of the coefficients for white-owned firms are significantly different from zero, but only the coefficients for the application equations are significant for minority-owned firms. In fact, for minority-owned firms, the estimated coefficients of the conditional probability of approval are all insignificant when we use the bootstrap standard error of 200 replications¹⁹. This is because the nonparametric bootstrap gives us accurate inferences only for a large samples (Efron & Tibshirani, 1993, p. 395). There are only 372 minority-owned firms in the sample and that is the smallest of the four groups we are analyzing here.

The probability of approval for a firm which applies is 76 percent, on average, for minority-owned firms and 73 percent for white-owned firms. This difference is statistically significant at the 1% level. This result shows that minority-owned firms that apply for a loan have a higher probability of approval. This seems the opposite of our previous findings, where minority-owned firms were found to have a lower probability of approval (or a higher probability of denial) than white-owned firms. The difference arises because here we estimate the conditional probability of approval, which excludes firms that did not apply, whereas we estimate unconditional probability in Chapter Four.

¹⁹ We also used the bootstrap standard errors of 1000 replications (not shown here). The result did not vary at all. That is, the individual coefficients are not different from zero with the bootstrap standard error.

Table 5.3.B. Results from BiVariate Probit Regression for Minority and White-Owned Firms

| Parameter | Minority-owned firms | | | White-owned firms | | |
|----------------------------------|----------------------------------|-----------------|-----|----------------------------------|-----------------|-----|
| | Estimate | SE ^a | | Estimate | SE ^a | |
| A. Dependent Variable-Apply | Pr(Apply)=0.61 ^b | | | Pr(Apply)=0.61 ^b | | |
| Intercept | -2.346 | 0.039 | *** | -3.212 | 0.028 | *** |
| Log of Prob(Approve) | 0.241 | 0.011 | *** | -0.274 | 0.022 | *** |
| Log of Sales | 0.144 | 0.003 | *** | 0.205 | 0.002 | *** |
| Log of Equity Capital | -0.001 | 0.001 | | -0.010 | 0.000 | *** |
| ROA | -0.002 | 0.002 | | -0.022 | 0.001 | *** |
| Long term debt | 0.039 | 0.004 | *** | 0.002 | 0.001 | |
| Short term debt | 0.132 | 0.010 | *** | -0.002 | 0.004 | |
| Type-S Corporation | 0.188 | 0.015 | *** | 0.210 | 0.006 | *** |
| Type-C Corporation | 0.000 | 0.015 | | 0.299 | 0.007 | *** |
| Type-Partnership | 0.161 | 0.041 | *** | 0.067 | 0.012 | *** |
| Rural county | 0.081 | 0.020 | *** | 0.188 | 0.005 | *** |
| Industry-Retail | 0.309 | 0.017 | *** | 0.181 | 0.007 | *** |
| Industry-Services | -0.118 | 0.012 | *** | 0.195 | 0.005 | *** |
| B. Dependent Variable-Approve | Pr(Appr/Apply)=0.76 ^b | | | Pr(Appr/Apply)=0.73 ^b | | |
| Intercept | 1.206 | 4.850 | | -3.459 | 0.067 | *** |
| Log of Sales | 0.026 | 1.775 | | 0.175 | 0.004 | *** |
| Age of firm-old (>24 year old) | -0.598 | 6.375 | | -0.068 | 0.023 | *** |
| Age of firm-middle age (5-24) | -0.512 | 10.830 | | 0.150 | 0.020 | *** |
| Age of firm-adolscnt (3-4 year) | -0.981 | 11.191 | | 0.047 | 0.023 | ** |
| Type-S Corporation | 0.083 | 7.229 | | -0.029 | 0.013 | ** |
| Type-C Corporation | 0.069 | 3.929 | | 0.051 | 0.014 | *** |
| Type-Partnership | -0.614 | 12.636 | | 0.029 | 0.098 | |
| Rural county | -0.445 | 8.632 | | 0.133 | 0.011 | *** |
| Industry-Retail | -0.338 | 8.351 | | 0.436 | 0.011 | *** |
| Industry-Services | 0.005 | 1.911 | | 0.088 | 0.011 | *** |
| Owner's Education (degree) | -0.041 | 1.628 | | -0.010 | 0.009 | |
| Owner's Education (some college) | -0.015 | 6.884 | | -0.027 | 0.010 | *** |
| Owner's Experience | -0.002 | 0.431 | | -0.004 | 0.001 | *** |
| Owner's age | 0.005 | 0.029 | | 0.013 | 0.001 | *** |
| D&B Credit Score | 0.137 | 0.294 | | 0.131 | 0.004 | *** |
| No homeownership | 0.278 | 7.943 | | -0.426 | 0.016 | *** |
| Log of Equity Capital | 0.015 | 0.197 | | 0.010 | 0.001 | *** |
| ROA | -0.008 | 0.057 | | -0.018 | 0.002 | *** |
| Long term debt | -0.036 | 1.829 | | 0.013 | 0.002 | *** |
| Short term debt | -0.212 | 1.145 | | -0.020 | 0.007 | *** |
| Bank-borrower relationship | -0.001 | 0.050 | | 0.001 | 0.000 | *** |
| Family-owned firm | 0.271 | 6.238 | | 0.123 | 0.028 | *** |
| _Rho | -0.99999 | 0.000 | | 0.661 | 0.458 | |

^aThe standard errors are from bootstrapping after 200 replications.

^bFor the t-test of means of Prob(Apply) and Prob(Approve/Apply) for minority and white-owned firms, we used the bootstrap standard errors.

***, **, * means that statistically significant at 1 percent, 5 percent and 10 percent, accordingly

Bold Italic, **Bold** and *Italic* means significant at 1%, 5% and 10%, accordingly when comparing minority- to white-owned firms

The probability of approval affects positively firms' likelihood of applying for minority-owned firms. This again indicates that a higher denial rate has a discouraging effect on the application decision for minorities. Finally, the estimated probability of applying is 61 percent for both minority and white-owned firms.

To conclude, we fail to reject the null hypotheses of H1 and H2 which state that banks do not ration women and minority-owned firms more. This result seems contrary what we have found previously. However, what we are examining here is different. The main finding here is that for those who applied for a loan, women and men have an equal probability of approval. This result, in fact, is consistent with findings in the previous studies that conclude there is no difference between women and men-owned firms (Mitchell & Pearce, 2005; Robb et al., 2002) because they examined only firms that applied for a loan. Since we estimate the conditional probability here for those who actually applied, this could explain the difference in results when compared to our previous findings.

For minority-owned firms, we find a 3 percent higher approval rate than white-owned firms, which indicates that again among those who applied for a loan, minority-owners have better a chance to get it approved. However, this fact combined with the fact that the probability of approval has a positive effect on the probability of applying for both women and minority owners suggest that women and minority owners apply for a loan only when they perceive themselves as good borrowers.

SECTION 5.4 CONCLUSIONS

This chapter examines type 2 credit rationing for discouraged borrowers a little more closely. In order to do that, here we exclude borrowers who would not apply for a loan anyway either because they had accumulated too much debt in the past or for whatever reason they don't need a loan. By removing these firms, we want to see how the relationship between the probability of denial and the probability of applying changes. This is to test whether borrowers' perception of fear of rejection of their loan application is realistically in line with banks' actual approval or denial decisions. Our results from the two-stage model confirms the results from the previous chapter that women and minority-owned firms have 5.3 and 12.3 percent, respectively, higher loan denial rates than their male- and white-owned counterparts. Although the higher probability of denial has no discouraging effect on their probability of applying for women and minority owners, they still apply for a loan at a significantly lower rate than their counterparts.

Lastly, we estimate the conditional probability of approval and maximize utilities for both banks and borrowers using a bivariate probit model. Here we find seemingly contradicting results that women-owned firms have higher application rates and minority-owned firms have higher approval rates. This result simply means that minority owners who apply for credit have a higher probability of loan approval, perhaps because only those with a higher quality apply. We also find that a lower approval rate has a discouraging effect on the application decision for both women and minority owners.

CHAPTER SIX: LOAN SIZE AND CREDIT RATIONING BY GENDER AND RACE

SECTION 6.1 INTRODUCTION

In the previous two chapters, we examine a comprehensive study of type 2 credit rationing that includes discouraged borrowers, to investigate whether credit rationing is related to gender and/or race of small business owners. Using the same dataset, the 2003 (SSBF), this chapter examines type 1 credit rationing and the loan amount to see whether women and minority-owned firms are more likely to be type 1 rationed, how the loan amount is determined, and whether there is a bias in the approved loan amount based on a borrower's race and/or gender. This is another way to examine whether banks treat women and minority-owned firms differently than men and white-owned firms.

There are only a few studies examining type 1 credit rationing. Allen (1987) surveys the credit rationing phenomenon and answers why equilibrium credit rationing exists and its implications on the microeconomic theory of banking firms. Since the price mechanism (interest rates) is ineffective in allocating capital, lenders use non-price elements "such as past experience, reputation, collateral and other forms of borrower self-insurance" (Allen, 1987, p. 2) to decide who gets a loan and how much. De Mesa and Webb (1992) show the existence of type 1 credit rationing as a result of capital market efficiency. They developed a theoretical model in which even if information were not

asymmetric, the equilibrium credit rationing is characterized by a loan size that is well below the bankruptcy level. This is because of limited-liability debt contracts, lenders' rationing depends on a project's risk but projects with intermediate risks are the most biased against.

A related concept to type 1 credit rationing is "credit ceiling" which is examined by Fender and Sinclair (2000). They define credit ceiling as lenders' unwillingness "to finance an investment project optimally". They show what determines credit ceiling when there is a credible threat to bankruptcy, in which case the contract may be renegotiated.

Freel (2007) examines exclusively type 1 credit rationing for small innovative firms using 256 firms from the UK. His results show that small innovative firms are more likely to be type 1 rationed than their less innovative counterparts. He also finds faster growing firms and older firms are more likely to be rationed, while larger firms and exporters are less likely to be type 1 rationed. He concludes that while a little innovation is desirable, too much innovation signals to banks a risky project.

Finally, Treichel and Scott (2006) use three surveys for U.S small firms to examine loan application rates, loan denial rates and loan amount by gender of the business owners. These surveys were conducted by the National Federation of Independent Business in 1987, 1995 and 2001. They find that women-owned businesses are less likely to apply for a bank loan and if approved, they are more likely to receive a smaller loan. They conclude that the results could be due to

omitted variable biases such as ownership control, fear of rejection, and lender-borrower relationship.

SECTION 6.2 METHODOLOGY AND HYPOTHESES

By definition, type 1 rationing occurs when a borrower receives smaller amount than he/she requested. We examine type 1 credit rationing in two ways. First, we estimate the probability of type 1 rationing and compare the probability for female and minority-owned firms with their male and white-owned counterparts. Second, we estimate the loan amount using a simultaneous equation model to investigate whether or not there exists a bias against women and minority-owned firms in the approved loan amount.

Section 6.2.1 Type 1 Rationing by Gender and Race of Business Owners

We use a probit model to estimate the probability of type 1 rationing for those firms that applied for a loan. We classify borrowers as type 1 rationed if they receive less than they requested. Then we use the estimated coefficients to calculate the probability for those firms that did not apply for a loan. This method includes discouraged borrowers (those firms that did not apply for a loan because of fear of rejection) and is adapted from Levenson and Willard (2000). We estimate the probability using the following equation:

$$\Pr(\text{Type_1_Rationed} = 1) = \alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon \quad (6.2.1)$$

where α and β are unknown parameters, x_1, x_2, \dots, x_k are explanatory variables relevant to banks' loan approval decisions and ε is a random error. In order to capture differences between women and men and between minority and white owners properly, we did not use just a dummy variable for gender and/or race. Instead we run this equation separately for women, men, minority and white-owned firms to estimate the parameters first. Then we use the parameters to calculate the probability of type 1 rationing for all firms (including discouraged borrowers). We then compare the probability of women to men and for minority with white-owned firms to test the following hypotheses:

H9: Women and men owners face the same probability of type 1 rationing.

H10: Minority and white owners face the same probability of type 1 rationing.

If we reject this hypothesis, it is possible that banks' use a bias based on gender and/or race of the business owners when they grant loans.

Section 6.2.2 Loan Size by Gender and Race of the Business Owners

Measuring type 1 credit rationing in this way is very subjective. Borrowers who receive a few hundred dollars less are treated the same as borrowers who receive a few thousand or million dollars less. Therefore, we analyze the actual loan amounts using a model developed by Hanley & Girma (2006). Their 2SLS method can be written as follows. We first estimate the predicted values of interest margin and approval decision using instrumental variables.

$$i = \alpha_1 + Z' \beta_1 + X \gamma_1 + \varepsilon_1, \quad (6.2.2.1)$$

$$\Pr(\text{Approval} = 1) = \alpha_2 + Z' \beta_2 + X \gamma_2 + \varepsilon_2 \quad (6.2.2.2)$$

where Z is a vector of instruments, X is orthogonal variables that also entered in a loan amount, α , β , and γ are coefficients and ε_1 and ε_2 are non-stochastic error terms.

Then the predicted values of interest margin and approval decision are used as determinants of loan amount.

$$\text{Log}(\text{loan}) = \alpha_3 \text{Estimated}_i + \alpha_4 \text{Pr}(\text{Approval}) + X\gamma_3 + \varepsilon_3, \quad (6.2.2.3)$$

where ε_3 is a stochastic error term.

Here we investigate the effect of loan approval and interest rate on the size of loan and how the loan amounts vary among different groups of borrowers.

We test the following hypotheses:

H11: The size of loans granted is the same regardless of the gender of the business owner.

H12: The size of loans granted is the same regardless of the race of the business owner.

If we reject this hypothesis, then it is further evidence that banks use a bias against women and minority-owned firms.

SECTION 6.3 RESULTS

Section 6.3.1 Results for Type 1 Rationing

First, we explain results from probit estimation for type 1 rationing in Table 6.3.A²⁰. For female-owned firms, higher sales decrease the probability of getting

²⁰ Due to too few observations for women and minority-owned firms that are classified as type 1 rationing, we are unable to use all variables described in Table 4.1. Namely, we reclassify credit score in two categories: low and average or above the average score. We exclude firm's age and type of a firm from the probit regression.

smaller loan than requested; whereas the coefficient for women with some education and non-family-owned firms indicate that these firms have significantly higher probability of type 1 rationing. Using the estimated coefficients, we calculate the probabilities of type 1 rationing for all women-owned firms. The average of these probabilities is 9.8 percent (the top row) with standard deviations 16.4. For men-owned firms, the more experienced the owner is the less likely the firm is rationed. Also, firms with above average credit score face significantly lower probability of rationing. On average, men's probability of being rationed is 6.5 percent with standard deviation 4.3. When we compare these average probabilities using two-sample mean, women have significantly higher probability of being rationed than men-owned firms; therefore we reject H9.

Minority-owned firms in non-retail industry have a lower probability of type 1 rationing and it is significant at 5% level. For white-owned firms, being in a rural area, longer experience of the owner, an above average credit score and higher short term debt significantly reduce the probability. The average probability of type 1 rationing for minority-owned firms is 20.3 percent and for white-owned firms, it is 6.3 percent. The difference is statistically significant and we reject H10.

This result indicates women and minority-owned firms have, on average, a higher probability of type 1 rationing than their male and white-owned counterparts. The difference between minority and white-owned firms is much higher than the difference between women and men-owned firms, which is

Table 6.3.A Probit Estimates of Parameters on Probability of Type 1 Rationing

| Parameter | Female-owned firms | | Male-owned firms | | t-test between women and men | | Minority-owned firms | | White-owned firms | | t-test between minorities and whites | |
|-------------------------------|--------------------|-------------|------------------|--------------|------------------------------|-------|----------------------|-------------|--------------------------|-------------|--------------------------------------|--------|
| | Est. | Std.E. | Est. | Std.E. | <i>Pr(Rationed)=6.5%</i> | | Est. | Std.E. | <i>Pr(Rationed)=6.3%</i> | | Est. | Std.E. |
| Intercept | 0.23 | 1.40 | -1.31 | 0.63 | ** | 1.00 | 0.13 | 1.72 | -1.29 | 0.58 | ** | 0.78 |
| Log of Sales | -0.15 | 0.06 | *** | 0.04 | | -1.83 | -0.11 | 0.12 | -0.04 | 0.03 | | -0.58 |
| Location-rural county | -1.05 | 0.70 | | 0.21 | | -1.02 | -0.27 | 0.73 | -0.44 | 0.21 | ** | 0.22 |
| Industry – nonretail | 0.01 | 0.52 | | 0.13 | 0.21 | -0.21 | -1.32 | 0.65 | 0.23 | 0.21 | | -2.27 |
| Industry – non-service | 0.63 | 0.55 | | 0.02 | 0.17 | 1.04 | -0.52 | 0.52 | 0.23 | 0.17 | | -1.35 |
| Owner's educ. – degree | -0.24 | 0.51 | | -0.07 | 0.18 | -0.30 | -0.50 | 0.52 | 0.02 | 0.18 | | -0.95 |
| Owner's educ. – certificate | 1.26 | 0.51 | *** | -0.17 | 0.25 | 2.51 | 0.35 | 0.55 | 0.09 | 0.24 | | 0.44 |
| Owner's experience, years | -0.04 | 0.03 | | -0.02 | 0.01 | -0.71 | -0.01 | 0.03 | -0.02 | 0.01 | ** | 0.36 |
| Owner's age, years | 0.01 | 0.02 | | 0.01 | 0.01 | 0.03 | 0.04 | 0.03 | 0.01 | 0.01 | | 0.95 |
| Credit score-average or above | -0.06 | 0.38 | | -0.36 | 0.15 | 0.72 | 0.23 | 0.44 | -0.44 | 0.15 | *** | 1.44 |
| No homeownership | -0.86 | 0.74 | | -0.04 | 0.30 | -1.03 | -0.50 | 0.73 | -0.22 | 0.34 | | -0.35 |
| Log of Equity | -0.02 | 0.04 | | 0.00 | 0.01 | -0.59 | 0.02 | 0.03 | 0.00 | 0.01 | | 0.56 |
| Return on Asset | -0.03 | 0.08 | | -0.01 | 0.04 | -0.22 | 0.12 | 0.14 | -0.03 | 0.04 | | 0.98 |
| Long-term debt to assets | -0.53 | 0.54 | | -0.05 | 0.08 | -0.89 | -0.17 | 0.22 | -0.06 | 0.09 | | -0.48 |
| Short-term debt to assets | -0.86 | 0.92 | | -0.44 | 0.35 | -0.42 | 0.02 | 0.32 | -0.68 | 0.39 | * | 1.36 |
| Relationship w/bank, months | 0.00 | 0.00 | | 0.00 | 0.00 | 0.55 | 0.00 | 0.00 | 0.00 | 0.00 | ** | -1.11 |
| Non-family-owned firm | 1.63 | 0.82 | ** | 0.14 | 0.21 | 1.76 | -0.30 | 0.65 | 0.34 | 0.21 | | -0.92 |
| Log Likelihood | -29.75 | | -185.80 | | | | -30.50 | | -183.86 | | | |
| No. of observations | 178 | | 876 | | | | 105 | | 949 | | | |

* **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, and **Bold** coefficients for women and men are statistically different from each other at the 10 and 5% level.

consistent with findings from previous studies, where they find persistent evidence against black-owned firms. Knowing that women and minorities have a higher probability of rationing than their counterparts, we now turn to loan amount analysis.

Section 6.3.2 Results for Loan Size

The results from the 2SLS model are shown in Tables 6.3.B and 6.3.C for women and men-owned firms. First, we explain the interest rate equation in 6.2.1. Homeownership and an increase in equity capital significantly reduce the interest rate for both women and men-owned firms. These two are the only significant determinants of the interest rate for women-owned firms at the 5% and 10% level, respectively. For men-owned firms, an increase in sales, an owner's age and experience also reduce the interest rate. In addition, men owners with a degree get significantly lower interest rates than men with a high school diploma. The only determinant that increases the interest rates for men-owned firms is being in non-services industry. The result indicates that men owners in the services industry are given a 55 basis point lower interest rate compared to men in other industries, and it is significant at the 1% level. This is perhaps because the loan purpose or credit terms for firms in the services industry are completely different than those of the other industries; therefore, they pay lower interest rates. Contrary to what we expect, credit score did not have any significant effect on interest rate either for women-owned firms or for men-owned ones.

Table 6.3.B Result of 2SLS Method for Women-Owned Firms

| Variable | Women-Owned firms | | | |
|-----------------------------------|---------------------------------|-------|-----------|-------|
| | Interest Rate | | Approved | |
| | Estimate | SE | Estimate | SE |
| Intercept | 8.550 *** | 2.561 | 0.742 *** | 0.191 |
| Log of Sales | -0.078 | 0.126 | -0.003 | 0.009 |
| Rural county | -0.836 | 0.622 | 0.013 | 0.046 |
| Industry-nonretail | -0.843 | 0.751 | -0.076 | 0.056 |
| Industry-non-service | 0.684 | 0.613 | 0.013 | 0.046 |
| Non-family-owned firm | 1.258 | 1.174 | 0.058 | 0.088 |
| Age of firm-old (>24 year old) | -0.228 | 1.496 | -0.129 | 0.112 |
| Age of firm-middle age (5-24) | -0.425 | 1.117 | -0.030 | 0.083 |
| Age of firm-adolescent (3-4 year) | 0.450 | 1.324 | 0.059 | 0.099 |
| Type-S Corporation | -0.735 | 0.729 | -0.049 | 0.054 |
| Type-C Corporation | -1.114 | 0.887 | -0.005 | 0.066 |
| Type-Partnership | -0.974 | 1.805 | 0.057 | 0.135 |
| Owner's Education (degree) | -0.076 | 0.621 | -0.081 * | 0.046 |
| Owner's Education (some college) | 0.668 | 0.768 | -0.067 | 0.057 |
| Owner's Experience | -0.033 | 0.035 | 0.001 | 0.003 |
| Owner's age | 0.028 | 0.031 | 0.002 | 0.002 |
| D&B Credit Score | 0.114 | 0.179 | 0.023 * | 0.013 |
| Homeownership | -1.778 ** | 0.884 | 0.047 | 0.066 |
| Log of Equity Capital | -0.067 * | 0.034 | 0.006 ** | 0.003 |
| ROA | 0.107 | 0.091 | 0.003 | 0.007 |
| Long term debt | 0.055 | 0.110 | 0.008 | 0.008 |
| Short term debt | 0.018 | 0.508 | -0.001 | 0.038 |
| Bank-borrower relationship | -0.003 | 0.003 | 0.000 | 0.000 |
| # of observations | 177 | | 875 | |
| R-square | 0.203 | | 0.156 | |
| Pr>F | 0.021 | | 0.178 | |
| Variable | Log(Loan)-2 nd stage | | | |
| | Estimate | SE | | |
| Intercept | 8.515 *** | 1.706 | | |
| Log of Sales | 0.284 *** | 0.053 | | |
| Interest rate (instrumented) | -0.300 *** | 0.089 | | |
| Approved (instrumented) | 0.801 | 1.213 | | |
| # of observations | 177 | | | |
| R-square | 0.319 | | | |
| Pr>F | <.0001 | | | |
| Test for overidentification | 0.334 | | | |
| F value | 1.12 | | | |

***, **, * means that statistically significant at 1%, 5% and 10%, respectively

Bold Italic, **Bold** and *Italic* means significant at 1%, 5% and 10%, respectively when comparing to men-owned firms

Table 6.3.C Result of 2SLS Method for Men-Owned Firms

| Variable | Men-Owned firms | | | | | |
|-----------------------------------|---------------------|-----|-------|----------|-----|-------|
| | Interest Rate | | | Approved | | |
| | Estimate | | SE | Estimate | | SE |
| Intercept | 12.853 | *** | 0.947 | 0.725 | *** | 0.073 |
| Log of Sales | -0.230 | *** | 0.049 | 0.005 | | 0.004 |
| Rural county | -0.012 | | 0.232 | 0.002 | | 0.018 |
| Industry-nonretail | 0.122 | | 0.237 | -0.045 | ** | 0.018 |
| Industry-non-services | 0.553 | *** | 0.209 | 0.009 | | 0.016 |
| Non-family-owned firm | -0.083 | | 0.265 | 0.007 | | 0.020 |
| Age of firm-old (>24 year old) | -0.116 | | 0.490 | -0.032 | | 0.038 |
| Age of firm-middle age (5-24) | -0.387 | | 0.428 | -0.029 | | 0.033 |
| Age of firm-adolescent (3-4 year) | -0.102 | | 0.524 | -0.031 | | 0.040 |
| Type-S Corporation | -0.044 | | 0.255 | 0.042 | ** | 0.020 |
| Type-C Corporation | -0.191 | | 0.277 | 0.015 | | 0.021 |
| Type-Partnership | -0.459 | | 0.516 | 0.045 | | 0.040 |
| Owner's Education (degree) | -0.576 | ** | 0.224 | -0.012 | | 0.017 |
| Owner's Education (some college) | 0.313 | | 0.290 | -0.006 | | 0.022 |
| Owner's Experience | -0.021 | * | 0.012 | 0.000 | | 0.001 |
| Owner's age | -0.021 | * | 0.012 | 0.001 | | 0.001 |
| D&B Credit Score | -0.057 | | 0.060 | 0.011 | ** | 0.005 |
| No homeownership | -1.042 | *** | 0.367 | 0.069 | ** | 0.028 |
| Log of Equity Capital | -0.025 | ** | 0.012 | 0.002 | * | 0.001 |
| ROA | -0.012 | | 0.034 | 0.002 | | 0.003 |
| Long term debt | -0.069 | | 0.044 | 0.003 | | 0.003 |
| Short term debt | -0.015 | | 0.163 | 0.008 | | 0.013 |
| Bank-borrower relationship | 0.000 | | 0.001 | 0.000 | | 0.000 |
| # of observations | 875 | | | 875 | | |
| R-square | 0.150 | | | 0.050 | | |
| Pr>F | <.0001 | | | 0.001 | | |
| Variable | Log(Loan)-2nd stage | | | | | |
| | Estimate | | SE | | | |
| Intercept | 4.398 | *** | 1.839 | | | |
| Log of Sales | 0.417 | *** | 0.037 | | | |
| Interest rate | -0.292 | *** | 0.086 | | | |
| Approved | 3.337 | ** | 1.490 | | | |
| # of observations | 875 | | | | | |
| R-square | 0.374 | | | | | |
| Pr>F | <.0001 | | | | | |
| Test for overidentification | <.0001 | | | | | |
| F value | 3.29 | | | | | |

***, **, * means that statistically significant at 1%, 5% and 10%, respectively

Bold Italic, **Bold** and *Italic* means significant at 1%, 5% and 10%, respectively when comparing to women-owned firms

Then, we explain banks' loan approval decisions in equation 6.2.2. The higher the credit scores the higher the approval rate. The same is true for equity capital for both women and men-owned firms. In addition, women with a degree have a lower loan approval rate than women with a high school diploma. This counter-intuitive result is significant at the 10% level and can be explained by the fact that women-owned firms tend to concentrate in the services and retail industries where higher education is not necessary. For men-owned firms, homeownership and being a firm formed as S-Corporation (as compared to proprietorship) increase chances of approval at the 5% level. However, being in the retail industry reduces the approval rate.

Next, the results for equation 6.2.3 are explained here (the bottom part of Tables 6.3.B and 6.3.C for women and men-owned firms, respectively). All three variables have the expected signs: higher sales increase the loan amount, and higher interest rates lower the loan amount. These results are statistically significant except for women-owned firms where the effect of the approval decision on the size of the loan is not different from zero.

Higher sales increase the loan amount for women-owned firms significantly less than they do for men-owned firms at the 5% level. One unit increase in log of sales would increase log of loan amount by only 0.28 for women-owned firms and by 0.417 for men-owned firms. Finally, we explain the results for our hypothesis testing. The estimated average loan amount for women-owned firms is \$64,126, which is half that of men-owned firms at \$137,555. The difference is statistically significant at the 1% level. Therefore we

reject the null hypothesis H11, that the loan size is the same for women and men-owned firms.

Now we move on to the results for minority versus white-owned firms, which is shown in Tables 6.3.D and 6.3.E. For minority-owned firms, old firms (as compared to infant firms) or firms formed as C-corporation (as compared to proprietorship) or firms with higher sales or equity capital obtain a lower interest rate. Surprisingly, a higher amount of long term debt also lowers the interest rate for minority owners. In addition, owners with a degree or some college education face a higher interest rate than do those with high school diplomas. For white-owned firms, the interest rate is negatively affected by sales, equity capital, owner's experience and education, and homeownership. However, white-owned firms in the non-services industry have 54 basis point higher interests than firms in the other industries.

Banks' approval rate is higher for minority owners with higher equity capital, but they approve fewer loans to old firms compared to infant firms. For white-owned firms, a higher credit score, homeownership and a higher equity increase the approval rate. However, being in a nonretail industry and an owner's degree reduce the probability of approval.

Similar to women and men-owned firms, there exists a negative relationship between the loan amount and the interest rate for both minority and white-owned firms. Also, higher sales significantly increase the loan amount for both minorities and whites at the 1% level. However, a higher approval rate is

Table 6.3.D Result of 2SLS Method for Minority-Owned Firms

| Variable | Minority-Owned firms | | | |
|-----------------------------------|----------------------|-------|---------------|-------|
| | Interest Rate | | Approved | |
| | Estimate | SE | Estimate | SE |
| Intercept | 20.869 *** | 4.207 | 0.548 | 0.367 |
| Log of Sales | -0.403 * | 0.242 | 0.003 | 0.021 |
| Rural county | -0.825 | 1.380 | 0.083 | 0.120 |
| Industry-nonretail | -1.534 | 1.331 | -0.048 | 0.116 |
| Industry-non-services | -0.479 | 0.941 | -0.024 | 0.082 |
| Non-family-owned firm | -1.566 | 1.285 | 0.081 | 0.112 |
| Age of firm-old (>24 year old) | -2.701 | 1.910 | -0.242 | 0.166 |
| Age of firm-middle age (5-24) | -2.162 * | 1.270 | -0.222 ** | 0.111 |
| Age of firm-adolescent (3-4 year) | -1.072 | 1.975 | -0.209 | 0.172 |
| Type-S Corporation | -1.158 | 1.064 | 0.028 | 0.093 |
| Type-C Corporation | -3.275 ** | 1.329 | 0.006 | 0.116 |
| Type-Partnership | -4.391 | 2.765 | 0.033 | 0.241 |
| Owner's Education (degree) | 1.797 * | 1.041 | 0.026 | 0.091 |
| Owner's Education (some college) | 2.546 ** | 1.160 | 0.013 | 0.101 |
| Owner's Experience | 0.006 | 0.056 | -0.002 | 0.005 |
| Owner's age | -0.038 | 0.046 | 0.003 | 0.004 |
| D&B Credit Score | -0.041 | 0.298 | 0.037 | 0.026 |
| No homeownership | -0.221 | 1.390 | -0.064 | 0.121 |
| Log of Equity Capital | -0.117 ** | 0.052 | 0.009 ** | 0.005 |
| ROA | 0.285 | 0.227 | 0.012 | 0.020 |
| Long term debt | -0.672 ** | 0.292 | 0.004 | 0.025 |
| Short term debt | 0.405 | 0.639 | 0.036 | 0.056 |
| Bank-borrower relationship | -0.004 | 0.005 | 0.001 | 0.000 |
| # of observations | 104 | | 104 | |
| R-square | 0.407 | | 0.149 | |
| Pr>F | 0.001 | | 0.868 | |
| Log(Loan)-2 nd stage | | | | |
| Variable | Estimate | SE | | |
| Intercept | 4.100 ** | 1.756 | | |
| Log of Sales | 0.566 *** | 0.070 | | |
| Interest rate | -0.134 ** | 0.064 | | |
| Approved | 0.713 | 1.165 | | |
| # of observations | 104 | | | |
| R-square | 0.595 | | | |
| Pr>F | <.0001 | | | |
| Test for overidentification | 0.189 | | | |
| F value | 1.33 | | | |

***, **, * means that statistically significant at 1%, 5% and 10%, respectively

Bold Italic, **Bold** and *Italic* means significant at 1%, 5% and 10%, respectively when comparing to white-owned firms

Table 6.3.E Result of 2SLS Method for White-Owned Firms

| Variable | White-Owned firms | | | | | |
|-----------------------------------|-------------------|-----|-------|--------------|-----|-------|
| | Interest Rate | | | Approved | | |
| | Estimate | | SE | Estimate | | SE |
| Intercept | 11.282 | *** | 0.887 | 0.715 | *** | 0.068 |
| Log of Sales | -0.203 | *** | 0.044 | 0.003 | | 0.003 |
| Rural county | -0.272 | | 0.209 | 0.002 | | 0.016 |
| Industry-nonretail | 0.039 | | 0.220 | -0.051 | *** | 0.017 |
| Industry-non-services | 0.539 | *** | 0.195 | 0.012 | | 0.015 |
| Non-family-owned firm | -0.013 | | 0.261 | 0.007 | | 0.020 |
| Age of firm-old (>24 year old) | <i>0.648</i> | | 0.484 | -0.009 | | 0.037 |
| Age of firm-middle age (5-24) | <i>0.378</i> | | 0.427 | 0.006 | | 0.033 |
| Age of firm-adolescent (3-4 year) | 0.602 | | 0.509 | 0.021 | | 0.039 |
| Type-S Corporation | -0.056 | | 0.238 | 0.022 | | 0.018 |
| Type-C Corporation | 0.023 | | 0.260 | 0.006 | | 0.020 |
| Type-Partnership | -0.267 | | 0.490 | 0.022 | | 0.038 |
| Owner's Education (degree) | -0.663 | *** | 0.204 | -0.029 | * | 0.016 |
| Owner's Education (some college) | 0.190 | | 0.269 | -0.027 | | 0.021 |
| Owner's Experience | -0.022 | ** | 0.011 | 0.000 | | 0.001 |
| Owner's age | -0.014 | | 0.011 | 0.001 | | 0.001 |
| D&B Credit Score | -0.010 | | 0.056 | 0.012 | *** | 0.004 |
| No homeownership | -1.197 | *** | 0.343 | 0.084 | *** | 0.026 |
| Log of Equity Capital | <i>-0.019</i> | * | 0.012 | 0.002 | ** | 0.001 |
| ROA | 0.017 | | 0.031 | 0.002 | | 0.002 |
| Long term debt | 0.001 | | 0.039 | 0.004 | | 0.003 |
| Short term debt | -0.046 | | 0.157 | 0.009 | | 0.012 |
| Bank-borrower relationship | 0.000 | | 0.001 | 0.000 | | 0.000 |
| # of observations | 948 | | | 948 | | |
| R-square | 0.139 | | | 0.051 | | |
| Pr>F | <.0001 | | | 0.000 | | |
| Log(Loan)-2nd stage | | | | | | |
| Variable | Estimate | | SE | | | |
| Intercept | 6.229 | *** | 1.662 | | | |
| Log of Sales | 0.366 | *** | 0.034 | | | |
| Interest rate | -0.391 | *** | 0.085 | | | |
| Approved | 2.694 | ** | 1.318 | | | |
| # of observations | 948 | | | | | |
| R-square | 0.354 | | | | | |
| Pr>F | <.0001 | | | | | |
| Test for overidentification | 0.0001 | | | | | |
| F value | 3.65 | | | | | |

***, **, * means that statistically significant at 1%, 5% and 10%, respectively

Bold Italic, **Bold** and *Italic* means significant at 1%, 5% and 10%, respectively when comparing to minority-owned firms

related to a higher loan amount for white-owned firms only. This coefficient is positive for minority-owned firms but insignificant.

One unit increase in log of sales increases the log of loan amount by 0.566 units for minority-owned firms but it increases only by 0.366 for white-owners. The difference is significant at the 5% level. A one percent increase in the interest rate reduces the log of loan by 0.134 units for minorities and by 0.391 units for white-owned firms. Finally, the estimated loan amount for minority-owned firms, on average, is \$108,380 and for white-owned firms, it is \$122,350. The difference is statistically not different from zero. This result indicates that although banks use different criteria for setting up the interest rate and for their approval process for minority and white-owned firms, the approved loan amounts are the same for minorities and whites. Thus we fail to reject the hypothesis H12.

Section 6.3.3 Robustness check: Loan Size in the Services and Retail Industries

In this section, we use the above 2SLS method to estimate the loan amount for the services and retail industries and determine how it differs for women and minority owners compared to their male and white counterparts. Here again we hypothesize that the observed difference in the approved loan amount between women and men-owned firms should disappear within certain industries, in this case within the services and retail industries.

We find that women-owned firms in the services and retail industries still receive significantly lower loan amounts than do the men-owned firms. In Table 6.3.F, we compare results from the previous section for all firms that received

loans²¹. Firms in the services and retail industries, in general, receive lower loan amounts compared to other industries.

The average loan amount for women-owned firms in these two industries is \$38,163 versus \$89,751 for men. Therefore, the observed difference between women and men-owned firms did not disappear. On the other hand, there is no difference in the estimated loan amount between minority and white-owned firms in the services and retail industries. On average, minority-owned firms obtain \$69,148 loan and it is \$76,255 for white-owned firms. Therefore, we reject the null hypothesis that women and men-owned firms obtain the same loan amount for services and retail industries but accept the null hypothesis for minority and white-owned firms.

²¹ Detailed regression results for retail and services industries are available upon request from the authors.

Table 6.3.F 2SLS Result Comparison of All Firms with Firms in Services and Retail Industries only

A. All firms

| Female and Male-owned firms | | | | | | | | | | |
|--------------------------------|-------|--------|----------|-----------|-----|--------|----------|-----------|--------|----------------|
| Analysis Variable : Log(Loan) | | | | | | | | | | |
| FEMALE | N Obs | Mean | Std Dev | Std Error | N | N Miss | Minimum | Maximum | Median | Mean \$ amount |
| 0 | 2154 | 11.832 | 1.629088 | 0.054948 | 879 | 1275 | 2.829944 | 15.282628 | 11.997 | 137554.9 |
| 1 | 666 | 11.069 | 1.344064 | 0.10046 | 179 | 487 | 5.257883 | 13.606295 | 11.288 | 64126.39 |
| Minority and White-owned firms | | | | | | | | | | |
| Analysis Variable : Log(Loan) | | | | | | | | | | |
| MINORITY | N Obs | Mean | Std Dev | Std Error | N | N Miss | Minimum | Maximum | Median | Mean \$ amount |
| 0 | 2448 | 11.715 | 1.619793 | 0.052498 | 952 | 1496 | 3.822946 | 15.366355 | 11.822 | 122350.3 |
| 1 | 372 | 11.593 | 1.62812 | 0.158137 | 106 | 266 | 7.464506 | 14.482945 | 11.794 | 108380.7 |

B. Services and Retail Industry

| Female and Male-owned firms | | | | | | | | | | |
|--------------------------------|-------|--------|----------|-----------|-----|--------|----------|-----------|--------|----------------|
| Analysis Variable : Log(Loan) | | | | | | | | | | |
| FEMALE | N Obs | Mean | Std Dev | Std Error | N | N Miss | Minimum | Maximum | Median | Mean \$ amount |
| 0 | 1237 | 11.405 | 1.407006 | 0.067539 | 434 | 803 | 4.523566 | 14.499594 | 11.495 | 89751.39 |
| 1 | 498 | 10.55 | 1.194977 | 0.112915 | 112 | 386 | 5.405173 | 12.908284 | 10.658 | 38163.28 |
| Minority and White-owned firms | | | | | | | | | | |
| Analysis Variable : Log(Loan) | | | | | | | | | | |
| MINORITY | N Obs | Mean | Std Dev | Std Error | N | N Miss | Minimum | Maximum | Median | Mean \$ amount |
| 0 | 1472 | 11.242 | 1.370192 | 0.06254 | 480 | 992 | 5.18826 | 14.21081 | 11.352 | 76255.83 |
| 1 | 263 | 11.144 | 1.278187 | 0.157334 | 66 | 197 | 8.518015 | 13.548682 | 11.174 | 69148.49 |

SECTION 6.4 CONCLUSIONS

In this chapter, we examine whether women and minority owners face a higher probability of being type 1 rationed, how banks determine the loan size, and whether or not there exists a difference in the approved loan amount between women and men-owned firms and between minority and white-owned firms. We find that women face a 3.3 percent higher probability of type 1 rationing than men, and minority owners have a 14 percent higher probability than white-owned firms. Our results indicate that women-owned firms receive significantly lower loan amounts than do men-owned firms. Even within the same industry (services and retail industries in this case), the observed difference in the approved loan amount did not disappear. Minority-owned firms, on the other hand, also receive a lower loan amount than white-owned firms, but the difference is insignificant.

We find evidence that women-owned firms obtain loans of only half the size of those granted to men-owned firms. In addition, they face a higher probability of being rationed. This is due to the fact that women indeed ask for smaller loan amounts, and this is consistent with findings in Chapter Four that women may be rationing themselves by not applying for a loan at the same rate as men-owned firms. This result could be explained by “men’s overconfidence” (Barber & Odean, 2001) or de Mesa and Webb’s (1992) argument that borrowers (in this case, men-owned firms) actually apply for a higher loan amount knowing that lenders ration loan amounts. Considering that there is a direct correlation between firm size and access to external finances, future research is needed to

explore this connection, and why women owned firms request smaller loans and yet are rationed by banks more often.

CHAPTER SEVEN: SUMMARY

The importance of small businesses in the economy is great, yet they face tremendous disadvantages in access to credit compared to large corporations because of newness, smallness, information opacity, transaction costs, riskiness etc. Freel (2007) summarized reasons for small firms' disadvantage in the access to credit. These reasons include "presumed high level of risk due to higher probability of failure, fixed costs in assessing loan application, greater scope of information asymmetry and moral hazard; and higher due diligence and monitoring costs" (p. 25). In addition, a number of studies found evidence that women and minority-owned firms face even greater difficulty in access to credit in spite of their fast growth in recent years.

This dissertation examines the relationship between credit rationing and the race or gender of the firm owner in the small business credit market to explore whether the observed differences in access to credit between women and men-owned firms and between minority and white-owned firms is due to discrimination. Using data from the 2003 SSBF and three different methodologies to measure credit rationing, this study tests several hypotheses about whether banks ration women and minority owned firms more than their men and white-owned counterparts and whether banks' rationing affects firms' likelihood of applying for credit.

In Chapter Four, we find evidence that women and minority-owned firms have significantly higher loan denial rates than men and white-owned firms. That is to say women and minority owners are more type 2 rationed. The evidence is robust with respect to minority owned-firms but not for women-owned firms. Women owners are found to have the same denial rates as male-owned firms in some subsamples when we perform the same analysis for small and young firms. We also find women and minority-owned firms have significantly lower application rates than their counterparts. The lower application rates are affected by the higher denial rates for women-owned firms in the lowest 10th percentile and minority-owned firms in the highest 10th percentile of the probability of denial. This confirms why women and minority owners are more discouraged to apply. Their perception that their applications will be turned down is consistent with our findings and this perception is a form of credit rationing as well.

Among those who applied for credit, we find that minority owners have higher approval rates than white-owned firms. This result seems contradictory to our previous results and previous studies on credit access differences. However, in this calculation, we estimate the conditional probability of approval which excludes firms that did not apply.

The results for type 2 rationing show persistent evidence of higher denial rates for women and minority owners. Higher denial rates may or may not be related to the fact that banks use different criteria to evaluate loan applications. However, even if banks used the same criteria for all potential borrowers, would the denial rates be the same for women and minorities compared to their

counterparts? In order to see this, we calculate the probability of denial of the median man using women's equation and compare it to the median woman using the same criteria. Similarly, we can calculate the probability of denial for the median man and woman using the estimated coefficient for men-owned firms and compare the probabilities.

In Table 7.1, we compared the probability of denial for the median woman with the median man and for the median minority owner with the median white owner using the same criteria. We also used mean values²² in addition to median values.

The probability of denial for the median man using parameter estimates for women-owned firms is 0.02 vs. 0.04 for the median woman (see 1st row of panel A in Table 7.1). When we use the coefficient for men-owned firms, the median man's probability is 0.13 vs. 0.15 for the median woman. This confirms women have higher denial rates even though we used the same criteria. Similarly, when we calculate the probability of denial for the median minority and white owners using the same criteria, we also find a higher denial rates for minorities in both criteria. The median white owner will have 11 percent denial compared to 19 percent for the median minority owner when we use estimated coefficients for minority owners (see 1st row of panel B in Table 7.1). When we use the white owners' coefficients, the probabilities are 10 percent vs. 15 percent for the median white and the median minority owner, respectively. In fact, all highlighted fields in Table 7.1 indicate that women and minority owners still have higher denial rates even if banks used the same criteria for when to grant a

²² We used mean values of continuous variables and median values for categorical and dummy variables.

Table 7.1. The Probability of Denial* Using Median and Mean Values of Each Group

A. Median Women and Man

| | Women's Equation | | Man- Woman Difference | Men's Equation | | Man- Woman Difference |
|---------------------------|------------------|-----------------|-----------------------------|----------------|-----------------|-----------------------------|
| | Median Man | Median Woman | | Median Man | Median Woman | |
| All firms | 0.02 | 0.04 | -0.02 | 0.13 | 0.15 | -0.02 |
| Service & Retail Industry | 0.10 | 0.09 | 0.01 | 0.09 | 0.10 | -0.01 |
| Discouraged Borrowers | 0.02 | 0.08 | -0.06 | 0.11 | 0.18 | -0.06 |
| Bivariate Probit* | 0.95 | 0.95 | 0.00 | 0.75 | 0.71 | 0.04 |

B. Median Minority and White Owner

| | Minority's Equation | | White- Minority Difference | White's Equation | | White- Minority Difference |
|---------------------------|---------------------|--------------------|----------------------------------|------------------|--------------------|----------------------------------|
| | Median White | Median Minority | | Median White | Median Minority | |
| All firms | 0.11 | 0.19 | -0.08 | 0.10 | 0.15 | -0.05 |
| Service & Retail Industry | 0.15 | 0.27 | -0.11 | 0.09 | 0.12 | -0.04 |
| Discouraged Borrowers | 0.08 | 0.19 | -0.10 | 0.09 | 0.16 | -0.07 |
| Bivariate Probit* | 0.84 | 0.86 | -0.02 | 0.72 | 0.57 | 0.15 |

C. Mean Values for Women and Men

| | Women's Equation | | Men- Women Difference | Men's Equation | | Men- Women Difference |
|---------------------------|------------------|------------------|-----------------------------|----------------|------------------|-----------------------------|
| | Mean of Men | Mean of Women | | Mean of Men | Mean of Women | |
| All firms | 0.02 | 0.07 | -0.05 | 0.13 | 0.17 | -0.04 |
| Service & Retail Industry | 0.16 | 0.15 | 0.01 | 0.09 | 0.11 | -0.02 |
| Discouraged Borrowers | 0.03 | 0.09 | -0.06 | 0.12 | 0.17 | -0.05 |
| Bivariate Probit* | 0.94 | 0.94 | 0.00 | 0.74 | 0.67 | 0.07 |

D. Mean Values for Minorities and White owners

| | Minority's criteria | | White- Minority Difference | White's criteria | | White- Minority Difference |
|---------------------------|-------------------------------|-------------------------------|----------------------------------|-------------------------------|----------------------------------|----------------------------------|
| | Mean of White Owners | Mean of Minority Owners | | Mean of White Owners | Mean of Minority Owners | |
| All firms | 0.18 | 0.20 | -0.02 | 0.11 | 0.14 | -0.03 |
| Service & Retail Industry | 0.53 | 0.45 | 0.08 | 0.08 | 0.11 | -0.03 |
| Discouraged Borrowers | 0.14 | 0.22 | -0.08 | 0.11 | 0.15 | -0.04 |
| Bivariate Probit* | 0.82 | 0.85 | -0.03 | 0.71 | 0.57 | 0.14 |

* In Bivariate Probit model, we estimate Probability of Approval, so a positive difference indicates a Male or White owner has a higher probability of approval.

loan. This indicates that banks' use of different criteria for woman and minorities is not the cause for their higher denial rates. Nevertheless, we find persistent evidence of higher denial rates for women and minority-owned firms that could be related to discrimination based on business owner's gender and/or race.

In Chapter Six, we examine whether banks type 1 credit ration more women and minority owners and whether there is any difference in the approved loan amounts between women and men and between minority and white owners. The results show that women and minority-owned firms have much higher probability of type 1 rationing than men and white-owned firms. In addition, we find that women-owned firms obtain significantly lower loan amounts than men-owned firms. This result is consistent even within the services and retail industry. It seems the main reason for a smaller loan amount granted is that women tend to apply for smaller loans. However, this suggests that further research is needed to determine why women owners apply for smaller loans given that there is a strong correlation between business successes and access to capital. Minority-owned firms also obtain smaller loan amounts than white-owned firms but the difference is insignificant.

We find persistent evidence that women and minority-owned firms are more rationed and they are less likely to apply than men and white-owned firms. When it comes to whether it is related to discrimination, the results are inconclusive. Even though our results show that women and minority-owned firms have higher denial rates and lower application rates, the fact that their conditional loan approval is not lower than their counterparts suggest some

unaddressed issues for the discouraged borrowers. It seems that women and minority-owned firms ration themselves more based on their perception that they are not big enough, not profitable enough or not good enough, which is in line with banks' judgment. Therefore, it is inconclusive in a sense that we do find type 2 rationing for women and minority-owned firms more than their counterparts. However, the 2003 SSBF does not have enough information for a detailed analysis for type 1 rationing and analysis of discouraged borrowers and therefore, these areas need to be examined in future research.

Also due to data limitations we were unable to examine credit rationing in more detail. Therefore, this study can be extended in many ways with a larger dataset. For example, one should examine creditworthy borrowers only since credit rationing refers to creditworthy borrowers being denied. Also it is interesting to look at credit rationing of "observationally distinguishable" borrowers. That is by distinguishing borrowers by their credit score, one should examine who is rationed within each credit score. Similarly, one can analyze credit rationing within each industry because firms' credit needs are quite different for each industry.

In addition, the US SBA's definition of small firms is very broad. Credit needs of a firm that has only 2-10 employees are quite different from a firm with 100-500 employees. Also many studies have found that as a firm grows, it finds it more difficult to obtain external finances (Mushinski & Pickering, 2007; Parker, 2002). Therefore, it would be interesting to compare and analyze credit rationing

among the small, medium-sized and large small businesses, to determine what differences, if any, exist.

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APPENDIX A

The predicted probability is a non-linear function of the estimated parameters. It takes the logit form and is written as:

$$\hat{\Pr}(D = 1) = P_i(\theta) = \frac{e^{\theta'z_i}}{1 + e^{\theta'z_i}} \text{ or } \frac{1}{1 + e^{-\theta'z_i}} \quad (\text{B.1})$$

In large samples, we assume the parameters are distributed normally.

Since $\theta \rightarrow N(\hat{\theta}, \sigma_\theta^2 / \sqrt{n})$, we can use the delta method to transform the predicted probability into the normal distribution. In our case,

$$P \rightarrow N(P(\hat{\theta}), P'(\hat{\theta})^2 \sigma_\theta^2 / \sqrt{n}) \quad (\text{B.2})$$

where P' is the first derivative of the above logit function with respect to θ .

Now we take the first derivative of the predicted probability with respect to each parameter and it can be written as:

$$P' = \begin{bmatrix} \frac{\partial P}{\partial \theta_0} \\ \frac{\partial P}{\partial \theta_1} \\ \vdots \\ \frac{\partial P}{\partial \theta_k} \end{bmatrix} = \begin{bmatrix} \frac{\partial(1 + e^{-\theta'z_i})^{-1}}{\partial \theta_0} \\ \frac{\partial(1 + e^{-\theta'z_i})^{-1}}{\partial \theta_1} \\ \vdots \\ \frac{\partial(1 + e^{-\theta'z_i})^{-1}}{\partial \theta_k} \end{bmatrix} = \begin{bmatrix} \frac{e^{\theta'z_i}}{(1 + e^{\theta'z_i})^2} \\ z_1 e^{\theta'z_i} \\ \vdots \\ z_k e^{\theta'z_i} \\ \frac{z_k e^{\theta'z_i}}{(1 + e^{\theta'z_i})^2} \end{bmatrix} \quad (\text{B.3})$$

Normally P' is k by n matrix, where n is the number of observations and k is the number of parameters. We evaluate P' at the mean values²³ of Z so P' for women-owned firms, for example, would be k by 1 vector:

²³ For categorical or dummy variables, we use the median values.

$$P^{women} = \begin{bmatrix} \bar{z}_0^{women} \\ \bar{z}_1^{women} \\ \vdots \\ \bar{z}_k^{women} \end{bmatrix} \times \frac{e^{\theta \bar{z}^{women}}}{(1 + e^{\theta \bar{z}^{women}})^2} \quad (B.4)$$

The predicted probability would have a normal distribution with mu and sigma

$$P^{women} \rightarrow N(P(\hat{\theta}^{women}), (P^{women})^T \sigma_{\theta}^2 P^{women} / \sqrt{n})$$

We could transform the predicted probabilities for men, women, minorities and white owners to get this mu and sigma, and test the hypotheses H1-H2, H5-H6, and H9-H10 using a two-sample t-test.

APPENDIX B

Appendix B.1. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application Female and Male-Owned Firms for Services and Retail Industry

| Parameter | Female-owned firms | | | | Male-owned firms | | | |
|-------------------------------|---------------------------|--------|---------------------------|--------|---------------------------|--------|---------------------------|--------|
| | 1st stage: $Pr(D)=21.1\%$ | | 2nd stage: $Pr(A)=27.7\%$ | | 1st stage: $Pr(D)=15.9\%$ | | 2nd stage: $Pr(A)=39.1\%$ | |
| | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. |
| Intercept | 3.41 | 2.45 | -3.31 | 0.95 | 2.14 | 1.50 | -3.36 | 0.77 |
| Log of Sales | -0.10 | 0.12 | 0.18 | 0.07 | -0.18 | 0.09 | 0.32 | 0.05 |
| Age of firm – old | 3.15 | 0.94 | *** | ** | -0.07 | 0.36 | | *** |
| Age of firm – middle | -0.70 | 0.51 | | | -0.14 | 0.21 | | |
| Type – S Corporation | -0.18 | 0.76 | | ** | -0.23 | 0.31 | 0.02 | 0.12 |
| Type – C Corporation | -1.12 | 1.05 | | | 0.06 | 0.33 | 0.40 | *** |
| Type – Partnership | 0.39 | 1.79 | | | 0.07 | 0.64 | -0.43 | * |
| Location–rural county | -0.55 | 0.48 | | | -0.03 | 0.20 | 0.24 | *** |
| Industry – services | -0.69 | 0.39 | * | | -0.34 | 0.16 | -0.07 | 0.09 |
| Owner's educ. – degree | 0.75 | 0.47 | | * | -0.02 | 0.21 | -0.03 | 0.10 |
| Owner's educ. – certificate | 0.69 | 0.51 | | | 0.05 | 0.28 | -0.02 | 0.13 |
| Owner's experience, years | 0.03 | 0.05 | | | 0.01 | 0.02 | -0.02 | *** |
| Owner's age, years | -0.07 | 0.04 | * | | -0.04 | 0.02 | | ** |
| Credit score – 1 | 1.05 | 0.91 | | | 1.01 | 0.33 | 0.52 | 0.24 |
| Credit score – 2 | 1.02 | 0.58 | * | *** | -0.01 | 0.39 | -0.13 | 0.17 |
| Credit score – 3 | -0.07 | 0.73 | | | 0.20 | 0.32 | 0.08 | 0.15 |
| Credit score – 4 | -0.72 | 0.74 | | | 0.06 | 0.28 | 0.05 | 0.12 |
| Credit score – 5 | -2.44 | 1.03 | ** | | -0.75 | 0.39 | -0.28 | * |
| No homeownership | -0.31 | 0.45 | | | 0.31 | 0.23 | | |
| Log of Equity | -0.04 | 0.04 | | | -0.01 | 0.02 | -0.02 | 0.01 |
| Return on Asset | -0.12 | 0.14 | | | 0.00 | 0.05 | -0.05 | *** |
| Long-term debt to assets | 0.14 | 0.10 | | | -0.06 | 0.08 | 0.00 | 0.01 |
| Short-term debt to assets | 0.83 | 0.34 | ** | | 0.12 | 0.22 | -0.05 | 0.11 |
| Relationship w/bank, months | 0.00 | 0.00 | | | 0.00 | 0.00 | 0.00 | 0.00 |
| Non-family-owned firm | 1.01 | 1.00 | | | -0.77 | 0.40 | | * |
| Pr(D)-lowest 10th percentile | | | 202.30 | 125.70 | | | -7.27 | 11.27 |
| Pr(D)-middle 80th percentile | | | 0.52 | 0.92 | | | -2.34 | 1.37 |
| Pr(D)-highest 10th percentile | | | -0.94 | 0.67 | | | -1.11 | 0.89 |
| Log Likelihood | -41.15 | | -435.66 | | -158.65 | | -715.32 | |
| R-square | 0.31 | | 0.15 | | 0.11 | | 0.14 | |
| Df | 24 | | 22 | | 24 | | 22 | |
| Number of Observations | 473 | | 1207 | | 129 | | 465 | |

*, **, *** estimates are different from 0 at the 10, 5, and 1% level. *Italic, Bold, Bold and Italic* coefficients for women and men are not equal.

**Appendix B.2. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application
Minority and White-Owned Firms for Services and Retail Industry**

| Parameter | Minority-owned firms | | | | White-owned firms | | | |
|---------------------------------|----------------------|----------|---------------------|----------|---------------------|----------|---------------------|----------|
| | 1st stage | | 2nd stage | | 1st stage | | 2nd stage | |
| | <i>Pr(D)</i> =37.4% | | <i>Pr(A)</i> =34.1% | | <i>Pr(D)</i> =12.6% | | <i>Pr(A)</i> =36.3% | |
| | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. |
| Intercept | 11.27 | 4.15 *** | -2.56 | 1.49 * | 2.22 | 1.29 * | -4.99 | 0.61 *** |
| Log of Sales | -0.73 | 0.26 *** | 0.21 | 0.11 ** | -0.08 | 0.07 | 0.37 | 0.04 *** |
| Age of firm - old | -0.09 | 1.32 | | | 0.64 | 0.34 * | | |
| Age of firm - middle | -0.59 | 0.65 | | | -0.25 | 0.21 | | |
| Type - S Corporation | 0.36 | 0.69 | 0.46 | 0.30 | -0.03 | 0.30 | 0.15 | 0.12 |
| Type - C Corporation | 1.02 | 0.80 | 0.20 | 0.35 | -0.15 | 0.34 | 0.44 | 0.14 *** |
| Type - Partnership | -1.55 | 1.27 | -0.58 | 0.57 | -0.03 | 0.62 | -0.45 | 0.24 * |
| Location-rural county | 0.42 | 0.53 | 0.33 | 0.24 | -0.14 | 0.20 | 0.25 | 0.08 *** |
| Industry - services | -0.24 | 0.48 | 0.36 | 0.18 | -0.42 | 0.16 *** | 0.01 | 0.08 |
| Owner's educ - degree | -0.44 | 0.50 | -0.61 | 0.23 *** | 0.20 | 0.21 | 0.02 | 0.09 |
| Owner's educ - certificate | 0.16 | 0.62 | 0.52 | 0.27 | 0.09 | 0.28 | -0.11 | 0.12 |
| Owner's experience, years | 0.03 | 0.06 | -0.05 | 0.02 ** | 0.01 | 0.02 | -0.01 | 0.01 |
| Owner's age, years | -0.11 | 0.05 ** | | | -0.05 | 0.02 ** | | |
| Credit score - 1 | 1.60 | 0.84 * | 0.42 | 0.39 | 0.47 | 0.33 | 0.04 | 0.19 |
| Credit score - 2 | 0.60 | 0.70 | -0.07 | 0.33 | 0.21 | 0.33 | 0.05 | 0.15 |
| Credit score - 3 | -1.63 | 0.79 ** | 0.26 | 0.33 | 0.38 | 0.28 | -0.08 | 0.13 |
| Credit score - 4 | 0.41 | 0.71 | -0.37 | 0.29 | -0.01 | 0.26 | 0.07 | 0.11 |
| No homeownership | -0.99 | 0.50 ** | | | 0.65 | 0.22 *** | | |
| Log of Equity | 0.07 | 0.07 | 0.01 | 0.03 | -0.03 | 0.02 * | -0.02 | 0.01 ** |
| Return on Asset | 0.20 | 0.22 | -0.03 | 0.03 | -0.06 | 0.08 | -0.04 | 0.02 ** |
| Long-term debt to assets | 0.36 | 0.29 | 0.07 | 0.08 | -0.03 | 0.05 | 0.00 | 0.01 |
| Short-term debt to assets | 0.53 | 0.39 | 0.46 | 0.19 ** | 0.08 | 0.22 | -0.14 | 0.12 |
| Relationship w/bank, months | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Prob(D)-lowest 10th percentile | | | 23.69 | 84.99 | | | 11.53 | 15.14 |
| Prob(D)-middle 80th percentile | | | -0.23 | 0.82 | | | 2.83 | 1.34 ** |
| Prob(D)-highest 10th percentile | | | -0.57 | 1.00 | | | 0.62 | 0.75 |
| Log Likelihood | -33.88 | | -142.80 | | -162.70 | | -810.07 | |
| R-square | 0.38 | | 0.14 | | 0.09 | | 0.16 | |
| Df | 22 | | 21 | | 22 | | 21 | |
| Number of Observations | 516 | | 1420 | | 86 | | 252 | |

*, **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, Bold, Bold and Italic coefficients for women and men are statistically different from each other at the 10, 5, and 1% level.

**Appendix B.4. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application
Minority and White-Owned Young Firms (10 years or younger)**

| Parameter | Minority-owned firms | | | | White-owned firms | | | |
|---------------------------------|----------------------|----------|---------------------|----------|---------------------|---------|---------------------|----------|
| | 1st stage | | 2nd stage | | 1st stage | | 2nd stage | |
| | <i>Pr(D)</i> =39.3% | | <i>Pr(A)</i> =37.0% | | <i>Pr(D)</i> =16.6% | | <i>Pr(A)</i> =36.3% | |
| | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. |
| Intercept | 0.49 | 4.53 | -4.46 | 1.36 *** | 1.93 | 1.24 | -5.11 | 0.78 *** |
| Log of Sales | -0.56 | 0.30 * | 0.33 | 0.10 *** | -0.08 | 0.07 | 0.38 | 0.05 *** |
| Age of firm - middle | -0.86 | 0.74 | | | -0.09 | 0.24 | | |
| Age of firm - adolescent | 1.99 | 0.75 *** | | | -0.10 | 0.28 | | |
| Type - S Corporation | -0.64 | 0.78 | 0.18 | 0.30 | 0.34 | 0.30 | -0.02 | 0.14 |
| Type - C Corporation | 0.31 | 0.94 | -0.26 | 0.36 | 0.05 | 0.40 | 0.34 | 0.19 * |
| Type - Partnership | 1.05 | 1.12 | 0.27 | 0.48 | -0.24 | 0.60 | -0.09 | 0.25 |
| Industry - retail | -0.04 | 0.73 | 0.12 | 0.26 | -0.37 | 0.20 * | 0.07 | 0.12 |
| Industry - services | -0.50 | 0.62 | -0.19 | 0.22 | 0.19 | 0.21 | 0.16 | 0.09 * |
| Owner's educ - degree | 0.71 | 0.52 | 0.05 | 0.20 | 0.14 | 0.17 | 0.08 | 0.08 |
| Owner's experience, years | 0.04 | 0.06 | -0.03 | 0.02 | 0.00 | 0.02 | -0.01 | 0.01 |
| Owner's age, years | 0.04 | 0.05 | | | -0.04 | 0.02 * | | |
| Credit score - above 3 | 0.56 | 0.50 | -0.29 | 0.18 | -0.09 | 0.17 | -0.04 | 0.08 |
| No homeownership | -0.20 | 0.60 | | | 0.54 | 0.25 ** | | |
| Log of Equity | 0.22 | 0.12 * | -0.03 | 0.03 | -0.01 | 0.02 | 0.00 | 0.01 |
| Return on Asset | 0.37 | 0.24 | -0.11 | 0.05 ** | 0.03 | 0.03 | -0.02 | 0.01 |
| Long-term debt to assets | 0.76 | 0.34 ** | 0.02 | 0.07 | 0.03 | 0.06 | 0.06 | 0.03 ** |
| Short-term debt to assets | 2.55 | 1.41 * | 0.25 | 0.19 | 0.01 | 0.24 | -0.01 | 0.06 |
| Relationship w/bank, months | 0.00 | 0.01 | 0.01 | 0.00 * | -0.01 | 0.00 | 0.00 | 0.00 |
| Prob(D)-lowest 10th percentile | | | -22.19 | 52.83 | | | 1.43 | 9.86 |
| Prob(D)-middle 80th percentile | | | -0.24 | 0.67 | | | 1.48 | 1.51 |
| Prob(D)-highest 10th percentile | | | -0.15 | 1.18 | | | 0.12 | 0.92 |
| Log Likelihood | -23.99 | | -108.66 | | -122.12 | | -499.38 | |
| R-square | 0.44 | | 0.15 | | 0.09 | | 0.16 | |
| Df | 18 | | 18 | | 18 | | 18 | |
| Number of Observations | 321 | | 883 | | 70 | | 189 | |

* ** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, Bold, Bold and Italic coefficients for women and men are statistically different from each other at the 10, 5, and 1% level.

**Appendix B.5. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application
Female and Male-Owned Small Firms with Less than \$50,750 in Assets**

| Parameter | Female-owned firms | | | | Male-owned firms | | | |
|---------------------------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|-------------|
| | 1st stage | | 2nd stage | | 1st stage | | 2nd stage | |
| | <i>Pr(D)</i> =23.6% | | <i>Pr(A)</i> =17.2% | | <i>Pr(D)</i> =20.2% | | <i>Pr(A)</i> =19.8% | |
| | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. |
| Intercept | 7.38 | 5.24 | -3.90 | 1.23 *** | 1.81 | 1.78 | -2.41 | 0.77 *** |
| Log of Sales | -0.22 | 0.29 | 0.17 | 0.10 * | -0.05 | 0.10 | 0.15 | 0.06 ** |
| Age of firm - old | 8.81 | 3.67 ** | | | 1.54 | 0.63 ** | | |
| Age of firm - middle | -2.44 | 1.12 ** | | | -0.27 | 0.36 | | |
| Industry - retail | -0.12 | 1.03 | 0.28 | 0.31 | -0.17 | 0.39 | -0.08 | 0.19 |
| Industry - services | 0.52 | 0.82 | -0.12 | 0.22 | 0.41 | 0.28 | -0.14 | 0.13 |
| Owner's educ - degree | 0.56 | 0.65 | -0.28 | 0.17 * | 0.16 | 0.27 | -0.07 | 0.11 |
| Owner's experience, years | -0.37 | 0.20 * | 0.03 | 0.03 | -0.05 | 0.04 | 0.00 | 0.01 |
| Owner's age, years | -0.01 | 0.07 | | | -0.04 | 0.03 | | |
| No homeownership | -0.29 | 0.89 | | | 0.26 | 0.37 | | |
| Log of Equity | 0.13 | 0.12 | -0.03 | 0.03 | 0.02 | 0.04 | -0.08 | 0.01 *** |
| Return on Asset | -0.10 | 0.08 | 0.00 | 0.01 | -0.03 | 0.05 | -0.02 | 0.01 * |
| Long-term debt to assets | 0.21 | 0.12 * | 0.03 | 0.04 | 0.01 | 0.06 | 0.00 | 0.01 |
| Short-term debt to assets | 1.35 | 0.70 ** | 0.38 | 0.16 ** | 0.21 | 0.22 | -0.06 | 0.09 |
| Relationship w/bank, months | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Prob(D)-lowest 10th percentile | | | -1502.90 | 1316.90 | | | -0.05 | 13.53 |
| Prob(D)-middle 80th percentile | | | 0.83 | 0.86 | | | 0.28 | 1.36 |
| Prob(D)-highest 10th percentile | | | -1.18 | 0.87 | | | 0.32 | 0.98 |
| Log Likelihood | -15.26 | | -124.56 | | -57.32 | | -301.24 | |
| R-square | 0.39 | | 0.09 | | 0.11 | | 0.08 | |
| Df | 14 | | 15 | | 14 | | 15 | |
| Number of Observations | 131 | | 660 | | 52 | | 302 | |

* ** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, Bold, Bold and Italic coefficients for women and men are statistically different from each other at the 10, 5, and 1% level.

**Appendix B.6. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application
Minority and White-Owned Small Firms with Less than \$50,750 in Assets**

| Parameter | Minority-owned firms | | | | White-owned firms | | | |
|-------------------------------|----------------------|--------|--------------|-------------|-------------------|----------|--------------|-------------|
| | 1st stage | | 2nd stage | | 1st stage | | 2nd stage | |
| | Est. | Std.E. | Pr(D)=53.4% | Pr(A)=22.3% | Est. | Std.E. | Pr(D)=17.1% | Pr(A)=18.4% |
| Intercept | 8.90 | 8.70 | 0.36 | 2.35 | 2.23 | 2.06 | -2.55 | 0.66 *** |
| Log of Sales | -1.02 | 0.67 | -0.03 | 0.17 | 0.04 | 0.12 | 0.13 | 0.05 ** |
| Age of firm - old | -1.72 | 3.11 | | | 2.35 | 0.75 *** | | |
| Age of firm - middle | 0.87 | 1.48 | | | -0.56 | 0.41 | | |
| Location-rural county | 1.14 | 1.29 | 0.05 | 0.52 | -0.42 | 0.37 | 0.17 | 0.13 |
| Industry - retail | -0.18 | 1.57 | 0.23 | 0.41 | -0.36 | 0.40 | -0.01 | 0.17 |
| Industry - services | 0.83 | 1.29 | 0.00 | 0.33 | 0.63 | 0.32 | -0.13 | 0.12 |
| Owner's educ. - degree | 0.42 | 0.80 | 0.01 | 0.27 | 0.43 | 0.32 | -0.09 | 0.11 |
| Owner's experience, years | -0.05 | 0.11 | -0.07 | 0.03 ** | -0.05 | 0.05 | 0.01 | 0.01 |
| Owner's age, years | 0.03 | 0.07 | | | -0.08 | 0.04 ** | | |
| Credit score - above 3 | -0.31 | 0.97 | -0.35 | 0.26 | -0.53 | 0.30 * | -0.06 | 0.10 |
| No homeownership | -1.27 | 0.92 | | | 0.12 | 0.42 | | |
| Log of Equity | -0.10 | 0.13 | -0.07 | 0.04 * | 0.08 | 0.05 | -0.07 | 0.01 *** |
| Return on Asset | 0.31 | 0.29 | 0.02 | 0.03 | 0.01 | 0.03 | -0.01 | 0.01 |
| Long-term debt to assets | -0.11 | 0.25 | 0.02 | 0.06 | 0.05 | 0.05 | 0.00 | 0.01 |
| Short-term debt to assets | 0.36 | 0.48 | 0.43 | 0.17 ** | 0.16 | 0.29 | -0.03 | 0.08 |
| Relationship w/bank, months | 0.01 | 0.01 | 0.01 | 0.00 ** | 0.00 | 0.00 | 0.00 | 0.00 |
| Pr(D)-lowest 10th percentile | | | -47.67 | 55.57 | | | -73.13 | 47.55 |
| Pr(D)-middle 80th percentile | | | -2.51 | 1.12 ** | | | 0.80 | 1.01 |
| Pr(D)-highest 10th percentile | | | -4.72 | 2.25 ** | | | 0.03 | 0.71 |
| Log Likelihood | -12.88 | | -63.95 | | -49.61 | | -360.21 | |
| R-square | 0.45 | | 0.18 | | 0.18 | | 0.07 | |
| df | 16 | | 15 | | 16 | | 15 | |
| Number of Observations | 150 | | 814 | | 33 | | 148 | |

*, **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.
Italic, Bold, Bold and Italic coefficients for women and men are statistically different from each other at the 10, 5, and 1% level.

**Appendix B.7. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application
Female and Male-Owned Small Firms with Less than \$110,949.5 in Sales or \$13,357.5 in Profit**

| Parameter | Female-owned firms | | | | Male-owned firms | | | |
|-------------------------------|--------------------|--------|-----------|--------|------------------|--------|-----------|--------|
| | 1st stage | | 2nd stage | | 1st stage | | 2nd stage | |
| | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. |
| Intercept | 1.89 | 2.89 | -1.93 | 0.95 | -0.07 | 1.33 | -3.28 | 0.77 |
| Log of Sales | -0.08 | 0.14 | 0.14 | 0.08 | -0.08 | 0.07 | 0.28 | 0.05 |
| Age of firm -- old | 1.67 | 0.96 | | | 0.21 | 0.38 | | |
| Age of firm -- middle | -0.69 | 0.50 | | | -0.02 | 0.24 | | |
| Type -- S Corporation | -0.59 | 0.87 | 0.30 | 0.31 | -0.46 | 0.36 | -0.04 | 0.16 |
| Type -- C Corporation | -0.74 | 1.05 | 0.45 | 0.34 | -0.06 | 0.35 | 0.28 | 0.17 |
| Type -- Partnership | 1.56 | 2.19 | -0.10 | 0.70 | 0.27 | 0.67 | -0.17 | 0.28 |
| Location-rural county | -0.04 | 0.42 | 0.14 | 0.16 | -0.36 | 0.24 | 0.10 | 0.11 |
| Industry -- retail | -0.81 | 0.57 | 0.04 | 0.22 | -0.50 | 0.22 | -0.11 | 0.14 |
| Industry -- services | -0.28 | 0.53 | 0.01 | 0.16 | -0.08 | 0.21 | 0.09 | 0.09 |
| Owner's educ - degree | -0.41 | 0.39 | 0.26 | 0.14 | -0.02 | 0.18 | 0.02 | 0.08 |
| Owner's experience, years | 0.03 | 0.06 | -0.01 | 0.02 | 0.00 | 0.02 | -0.01 | 0.01 |
| Owner's age, years | -0.04 | 0.05 | | | -0.01 | 0.02 | | |
| Credit score - above 3 | -1.06 | 0.45 | -0.39 | 0.19 | -0.26 | 0.18 | -0.22 | 0.09 |
| No homeownership | -0.74 | 0.71 | | | 0.38 | 0.25 | | |
| Log of Equity | -0.01 | 0.05 | -0.02 | 0.02 | -0.03 | 0.02 | -0.03 | 0.01 |
| Return on Asset | 0.00 | 0.08 | 0.00 | 0.00 | 0.18 | 0.11 | -0.02 | 0.03 |
| Long-term debt to assets | 0.23 | 0.17 | 0.03 | 0.05 | -0.06 | 0.05 | -0.01 | 0.01 |
| Short-term debt to assets | 0.55 | 0.30 | 0.27 | 0.15 | 0.11 | 0.19 | 0.01 | 0.04 |
| Relationship w/bank, months | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non-family-owned firm | 0.98 | 1.30 | | | -0.57 | 0.41 | | |
| Pr(D)-lowest 10th percentile | | | -36.48 | 51.74 | | | 6.94 | 7.67 |
| Pr(D)-middle 80th percentile | | | -2.15 | 1.60 | | | -2.28 | 1.42 |
| Pr(D)-highest 10th percentile | | | -1.10 | 1.03 | | | -1.74 | 1.00 |
| Log Likelihood | -35.43 | | -208.04 | | -120.95 | | -525.64 | |
| R-square | 0.28 | | 0.12 | | 0.10 | | 0.17 | |
| Df | 20 | | 18 | | 20 | | 18 | |
| Number of Observations | 319 | | 968 | | 104 | | 420 | |

* **, *** estimates are different from 0 at the 10, 5, and 1% level. *Italic, Bold, Bold and Italic* coefficients for women and men are not equal.

**Appendix B.8. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application
Minority and White-Owned Small Firms with Less than \$110,949.5 in Sales or \$13,357.5 in Profit**

| Parameter | Minority-owned firms | | | | White-owned firms | | | |
|---------------------------------|----------------------|--------|-------------|--------------|-------------------|--------------|-----------|-------------|
| | 1st stage | | 2nd stage | | 1st stage | | 2nd stage | |
| | Est. | Std.E. | Pr(D)=50.1% | Est. | Std.E. | Pr(D)=14.4% | Est. | Std.E. |
| Intercept | 14.89 | 6.17 | ** | -2.33 | 1.48 | 0.31 | 1.30 | 0.31 |
| Log of Sales | -1.24 | 0.45 | *** | 0.18 | 0.11 | -0.07 | 0.07 | 0.31 |
| Age of firm - old | -3.99 | 1.83 | ** | | | 0.82 | 0.38 | 0.05 |
| Age of firm - middle | 1.09 | 0.90 | | | | -0.16 | 0.24 | |
| Type - S Corporation | -3.56 | 1.44 | ** | -0.02 | 0.39 | 0.04 | 0.32 | 0.20 |
| Type - C Corporation | 2.78 | 1.17 | ** | 0.00 | 0.42 | -0.24 | 0.37 | 0.36 |
| Type - Partnership | -0.87 | 1.34 | | 0.36 | 0.68 | 0.29 | 0.65 | -0.25 |
| Location-rural county | 1.65 | 0.93 | * | 0.00 | 0.31 | -0.36 | 0.24 | 0.24 |
| Industry - retail | -1.65 | 1.18 | | -0.31 | 0.31 | -0.42 | 0.22 | 0.10 |
| Industry - services | 0.23 | 1.07 | | -0.43 | 0.24 | 0.16 | 0.21 | 0.18 |
| Owner's educ - degree | -0.59 | 0.53 | | 0.34 | 0.20 | -0.15 | 0.18 | 0.02 |
| Owner's experience, years | 0.21 | 0.10 | | -0.02 | 0.02 | -0.01 | 0.03 | 0.00 |
| Owner's age, years | -0.14 | 0.07 | * | | | -0.01 | 0.02 | |
| Credit score - above 3 | -0.13 | 0.57 | | -0.13 | 0.19 | -0.54 | 0.18 | -0.12 |
| No homeownership | -1.90 | 0.86 | ** | | | 0.35 | 0.28 | |
| Log of Equity | 0.06 | 0.08 | | -0.02 | 0.03 | -0.03 | 0.02 | -0.02 |
| Return on Asset | 0.38 | 0.47 | | 0.00 | 0.02 | 0.06 | 0.06 | -0.03 |
| Long-term debt to assets | 0.23 | 0.34 | | 0.01 | 0.07 | -0.01 | 0.04 | 0.00 |
| Short-term debt to assets | 0.61 | 0.51 | | 0.24 | 0.15 | -0.18 | 0.29 | 0.01 |
| Relationship w/bank, months | 0.01 | 0.01 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Prob(D)-lowest 10th percentile | | | | 394.10 | 625.80 | | | 13.92 |
| Prob(D)-middle 80th percentile | | | | -0.40 | 0.62 | | | 1.95 |
| Prob(D)-highest 10th percentile | | | | -1.78 | 1.26 | | | 0.39 |
| Log Likelihood | -20.27 | | | -105.53 | | 121.19 | | -625.19 |
| R-square | 0.50 | | | 0.14 | | 0.09 | | 0.16 |
| df | 19 | | | 18 | | 19 | | 18 |
| Number of Observations | 361 | | | 1198 | | 62 | | 190 |

*, **, *** estimates are different from zero at the 10, 5, and 1% level. *Italic, Bold and Italic* coefficients for women and men are not equal.

**Appendix B.9. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application
Female and Male-Owned Small Firms with 3 or Fewer Employees**

| Parameter | Female-owned firms | | | | Male-owned firms | | | |
|---------------------------------|--------------------|----------|-------------|----------|------------------|---------|--------------|----------|
| | 1st stage | | 2nd stage | | 1st stage | | 2nd stage | |
| | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. |
| Intercept | -2.34 | 3.25 | -2.55 | 1.00 *** | 0.09 | 1.29 | -1.98 | 1.07 * |
| Log of Sales | -0.06 | 0.20 | 0.12 | 0.08 | -0.09 | 0.08 | 0.25 | 0.07 *** |
| Location-rural county | 0.27 | 0.56 | 0.24 | 0.19 | -0.09 | 0.24 | 0.16 | 0.11 |
| Industry - retail | | | 0.41 | 0.28 | | | -0.03 | 0.14 |
| Industry - services | 0.71 | 0.52 | 0.03 | 0.24 | -0.02 | 0.19 | -0.02 | 0.09 |
| Owner's educ - degree | -0.62 | 0.47 | 0.17 | 0.21 | 0.48 | 0.20 ** | 0.39 | 0.16 ** |
| Owner's experience, years | 0.07 | 0.06 | 0.04 | 0.02 | -0.02 | 0.02 | -0.01 | 0.01 |
| Owner's age, years | 0.00 | 0.06 | | | 0.00 | 0.02 | | |
| Credit score - above 3 | -1.91 | 0.73 *** | -0.56 | 0.38 | -0.17 | 0.20 | -0.33 | 0.10 *** |
| No homeownership | 0.45 | 0.49 | | | 0.54 | 0.25 ** | | |
| Log of Equity | 0.00 | 0.06 | -0.02 | 0.03 | -0.02 | 0.03 | -0.05 | 0.01 *** |
| Return on Asset | 0.05 | 0.08 | 0.00 | 0.00 | 0.04 | 0.06 | -0.05 | 0.02 ** |
| Long-term debt to assets | 0.10 | 0.23 | 0.01 | 0.05 | -0.06 | 0.06 | 0.04 | 0.03 |
| Short-term debt to assets | | | 0.42 | 0.18 ** | | | -0.26 | 0.16 |
| Relationship w/bank, months | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Prob(D)-lowest 10th percentile | | | -78.87 | 168.20 | | | -8.00 | 5.00 |
| Prob(D)-middle 80th percentile | | | -3.23 | 2.18 | | | -5.79 | 2.29 *** |
| Prob(D)-highest 10th percentile | | | -1.34 | 1.56 | | | -2.83 | 1.41 ** |
| Log Likelihood | -22.04 | | -150.86 | | -94.41 | | 432.01 | |
| R-square | 0.27 | | 0.08 | | 0.06 | | 0.10 | |
| df | 12 | | 15 | | 12 | | 15 | |
| Number of Observations | 213 | | 842 | | 65 | | 333 | |

*, **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, Bold, Bold and Italic coefficients for women and men are statistically different from each other at the 10, 5, and 1% level.

**Appendix B.10. Logit Estimates of Parameters on Probability of Bank Loan Denial and Probability of Loan Application
Minority and White-Owned Small Firms with 3 or Fewer Employees**

| Parameter | Minority-owned firms | | | | White-owned firms | | | |
|---------------------------------|----------------------|---------|---------------------|--------|---------------------|--------|-------------------|----------|
| | 1st stage | | 2nd stage | | 1st stage | | 2nd stage | |
| | <i>Pr(D)</i> =42.6% | | <i>Pr(A)</i> =27.4% | | <i>Pr(D)</i> =14.6% | | <i>Pr(A)</i> =23% | |
| | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. | Est. | Std.E. |
| Intercept | 7.48 | 5.67 | -1.90 | 2.24 | -0.31 | 1.58 | -4.05 | 0.70 *** |
| Log of Sales | -0.85 | 0.41 ** | 0.16 | 0.17 | 0.01 | 0.10 | 0.26 | 0.06 *** |
| Age of firm - old | -1.42 | 1.71 | | | 0.33 | 0.43 | | |
| Age of firm - middle | 0.39 | 0.86 | | | -0.21 | 0.28 | | |
| Location-rural county | 0.92 | 0.68 | 0.33 | 0.33 | -0.29 | 0.26 | 0.27 | 0.11 ** |
| Industry - retail | -0.78 | 0.76 | -0.05 | 0.32 | -0.47 | 0.30 | 0.23 | 0.16 |
| Industry - services | -0.20 | 0.70 | -0.22 | 0.26 | -0.05 | 0.24 | 0.03 | 0.09 |
| Owner's educ - degree | 0.35 | 0.56 | 0.38 | 0.20 * | 0.17 | 0.21 | 0.03 | 0.09 |
| Owner's experience, years | -0.03 | 0.07 | -0.03 | 0.02 | 0.02 | 0.03 | 0.00 | 0.01 |
| Owner's age, years | 0.00 | 0.05 | | | -0.03 | 0.03 | | |
| Credit score - above 3 | -0.07 | 0.59 | -0.39 | 0.21 * | -0.37 | 0.21 * | -0.07 | 0.10 |
| No homeownership | -1.00 | 0.67 | | | 0.49 | 0.27 | | |
| Log of Equity | 0.12 | 0.09 | -0.03 | 0.03 | 0.00 | 0.03 | -0.03 | 0.01 ** |
| Return on Asset | 0.15 | 0.18 | 0.00 | 0.01 | 0.03 | 0.04 | -0.05 | 0.02 *** |
| Long-term debt to assets | 0.19 | 0.18 | 0.03 | 0.06 | -0.04 | 0.08 | 0.05 | 0.03 * |
| Short-term debt to assets | 0.86 | 0.41 ** | 0.28 | 0.16 * | 0.22 | 0.44 | -0.17 | 0.13 |
| Relationship w/bank, months | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Prob(D)-lowest 10th percentile | | | 4.31 | 17.26 | | | -1.60 | 7.75 |
| Prob(D)-middle 80th percentile | | | -0.81 | 1.01 | | | 2.03 | 2.11 |
| Prob(D)-highest 10th percentile | | | -1.26 | 1.28 | | | 2.12 | 1.26 * |
| Log Likelihood | -19.85 | | -88.19 | | -87.76 | | -507.32 | |
| R-square | 0.38 | | 0.12 | | 0.07 | | 0.07 | |
| Df | 16 | | 15 | | 16 | | 15 | |
| Number of Observations | 232 | | 1007 | | 46 | | 168 | |

*, **, *** means estimates are statistically different from zero at the 10, 5, and 1% level, respectively.

Italic, Bold, Bold and Italic coefficients for women and men are statistically different from each other at the 10, 5, and 1% level.

ENDNOTES

ⁱ Given the increasing use of credit scoring by banks, we test whether or not the credit score variable adds explanatory power to the model and whether it is correlated with the other explanatory variables. There is clearly variability among banks in the use of credit scores. Some recent studies show that only a small percentage of banks rely either on business credit score or both business and owner credit scores. The log-likelihood values of the restricted and unrestricted models are -357.73 and -377.97, and although there is no real difference in performance between the two the R^2 for the model with credit score is 0.0955, and for the model without credit score, it is 0.077 indicating some explanatory power from including the credit score. We also looked at the correlation between these credit scores and the other variables. The highest correlation is 0.2 for women and minority-owned firms and 0.28 for men and white-owned firms. Furthermore, individual coefficients for credit scores are significant in many instances, indicating that some banks totally rely on credit scores while others use soft information.

ⁱⁱ We also tried to examine credit rationing of creditworthy borrowers. True credit rationing refers to creditworthy borrowers being denied. We want to see if banks ration borrowers that have higher than average credit scores. If they do ration these creditworthy applicants, then the next question would be whether there is any difference in granting loans between women- and men-owned firms and between minority- and white- owned firms. We classify creditworthy applicants as those firms whose credit score is 4 and above, which is the average credit score in our sample. In our dataset, 683 creditworthy applicants applied for credit and 34 of them were denied. Unfortunately, due to data limitations, we were unable to run the above two-stage analysis separately for women-, men-, minority- and white-owned firms. That is, only 3 of the 34 firms that were denied were women-owned firms and 8 of them were minority-owned firms.