When Do Firms Risk Shift? Evidence from Venture Capital*

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Abstract

This paper studies the agency costs of debt and the role of risk shifting as firms face financial distress. The Small Business Investment Company (SBIC) program is a novel setting to evaluate the importance of these costs. It provides participating venture capital funds with debt financing from the U.S. government at a negligible premium to the 10-year Treasury Note. Economic mechanisms that might prevent risk shifting, such as covenants and reputation concerns, are primarily not present in this program. Using a difference-in-differences setting, I find that managers of distressed funds invest in firms with lower credit scores, sales, employment and patenting activity, and are more likely to use equity investments. Distressed funds reallocate capital to riskier firms in their portfolio, rather than searching for new investments. Equityholders respond positively to riskier investments for distressed funds and debtholder losses increase, consistent with the prediction that risk shifting transfers wealth from bondholders to equityholders.

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1 Introduction

A substantial body of literature studies the agency costs of debt. Theory suggests that managers shift to riskier investments as distress increases, transferring wealth from bondholders to equityholders (Jensen and Meckling (1976)). However, certain economic mechanisms limit the extent of these agency costs in debt markets. Covenants in debt contracts often explicitly or indirectly control managerial actions when a firm becomes distressed (Smith and Warner (1979)). Further, bankruptcy costs and changes in the cost of capital prevent firms from excessive risk-taking (Andrade and Kaplan (1998)). Lastly, reputation — both from repeated interactions with debt markets (Diamond (1989)) and career concerns of managers (Fama (1980)) — discourages risk shifting by managers.

Yet it remains an empirical challenge to identify the impact of incentive conflicts between bondholders and equityholders on managerial risk-taking. First, debt contracts may develop endogenously to curb these agency costs. Second, previous studies on risk shifting focus on settings where covenants, market-determined cost of capital and reputation concerns are present, and find that distressed firms invest in less risky projects (Rauh (2009) and Gilje (2016)). Third, it is often difficult to observe individual investment decisions by managers. Common risk proxies are frequently either at the firm level or based on a model. Fourth, adjustment and transaction costs reduce the ability of managers to alter investment policies in large, industrial firms.

In this paper, I focus on a unique setting that mitigates these identification concerns. Governments regularly provide capital to venture capital funds with the goal of spurring economic growth and innovative activity. Since 1958, the U.S. government has offered debt financing to venture capital funds through the Small Business Investment Company (SBIC) program. Based on several of its features, this program is a novel setting to evaluate the agency costs of debt. First, participating venture capital funds are largely unrestricted in their investment decisions, reflecting a lack of covenants in government debt. Second, the

program offers debt financing at a slight premium to the 10-year Treasury Note, which is a relatively low cost of capital. This rate does not change if a fund becomes financially distressed. Third, reputation concerns are largely muted since the government is the bondholder. Lastly, leverage is received before the investment decisions of managers. This alleviates the potential for renegotiation if a fund becomes distressed. The SBIC program continues to be active with more than 300 current licensed venture capital funds and over $13.7 billion in committed government capital.

Using a Freedom of Information Act (FOIA) request, I manually link venture capital investments to funds participating in the SBIC program. This request provides the exact dates of entry and exit from the program. I match 500 SBIC funds and 22,789 rounds of financing. The average fund size is $62.0 million and 27.6% of investments are in the first round. To measure the riskiness of fund investments, I incorporate data on the portfolio company's credit score, sales and employment growth, patenting activity prior to investment and the type of investment, such as equity. Since the cost of capital offered by the government is below the risk-adjusted rate of return for the venture capital market (Kaplan and Schoar (2005)), this suggests that funds will request the maximum amount of debt available, which leads to a debt-to-asset ratio of about two-thirds.[1] Therefore, I focus on funds participating in the program and receiving leverage.

I identify the effect of financial distress on managerial risk-taking by using a difference-in-differences framework. Since funds participating in the program tend to withdraw the maximum amount of debt financing, I focus on variation in the financial distress of funds by exploiting the design of the program. In particular, SBIC funds are transferred to the Office of Liquidation when their capital is below a specific threshold or for regulatory violations. This transfer appears to be unanticipated by funds and, on average, a fund continues to operate

[1]There are primarily three types of SBIC funds: leveraged, non-leveraged and specialized. The vast majority of capital is provided to leveraged funds. The maximum leverage is currently $150 million and only higher for special exceptions. Historically, the amount of leverage has changed based on revisions to the Small Business Investment Act of 1958. Conversations with program employees and a former administrator of the program confirm that SBIC funds tend to receive the maximum amount of debt.

and invest for the following seven years. I include fund and industry fixed effects in the specification to absorb time-invariant unobserved heterogeneity across funds and industries, in addition to year fixed effects to account for time-varying differences in risk-taking. This setting compares the average change in risk-taking by managers at funds in financial distress relative to the average change in risk-taking at funds that remain solvent.

I find that managers of distressed funds take on riskier investments. The first two measures of risk are credit scores and the credit risk class of the portfolio company. Investments by distressed funds are related to a 10.2% decrease in credit scores relative to one standard deviation and are 26.4% more likely to be a high credit risk, relative to the sample mean. Next, I examine sales and employee growth in the previous year, which focus on a firm's performance in the prior year. Investments at distressed funds are associated with lower sales growth of 26.4% and employee growth of 22.6%. This is a decrease of 16.4% and 18.9% of one standard deviation in sales and employee growth, respectively. These effects are economically meaningful and statistically significant. I additionally measure risk using the patenting activity of a portfolio company prior to receiving an investment from a venture capital fund. Venture capital funds often invest in innovative firms with high potential patenting activity and there is arguably greater uncertainty for those firms with fewer patents (Lerner, Sorensen and Strömberg (2011)). I find that funds in distress invest in portfolio companies with lower prior patenting activity. The decrease of 0.17 patents is a 24.6% decline relative to the sample mean. Lastly, funds may alter the types of investments that they use when in distress. In particular, managers may adjust their portfolio by shifting towards relatively riskier investments, which could provide higher returns in certain states of the world. I find that distressed firms are 6.6% more likely to use equity investments in distress, which is a 22.0% increase relative to the sample mean. Absent mechanisms that prevent modifications to investment policy when in distress, these results provide evidence that managers at distressed funds invest in riskier firms.

The identifying assumption for the difference-in-differences approach is the parallel

trends assumption. This assumption presumes that, if distress did not occur, the change in risk-taking by managers of distressed funds would not be different than the change in risk-taking by solvent funds. A concern in this setting could be that managers might anticipate distress and adjust their investment behavior prior to being transferred to the Office of Liquidation. As a falsification test, I study the risk-taking behavior of distressed funds just prior to becoming distressed. In the two years prior to being transferred, I find that managers do not invest in riskier companies. The estimates are negligible and statistically insignificant for each measure of risk-taking for the two years directly before distress, while the magnitudes and significance during periods of distress remain quite similar. This supports the validity of the identification assumption for this specification.

An additional concern might be that managers of distressed funds diversify their portfolio by investing in different industries relative to their current holdings. If the investments in these industries are riskier, then an alternative interpretation of the findings is that managers are attempting to increase the diversification of investments in their portfolio, rather than risk shifting. To address this concern, I construct a measure of diversification based on the Herfindahl-Hirschman Index of a fund's investment by industry. I find that the results are largely unchanged when accounting for the diversification of a fund's investments.

One further issue might be that, if funds participating in the SBIC program and private venture capital funds respond similarly in distress, then riskier investments by SBIC funds are not necessarily driven by their relatively high leverage. To address this concern, I construct a sample of venture capital firms with both SBIC and private funds. This test holds constant unobserved differences between venture capital firms and compares how distressed funds in the SBIC program respond relative to private funds in distress at the same firm. I find that increased risk-taking is driven by distressed funds participating in the SBIC program. Across each measure of risk, I report similar estimates in terms of statistical significance and economic magnitude.

Next, I study how managers adjust their portfolios when the incentive to risk shift in-

creases. Venture capital funds often provide financing to firms in their portfolio through multiple rounds. For several reasons, it might be less costly for distressed funds to allocate capital to firms currently in their portfolio, instead of searching for new investments. First, search costs might be relatively high for new portfolio companies, particularly during financial distress. Second, capital adjustment costs could be lower for existing investments, since contracts are in place at these firms. Third, it could be costly for funds to liquidate positions in firms currently in their portfolio (Nadauld et al. (2017)) and redeploy the capital to new investments. I find that managers tend to reallocate their portfolios to riskier companies already in their holdings, rather than seeking out new investments. Using a panel of annual fund observations, I find that distressed funds are 11.8% to 13.0% more likely to invest in post-first round financings. Similarly, funds in distress are 2.4% to 4.2% more likely to allocate capital to companies already in their portfolio on a quarterly basis. The results for risk shifting remain quite similar to the baseline estimates when the initial round financing for funds in distress are excluded from the sample. This suggests that managers reallocate their portfolio to riskier investments through post-first round financings.

Lastly, I study the value effects of risk shifting for equityholders and debtholders. Theories of risk shifting predict that it increases the value of equity, while decreasing the value of debt. Since equity for venture capital funds is commonly raised privately, it is often difficult to observe return data, especially over short, well-defined intervals. However, publicly-traded venture capital funds raise capital through public, rather than private, equity. This type of firm is referred to as a business development company (BDC). I estimate the change in returns in a narrow window around investment dates, which helps to disentangle the effect of distress from risk shifting. I find that equityholders respond positively to decisions by managers of distressed funds to risk shift, with an average increase of 2.4% to 4.3%. This result implies that riskier investments for distressed funds increase the value of equity. Further, I study the loss to the government for the funds participating in the program. I find that funds in distress lose an average of $2.5 to $8.0 million. Taken together, this provides evidence

that risk shifting is beneficial to equityholders at the expense of debtholders, consistent with theories of risk shifting.

This paper contributes to the literature on risk shifting and the agency costs of debt. A longstanding stream of theoretical articles predicts that mangers invest in riskier projects as a firm becomes distressed (Modigliani and Miller (1958), Fama and Miller (1972), Jensen and Meckling (1976), Stiglitz and Weiss (1981) and Acharya and Viswanathan (2011)). The extant empirical literature on risk-shifting incentives has primarily documented that firms near bankruptcy undertake more conservative investments. Firms in financial distress during the 1980s did not take on particularly risky investments or acquisitions (Andrade and Kaplan (1998)), while studies of pension plans (Rauh (2009)) and oil and gas producers (Gilje (2016)) provide evidence that managers of distressed firms select less risky investments. Model-based simulations of equityholder-debtholder conflicts suggest that these agency costs do not have a first-order effect on capital structure decisions for firms with low leverage, though these costs grow as leverage and the size of the project increase (Parrino and Weisbach (1999)).

The literature documenting evidence of risk shifting is comparatively smaller. This paper suggests that economic mechanisms, such as covenants, market-based interest rates and reputation, place limits on the incentive and ability of managers to invest in riskier projects. Two case-based studies report evidence of risk shifting at thrift banks (Esty (1997)) and a large subprime mortgage lender (Landier, Sraer and Thesmar (2015)). Using a real-options framework, equity volatility is positively related to investment for distressed firms and investments by these firms are less valuable as uncertainty increases (Eisdorfer (2008)). Additionally, managers are less likely to invest in riskier projects when their fiduciary duty requires them to consider the interests of debtholders (Becker and Strömberg (2012)).

This paper offers insight into the design of government programs that aim to stimulate entrepreneurial activity. Many countries have programs tasked with these goals and provide capital directly to startups or invest through venture capital funds (Lerner (2009)). Yet it remains a relatively open question about the role of government intervention in the venture

capital market (Gompers and Lerner (2001), Gompers (2007) and Da Rin, Hellmann and Puri (2013) survey the growing literature on venture capital). An early article on the SBIC program offers summary statistics and argues against it (Widicus (1966)). Existing cross-country evidence documents a positive association between venture capital funds using both government and private capital and successfully exiting their investments (Brander, Du and Hellmann (2015)). Direct investment by governments in startups increases the chance of future funding for awardees and boosts their innovative activity (Howell (2017)). This study aims to provide important policy implications regarding the design of the SBIC program, about which relatively little is known.

A remaining question about the program might be why it continues to exist, despite the maturing of the venture capital market. One possibility is that the SBIC program is subject to regulatory capture, which occurs when a governmental agency focuses on the interests of the organizations that it regulates, rather than serving the role intended by law (Stigler (1971), Pelzman (1976), Tirole (1986), Laffont and Tirole (1991) and Shleifer and Vishny (2002)). Previous work details that firms with political connections are more likely to obtain government capital (Faccio, Masulis and McConnell (2006) and Duchin and Sosyura (2012)) and receive better access to credit markets (Johnson and Mitton (2003) and Khwaja and Mian (2005)). Over the past 15 years, SBIC funds and trade groups frequently hired lobbyists to advocate for the reauthorization and expansion of the program. Additionally, employees at these funds often contributed (about 45.7% of all funds) to candidates in Congressional elections. This offers a connection between the program's survival and the interests of participating funds.

2 Institutional Setting

2.1 Small Business Investment Company (SBIC) Program

The venture capital (VC) industry was born in 1946 with the creation of the American Research and Development Corporation and the first VC partnership was founded in 1958 (Lerner (2009)). In this same year, the U.S. Congress passed the Small Business Investment Act of 1958. This law established the Small Business Investment Company (SBIC) program, which is operated by the Small Business Administration (SBA). With the goal of stimulating entrepreneurship through the venture capital market, this program provides debt financing to licensed venture capital funds. The government offers VC funds about two dollars in capital for every dollar invested by the fund (Dilger (2013)). The program remains quite active even today with 313 current licensees and just over $13.7 billion in committed capital.[2]

To enter the SBIC program, a prospective venture capital fund submits an initial application called the SBA Management Assessment Questionnaire (MAQ). If the Program Development Office determines that the applicant is qualified, the management team is interviewed at the SBA's headquarters in Washington, DC. The Investment Committee votes on whether to proceed with the application and, if approved, a "green light" letter is issued. After raising a sufficient amount of capital, this letter allows the management team to submit a license application. This application is reviewed and voted on by two internal agency committees. If the license application is approved, the fund is officially part of the SBIC program and has access to government capital (Small Business Investment Company (SBIC) Program Overview (2016)).[3] In recent years, the time from initial application to licensing is about 8.4 months.

Through a Freedom of Information Act (FOIA) request, I identify every venture capital

[2]Data as of September 30, 2016. Retrieved from `https://www.sba.gov/sites/default/files/articles/SBIC_FY2016_annual_report.pdf`.

[3]Based on a conversation with a limited partner in SBIC funds, venture capital funds and their LPs often enter the program to magnify fund returns.

fund active in the program since January 1, 1976.[4] There are three main types of SBIC funds: leveraged, non-leveraged and specialized. Leveraged funds receive government capital as debt financing. These types of funds are referred to as debenture or participating securities SBICs. Debenture funds have existed since the program was founded in 1958, while participating securities licenses were available from 1994 to 2004.[5] Non-leveraged funds, which are often owned by banks, do not receive capital from the government. These types of SBICs are used by certain institutions to satisfy regulatory requirements (e.g., Community Reinvestment Act) or to increase their equity investments (e.g., exemptions in the Dodd-Frank Act) (Kite (2014)). Specialized SBICs are restricted to invest only in companies with "social or economic disadvantages" (Small Business Investment Act of 1958 (as amended) (2013)).

Table 1 details the licensing activity of the SBIC program since 1976. Over the past 40 years, more than 1,200 venture capital funds have participated in the program and 850 participants received government leverage. SBIC funds represent a non-trivial portion of the venture capital market. Since its inception to the end of 2015, there have been 5,210 venture capital funds in the U.S. (National Venture Capital Association (2016)). Program participants represent 24.7% of these funds, of which 66.1% receive government debt.

2.2 Program Design

The SBIC program is a novel setting to evaluate the agency costs of debt based on several of its features. First, covenants are absent for program participants and debt financing is provided to funds prior to their investment decisions. Second, the cost of capital for the government-backed debt is relatively low and offered at a slight premium to the 10-year Treasury Note. Third, concerns about repeated interactions with debt markets and managerial reputation are muted in this setting.

Covenants in debt contracts are restrictions on firm policies and managerial decisions,

[4]The program responded that data prior to 1976 is not available.

[5]Participating securities funds paid interest and principal to the SBA based on their retained earnings.

and are often state contingent. A large literature documents the existence and role of bond covenants in public and private debt markets (Smith and Warner (1979) and Bradley and Roberts (2015)), in addition to private equity (Kaplan and Strömberg (2003)). These provisions can be sorted into four groups: restrictions on a firm's investment and production decisions, limitations on dividend payouts, financing policy covenants, and limits on changes to debtholder payoffs. The last covenant is specifically related to controlling conflicts of interest between debtholders and equityholders. Studies on the implications of debt covenants tend to focus on covenants related to accounting variables (Chava and Roberts (2008)).

The design of the SBIC program mainly provides government debt without covenants to participating funds. First, if an applicant is accepted to the program, leverage from the government is available immediately and prior to managerial decisions. This alleviates concerns about subsequent changes to its terms and, further, this debt is not renegotiated. Second, beyond a requirement to invest in small businesses, funds are not restricted in how they allocate government capital.[6] Lastly, participating funds can be transferred to the Office of Liquidation for regulatory violations and excessive financial losses. This occurs when SBIC funds are financially constrained and does not alter the pricing or terms of the fund's current debt from the government, or restrict their investment decisions. Relative to private debt contracts, there are effectively no covenants in the debt offered to SBIC funds.[7] The implementation of the SBIC program has been confirmed in conversations with current employees and a former Associate Administrator of the program.

Leveraged licensees receive government money at a negligible premium over the 10-year Treasury Note. Figure 1 plots the SBIC cost of capital relative to the 10-year Treasury Note for the past 15 years. The average premium is just 80 basis points, with a mean cost of

[6]SBICs can invest in "small" companies with less than $19.5 million in net worth and less than $6.5 million in net income during the previous two years. Alternatively, companies can be classified as small based on their size, which is determined by the SBA's North American Industry Classification System (NAICS) code standards (Small Business Investment Company (SBIC) Program Overview (2016)).

[7]For example, a revolving credit agreement between Capitala Finance Corporation, the parent company of CapitalSouth Partners Funds I, II and III (SBIC funds), and ING Capital on October 17, 2014 contains numerous covenants, including restrictions on investment policy and dividend payments (available at `https://www.sec.gov/Archives/edgar/data/1571329/000114420414062166/v391743_ex10-2.htm`).

capital of 4.15%. When a fund draws on the leverage available, it incurs a slight charge of 72 basis points, on average. The cost of capital offered to SBIC funds through debt financing is lower than the risk-adjusted return provided to investors in venture capital funds (Kaplan and Schoar (2005)).[8] Appendix C details how the SBIC program is financed. At the time of issuance, I find that the yield spread of debt originated to finance the program is between 38 and 80 basis points. This highlights that investors anticipate the program to be backed fully by the U.S. federal government.

Lastly, concerns about reputation may limit the agency costs of debt. First, firms may not invest in riskier projects because of its potential to change their reputation in debt markets (Diamond (1989)). Debtholders might adjust the pricing and terms if a firm acquires a reputation for asset substitution. Since SBIC participants receive debt financing before their investment decisions, these funds are unlikely to be concerned about their reputation with the government. Second, managers of firms may have career concerns, especially as the likelihood of bankruptcy increases (Fama (1980)). If a manager at a distressed firm seeks a new job, prospective employers might not view increased risk-taking favorably. In the SBIC program, this concern is limited since the incentives of venture capital fund managers tend to be well-aligned with the interests of equityholders. Taken together, the SBIC program is a novel setting to understand the importance of incentive conflicts between bondholders and equityholders.

2.3 Leverage

Participating venture capital funds in the SBIC program are generally allowed to obtain up to two dollars in leverage from the government for each dollar of equity, up to a pre-specified program limit. As detailed above, the interest rate charged to SBIC funds is the 10-year Treasury Note plus a slight premium that has averaged 80 basis points. There are

[8]Kaplan and Schoar (2005) report that average returns after fees for a private equity fund are close to the returns of the S&P 500.

two primary reasons to suggest that participating funds tend to withdraw the maximum amount of leverage available. First, the cost of capital for the program's debt is relatively low compared to the risk-adjusted cost of capital for venture capital funds. This implies that managers at SBIC funds have an incentive to request the full leverage available to them. Second, discussions with current employees and a former Associate Administrator of the program confirm that most funds are fully levered. An additional and relevant feature of the program is that leverage is set at the time of the fund's entrance. It is determined by the equity raised when the fund receives its license. The timing of debt financing provided by the government influences the empirical design for this paper. Since leverage is set when a fund enters the program, it is arguably exogenous to subsequent distress and omitted from the empirical specification.

Using loan-level data, Figure 2 provides a histogram of the timing of debt financing provided to SBIC participants.[9] While the total amount of leverage available is set once a fund enters the program, funds do not necessarily withdraw the full amount immediately. This could be based on the timing of the venture capital fund's investment decisions and on the performance of these investments. The figure shows that about 60.3% of leverage is provided to funds within the first three years of being issued a license. While much of the financing is received towards the start of a fund's life, participants in the program continue to draw on debt financing during the following years. Overall, this suggests that SBIC funds remain active throughout their participation in the program.

2.4 Regulatory Capture

One might wonder why the SBIC program continues to exist. The program was founded in 1958 with the goal of spurring venture capital activity. During the ensuing fifty years, the venture capital market has grown and matured, questioning the role of government inter-

[9]The figure plots the timing of leverage within ten years of receiving a license. Program participants continue to receive leverage after this window, though the frequency is relatively low.

vention. Regulatory capture occurs when a governmental agency caters to the interests of the organizations that it regulates, instead of serving its legal role (Stigler (1971)). Empirical evidence suggests that regulatory capture can be costly (Khwaja and Mian (2005) and Faccio, Masulis and McConnell (2006)).

To understand the links between participating funds and the government, I collect data on lobbying expenses and political contributions by funds in the SBIC program. Lobbying data is provided by OpenSecrets.org. Since 1980, the Federal Election Commission (FEC) offers detailed data on political contributions by individuals to candidates in U.S. Congressional elections. I manually match participating funds to lobbying and campaign contributions data.

I find that funds in the SBIC program and related trade groups spent $23.2 million on 136 lobbyists in the past 15 years. The funds and groups frequently lobby on issues related to the reauthorization and expansion of the program. Additionally, I map contributions from fund employees to candidates in Congressional elections. Of active funds since 1980, I find that individuals at 704 SBIC funds contribute in these election races, which represents 45.7% of program participants. This suggests a link between the continuation and growth of the program and the funds that it regulates.

3 Data and Empirical Strategy

3.1 Data Sources

The main dataset for this study is constructed from several sources. Venture capital funds participating in the Small Business Investment Company program were provided through a Freedom of Information Act (FOIA) request. This allows for exact identification of SBIC funds and the dates of entry and exit from the program.[10] The request also provides the date when the fund is transferred to the Office of Liquidation, if applicable. For each program

[10]This addresses a concern that VentureXpert does not properly identify SBIC funds.

participant since 1976, I received the fund name and location, in addition to its type and status. SBIC funds are mainly of three types: leveraged, non-leveraged and specialized, as detailed in Section 2.1. This paper studies the agency costs of debt and, accordingly, focuses on those funds receiving leverage from the government. Through an additional FOIA request, I received a list of funds entering the Office of Liquidation and the losses incurred by the program for each fund.[11] Fund leverage is extracted from the Federal Assistance Award Data System (FAADS) through the National Archives and Records Administration of the United States and at USAspending.gov. Appendix B.1 explains the procedure to match fund participants with leverage data.

I match venture capital funds participating in the SBIC program to their investments provided by VentureXpert. This dataset, also referred to as ThomsonOne and Venture Economics, is one of the primary datasets for studies on venture capital (Da Rin, Hellmann and Puri (2013)). This source contains data on fund investments and their characteristics. ThomsonOne provides unbiased, though at times noisy, data on venture capital activity (Kaplan, Sensoy, and Strömberg (2002)). Appendix B.2 details the steps for matching SBIC funds to their investments in VentureXpert.

Measurement of performance and innovation for small businesses is a major challenge. While data on U.S. public firms is standard and regularly released, nascent firms are, by their nature, difficult to observe. These companies are newly formed and reporting requirements are quite limited. To overcome these hurdles, I use credit score and credit risk class data from Equifax, in addition to the National Establishment Time-Series (NETS) database to measure firm-level business activity. The NETS data cover 52.4 million establishments from 1990 to 2012 and provide annual observations of firm sales and employment.[12] Additionally, this dataset allows for a company's survival to be tracked. Appendix B.3 explains the

[11] The data provides losses for 149 SBIC funds in my sample out of 268 liquidated funds in VentureXpert.

[12] Estimated sales and employment data are identified by NETS. Employment data is known to be sticky (`http://www.kauffman.org/blogs/data-maven/2011/04/the-best-uses-of-nets`). The measures of risk are based on sales and employment growth to alleviate measurement concerns.

methodology for linking NETS data to investments in VentureXpert.

A common proxy of innovative activity is patents. Patents provide researchers with a clear and well-recorded measure of innovation, where the number of patents and patent citations are argued to quantify the scale and novelty of a company's innovations, respectively (Kogan et al. (2017)). Venture capital investment in nascent firms often leads to patent production (Lerner, Sorensen and Strömberg (2011)). I extracted all patent data starting in 1976 from the U.S. Patent and Trademark Office (USPTO) and developed an algorithm to match patent awardees with companies based on their cosine similarity.[13] Appendix B.4 details the extraction and matching of patent data with portfolio companies in VentureXpert.

Lastly, I incorporate data on publicly-traded venture capital firms, commonly referred to as business development companies (BDCs). To identify funds with public equity, I use three sources. First, a FOIA request provided a list of current SBIC funds that are part of a BDC. Second, the Securities Exchange Commission (SEC) offers a report of firms registered as a BDC using Form N-6F.[14] I also search SEC filings that mention SBIC or small business investment company. Third, I extract data from Bloomberg on public equity listed as a BDC. I link these BDC funds to data on prices from the Center for Research in Security Prices (CRSP).

Panel A of Table 2 provides summary statistics for the sample of funds and investments matched to VentureXpert from 1976 to 2015. The data consists of 500 funds and 22,789 rounds of financing, of which 12,790 observations are matched to credit data from Equifax and 8,972 observations are matched to sales and employment data in NETS. The average fund size is \$62.0 million[15] and about 27.6% of investments are the first round of financing in a firm for a particular fund. Panel B of Table 2 compares SBIC funds to private funds in VentureXpert. While the comparisons between funds are limited by data availabil-

[13]Cosine similarity measures the cosine of the angle between two vectors of strings. It is defined as the dot product of the two vectors divided by the product of the Euclidean norm of each vector. Strings that are exactly the same receive a score of 1, unrelated strings have a score near 0, and opposite strings earn a score close to -1.

[14]This data is available at: `https://www.sec.gov/opa/data/opendatasetsshtmlbdc.html`.

[15]Fund size is only reported for certain funds in VentureXpert.

ity, this panel begins by examining fund size and fund sequence. I find that SBIC funds tend to be smaller than private funds, with the average SBIC fund size of $62.0 million and the average private fund size of $331.1 million. Fund sequence is a chronological numbering of funds for a particular venture capital firm and starts at one. I report that SBIC funds tend to be earlier in the sequence of funds. Additionally, I find that the round amounts are smaller for SBIC funds at $9.9 million, compared to $29.5 million for private funds. Lastly, the differences in the round number and the number of investors in a particular round between SBIC and private funds, while statistically significant, are generally similar for SBIC and private funds. Overall, this suggests that there are differences, which may be observed and perhaps unobserved, between SBIC funds and private funds.

3.2 Empirical Methodology

To study the effect of distress on risk-taking by fund managers, I use a difference-in-differences approach. I estimate the following specification at the fund-investment level:

$$y_{ijt} = \beta \, \textit{Fund distress}_{it} + \gamma' X_{it} + \eta_i + \lambda_j + \delta_y + \varepsilon_{ijt}. \tag{1}$$

The measures of risk for an investment by fund i in industry j at round day t are denoted by y_{ijt}. The variable $\textit{Fund distress}_{it}$ is equal to one if fund i is in financial distress at round day t. Measures of risk and distress are detailed below. I include fund (η_i) and industry (λ_j) fixed effects to absorb unobserved time-invariant heterogeneity by fund and industry,[16] respectively, and X_{it} is a vector of controls.[17] I also include year fixed effects (δ_y) to capture temporal variation. The unit of observation for this specification is an investment by a fund

[16]Industries are defined by the VentureXpert industrial classification (biotechnology, communications/media, computer hardware, computer software/services, consumer related, industrial/energy, internet specific, medical/health, semiconductors/other electronics, and other products).

[17]The controls include the natural log of round amount, venture capital firm age, fund age and portfolio company age. All results are robust to excluding the controls, which alleviates a concern that these variables might be affected by distress.

participating in the SBIC program.[18] Fund leverage is determined by the size of the fund at the beginning of its life. Then, leverage is plausibly considered exogenous and not included in the specification because there is no identifiable variation in it, and most funds are fully levered. The sample for most tests focuses on participating funds in the SBIC program to mitigate concerns that the findings are driven by unobservable differences between SBIC funds and non-participating venture capital funds. Instances when the sample includes funds outside of the program will be detailed in the relevant section. Standard errors are clustered at the fund level.

This paper seeks to understand the response by fund managers to financial distress in an environment in which they are relatively unrestricted in their investment decisions. The coefficient of interest, β, in this setting is the difference-in-differences estimate. It captures the effect of distress on managerial risk-taking at a distressed (treated) fund relative to risk-taking by funds in the program that do not become distressed. Fund and year fixed effects absorb the first difference estimates. The identifying assumption for this specification is the parallel trends assumption. Specifically, this assumes that, if a distressed fund did not enter distress, its investments would be similarly risky compared to those funds that never became distressed. As a falsification test, I examine risk-taking by funds just prior to becoming distressed using the following specification:

$$y_{ijt} = \beta_1 \textit{Fund distress}_{it} + \beta_2 \textit{Prior distress}_{it} + \gamma' X_{it} + \eta_i + \lambda_j + \delta_y + \varepsilon_{ijt}. \tag{2}$$

The additional variable $\textit{Prior distress}_{it}$ is an indicator variable equaling one for the two years prior to a distressed fund entering distress. If fund distress changes risk-taking and is unanticipated by funds, then risk-taking should change when a fund enters distress and not prior to it. This implies that the estimate of β_2 should not statistically differ from zero.

I identify a financially distressed fund in the program based on its transfer to the Office

[18]The sample for this specification is investments by funds and there is not a specific period of time between investments for a particular fund.

of Liquidation, which occurs when a fund crosses a particular threshold or is subject to regulatory violations. This is an appealing measure of distress as its date is clearly defined and observable, and the transfer is based on program guidelines. The Office of Liquidation is responsible for determining if SBIC funds are capitally impaired or violate regulations of the program. This is identified by field-based examinations and review of financial documents. Funds continue to operate and invest after being transferred, and the average time from transfer to exit is 7.4 years. Section 4.2 tests whether funds anticipate transfer to this office.

Lastly, I use several measures of risk for a fund's investments. First, I measure risk using the credit score and credit risk class of the portfolio company. Second, sales growth and employee growth are two proxies of risk. Those portfolio companies with lower growth in the year prior to investment are considered ex-ante riskier relative to those firms with higher growth. Third, I use patenting activity prior to a fund's investment to proxy for information asymmetry about the prospects of the portfolio company. There is arguably less uncertainty about those firms with relatively higher patenting activity relative to those with lower patent production. Finally, I measure risk based on the type of investment in the portfolio company. Venture capital funds tend to invest with equity, preferred stock or debt securities. The cash flows received by funds from equity are relatively riskier than those provided by preferred stock or debt.

4 Results

4.1 Agency Costs of Debt

Do managers invest in riskier projects as funds become distressed? Theories of risk shifting predict that managers, acting in the interest of equityholders, take on riskier investments as distress increases (Jensen and Meckling (1976)). As a firm with debt becomes distressed, it is increasingly less likely that the owners will receive any cash flows from the firm since bondholders are paid first. This incentivizes managers to take on more risk, at the expense

of debtholders. Yet previous studies document that managers of distressed firms invest in less risky projects. By using the SBIC program, I focus on a setting where managers are largely unconstrained in their investment decisions, even while in distress.

Table 3 provides the difference-in-differences estimates of risk shifting by managers of distressed funds. The dependent variable is one of several measures of risk at the fund-investment level. The sample focuses on funds participating in the SBIC program. The first two columns use credit data from Equifax. Column 1 reports that distressed funds invest in portfolio companies with lower credit scores of 11.3, which is a 10.2% decrease relative to one standard deviation. This accounts for fund and industry time-invariant unobserved heterogeneity and time-varying differences in risk-taking, in addition to controlling for the natural log of the round amount and age of the venture capital firm, fund and portfolio company. Equifax classifies companies into five credit risk classes. In column 2, I find that distressed funds are 4.9% more likely to invest in portfolio companies in the highest risk class. This is a 26.4% increase relative to the sample mean.

The next two columns use company-level measures of performance in the year prior to a fund's investment. These data are from the NETS database, which provides data on establishments from 1990 to 2012, and restricts the sample for these specifications. Column 3 reports that funds in distress invest in portfolio companies with 26.4% lower sales growth. This estimate is the change in sales growth for funds in distress relative to the change in sales growth for funds that remain solvent. Column 4 reports that distressed funds invest in firms with 22.6% lower employee growth on average. These findings are statistically significant and economically meaningful. The estimates for sales and employee growth are a decrease of 16.4% and 18.9% of one standard deviation, respectively.

Next, column 5 uses patenting activity prior to investment as a proxy for risk. Venture capital funds often invest in companies that patent frequently (Lerner, Sorensen and Strömberg (2011)). I find that managers of distressed funds invest in portfolio companies with 0.17 fewer patents on average. This result is a 24.6% decrease relative to the sample

mean. The specification for column 5 is estimated using a conditional fixed effects negative binomial model, since the dependent variable of patents is a count variable. Column 6 examines the change in investments by funds in distress. The variable *Equity investment* is defined as an indicator equaling one if a fund makes an equity investment in a portfolio company. Preferred stock and debt are common alternative forms of investment by venture capital funds. I report that distressed funds are 6.6% more likely to use equity investments, relative to funds not in distress. This is a 22.0% increase relative to the sample mean.

Taken together, the results in this section suggest that managers, acting in the interests of equityholders, shift to riskier investments when in distress. This is statistically significant and economically meaningful across several measures of risk, including credit proxies, prior performance for the portfolio company, patenting activity, and type of investment. Importantly, these findings provide evidence that there are conflicts of interest between debtholders and equityholders, and suggest that market mechanisms might have evolved to prevent these conflicts, such as covenants. Lastly, leveraged SBIC funds tend to have a debt-to-asset ratio of about two-thirds. Since this could be considered a relatively high leverage ratio, the baseline estimates in this section might be considered an upper bound on the agency costs of debt.

4.2 Falsification Test

The parallel trends assumption is the identifying assumption for the difference-in-differences methodology. Distress is based on a fund's transfer to the program's Office of Liquidation. While this provides a specific and observable definition of distress, a concern might be that funds anticipate distress and adjust their investment policy prior to being transferred. To address this potential issue, I augment the baseline specification with an indicator equaling one for the two years prior to a distressed fund becoming distressed, defined as *Prior distress*. This captures the average change in risk-taking by distressed funds prior to being classified as distressed. To satisfy the parallel trends assumption, the riskiness of investments prior to

distress should not significantly differ from a fund's average risk-taking.

Table 4 reports the findings from this falsification test. The first two columns follow the specification from Table 3 with an additional indicator for the two years prior to distress. I find that the estimates for *Prior distress* are economically negligible and statistically insignificant. Additionally, the decrease in credit scores of 10.9 and the increase in the likelihood of investments in the high credit risk class of 4.8% remain similar to previous estimates of −11.3 and 4.9% in the baseline specification. Further, the decrease in sales and employee growth are similar to previous estimates at 22.0%−25.7%, compared to 22.6%−26.4% in the baseline findings. Column 5 provides the findings for patent activity. I report no statistical change in patenting for investments prior to distress, while the decrease after distress of 0.16 patents continues to be statistically significant and is close to the baseline estimate of 0.17 fewer patents. The last column concludes by estimating the model for equity investments and finds no significant change in investment type prior to distress, but a significant increase in equity of 7.1% in distressed funds, similar to the baseline finding of 6.6%. Overall, I do not find any evidence of changes in a fund's risk-taking just prior to becoming distressed. This falsification test provides evidence that transfer to the Office of Liquidation is largely unanticipated by funds, which is consistent with the parallel trends assumption.

4.3 Diversification

Diversification might be an alternative explanation of the results. Managers of distressed funds may increase the diversification of the fund's portfolio of investments. This could be consistent with the findings of increased risk-taking during distress if diversification of a fund's portfolio is correlated with the riskiness of these investments.

To test this explanation, I augment the baseline specification with a measure of fund diversification and interact it with fund distress. I define fund diversification as the Herfindahl-Hirschman Index (HHI) of a fund's investments by industry. Industries are defined by the VentureXpert industrial classification. For each fund, I construct *Diversification* as follows.

First, I square the number of investments in industry j by fund i relative to the total number of investments in its portfolio. Next, I sum these values for all industries in a fund's portfolio. This measure varies between zero and one. To ease interpretation, I set one to represent a fully diversified portfolio and zero to denote a completely concentrated portfolio. I estimate the following specification to test the alternative explanation of diversification:

$$y_{ijt} = \beta_1 \textit{Fund distress}_{it} + \beta_2 \textit{Diversification}_i + \beta_3 \textit{Fund distress}_{it} \times \textit{Diversification}_i + \gamma' X_{it} + \eta_i + \lambda_j + \delta_y + \varepsilon_{ijt}. \quad (3)$$

The coefficient of interest is β_3 and captures the change in riskiness for diversified funds in distress.

Table 5 details the findings about the role of diversification for distressed funds. Column 1 repeats the specifications from Table 3 and additionally includes *Diversification* and its interaction with *Fund distress*. I find that the estimated change in credit scores remains negative and statistically significant. The estimate in this specification is a decrease of 18.9 in the credit score of the portfolio companies for distressed funds, which is larger in magnitude relative to the baseline findings. The estimate of diversification is not statistically distinguishable from zero. I report a directionally similar estimate in column 2, though the magnitude is smaller and no longer statistically significant. Columns 3 and 4 report the estimates for sales and employee growth, and find a decrease of 56.8% and 44.0%, respectively, which are larger in magnitude relative to the baseline findings. The coefficient on the interaction term between diversification and distress is an increase of 1.4% and 1.0% for sales and employee growth, respectively, and statistically significant at the 5% and 10% level, respectively. These findings suggest that diversified funds invest in relatively less risky firms, which is not consistent with diversification as an alternative explanation for risk shifting. Further, the estimated magnitude for diversification appears to be economically negligible relative to the change in risk-taking for distressed funds. Column 5 reports the results for

patenting activity and details similar results. I find that distressed funds invest in firms with lower patenting activity, while the estimates for diversification and its interaction term are slightly positive and significant. These findings remain consistent with the notion that diversified funds in distress invest in less risky portfolio companies, though the estimates continue to be economically small. Lastly, column 6 finds a similar estimate for the likelihood of selecting an equity investment, though it is no longer statistically significant. The coefficient on diversification and its interaction continue to be negligible and are statistically insignificant. Overall, these results cast doubt on the importance of diversification as an explanation for the finding that managers of distressed funds risk shift.

4.4 Differences Within Venture Capital Firms

The results up to this point focus on the sample of funds participating in the SBIC program. An issue might be that SBIC funds and private venture capital funds respond similarly in distress, implying that undertaking riskier investments by distressed funds is not a response to the high leverage of SBIC participants. Yet it is challenging to determine an appropriate sample of private funds to match with SBIC funds. To address this concern, I link venture capital firms with both SBIC and private funds. This test holds constant unobserved differences between venture capital firms and compares how funds respond differentially to distress in the SBIC program relative to private funds at the same firm. I estimate the following specification to test the response to distress by SBIC funds:

$$y_{ijt} = \beta_1 \textit{Fund distress}_{it} \times \text{SBIC}_i + \beta_2 \textit{Fund distress}_{it} + \gamma' X_{it} + \eta_i + \lambda_j + \delta_y + \varepsilon_{ijt}. \qquad (4)$$

The coefficient of interest is β_1 and captures the change in riskiness for SBIC funds in distress relative to private funds. The indicator for SBIC funds is absorbed by the fund fixed effects. Similar to above, distress for SBIC funds is based on its transfer to the Office of Liquidation. To construct a proxy of distress for private funds, I define distress for private funds as those

investments by funds in the top decile of the sum of failed investments relative to total investments.

Table 6 studies the response to distress for SBIC funds relative to private funds at the same firm. Columns 1 and 2 examine the differences in credit scores and investments in high credit risk portfolio companies at SBIC funds, relative to private funds. I find that the effect of risk shifting is concentrated in SBIC funds. The coefficient on the interaction term of distress and SBIC is statistically significant and economically meaningful, with a similar magnitude to the baseline specification. The effect of distress for these variables is small and statistically insignificant. Columns 3 and 4 studies the differences in sales and employee growth and reports that the effect remains focused in SBIC funds. Column 5 evaluates innovative activity at the portfolio company prior to investments. Consistent with the findings above, I report that SBIC funds invest in companies with 0.21 fewer patents, close to the baseline estimate. However, I find that private funds in distress shift capital to portfolio companies with more patents. Column 6 reports that SBIC funds in distress are more likely to use equity investments, while there is no significant difference for private funds. Taken together, these findings provide additional evidence that high leverage at distressed SBIC funds is linked to changes in risk-taking.

5 Risk Shifting and Portfolio Adjustment

In this section, I study how managers at distressed funds adjust their portfolios as they shift to riskier investments. Venture capital funds allocate capital to firms in their portfolio through multiple rounds of financing. Do distressed funds shift to riskier investments already in their portfolio or do they search for new, riskier firms to invest in? There are several reasons why it might be less costly to allocate capital to firms already in a distressed fund's portfolio, rather than searching for new investment opportunities. First, search costs could be relatively high for finding new portfolio companies, particularly during financial distress.

Second, capital adjustment costs might be lower for existing investments, as contracts are already in place at these firms. A large literature in macroeconomics suggests that capital adjustment costs can be considerable (Lucas (1967)). Third, it could be costly for distressed funds to liquidate positions in firms currently in their portfolio or by using the secondary market (Nadauld et al. (2017)). This suggests that distressed funds could be more likely to invest in companies in their portfolio, instead of seeking out new firms.

First, I evaluate how managers of distressed funds adjust the allocation of capital in their portfolio. For each fund in the SBIC program, I construct an annual or quarterly time-series of investments, which begins at the fund life and ends with the fund's last observed investment. I estimate the following specification:

$$y_{it} = \beta \, Fund \; distress_{it} + \gamma X_{it} + \delta_t + \varepsilon_{it}. \tag{5}$$

The dependent variable y_{it} is the proportion of post-first round investments, equal- or value-weighted, for fund i in year or quarter t. I include fund age to control for the variation in investments attributed to the age of the fund and year fixed effects. This specification is estimated at an annual and quarterly frequency to provide evidence that the results are not sensitive to the frequency of the data.

Panel A of Table 7 reports the results on portfolio adjustments by distressed funds. Column 1 details the results for the equal-weighted proportion of post-first round investments. I find that managers at distressed funds are 11.8% more likely to invest in post-first rounds of financing, on an annual basis. Using a value-weighted measure of financings, column 2 reports that distressed funds are 13.0% more likely to invest in post-first rounds annually. These effects are statistically significant and economically meaningful. This is a 28.4% to 34.0% increase relative to the sample mean. Columns 3 and 4 estimate the specification on a quarterly basis for the equal- and value-weighted measure of post-first round financings. I find managers of distressed funds are 2.4% to 4.2% more likely to invest in post-first

round financings, on a quarterly basis. These estimates remain statistically significant and represent a 9.8% to 19.5% increase relative to the sample mean.

While these findings provide evidence that managers reallocate their portfolios to post-first round financings, these investments might not adjust the riskiness of the fund's portfolio. Consistent with the findings in Panel A of Table 7, first-round financings are relatively infrequent when a fund is distressed. In my sample, just 16.5% of investments for distressed funds are in the first round. To ensure that the risk-shifting results are not driven by first-round investments, I exclude first-round investments for distressed funds and re-estimate the specifications from Section 4.2. Panel B of Table 7 provides the results for this sample of investments. I find strikingly similar results to the baseline models, suggesting that distressed funds invest in riskier portfolio companies through post-first round financings. Columns 1 and 2 find that, for funds entering distress, credit scores of investments decline by 11.7 and the likelihood of investing in portfolio companies with the highest risk class increases by 5.1%, close to the baseline results. Columns 3 and 4 report that distressed funds invest in companies with a decrease of 26.4% in sales growth and a decrease of 23.0% in employee growth, compared to the baseline estimates of 26.4% and 22.6% lower sales and employee growth, respectively. Column 5 finds that innovative activity declines by 0.19 patents, relative to the main result of a 0.17 decrease in patents. Lastly, column 6 reports that distressed funds are 6.6% more likely to use equity in their investments, which is the same as the baseline estimate. Taken together, I find that managers of distressed funds tend to reallocate their portfolios to riskier companies already in their holdings, rather than seeking out new investments. This is consistent with relatively lower adjustment costs to allocate capital for firms currently in a fund's portfolio.

6 Equityholder Reaction and Debtholder Loss

6.1 Equityholder Reaction

How do equityholders respond to riskier investments when firms are distressed? It is challenging to study the response by equityholders to news of risk shifting for at least two reasons. First, the exact timing of the event might be unknown or the measure of risk is aggregated either by firm or over time. The setting of this study allows me to observe individual decisions by managers and their timing. Second, it might be infeasible to observe equity prices, particularly over a specific period of time and at a high frequency. To overcome these challenges, I link funds in the SBIC program to publicly-traded venture firms, referred to as business development companies (BDCs). Rather than raising capital through private equity, these firms use public equity markets to raise capital for their funds. This allows me to observe the reaction by shareholders to the investment decisions of funds.

I use an event study methodology to study the response by equityholders to news of investment decisions. The abnormal return is defined as:

$$AR_{it} = R_{it} - E\left[R_{it}\right], \tag{6}$$

where R_{it} is the realized excess return for investment i on event date t and $E[R_{it}]$ is the expected excess return for investment i on event date t. The model for the expected excess return is estimated using a three- or five-factor model for the previous 61 to 260 trading days prior to an investment. The three-factor model includes the market return, SMB (small minus big) and HML (high minus low) factors, while the five-factor model also includes the momentum and Pástor-Stambaugh liquidity factors.[19] For each investment i, I sum the abnormal returns over an event window around the investment date to form the cumulative

[19]Data on the factors is provided by Ken French at `http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`, except for the liquidity factor, which is available at `http://faculty.chicagobooth.edu/lubos.pastor/research`.

abnormal return for investment i, denoted as CAR_i.

Theory predicts that risk shifting transfers wealth from bondholders to equityholders. This suggests that riskier investments for distressed funds increase the value of equity, while decreasing the value of debt. I link 376 investments by funds to equity returns. Since these funds are relatively recent in the SBIC program, I construct an alternative measure of distress. I define *Fund distress* as the percentage of investments in a fund's portfolio that are bankrupt or considered defunct. *High distress* is an indicator variable equaling one if a fund has above median *Fund distress*. *High risk* is a binary variable equaling one when the first principal component of *Sales growth*, *Employment growth*, *Patent activity*, and *Equity investment* is above the median. I test shareholders' response to fund investment decisions using the following specification:

$$CAR_i = \alpha + \beta_1 High\ distress_i + \beta_2 High\ risk_i + \beta_3 High\ distress_i \times High\ risk_i + \varepsilon_i, \quad (7)$$

where $High\ distress_i \times High\ risk_i$ is the interaction term between $High\ distress_i$ and $High\ risk_i$. These models are estimated using robust standard errors.

Table 8 details the equityholder response to risk shifting by distressed funds for varying event windows and expected returns models. Column 1 reports the results using a three-factor model and an event window from one day prior to the investment date to one day afterwards. I find that distressed funds tend to have lower returns of 2.5% on average and those investments with high risk also are related to lower returns of 2.6%. However, risky investments at distressed funds tend to increase the value of equity by 2.6%. This is consistent with the prediction that risk shifting by managers of distressed funds increases the value of equity. Column 2 reports the results for a larger event window around the investment date of three days prior to the investment to three days afterwards. The findings remain similar to using a narrower event window. Shareholders react positively to risky investments during distress, while returns tend to be negative for the separate indicators for distress or

risky investments. Columns 3 and 4 continue by reporting the results for the same event windows and using a five-factor model to estimate expected returns. These additional factors address concerns that returns for these equities may be related to momentum and liquidity. I find strikingly similar results across both columns. While the estimates appear large based on the investment size, they offer evidence about the average response by equityholders. These results suggest that equityholders respond positively to risk shifting by fund managers, increasing the value of equity.

6.2 Debtholder Loss

While the value of equity increases, it does not necessarily imply a corresponding loss for debtholders. Managers may invest in riskier projects and there could be no effect on the returns to bondholders. Then, the riskier projects could be interpreted as value increasing for the firm, rather than transferring wealth from debtholders to equityholders. The debtholder for the SBIC program is the U.S. federal government, since they provide debt to participating funds. A FOIA request provided losses by fund, though not all liquidated funds are included in the data. The average time to resolve a liquidation is 7.4 years, with a median length of 6.8 years. Of 268 liquidated funds in the VentureXpert dataset, I match data on debtholder losses for 149 funds. To study the wealth effects for debtholders, I construct several proxies for their losses. The first proxy, *Loss measure 1*, is the loss in millions of dollars for debtholders and is dropped if the FOIA request does not provide information for a particular fund. The second proxy, *Loss measure 2*, is the loss in millions of dollars for the government and is denoted as zero if no data is provided in the request. The second measure is arguably more conservative, since it assumes that bondholders are fully repaid if no data is provided. I estimate the following specification to study the loss to debtholders:

$$Y_i = \alpha + \beta \, Liquidated_i + \gamma X_i + \delta_y + \varepsilon_i, \tag{8}$$

where Y_i is a measure of debtholder loss for fund i, $Liquidated_i$ is an indicator equaling one if fund i is liquidated, X_i is a vector of fund controls and δ_y is year fixed effects. The fund controls, X_i, are *Follow-on fund*, fund stage, and fund location. *Follow-on fund* is an indicator variable equaling one if the fund sequence is greater than one for a particular venture capital firm. Fund stage is an indicator for each of the following stages: balanced, early, later, buyouts, mezzanine or other. Fund location is an indicator for each of the following locations: east, midwest, south, west or other. Standard errors are clustered at the year level.

Table 9 reports the findings for the loss to debtholders using equation (8). Column 1 is based on funds in VentureXpert and includes liquidated funds with data on losses. I find that the SBIC program loses $8.0 million on average. This result is statistically significant and economically meaningful, representing a 12.9% loss relative to the fund size reported in VentureXpert. Column 2 reports the estimated losses for the same sample and uses the log measure of losses. It details that debtholders have significant losses for liquidated funds. Column 3 uses the alternative measure *Loss measure 2*, which is based on the assumption that the missing data corresponds to no loss for debtholders. Consistently, I find lower estimated losses of $3.7 million on average, which remains statistically significant at the 1% level. Lastly, column 4 is based on the full sample of program participants since 1976 and, since VentureXpert data is unavailable for some funds, only includes year fixed effects. I report that liquidated funds on average lose $2.5 million in the full sample. This estimate is slightly lower since the sample includes earlier, and smaller, funds in the program. Overall, these findings provide evidence that the value of debt decreases for liquidated funds and that wealth transfers from debtholders to equityholders.

7 Conclusion

Do managers engage in risk shifting? It has been nearly forty years since theory predicted this effect and much focus on this incentive ensued, yet there has been surprisingly little evidence that managers invest in riskier projects as distress increases. A potential limitation of previous studies might be mechanisms in place that prevent managers from risk shifting. Covenants in debt contracts constrain managers from shifting to riskier investments. Further, bankruptcy costs and adjustments in the cost of capital limit the ability of a firm to take on additional debt. Lastly, reputation concerns in debt markets or career concerns for managers may reduce incentive conflicts between bondholders and equityholders.

The SBIC program is a unique setting to study the agency costs of debt largely without these mechanisms. I find that managers of distressed funds invest in riskier firms relative to funds that remain solvent. Risk shifting occurs just when a fund enters distress and it is not driven by changes prior to becoming distressed. This finding is not driven by diversification of a distressed fund's portfolio. Further, I find similar results when comparing funds in the program to private funds within the same venture capital firm, providing evidence that risk shifting is driven by distress of leveraged funds and not by unobservable differences for funds in the program or a particular feature of the venture capital industry. Additionally, I find that funds reallocate their investments to riskier companies in their portfolio, rather than seeking out new investments. Equityholders respond positively to riskier investments when funds are distressed. However, the government, which is considered the debtholder in the program's funds, incurs significant losses from distressed funds. Taken together, this paper presents evidence on the agency costs of debt when there are no mechanisms in place to constrain managerial investment policy.

There are several potential avenues for future research. First, what is the role of government in supporting venture capital and startup activity? While this study highlights distortions from the type of capital provided to the program participants, it remains an

open question about how and when governments can develop programs to spur economic growth. Second, what is the importance of regulatory capture in the design and continuation of the program? Future work could offer insights into the progression of regulatory capture and its effects. Third, how do governments liquidate their investments? While this paper uses liquidation as a measure of distress, a further question might be understanding how governments reclaim capital from distressed investments, which became particularly relevant during the recent financial crisis.

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Figure 1: Cost of Capital for SBIC Funds

This figure plots the interest rate charged to licensed venture capital funds in the Small Business Investment Company (SBIC) and the 10-Year Treasury Note. The cost of capital for funds is based on the 10-Year Treasury Note plus a spread, which has ranged from 34 to 227 basis points since 2001. Data on the cost of capital and the comparable Treasury rate is provided by the SBIC program website from September 20, 2001 to September 14, 2016.

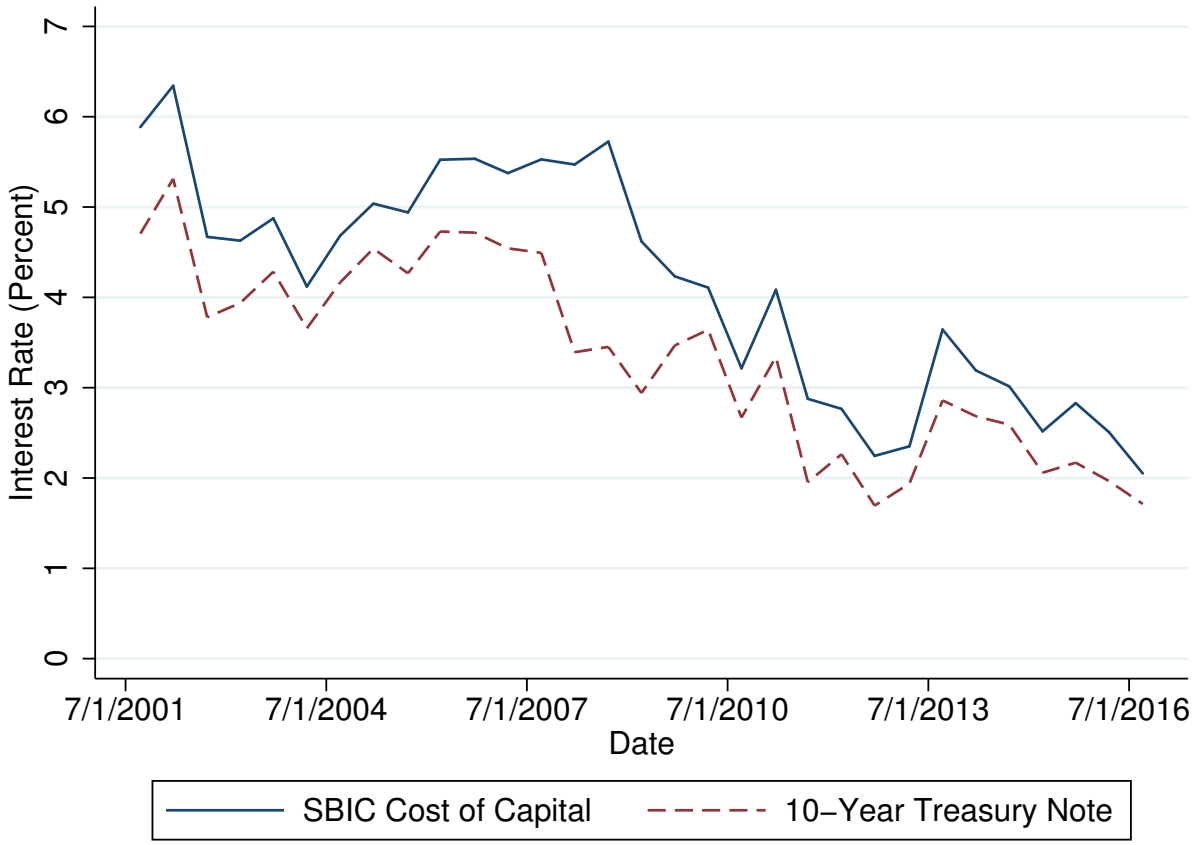


Figure 2: Leverage Timing

This figure displays a histogram of the timing of leverage provided to venture capital funds participating in the Small Business Investment Company (SBIC) program. The frequency of leverage is based on the years since an SBIC fund received its license. The U.S. government offers debt capital to SBIC funds and provides about two times the financing provided by equity investors. Data on loans from the U.S. government to venture capital funds are extracted from the Federal Assistance Award Data System (FAADS) through the National Archives and Records Administration of the United States and at USAspending.gov.

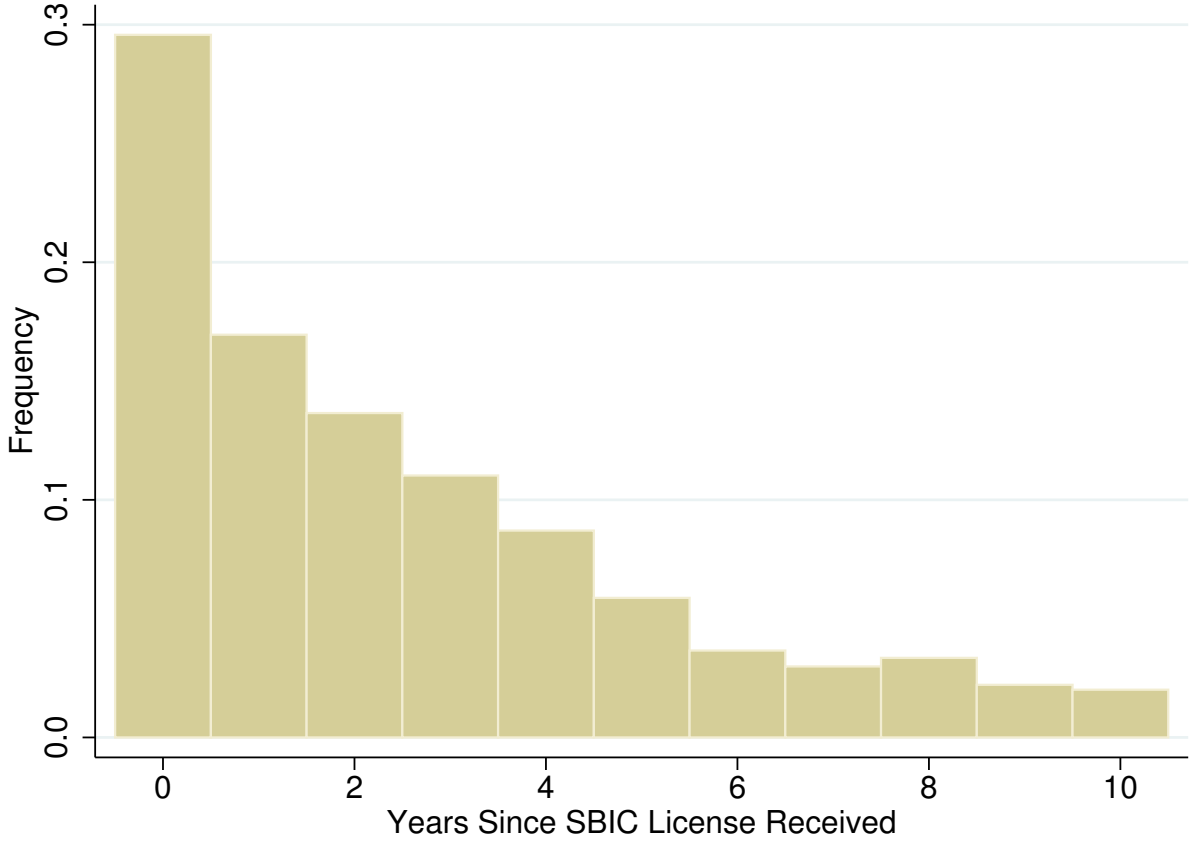


Table 1: Small Business Investment Company (SBIC) Program

This table details venture capital funds participating in the small business investment company (SBIC) program by licensing year from 1976 to 2015. Each fund is one of the following types: leveraged, bank-owned or non-leveraged, and specialized. Leveraged SBICs receive government capital as debt and are called debenture or participating securities funds. Bank-owned and non-leveraged funds do not receive capital from the government. These types of SBICs are used by certain institutions to satisfy regulatory requirements (e.g., Community Reinvestment Act) or increase their equity investments (e.g., exemptions in the Dodd-Frank Act). Specialized SBICs are restricted to invest only in companies with "social or economic disadvantages." Data on venture capital funds participating in the SBIC program at any time since January 1, 1976 was provided through a Freedom of Information Act (FOIA) request.

Number of Licenses Issued by Type				
Years	Leveraged	Bank-Owned or Non-Leveraged	Specialized	Total
1976 – 1980	140	33	98	271
1981 – 1985	122	63	70	255
1986 – 1990	43	32	35	110
1991 – 1995	61	13	6	80
1996 – 2000	171	43	2	216
2001 – 2005	152	12	0	164
2006 – 2010	56	9	0	65
2011 – 2015	105	20	0	125
Total	850	225	211	1,286

Table 2: Summary Statistics

This table reports summary statistics for funds and investments of SBIC participants between 1976 and 2015. Panel A details the summary statistics, including the number of observations, mean, median, minimum, maximum and standard deviation, for the following variables. *Fund distress* is an indicator variable equaling one if a fund is in distress, as defined by its transfer to the Office of Liquidation. *Credit score* is the credit score from Equifax of the portfolio company. *High credit risk* is an indicator variable equaling one if the credit risk class is the most risky. *Sales growth* is the growth in sales at the portfolio company in the previous year and *Employee growth* is the growth in employees at the portfolio company during the previous year. Both of these variables are winsorized at the 1% level. *Patenting activity* is the sum of patents prior to a fund's investment in the portfolio company. *Equity investment* is an indicator variable equaling one if the fund uses an equity investment in the portfolio company. *Failed investment* is a binary variable equaling one if a fund does not successfully exit an investment, where a success is defined as an acquisition or IPO. *First round* is an indicator variable equaling one if this is the first investment in a portfolio company by a particular fund. *Round amount* is the natural log of total financing (in millions of dollars) received by the portfolio company. *VC firm age* is the natural log of the venture capital firm's age and *Fund age* is the natural log of the venture capital fund's age. *Portfolio company age* is the natural log of the portfolio company's age. *Fund size* is the total amount (in millions of dollars) of capital committed to a fund by its limited partners and general partners. Panel B compares the differences in means for SBIC funds and private funds. *Fund sequence* is the chronological numbering of funds for a particular venture capital firm, starting at one. *Round number* is a count of the number of financings for a portfolio company and *Round number of investors* is a count of the number of investors in a particular round.

Panel A: Summary Statistics

Variable	Number of observations	Mean	Median	Minimum	Maximum	Standard deviation
Fund distress	22,789	0.094	0.000	0.000	1.000	0.292
Credit score	12,790	406.040	442.000	101.000	595.000	110.548
High credit risk	12,790	0.186	0.000	0.000	1.000	0.389
Sales growth	8,972	0.426	0.000	−0.746	11.400	1.606
Employee growth	8,972	0.336	0.000	−0.530	8.200	1.195
Patenting activity	22,789	0.690	0.000	0.000	474.000	5.359
Equity investment	22,789	0.300	0.000	0.000	1.000	0.458
Failed investment	22,789	0.502	1.000	0.000	1.000	0.500
First round	22,789	0.276	0.000	0.000	1.000	0.447
Round amount (log)	22,789	6.693	7.962	0.000	15.054	3.479
VC firm age (log)	22,789	2.604	2.708	0.000	4.787	0.898
Fund age (log)	22,789	2.311	2.303	0.000	4.673	0.982
Portfolio company (log)	22,789	1.802	1.792	0.000	5.328	0.956
Fund size ($ million)	245	62.003	51.000	0.100	400.000	60.572

Panel B: SBIC Funds and Private Funds

Variable	Mean for SBIC funds	Mean for private funds	Difference	p-value
Fund size ($ millions)	62.003	331.072	-269.069^{***}	0.000
Fund sequence	1.593	4.007	-2.411^{***}	0.000
Round amount ($ millions)	9.871	29.526	-19.656^{***}	0.000
Round number	2.712	3.042	-0.330^{***}	0.000
Round number of investors	4.071	3.795	0.277^{***}	0.003

Table 3: Agency Costs of Debt

This table studies the effect of fund distress on risk shifting. *Credit score* is the credit score from Equifax of the portfolio company. *High credit risk* is an indicator variable equaling one if the credit risk class is the most risky. *Sales growth* is the growth in sales at the portfolio company in the previous year and *Employee growth* is the growth in employees at the portfolio company during the previous year. Both of these variables are winsorized at the 1% level. *Patenting activity* is the sum of patents prior to a fund's investment in the portfolio company. *Equity investment* is an indicator variable equaling one if the fund uses an equity investment in the portfolio company. *Fund distress* is an indicator variable equaling one if a fund is in distress, as defined by its transfer to the Office of Liquidation. *Round amount* is the natural log of total financing (in millions of dollars) received by the portfolio company. *VC firm age* is the natural log of the venture capital firm's age and *Fund age* is the natural log of the venture capital fund's age. *Portfolio company age* is the natural log of the portfolio company's age. Industries are defined by the VentureXpert industrial classification (biotechnology, communications/media, computer hardware, computer software/services, consumer related, industrial/energy, internet specific, medical/health, semiconductors/other electronics, and other products). All models include fund, industry and year fixed effects and an intercept term. Column 3 is estimated using a conditional fixed effects negative binomial model, since the dependent variable of patents is a count variable. Standard errors are reported in parentheses and clustered at the fund level. ***, **, and *denote significance at 1%, 5%, and 10%, respectively.

Dependent variable	Credit Score	High Credit Risk	Sales Growth	Employee Growth	Patenting Activity	Equity Investment
Model	(1)	(2)	(3)	(4)	(5)	(6)
Fund distress	-11.287^{**}	0.049^{**}	-0.264^{***}	-0.226^{***}	-0.170^{***}	0.066^{***}
	(4.761)	(0.021)	(0.083)	(0.069)	(0.044)	(0.021)
Round amount	0.541	-0.003^{**}	0.005	0.006	0.041^{***}	0.009^{***}
	(0.476)	(0.001)	(0.005)	(0.004)	(0.004)	(0.001)
VC firm age	6.391	−0.027	0.253^{**}	0.140^{*}	0.033	−0.011
	(6.580)	(0.023)	(0.098)	(0.077)	(0.034)	(0.018)
Fund age	-6.651^{***}	0.030^{***}	−0.008	−0.017	-0.067^{***}	−0.002
	(3.022)	(0.011)	(0.051)	(0.042)	(0.025)	(0.008)
Portfolio company age	−3.292	−0.000	−0.010	-0.036^{*}	0.316^{***}	-0.010^{**}
	(2.313)	(0.009)	(0.026)	(0.020)	(0.015)	(0.005)
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.019	0.021	0.014	0.019	0.063	0.060
Observations	12,790	12,790	8,972	8,972	22,789	22,789

Table 4: Falsification Test

This table examines a falsification test for the timing of fund distress. *Credit score* is the credit score from Equifax of the portfolio company. *High credit risk* is an indicator variable equaling one if the credit risk class is the most risky. *Sales growth* is the growth in sales at the portfolio company in the previous year and *Employee growth* is the growth in employees at the portfolio company during the previous year. Both of these variables are winsorized at the 1% level. *Patenting activity* is the sum of patents prior to a fund's investment in the portfolio company. *Equity investment* is an indicator variable equaling one if the fund uses an equity investment in the portfolio company. *Fund distress* is an indicator variable equaling one if a fund is in distress, as defined by its transfer to the Office of Liquidation. *Prior distress* is a binary variable equaling one for the two years prior to distress for a fund that is eventually transferred to the Office of Liquidation. *Round amount* is the natural log of total financing (in millions of dollars) received by the portfolio company. *VC firm age* is the natural log of the venture capital firm's age and *Fund age* is the natural log of the venture capital fund's age. *Portfolio company age* is the natural log of the portfolio company's age. Industries are defined by the VentureXpert industrial classification (biotechnology, communications/media, computer hardware, computer software/services, consumer related, industrial/energy, internet specific, medical/health, semiconductors/other electronics, and other products). All models include fund, industry and year fixed effects and an intercept term. Standard errors are reported in parentheses and clustered at the fund level. ***, **, and *denote significance at 1%, 5%, and 10%, respectively.

Dependent variable	Credit Score	High Credit Risk	Sales Growth	Employee Growth	Patenting Activity	Equity Investment
Model	(1)	(2)	(3)	(4)	(5)	(6)
Fund distress	-10.931^{**}	0.048^{**}	-0.257^{**}	-0.220^{**}	-0.159^{***}	0.071^{***}
	(5.115)	(0.021)	(0.109)	(0.089)	(0.046)	(0.023)
Prior distress	1.752	−0.005	0.017	0.012	0.041	0.014
	(7.101)	(0.024)	(0.131)	(0.098)	(0.048)	(0.017)
Round amount	0.541	-0.003^{**}	0.005	0.006	0.040^{***}	0.009^{***}
	(0.476)	(0.001)	(0.005)	(0.004)	(0.004)	(0.001)
VC firm age	6.256	−0.027	0.250^{***}	0.137^{*}	0.033	−0.013
	(6.456)	(0.022)	(0.096)	(0.075)	(0.034)	(0.018)
Fund age	-6.667^{**}	0.030^{***}	−0.009	−0.017	-0.067^{***}	−0.002
	(3.034)	(0.011)	(0.051)	(0.042)	(0.025)	(0.008)
Portfolio company age	−3.297	−0.000	−0.010	-0.036^{*}	0.316^{***}	-0.010^{**}
	(2.313)	(0.009)	(0.026)	(0.020)	(0.015)	(0.005)
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.019	0.021	0.014	0.019	0.064	0.060
Observations	12,790	12,790	8,972	8,972	22,789	22,789

Table 5: Diversification

This table studies the role of fund diversification in risk shifting. *Credit score* is the credit score from Equifax of the portfolio company. *High credit risk* is an indicator variable equaling one if the credit risk class is the most risky. *Sales growth* is the growth in sales at the portfolio company in the previous year and *Employee growth* is the growth in employees at the portfolio company during the previous year. Both of these variables are winsorized at the 1% level. *Patenting activity* is the sum of patents prior to a fund's investment in the portfolio company. *Equity investment* is an indicator variable equaling one if the fund uses an equity investment in the portfolio company. *Fund distress* is an indicator variable equaling one if a fund is in distress, as defined by its transfer to the Office of Liquidation. *Diversification* is the Herfindahl-Hirschman Index (HHI) of a fund's investments by industry, which is set to one to represent a fully diversified portfolio and zero to denote a completely concentrated portfolio. *Fund distress* × *Diversification* is the interaction term of *Fund distress* and *Diversification*. *Round amount* is the natural log of total financing (in millions of dollars) received by the portfolio company. *VC firm age* is the natural log of the venture capital firm's age and *Fund age* is the natural log of the venture capital fund's age. *Portfolio company age* is the natural log of the portfolio company's age. Industries are defined by the VentureXpert industrial classification (biotechnology, communications/media, computer hardware, computer software/services, consumer related, industrial/energy, internet specific, medical/health, semiconductors/other electronics, and other products). All models include fund, industry and year fixed effects and an intercept term. Standard errors are reported in parentheses and clustered at the fund level. ***, **, and *denote significance at 1%, 5%, and 10%, respectively.

Dependent variable	Credit Score	High Credit Risk	Sales Growth	Employee Growth	Patenting Activity	Equity Investment
Model	(1)	(2)	(3)	(4)	(5)	(6)
Fund distress	-18.944^{**}	0.007	-0.568^{***}	-0.440^{***}	-0.403^{***}	0.057
	(9.044)	(0.031)	(0.154)	(0.162)	(0.084)	(0.060)
Diversification	12.084	−0.050	−0.002	−0.007	0.009^{***}	−0.003
	(67.823)	(0.041)	(0.008)	(0.005)	(0.002)	(0.002)
Fund distress	0.354	0.002^{*}	0.014^{**}	0.010^{*}	0.012^{***}	0.000
× Diversification	(0.392)	(0.001)	(0.005)	(0.006)	(0.003)	(0.002)
Round amount	0.542	-0.003^{**}	0.005	0.006	0.040^{***}	0.009^{***}
	(0.476)	(0.001)	(0.005)	(0.004)	(0.004)	(0.001)
VC firm age	6.477	−0.027	0.255^{***}	0.144^{*}	0.053	−0.010
	(6.559)	(0.023)	(0.098)	(0.077)	(0.034)	(0.018)
Fund age	-6.707^{**}	0.030^{***}	−0.010	−0.020	-0.052^{**}	−0.002
	(3.020)	(0.011)	(0.051)	(0.042)	(0.026)	(0.008)
Portfolio company age	−3.319	−0.001	−0.010	-0.036^{*}	0.318^{***}	-0.010^{**}
	(2.315)	(0.009)	(0.026)	(0.020)	(0.015)	(0.005)
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.013	0.015	0.014	0.019	0.064	0.061
Observations	12,790	12,790	8,972	8,972	22,789	22,789

Table 6: Within Venture Capital Firm Differences

This table explores the effect of distress on risk shifting for SBIC and private funds at the same venture capital firm. *Credit score* is the credit score from Equifax of the portfolio company. *High credit risk* is an indicator variable equaling one if the credit risk class is the most risky. *Sales growth* is the growth in sales at the portfolio company in the previous year and *Employee growth* is the growth in employees at the portfolio company during the previous year. Both of these variables are winsorized at the 1% level. *Patenting activity* is the sum of patents prior to a fund's investment in the portfolio company. *Equity investment* is an indicator variable equaling one if the fund uses an equity investment in the portfolio company. *Fund distress* is an indicator variable equaling one if an SBIC fund is in distress, defined by its transfer to the Office of Liquidation, or if a private fund is in distress, defined as the sum of failed investments relative to total investments in the top decile. SBIC is an indicator equaling one if a fund is a participant in the SBIC program. *Round amount* is the natural log of total financing (in millions of dollars) received by the portfolio company. *VC firm age* is the natural log of the venture capital firm's age and *Fund age* is the natural log of the venture capital fund's age. *Portfolio company age* is the natural log of the portfolio company's age. The sample includes only venture capital firms with both SBIC and private funds. Industries are defined by the VentureXpert industrial classification (biotechnology, communications/media, computer hardware, computer software/services, consumer related, industrial/energy, internet specific, medical/health, semiconductors/other electronics, and other products). All models include fund, industry and year fixed effects and an intercept term. Standard errors are reported in parentheses and clustered at the fund level. ***, **, and *denote significance at 1%, 5%, and 10%, respectively.

Dependent variable	Credit Score	High Credit Risk	Sales Growth	Employee Growth	Patenting Activity	Equity Investment
Model	(1)	(2)	(3)	(4)	(5)	(6)
Fund distress × SBIC	-11.825^{**}	0.058^{**}	-0.348^{***}	-0.219^{**}	-0.211^{***}	0.046^{***}
	(5.666)	(0.023)	(0.133)	(0.090)	(0.055)	(0.012)
Fund distress	1.967	−0.015	0.005	−0.047	0.134^{***}	0.013
	(3.572)	(0.014)	(0.106)	(0.066)	(0.041)	(0.020)
Round amount	−0.317	−0.000	0.005	0.007^{**}	0.043^{***}	0.008^{***}
	(0.327)	(0.001)	(0.005)	(0.003)	(0.003)	(0.001)
VC firm age	7.919	-0.028^{*}	0.175^{**}	0.135^{**}	0.027	−0.022
	(4.894)	(0.017)	(0.087)	(0.060)	(0.022)	(0.014)
Fund age	−3.240	0.021^{**}	0.041	0.006	−0.021	0.011
	(2.484)	(0.009)	(0.046)	(0.035)	(0.017)	(0.007)
Portfolio company age	−2.244	−0.001	−0.028	-0.052^{***}	0.322^{***}	−0.005
	(1.445)	(0.006)	(0.019)	(0.014)	(0.011)	(0.003)
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.009	0.013	0.009	0.015	0.063	0.044
Observations	25,486	25,486	16,976	16,976	46,071	46,071

Table 7: Portfolio Allocation

This table examines how distressed funds adjust their portfolios. Panel A examines changes in a fund's portfolio of investments during distress. Panel B focuses on post-first round investments. *Post-first round investments* is the proportion of investments during a given period that are after the initial round of financing, relative to the total number of investments in the period. This measure is equal-weighted or value-weighted by round amount. *Credit score* is the credit score from Equifax of the portfolio company. *High credit risk* is an indicator variable equaling one if the credit risk class is the most risky. *Sales growth* is the growth in sales at the portfolio company in the previous year and *Employee growth* is the growth in employees at the portfolio company during the previous year. Both of these variables are winsorized at the 1% level. *Patenting activity* is the sum of patents prior to a fund's investment in the portfolio company. *Equity investment* is an indicator variable equaling one if the fund uses an equity investment in the portfolio company. *Fund distress* is an indicator variable equaling one if a fund is in distress, as defined by its transfer to the Office of Liquidation. The following controls are included in the specifications for Panel B. *Round amount* is the natural log of total financing (in millions of dollars) received by the portfolio company. *VC firm age* is the natural log of the venture capital firm's age and *Fund age* is the natural log of the venture capital fund's age. *Portfolio company age* is the natural log of the portfolio company's age. Industries are defined by the VentureXpert industrial classification (biotechnology, communications/media, computer hardware, computer software/services, consumer related, industrial/energy, internet specific, medical/health, semiconductors/other electronics, and other products). All models in Panel A include time fixed effects and an intercept term, and all models in Panel B include fund, industry and year fixed effects and an intercept term. Standard errors are reported in parentheses and clustered at the fund level. ***, **, and *denote significance at 1%, 5%, and 10%, respectively.

Panel A: Portfolio Changes

Dependent variable	Post-First Round Investments (Equal-weighted)	Post-First Round Investments (Value-weighted)	Post-First Round Investments (Equal-weighted)	Post-First Round Investments (Value-weighted)
Model	(1)	(2)	(3)	(4)
Fund distress	0.118^{***}	0.130^{***}	0.024^{***}	0.042^{***}
	(0.015)	(0.020)	(0.008)	(0.007)
Fund age	-0.001	-0.001	-0.000	-0.001^{**}
	(0.001)	(0.001)	(0.000)	(0.000)
Time fixed effects	Yes	Yes	Yes	Yes
Frequency	Annual	Annual	Quarterly	Quarterly
R^2	0.092	0.064	0.047	0.038
Observations	9,967	9,967	37,807	37,807

Panel B: Post-first Round Investments

Dependent variable	Credit Score	High Credit Risk	Sales Growth	Employee Growth	Patenting Activity	Equity Investment
Model	(1)	(2)	(3)	(4)	(5)	(6)
Fund distress	-11.732^{**}	0.051^{**}	-0.264^{***}	-0.230^{***}	-0.191^{***}	0.066^{***}
	(4.764)	(0.021)	(0.083)	(0.069)	(0.045)	(0.020)
Fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.021	0.023	0.013	0.018	0.064	0.062
Observations	12,401	12,401	8,753	8,753	21,952	21,952

Table 8: Equityholder Response

This table details the equityholder response to risk shifting. Cumulative abnormal returns (CAR) are measured from one day before to one day after or three days before to three days after a fund's investment. Expected returns are estimated using a 3- or 5-factor model. *High distress* is an indicator variable equaling one if a fund has above median *Fund distress*. *Fund distress* is the percentage of investments in a fund's portfolio that have failed. *High risk* is a binary variable equaling one when the first principal component of *Sales growth*, *Employment growth*, *Patent activity*, and *Equity investment* is above the median. *Sales growth* is the growth in sales at the portfolio company in the previous year and *Employee growth* is the growth in employees at the portfolio company during the previous year. Both of these variables are winsorized at the 1% level. *Patenting activity* is the sum of patents prior to a fund's investment in the portfolio company. *Equity investment* is an indicator variable equaling one if the fund uses an equity investment in the portfolio company. Robust standard errors are reported in parentheses. ***, **, and *denote significance at 1%, 5%, and 10%, respectively.

Dependent variable	CAR$[-1,1]$	CAR$[-3,3]$	CAR$[-1,1]$	CAR$[-3,3]$
Model	(1)	(2)	(3)	(4)
High distress	-0.025^{***}	-0.042^{***}	-0.025^{***}	-0.046^{***}
	(0.009)	(0.012)	(0.010)	(0.012)
High risk	-0.026^{***}	-0.043^{***}	-0.028^{***}	-0.045^{***}
	(0.009)	(0.014)	(0.010)	(0.014)
High distress × High risk	0.026^{**}	0.043^{**}	0.024^{**}	0.042^{**}
	(0.012)	(0.018)	(0.012)	(0.019)
R^2	0.035	0.044	0.041	0.051
Model	3-factor	3-factor	5-factor	5-factor
Observations	376	376	376	376

Table 9: Loss to Debtholders

This table studies the loss to debtholders from liquidation. Losses to the SBIC program by fund are provided by a Freedom of Information Act (FOIA) request. *Loss measure 1* is the loss in millions of dollars for program participants and is dropped if no information is provided in the FOIA request. *Log of loss measure 1* is the natural log of *Loss measure 1*. *Loss measure 2* is the loss in millions of dollars for program participants and is set to zero if no information is provided in the FOIA request. *Liquidated* is an indicator equaling one if the fund is transferred to the Office of Liquidation at any point in its participation in the SBIC program. *Follow-on fund* is a binary variable equaling one if the fund sequence is greater than one for a venture capital firm. Fund stage fixed effects are indicators for fund stage defined as balanced, early, later, buyouts, mezzanine or other. Fund location fixed effects are indicators for a fund's location based on its location in the United States (east, midwest, south, west or other). All models include fund year fixed effects and an intercept term. Standard errors are reported in parentheses and clustered at the year level. ***, **, and *denote significance at 1%, 5%, and 10%, respectively.

Dependent variable	Loss Measure 1	Log of Loss Measure 1	Loss Measure 2	Loss Measure 2
Model	(1)	(2)	(3)	(4)
Liquidated	8.041***	1.147***	3.677***	2.531***
	(1.989)	(0.173)	(0.872)	(0.577)
Follow-on Fund	2.368***	0.180**	1.837***	
	(0.794)	(0.071)	(0.603)	
Fund stage fixed effects	Yes	Yes	Yes	No
Fund location fixed effects	Yes	Yes	Yes	No
Year fixed effects	Yes	Yes	Yes	Yes
Sample	VentureXpert	VentureXpert	VentureXpert	All funds
R^2	0.310	0.470	0.154	0.111
Observations	572	572	691	1,621

Appendix A Variable Definitions

This appendix defines the main variables in the paper and provides their source.

Variable Name	Description	Source
Fund distress	An indicator variable equaling one if a fund is in distress, as defined by its transfer to the Office of Liquidation.	Freedom of Information Act (FOIA) Request
Credit score	Credit score of the portfolio company.	Equifax
High credit risk	An indicator variable equaling one if the credit risk class is the most risky.	Equifax
Sales growth	The growth in sales at the portfolio company in the previous year.	National Establishment Time-Series (NETS) Database
Employee growth	The growth in employees at the portfolio company during the previous year.	NETS Database
Patenting activity	Patenting activity is the sum of patents prior to a fund's investment in the portfolio company.	U.S. Patent and Trademark Office
Equity investment	An indicator variable equaling one if the fund uses an equity investment in the portfolio company	VentureXpert
Round amount	Natural log of total financing (in millions of dollars) received by the portfolio company.	VentureXpert
VC firm age	Natural log of the venture capital firm's age.	VentureXpert
Fund age	Natural log of the venture capital fund's age.	VentureXpert
Portfolio company age	Natural log of the portfolio company's age.	VentureXpert
Failed investment	A binary variable equaling one if a fund does not successfully exit an investment, where a success is defined as an acquisition or IPO.	VentureXpert
First round	An indicator variable equaling one if this is the first investment in a portfolio company by a particular fund.	VentureXpert

Variable Name	Description	Source
Fund size	Total amount (in millions of dollars) of capital committed to a fund by its limited partners and general partners.	VentureXpert
Fund sequence	Chronological numbering of funds for a particular venture capital firm, starting at one.	VentureXpert
Round number	Count of the number of financings for a portfolio company.	VentureXpert
Round number of investors	Count of the number of investors in a particular round.	VentureXpert
Diversification	Herfindahl-Hirschman Index (HHI) of a fund's investments by industry, which is set to one to represent a fully diversified portfolio and zero to denote a completely concentrated portfolio.	VentureXpert
Post-first round investments	The proportion of investments during a given period that are after the initial round of financing, relative to the total number of investments in the period.	VentureXpert
CAR	Cumulative abnormal return for an investment by a business development company (BDC).	CRSP
Loss measure 1	Loss in millions of dollars for program participants and is dropped if no information is provided.	FOIA Request
Loss measure 2	Loss in millions of dollars for program participants and is set to zero if no information is provided.	FOIA Request
Follow-on fund	A binary variable equaling one if the fund sequence is greater than one for a venture capital firm.	VentureXpert

Appendix B Data Sources

This appendix describes the sources of data for this paper. Section B.1 explains the construction of data on fund leverage. Section B.2 details the sources of data on venture capital funds and how SBIC funds are identified. Sections B.3 and B.4 describe the methodology for linking venture capital investment to data from the National Establishment Time-Series (NETS) database and the U.S. Patent and Trademark Office (USPTO), respectively.

B.1 Debt Financing Data

Leverage for participants in the Small Business Investment Company (SBIC) program is extracted from two sources.[20] First, the Federal Assistance Award Data System (FAADS) provides detailed data on loans provided to funds from 1982 to 2005. Since the FAADS is no longer updated, the National Archives and Records Administration of the United States maintains historical records for this system, which are available at `http://catalog.archives.gov/id/604955`. From the quarterly data on awards, I extracted loans to SBIC funds during the available date range. Loans are identified by the Catalog of Federal Domestic Assistance (CFDA) program number of the SBIC program, which is 59.011. This leads to 2,642 observations of financing to 1,127 funds and a total of $17.1 billion in government capital.

Second, USASpending.gov offers data on spending by the US government and was mandated by the Federal Funding Accountability and Transparency Act of 2006. The website provides leverage data from 2006 to 2015. For the SBIC program, there are 436 observed loans to 250 funds, totaling $12.6 billion.

To merge leverage data with the program participant list, I combine the extracted data from the FAADS and USASpending.gov and hand-match SBIC funds' name to loan names

[20]These sources appear to provide noisy data on debt financing. A Freedom of Information Act (FOIA) request for the loan data directly from the Office of Investment and Innovation at the SBA, which administers the program, was denied.

in the award data. Manual matching is required as awardee names are not standardized and commonly misspelled or missing characters. Additionally, the locations of funds and awardees often differ.

B.2 Venture Capital Data and SBIC Funds

Data on venture capital investments is extracted from VentureXpert. For each fund in the SBIC program, I compute the Levenshtein distance between the fund name and location provided by a FOIA request to the program and the fund name and location in VentureXpert, after removing punctuation and common characters and phrases. The Levenshtein distance is a method of computing the difference between two strings and it is approximately a count of the number of edits necessary to change one string into the other string. The Levenshtein ratio is calculated as $(1 - L/S)$, where L is the Levenshtein distance and S is the length of the longest word. For each SBIC fund, I review the best potential match based on this ratio and check its accuracy using the fund name, location and dates of participation in the program.

B.3 National Establishment Time-Series (NETS) Database

The National Establishment Time-Series (NETS) database includes 52.4 million establishments from 1990 to 2012 and provides annual observations of firm sales and employment, in addition to tracking a company's survival. For each observation in the NETS database, I use a cosine similarity algorithm and convert each company name, city and state into a vector based on its term frequency-inverse document frequency, which is referred to as tf-idf. Implementing the cosine similarity algorithm, I calculate the dot product of each observation in NETS with each firm in VentureXpert, normalized by the product of their norms. I restrict the sample to those matches with a match quality of at least 75% and I manually review each match for accuracy. This leads to 264,993 NETS observations matched to

38,268 investments in VentureXpert.

B.4 Patent Data

Patent data is available for granted patents on each Tuesday of every week since July 31, 1790. I retrieve the weekly files starting in 1976 from Google[21] until 2015 and Reed Tech[22] since 2016. The weekly files are generally in three formats. First, from 1976 until 2001, the files are provided in column-delimited format and preceded by "pftaps." For each of these types of files, I convert the files to XML format. Second, from 2002 to 2004, the weekly data is offered in XML format with a shortened variable naming convention and is prefaced with "pg." Lastly, from 2005 until the present, the data is available as XML format with full variable names and the files begin with "ipg." Starting in 2013, there were a few changes in the naming hierarchy for citations, inventors and patent class. Finally, I convert each weekly patent gazette into a JSON file. This leads to a total of 5,996,795 patents from the beginning of 1976 to July 12, 2016.

A challenge in working with patent data is matching patent assignees with firms. This is complicated for at least two reasons. First, assignee names often vary. For example, International Business Machines has at least 49 different spellings of its name. To address this issue, I implement a cosine similarity algorithm and convert each string to a vector based on its term frequency-inverse document frequency (tf-idf). Second, the location of the patent assignee may differ from the firm's headquarters. To handle this concern, I compute the mode city of each assignee, which could be a more accurate representation of the location of the firm. Using the cosine similarity algorithm, I calculate the dot product of each assignee with each firm, normalized by the product of their norms. I restrict the sample to those patents with a match quality of 90% or higher and manually review each match for accuracy. The sample includes 899,957 patents matched to 26,196 firms in VentureXpert.

[21]The data from Google is available at: `https://www.google.com/googlebooks/uspto-patents-grants-text.html`.

[22]The data from Reed Tech is available at: `http://patents.reedtech.com/pgrbft.php`.

Appendix C Financing the SBIC Program

The SBIC program currently issues bonds to finance the underlying investments by program participants. About every six months, the program pools and securitizes the debt financing provided to funds since the last issuance. These bonds are referred to as trust certificates and are issued using underwriters. Since September 12, 2006, the bonds can be prepaid without a premium, though previously there was a slight and declining premium for prepayment. Notably, these bonds are fully backed by the United States government (Small Business Administration (2016)).

An offering circular, or debt contract, is available for each trust certificate issued since 2001. These circulars provide the terms of the debt and details about its underlying securities. During this period, the bonds issued by the SBA include leverage from 4 to 125 SBIC funds. Each contract details the median, minimum and maximum investment by the funds in the offering. On average, the median underlying investment is $2.3 million, with a minimum amount of $0.1 million and a maximum of $15.8 million.

From 1973 to 1986, the program was funded through bonds issued by the Federal Financing Bank, which was created with the goal of centralizing the issuance of government-backed securities and reducing the government's cost of capital. Starting on April 7, 1986, the bank was no longer allowed to finance the SBIC program and the SBA subsequently issued bonds to finance the program (Galante (1986)). The change in funding was linked to a push by President Reagan to eliminate the Small Business Administration from the federal government (Struck (1985)). The change was also tied to a budget reduction plan by the administration. With the removal of the SBIC program, the Federal Financing Bank raised additional funds needed to avoid a government default (Hershey (1985)).

Appendix Figure A.1 details the yield spread and prepayment of trust certificates. Daily yields for trust certificates are extracted from Bloomberg and Treasury Note yields are provided by CRSP Treasury. Data on bond repayment is available on the SBIC program

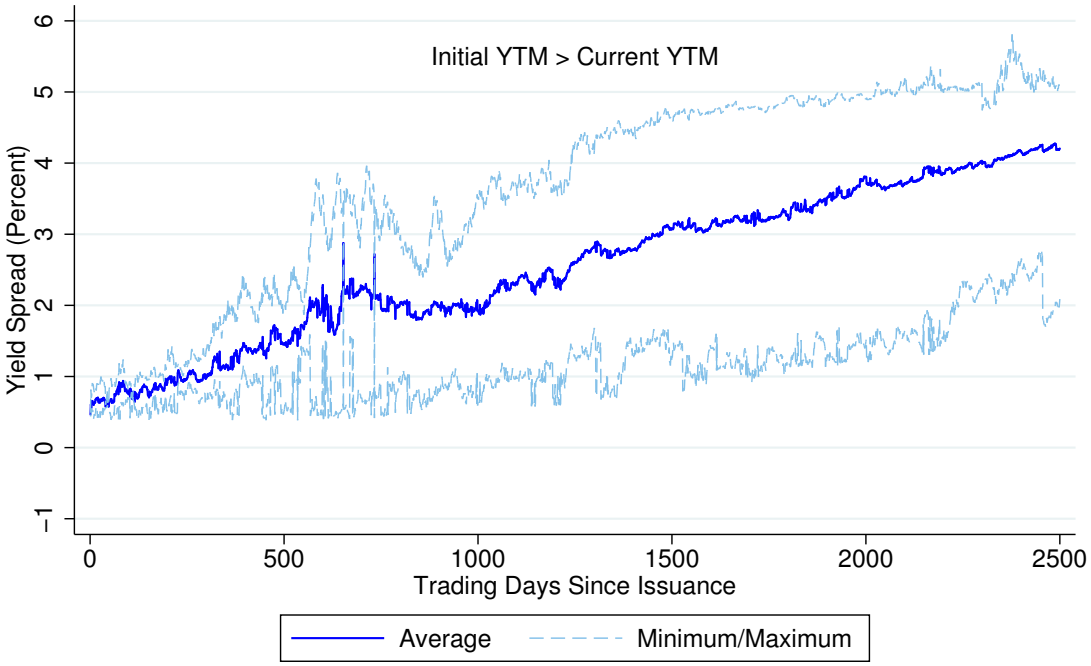
website. From February 4, 2002 to December 31, 2015, there are a total of 65,755 yields observed for 68 securities. For each security, I match the 10-year Treasury Note issued just prior to the trust certificate. I construct the yield spread as the difference in the yield to maturity (YTM) between the trust certificate and the 10-year Treasury Note. Panel A of Appendix Figure A.1 plots the average, minimum and maximum for the yield spread in trading days since issuance when the current YTM is below the YTM at issuance. Panel B plots the yield spread when the current yield-to-maturity is greater than or equal to the YTM when the bond was issued. I find that yield spreads are close to zero when prepayment risk is low, but the yield spread increases as the likelihood of prepayment increases. Panel C plots the historical prepayment of bonds in the sample. In the first two years of issuance, most bonds remain outstanding. Starting in the third year, bonds tend to be repaid and about half of the bonds are repaid after eight years. This suggests that the yield spread increases to compensate investors for prepayment risk when the current yield-to-maturity available to investors is below the YTM at issuance. Relatively low liquidity for SBIC bonds may also be related to widening yield spreads.[23]

[23]A conversation with the CEO of Government Loan Securities, a firm analyzing the secondary market for SBIC bonds, suggests that prepayment and illiquidity are two main factors for increases in yield spreads.

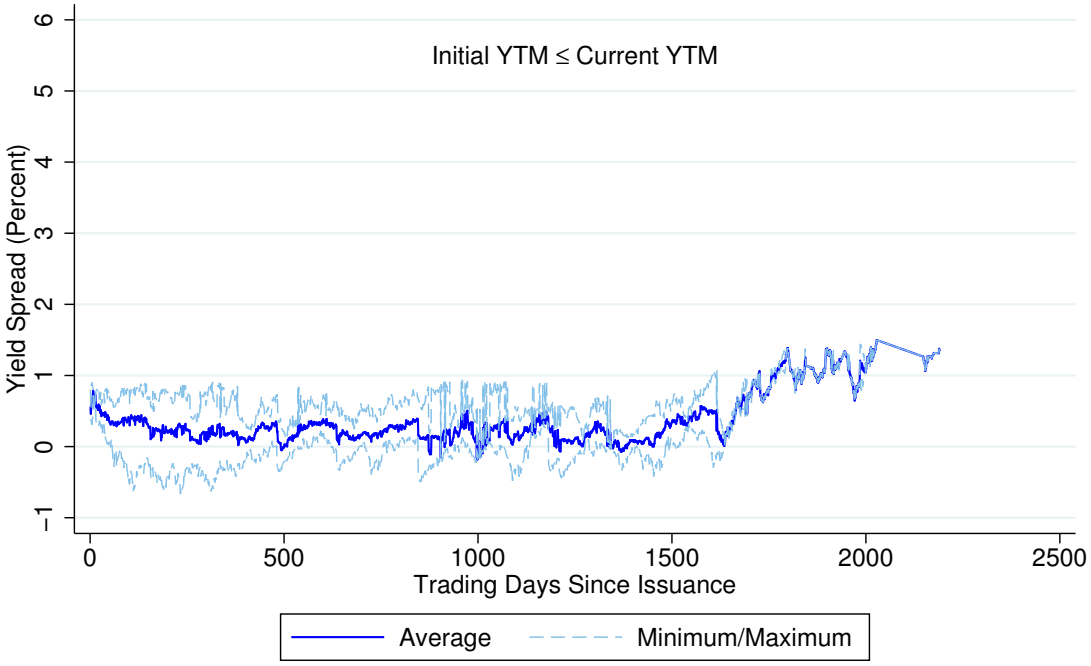
Figure A.1: Financing the SBIC Program

The Small Business Investment Company (SBIC) program has been financed by the issuance of debt, or trust certificates, since 1986. These are issued by the Small Business Administration (SBA) and fully guaranteed by the U.S. federal government. Panel A details the yield spread between trust certificates and matched 10-year Treasury Notes in trading days since issuance, when the initial yield-to-maturity (YTM) is above the current YTM. Panel B plots the yield spread between trust certificates and matched 10-year Treasury Notes when the initial YTM is below or equal to the current YTM. Panel C shows the percent of bonds with early repayment in trading days since issuance. Data on trust certificate yields are extracted from Bloomberg and Treasury Note yields are provided by CRSP Treasury. Early redemption of trust certificates data is available on the SBIC program website.

Panel A: Yield Spreads When Low Current YTM



Panel B: Yield Spreads When High Current YTM



Panel C: Percent of Bonds Paid Prior to Maturity