Mistake-based Discrimination in Early-stage Finance: Evidence from Security Choice

PRELIMINARY AND INCOMPLETE

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Abstract

Motivated by new stylized facts from Form D financings, we develop a simple framework in which security choice in early firm financing depends on the entrepreneurial talent contribution to firm value relative to capital, which investors may perceive with bias. Observed outcomes are not subject to such bias. Consistent with our model, female-led firms are more likely to use debt funding in early stages and exit at least as successfully as firms without a female founder, with a greater proportion of IPO exits. Female-led firms also have larger boards of directors at the initial stages, indicative of greater monitoring. The early differences in financing and monitoring subside in later rounds, suggesting that bias declines as information is produced. We argue that investors tend to under (over) estimate the human (physical) capital contribution to total firm value in female-led startups, offering new insight into the gender financing gap.

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1 Introduction

Globally, approximately one third of businesses are women-owned. The presence of female founders in high-growth, innovation-driven entrepreneurship, however, is limited to approximately 15% of firms, far lower than what might be predicted by educational attainment or representation in similarly demanding professions (Gompers and Wang (2017)). This discrepency may stem from both supply and demand, with gender norms and financing constraints playing a role. Personality traits associated with successful entrepreneurs such as (over)confidence, risk tolerance, negotiation ability, and ambition are often recognized as "masculine" rather than "feminine."[1] Women in business settings, in contrast, are characterized as cautious (Huang and Kisgen (2013)), trustworthy (Croson and Gneezy (2009), Shahriar et al. (2020)), or more likely to take on monitoring roles (Adams and Ferreira (2009)). While founders selecting into high growth ventures likely display less between-group variation than the general population, investors may apply a gendered lens when evaluating projects, thus allocating capital differently across male and female entrepreneurs depending on which strengths are considered crucial for success.

Using a novel dataset constructed from Form D filings that contains information on early financing events for young firms, we examine funding characteristics and outcomes for female and male founded U.S. startups. We develop a simple framework to understand and reconcile several disparate facts. Our model evinces a particular form of gender bias that *sometimes* limits funding for teams with female entrepreneurs, contributing to the gender gap in high-growth entrepreneurship.

We observe patterns in the data consistent with mistake-based discrimination that subsides after the initial financing round. Of particular note is a stark difference in security choice for female founded firms in intial rounds. Contrary to previous studies on executives' gender and capital structure (Faccio et al. (2016)), we find that firms with women in managerial roles at the time of the first round are almost 20% more likely to issue debt when compared to all-male teams. Obvious explanations for this difference such as those focused on risk or the nature of the firm's assets seem inconsistent with the data. In particular, there are no differences in the propensity for or characteristics of follow-on rounds, and more of these firms exit via a public offering. Similarly, models in which firms with female founders simply face a higher threshold for funding cannot alone explain the data.

To rationalize theese findings, our model hinges on investors *a priori* attributing a larger share

[1] Kerr et al. (2017), Astebro et al. (2014), Levine and Rubinstein (2017), Barber and Odean (2001), Niederle and Vesterlund (2007), and Schein et al. (1996). For examples in the social psychology literature see Koenig et al. (2011) and Braun et al. (2017).

of future firm value creation to physical capital rather than entrepreneurial talent in female-led startups. In the model, financing occurs in stages. The first stage consists of an experimentation period where entrepreneurs use resources provided by investors in order to achieve an intermediate goal, or "milestone." Conditional on achieveing the milestone, the startup produces cash flows in the second stage, which depend both on firm-specific characteristics and project type. There are two types of projects, "safe bets" and "long shots." Safe bets (long shots) are charcterized by low (high) ratios of entrepreneurial talent to physical capital productivity. In other words, the value of a long shot project depends crucially on entrepreneurial drive, ambition, and other intangible assets such as management's ability to work as a team. Safe bets can be thought of as generating value by optimally managing tangible assets. Investors observe project type, but they do not know the firm-specific share of talent (and capital) contribution to total value. Investors form beliefs on talent share and decide whether to invest and which security to use.

Debt takes the form of a loan maturing at the end of the experimentation period. If the experimentation phase is successful, debt is repaid with a fresh round. If unsuccessful, debt-holders liquidate the firm and (partially) recover their investment. The key feature of debt, then, is a maturity date upon which renegotiation or liquidation occurs. The benefit of the liquidation option is counterbalanced by higher negotiation costs of follow-on funding in case of success. The presence of gender bias in this specific form has two main implications. The first is that debt funding should be more common among female-led firms because the liquidation option is more valuable when capital contribution to firm value is (believed to be) relatively larger. The second implication is that female-led startups will be charcterized by under(over)-investment in long shots (safe bets). The reason is that a safe bet's value is increasing in capital share and decreasing in labor share, while the opposite is true for long shots.

That female-led startups in our sample are more likely to exit through an IPO is evidence consistent with an "outcome test" for underinvestment in female-led startups (Becker (1957)).[2] We are concerned with differentiated outcomes, however, since our model predicts overinvestment for safe-bet projects and under-investment only for long-shot firms. We build on results from previous research showing that startups' exit strategies depend on human-capital intensity, with IPOs being the preferred strategy for human-capital intensive firms (He and Li (2016), Chemmanur et al. (2018)). Moreover, Cumming

[2]The intuition behind the outcome test can be effectively summarized with Becker's discussion on discrimination toward black applicants in bank lending: "If banks discriminate against minority applicants, they should earn greater profits on the loans actually made to them than on those to whites." (Becker (1993), p.389)

(2008) shows that acquisitions are more likely when investors hold contractual rights to replace founders in executive positions, supporting the view that founder's managerial talent plays less of a role in exits achieved through business combinations. If investors tend to under-estimate the contribution of human capital, and specifically managerial talent, in female-led firms, selection must be particularly hard for women in "long shot" projects, i.e. ventures betting on new and unproven business models that attract investments on the basis of entrepreneurial ability rather than existing assets. For long shot projects, higher entrepreneurial abilities are crucial, and IPOs are the most likely exit avenues. On the other hand, women should have an advantage in raising capital for safe bets, e.g. funding to enter an existing market or develop a product for which the business model is well-understood (Bowen III et al. (2019)). For safe bets, entrepreneurial ability matters relatively less, fixed capital contributes relatively more to firm value, and acquisitions are the most common exit outcome. In acquisitions, bidders are able to acquire the target's assets without necessarily sharing control with the target's founders. Consistent with our modeling, we find that female-founded firms are less likely to exit through acquisitions and more likely to exit through IPOs when compared to firms founded by all male teams. Interestingly, the two effects offset, and we do not find significant differences in exits overall. This double outcome test validates the idea of both under-and over-investment being present depending on project type, as in the model.

We also investigate several indirect implications. First, we examine patterns around the increased use of debt. If discrimination takes the form of underestimating female founder contributions, mistakes should be larger when less information is available. As ventures mature from seed rounds to late stages, more information about potential profitability and managerial talent is produced. Therefore, *persistent* differences are consistent with accurate beliefs about firm heterogeneity across gender groups or taste-based discrimination. On the other hand, *transitory* differences indicate inaccurate beliefs or prejudice that dissipate over time as investors learn about true firm fundamentals (Bohren et al. (2019)). Female entrepreneurs' differential use of debt instruments is specific to early funding stages and young firms, when information is noisy and growth prospects are highly uncertain. It is also more pronounced in more conservative states, where female entrepreneurship is less common. Moreover, differential use of debt is confined to rounds where equity is not issued in combination with debt. That is, the pattern manifests only when examining debt alone or when convertible into equity. Therefore, it is not the case that our empirical tests are erroneously capturing debt and equity together as a simple way to replicate complex convertible equity securities.

Beyond gender differences in exit routes, the model further implies that other characteristics should have opposite relations with the different exits. In the data, the probability of IPO is negatively correlated with first round characteristics that suggest reliability of existing assets, and, therefore, are most likely associated with safe bets (e.g. existing patents, positive revenues, Delaware incorporation). Opposite relationships hold for acquisition probability. There is no difference in the probability of milestone completion between project types in the model. Again, in the data, the probability of second round finance is no different in all male and mixed-gender founding teams, nor is there a difference in the time between rounds or the step up in capital provided.

Traditional theories of capital structure do not fit the data, which is not necessarily surprising for firms at this stage. If debt were used solely to push off valuation to later rounds due to asymmetric information, for example, we would expect debt-funded firms to be associated with better fundamentals overall, which we do not observe. It is also unlikely that any tax benefits explain the differential use of debt. Effects become less pronounced as firms mature and are also less pronounced in high-tax states. Nor does debt seem to be acting as a monitoring device; we find a greater liklihood for the existence of a board and larger boards for female entrepreneurial teams, such that debt is not substituting for traditional monitoring. It is unlikely that this extra monitoring is driven by a less experienced founders since founding teams with females are no more likely to be replaced and are less likely to bring on professional managers in later stages. Last, use of debt to induce greater risk taking (through greater founder ownership) does not seem to explain the data, either. If debt were to induce risk-taking, we would expect a lower follow-on probability and higher-value exits on average associated with debt, which we do not observe.

Patterns also differ from what would be expected with forms of discrimination addressed in prior literature. Traditionally, discrimination can be viewed as a taste-based phenomenon, as in Becker (1957), or as a statistical outcome if accurate beliefs about a particular (unobservable) characteristic correlate with a given group. In financial markets, taste-based discrimination can be costly and, therefore, is likely to be competed away. One would imagine this to be especially true in the high-growth entrepreneurship setting. Statistical discrimination, on the other hand, is particularly troublesome since it can be self-reinforcing (Arrow 1973).[3] Both of these forms would result in a higher funding threshold for firms with female entrepreneurs, which would lead to better intermediate outcomes in the form of follow on funding and higher overall exit rates regardless of exit path. They offer no

[3] Independent of fairness considerations, financial economists are concerned with inefficiecies that result from discrimination in markets.

paricular prediction for the use of debt, but do result in persistent effects. As a result, the staged financing setting is an ideal one to distinguish between these traditional models of discrimination and ones incorporating inaccurate beliefs. Mistake-based discrimination, whereby market participants erroneously attribute a characteristic to a particular group, should correct over time and circumstance.

Our work contributes to a large literature on discrimination and gender differences in labor and other markets (see, for example, Altonji and Blank (1999) and Bertrand (2011) for reviews.) Interestingly, many gender differences observed in the general population may be selected away in highly screened settings such as high-growth entrepreneurship. For example, Adams and Funk (2012) and Adams and Ragunathan (2018) suggest that women serving on corporate boards do not exhibit greater risk aversion, as is usually the case in lab settings and financial markets. In the entrepreneurial setting specifically, Gompers and Wang (2017) provide evidence that women are dramatically underrepresented in high-growth entrepreneurship. Guzman and Kacperczyk (2019) argue that much of their absence can be attributed to the growth orientation of firms with female founders, but that the remaining difference is likely driven by investor preference. Howell and Nanda (2019) suggest that the gender gap in entrepreneurship may be partly explained by networking frictions, in that men are generally more proactive than women in building networks and reaching out to potential investors. Naaraayanan (2019) documents that access to finance constrains female entry into entrepreneruship. Ewens and Townsend (2020) show that women are less likely to receive angel funding, especially from male investors. Male-funded male teams underperform, suggesting they are overfunded. Similarly, Gompers and Wang (2017b) show that investment outcomes improve as investor diversity increases. Using data from an equity crowdfunding platform, Hellmann et al. (2019) show that female teams ask for less capital but are equally successful in their fundraising campaign as male-only teams.

Hebert (2019) finds that female-led start-ups are less likely to raise external equity and venture capital, and documents that discrimination may be based on stereotypes that assign higher probability of success to entrepreneurs that fit sector-specific gender roles (e.g. retail is perceived as a "feminine" sector, while technology a "masculine" one). In this paper, like in ours, gender discrimination is a more nuanced phenomenon, which can facilitate, as well as penalize, women in entrepreneurship, so long as the stereotype works in their favor. Of note, Hebert (2019) finds no gender differences in the probability of raising bank debt. Robb and Robinson (2014) show that female-run startups are less likely to access external non-bank funding, while Alesina et al. (2013) find that female entrepreneurs are charged higher loan rates.

Our interpretation is also in line with findings in Kanze et al. (2018), which, using records from a pitch competition, shows that VC investors ask "promotion" questions to male entrepreneurs, i.e. questions that offer respondants the chance to speak about their abilities and personal motivation (e.g. "what's your aspiration?"), while female entrepreneurs receive "prevention" questions, i.e. questions related to business validation, efficiency, and contingency plans. Since in case of financial distress, the liquidation process substantially destroys value created by human capital (e.g. organizational processes, customer and supplier networks) but (partially) preserves existing assets, investors are *more* willing to finance women when they overestimate the existence of such assets and use securities that offer higher liquidation rights. Results are also consistent with recent work byHu and Ma (2020) that suggests investors hold females to a higher standard for investment when forming impresions based on positivity and enthusiasm in accelerator application videos.

Due to our focus on security choices, this paper is the first to provide evidence that gender-biases can affect not only quantity and cost of funding, but also a firm's capital structure. Therefore, our paper also adds to the emerging literature, both in financial economics and financial law, that documents the increasing importance of venture debt in entrepreneurial finance (Davis et al. (2018), González-Uribe and Mann (2017), Coyle and Green (2014), Ibrahim (2010)). Finally, this study relates to the recent literature on the relationship between exit strategies and startup characteristics (He and Li (2016), Chemmanur et al. (2018), Bowen III et al. (2019)).

To our knowledge, we are the first to focus on security choice in early-stage finance to inform the basis for the gender financing gap. In addition, the form of discrimination we model may have application to other settings. The model delivers nuanced predicitions, in that some female teams are overfunded, just not in the high-growth setting. The empirical evidence is consistent with our framework and highlights the stark differences in securities used and the importance of differentiating exits. Last, we deliver evidence that, while there do appear to be patterns of discrimination for female founders, it appears to be mistake-based rather than taste-based or classically statistical.

The rest of this paper is organized as follows. Section 2 describes the data and provides descriptive statistics. In Section 3 we propose a simple conceptual framework for security choice in early stage funding in presence of bias and illustrate the empirical implications of the model, which we test in Section 4. In Section 5 we discuss our results in relationship with existing theories of capital structure. Section 6 concludes.

2 Data

The private financing data employed in this paper are taken from electronic Form D filings for exempt securities offerings under Regulation D. We augment this information using information from the US Patent and Trademarks Office (USPTO), the SEC Edgar database, and CrunchBase, a commonly-used commercial data source. Below, we provide regulatory background, outline construction of the data, and offer descriptive statistics.

2.1 Regulatory background: Form D Filings

Under the Securities Act of 1933, all securities issued in the United States must be registered with the SEC unless meeting criteria for exemption. The most common exemption for early-stage firms raising substantial amounts of external capital is the private offering exemption of Regulation D, and Rule 506 in particular.[4] While there is no comprehensive data on private offerings since disclosure is often not required, only Rule 506 pre-empts individual state registration rules and limits public financial disclosure (Ivanov and Bauguess (2013), Ewens and Farre-Mensa (2019).[5]

Regulation D requires firms to notify the SEC of the sale of securities via Form D within 15 days of the securities first sale date, though filing is not a condition of the exemption. Therefore, it is not clear to what extent truly informal financings comply with the filing requirement. Failure to comply can allow the SEC to enjoin future use of Regulation D under Rule 507, however, so it is likely that Form D filings capture most professional and quasi-professional arms-length financing events for early-stage firms raising capital in the U.S.

Under Rule 506, firms can raise unlimited amounts of capital without disclosure of extensive financial information as long as investors are "accredited," a designation meant to proxy for investor sophistication.[6] Up until the passage of the JOBS Act in 2012, general solicitation (advertising) to

[4]See `http://www.sec.gov/info/smallbus/qasbsec.htm`

[5]For example, firms could raise capital from U.S. investors in unregistered offerings under Section 3(a)(11), 4(a)(2) more generally, Regulation A, and Rules 504 and 505 under Regulation D. All of these, however, require compliance with state so-called 'blue sky' laws or, in the case of Regulation A, financial disclosures.

[6]The standards for accredited investor qualification were first set 1982 when Regulation D was issued. To be accredited, individual investors must meet minimum wealth or income thresholds. Regulation D defined accredited investor status for an individual as having income in excess of $200,000 in the most recent two years (with an expectation of continued income at the same level in the current year), or a net worth over $1 million. In 1988, the income requirement was refined to include a $300,000 joint-income test with one's spouse (Regulation D Adopting Release). In 2012 with the passage of Dodd-Frank, net worth standards were refined to exclude home equity in a primary residence. Other thresholds apply to entities that are not natural persons, and registered financial intermediaries, charity organizations, and directors or executives of the firm are also considered accredited.

non-accredited investors was prohibited. Rule 506 (now refined to 506(b)) permits up to 35 non-accredited investors, and, depending on the size of the offering, may require financial disclosures to investors. The solicitation of an offering became less restricted with the JOBS act in 2012. The new Rule 506(c) allows general solicitation provided that the offering is addressed only to accredited investors. Rules 504 and 505 apply to smaller issuances, currently up to $5million (Rule 505 was merged with 504 in 2016). Old Rule 505 allowed for amounts up to $5 million in a 12-month period from an unlimited number of accredited investors and up to 35 (affiliated) non-accredited investors. Old Rule 504 effectively required either that investors have a prior relationship with the company, investors meet accreditation thresholds, or the offering be registered at the state level. Therefore, it is reasonable to regard the presence of non-accredited investors in Form D filimgs to indicate the presence of "friends and family" financing.

Beginning March 2009, electronic filing of the Form D became mandatory. From these filings (publicly available on the SEC website), we retrieve information on issuer characteristics (year and state of incorporation, address, industry group, revenue range), type of securities issued (equity, debt, hybrid securities), offering and sales amount, issuers' managers names, and the total number of investors who participated in the offering.[7] Form D also contains the full name and address of "related persons," namely issuer's executive officers, directors or promoters.[8]

Compared to surveys on entrepreneurial activity or self-reported data provided by VC investors, Form D data extend the spectrum of observations in terms of types of firms and investors included. For this reason, they have been used in several recent studies (see for example Zaccaria (2017), Ewens and Malenko (2020), Denes et al. (2020)). Moreover, since Form D must be submitted within 15 days of the first securities sale date, filing should not be conditional on ex-post outcomes and are therefore less likely to suffer from reporting and survival bias compared to datasets based on investors' self-reported information or publicly available records (e.g. newswires, company websites). Crucially for our objectives, we obtain information on the type of securities issued for a large sample of financing events. However, the data are not without limitation. The compliance issue may present a bias towards more experienced entrepreneurs and investors or omit firms who wish to remain in "stealth" mode.

[7] See `https://www.sec.gov/files/formd.pdf` for a Form D sample.

[8] The definition of promoter includes: (i) Any person who, acting alone or in conjunction with one or more other persons, directly or indirectly takes initiative in founding and organizing the business or enterprise of an issuer; or (ii) Any person who, in connection with the founding and organizing of the business or enterprise of an issuer, directly or indirectly receives in consideration of services or property, or both services and property, 10 percent or more of any class of securities of the issuer or 10 percent or more of the proceeds from the sale of any class of such securities. However, a person who receives such securities or proceeds either solely as underwriting commissions or solely in consideration of property shall not be deemed a promoter within the meaning of this paragraph if such person does not otherwise take part in founding and organizing the enterprise. Securities Act of 1933, Rule 405, 17 C.F.R. § 230.405.

Such omissions, while potentially limiting the external validity of the analysis to substantially different types of financings, should not introduce a systematic bias. The proportion of female founder firms we observe (16%) is similar to other estimates of female participation in high growth entrepreneurship. For example, using data from Crunchbase and VentureSource, Ewens and Townsend (2020) document that in the last decade the average proportion of funded firms with a female founder is between 13.4% and 17.3%, while recent reports by data provider PitchBook show a 12.1%-22.4% range for the share of female (co-)founded VC deals between 2009 and 2017.[9]

Form D, although public, does not show details of the business plans or the identity of the investors, limiting the extent to which information can be used strategically by competitors. And, while some firms raising external private capital may use intra-state exemptions, which do not require Form D, these exemptions often limit the firm's operations to be substantiallly within the same state, which appear to be overly restrictive for growth-oriented start-ups.

2.2 Sample and Variable Construction

Our data extend from 2009, the year filings became mandatory in electronic format, to 2018. In order to capture entire financing histories, we exclude firms for which (1) the filing indicates that the firm is over 5 years old rather than listing the date of formation or (2) the filing indicates firm age (i.e. is younger than 5 years old) but was formed prior to 2009.

We use an algorithm freely available online (genderize.io) to classify the gender of all related persons in our dataset based on first names. Only 8% of related persons are unable to be classified; that is, they are not assigned a gender at 95% confidence or higher. We assign *founder* status to individuals who hold executive managerial positions in the firm at the time of its first round. We identify female-led firms as those where at least one of the founders is classified as female.

The issuer is required to indicate in the form the type or types of securities offered. The list of possible security types inlude equity, debt, and options.[10] The instructions provided by the SEC specify that if the securities are debt convertible into other securities, issuers should select "Debt" and any other appropriate types of securities except for "Equity." This suggests, for example, that a convertible note, common in early-stage financings, should be recorded as a combination of debt and options.

In terms of firm characteristics, we are able to observe entity type, i.e. whether the firm is an LLC

[9]Source: https://pitchbook.com/news/articles/the-vc-female-founders-dashboard, retrieved August 22nd, 2020

[10]For the complete list and the description of each category please see https://www.sec.gov/about/forms/formd.pdf.

or a corporation, and if incorporated, the state of incorporation, age, location, industry, and –if a firm chooses to disclose- revenue ranges. We define broad industry categories for Business Sevices, Energy, Health, Manufacturing, Real Estate, Retailing, Technology, Travel and Leisure, and Finance. We are able to observe if a particular industry is above or below the median in terms of the proportion of female-founded firms. Thus, we categorize Health and Retail as (relatively) female-dominated. For revenue ranges, we define an indicator for firms that are pre-revenue, and also consider whether or not they disclose.

In order to capture innovative capacity, we match by firm name and location to the US Patent database. We define an indicator variable for whether a firm holds a patent at the time of the first round. We also match firms to the SEC Edgar database (by cik) and Crunchbase (by firm name and location) to obtain information on firm exits. In particular, we retrieve information on IPOs from security registration forms (S-1) filed with the SEC, while information on acquisitions is collected from Crunchbase. A list of variables and definitions can be found in Table 1.

2.3 Descriptive Statistics

The resulting dataset includes 42,328 firms and approximately 60,000 financing rounds. Only 22% of firms in the sample secure follow-on funding, i.e. second or later rounds, while the probability of receiving further capital after the second round is approximately 50% in all later stages (Figure 3). This relatively low rate of follow-on funding after the first round may be due to the time period considered or the notion that not all of the firms filing Form D may be suitable for staged finance. Also, the heightened asymmetric information and uncertainty in early-stage entrepreneurship may be resolved only after an initial capital injection allows founders to develop their business sufficiently to be evaluated for later rounds. We focus our analysis on first round financing patterns since they provide insight on initial assessments in this highly uncertain process. The number of first round events observed in our sample increases steadily between the year 2010 and 2015 given our data construction process, and then plateaus between 2015 and 2017 (our coverage of 2009 and 2018 is limited to 10 and 4 months, respectively.) The proportion of firms with at least one female founder does not display significant trends, and stays fairly constant around 16% throughout the sample period (Figure 4).

Table 2 presents summary statistics for firms at the first Form D financing event. The median rounds size is $1.35M, the median number of investors is 4, and 14% of the offerings receive funds from non-accredited investors, signifying informal finance. Conditional on receiving a follow-on round, the subsequent funding event occurs for most firms after approximately one year and it involves a step-up in capital contribution of 25% relative to the first round. Importantly, 16% of the offerings have debt as one of the security types indicated in the form.

Table 3 presents firm summary statistics by gender mix of the founders. Since we identify female-led firms as those where at least one founder is a woman, it follows that these firms could have a larger founding team on average. Female-led firms have 2.6 founders on average while male firms have 1.9 founders. Female-led firms are also slightly older at the time of their first round of funding (1 year versus 10 months), more likely to be incorporated in Delaware (49% vs 47%) and to hold patents (7% vs 6%), and less likely to report zero revenues (22% vs 25%). Overall, these statistics seem to suggest that female-led firms are slightly more mature than other firms. On the other hand, the frequency of "family" firms, that is firms where at least two of the founders have the same last name (an admittedly imperfect proxy), is higher among female-led ventures (19% vs 7%), even when we restrict our sample to firms with at least two founders (24% vs 11%). This could suggest that women are more likely to be involved in "lifestyle" businesses rather than high-growth, tranformational companies, but it may also be a symptom of of women facing difficulties in forming entrepreneurial teams, signifying the need to bring in a trusted ally or being brought in only by someone whom she knows well.

We also observe that female-led firms commonly operate in the two most active industries in private capital markets, Health (including Biotechnology) and Technology . The combined share of these two sectors is 37% for female firms and 35% for male firms. Female firms are more present in retailing (5% vs 2%) and substantially less present in real estate (12% vs 21%). Table 4 shows descriptive statistics of related persons by gender. Out of the almost 80k founders in the dataset, 10% are women, and out of almost 30k directors and promoters involved in first rounds, 8% are women. In follow-on rounds, women represent 11% of executive management, and 7% of directors or promoters. The roles of executive officer, director, and promoter are not mutually exclusive and it is common for an executive to be a director of the company as well. Women tend to hold fewer roles then men on average, both in first rounds (1.61 vs 1.67) and subsequent funding events (1.65 vs 1.79).

Figure 5 focuses on the two main attributes of a funding round, namely round size (in natural logs) and the type of security issued. Two main facts emerge. First, differences in round size distributions across firms with and without a female founder do not appear to be large. In fact, it is one of the few variables for which the difference in means across groups is not statisticaly significant.[11] Second, and

[11]The others are the frequency of firms in the Financial industry, the time to the next round, and the step up in capital raised in the follow on round.

perhaps more surprising, female firms are more likely to issue debt, whether alone or in combination with other securities, such as equity, warrants or options.

Finally, we focus on exits. Figure 8 shows the proportion of firms that filed for an IPO (10) or were acquired (9), by year of incorporation. Given the recency of our sample and the broader sample of firms than Form Ds provide, only about 5% of firms have experienced exits. Of these, approximately 20% are IPO exits. Female-led firms appear significantly more likely to apply for public listing than to be acquired. Reported regressions employ an indicator for an IPO filing, but results are substantially similar if we use non-withdrawn IPOs as the outcome variable.

3 Conceptual Framework

In this section, we propose a simple framework for thinking about early-stage financing in the presence of investor bias, which reconciles the empirical evidence we document on security choice and exits.

3.1 Overview

Similar to previous studies (Ewens et al. (2018)), we characterize a startup's life-cycle in two stages. The first stage consists of an experimentation period in which entrepreneurs use resources (K) provided by investors in order to achieve a "milestone", that is an early outcome which can take the form of a prototype, a successful drug trial, or initial traction with costumers. The milestone can be interpreted as an indication that the project is commercially viable and can generate positive cash flows in the future. We incorporate this idea in our model by assuming that startups generate cash flows in the second stage if and only if the milestone is achieved at the end of the first stage, which happens with probability p.

Conditional on observing the outcome of the experimentation phase, investors have the option to contribute follow-on capital and start the commercialization phase, which leads to cash flow generation. Follow-on capital is $K_1 = \gamma K$, where γ represents the size of the step-up. Total firm value at the end of the commercialization period (V_i) is equal to the present value of future cash flows and it consists of the weighted average of two components: contributions from capital and contribution from managerial talent, written as follows:

$$V_{T,i} = \alpha_i \left[\beta\left(1+\gamma\right)K\right] + \left(1-\alpha_i\right)\left[\lambda_T \mu\right]$$

The contribution from capital depends on the amount of capital contributed in the two funding rounds $(1+\gamma)K$ and on capital productivity (β). The contribution from talent depends on talent endowement (μ), and its productivity (λ). In including managerial talent as a relevant factor in the generation of firm value, we are drawing from an extensive empirical literature showing that manager characteristics matter for firm performance (Bertrand and Schoar (2003); Bloom and Van Reenen (2010); Malmendier et al. (2011)).

We further assume that projects differ in the relative impact of managerial talent versus capital. In particular, we can think of projects belonging to one of two types: "long shots" ($T = LS$) and "safe bets" ($T = SB$). Long shot project success relies more on entrepreneurial talent than capital. These ventures are based on new and unproven business models. Safe bets, instead, more resemble expansion projects with a fairly reliable path forward conditional on a successful milestone. Entrepreneurial ability matters relatively less and capital contributes relatively more in determining realized value. To formalize this idea, we set $\lambda_{LS} \equiv \lambda > \lambda_{SB} = 1$ and describe this heterogeneity in reduced form by stating the following two key assumptions

Assumption 1: $\lambda\mu > \beta(1+\gamma)K$

Assumption 2: $\mu < \beta(1+\gamma)K$

In other words, in order to achieve the same final firm value, long shot projects leverage entrepreneurial talent relatively more than safe bets. Because of relative importance of founders' talent, we assume that long shots' most likely exit event is IPO, where founders typically retain (some) control, while founders of safe bets exit the venture (and cash in their investment) via acquisitions. We assume that there is a fixed proportion π of long shot projects in the economy.

Capital requirements (K and γ), project type (T), productivities (λ_T and β), and probabilities p and π are common knowledge. Additionally, investors observe firm-specific share of capital contribution $\alpha_i \in (0,1)$, potentially with bias, at the beginning of the experimentation phase. Based on this information, when matched with a startup, investors make two investment decisions to maximize expected payoff. The first is whether to initiate funding, and the second is to determine the security type (equity or debt) for the funding. To simplify the analysis we assume that opportunity cost of capital is zero, information is symmetric, and entrepreneurs do not strategically choose the level of effort provision, or, in other words, they do not affect outcomes other than through their "innate" talent. [12]

[12] We are aware that many models of security choice in this setting pursue a double moral hazard approach, whereby investors and entrpreneurs conribute effort based on their own potential payoffs. (See, for example, Casamatta (2003)

First round capital can be provided in the form of equity or in the form of debt with one period maturity. Since the firm does not generate cash flows until the end of the commercialization period, debt holders, if they wish to pursue commercialization, roll over their claims for an additional period by exchanging their initial investment (K) for equity and adding follow-on capital (γK) at the end of the experimentation period. Alternatively, if no milestone is achieved and investors anticipate expected firm value to be zero, debt holders can liquidate the firm. Thus, the salient feature of debt contracts in our model is that they allow investors to force termination in the form of liquidation.

Equity contracts, on the other hand, do not have this feature. If the milestone is not achieved, outside shareholders are locked in for one more period until operations are fully wound down. In this case, the firm continues as a "zombie" in the second period. This is of course a simplifying assumption, as in practice equity investors can use a combination of redemption rights and liquidation preference clauses to replicate the pay-off of debt-like securities. However, recent evidence suggests that redemption rights and, more so, liquidation preference clauses are not dominant features of VC contracts (Gompers et al. (2019)). Therefore our assumption does not substantially contradict common practice and it allows us to capture the idea that, in general, terminating operations is more costly for equity investors rather than debtholders.[13]

While our model makes no distinction between straight and convertible debt, it is crucial that debt-like securities have shorter maturity than equity. This very feature that makes debt preferable for investors is displeasing to entrepreneurs. Entrepreneurship provides founders with non-pecuniary benefits (Hurst and Pugsley (2011), (Hamilton 2000), (Moskowitz and Vissing-Jørgensen 2002)), even when the venture is not profitable, and therefore the possibility of early termination decreases their utility (Admati and Pfleiderer (1994)). To compensate for this utility loss, debt contracts must offer entrepreneurs a monetary advantage with respect to equity. Said differently, equity is sold at a discount proportional to the intensity of individual non-pecuniary benefits. In equilibrium, investors' security choice is based on the trade-off between liquidation value and equity discount. Alternatively, one can interpret this premium as an extra cost of debt associated with the renegotiation process at the end of the experimentation phase, when, conditional on achieving the milestone, startups may have more bargaining power vis a vis investors in setting the terms for follow-on capital contributions. We assume that in liquidation the managerial talent contribution to firm value is lost and only capital investment

and Repullo and Suarez (2004).) We will return to such considerations later in the paper.

[13] Moreover some investors may have incentives to postpone write-offs in order to delay information on poor investment performance (Chakraborty and Ewens (2017)).

can be (partly) recovered.

3.2 Timeline

The model unfolds over 3 periods:

- $t = 0$: First-Round
  - Project i, if funded, receives amount K. Experimentation phase starts if $K > 0$
  - Investors choose first-round security S, which can be (convertible) debt (D) with maturity $t = 1$, or equity (E) .
- $t = 1$: End of experimentation phase.
  - Project i achieves a "milestone" with probability p
  - Project i can either move to commercialization or be liquidated, conditional on milestone (i.e. there is no commitment to follow-on). Commercialization involves more capital injections (follow-on rounds) of size $K_1 = \gamma K$
  - Liquidation value is $V_{L,i}$. Liquidation can be initiated only by debt-holders, who seize the whole liquidation value.
  - If no liquidation nor commercialization, the firm is left in existence for one more period ("zombie" firm)
- $t = 2$: End of commercialization phase. The project's present value of future cash flows is either 0 or V_i . V_i is realized if the milestone is achieved and the project receives follow-on funding, i.e. commercialization is needed in order to generate cash flows.

3.3 Investor Choices

At time $t = 0$ investors receive signal $\hat{\alpha}_i$ on capital share $\alpha_i \in (0, 1)$. We start by analyzing the case of unbiased investors, who receive the following precise signal

$$\hat{\alpha}_i = \alpha_i$$

and form expectations on final value as

$$\hat{V}_{i,T} = \hat{\alpha}_i \left[\beta \left(1+\gamma\right) K\right] + \left(1-\hat{\alpha}_i\right) \left[\lambda_T \mu\right]$$

Based on their beliefs, risk neutral investors choose whether to initiate funding, and, if so, what security S to use, with $S \in (E, D)$ to maximize their expected payoff. For simplicity, we assume that investors obtain the entire surplus of the project so that their expected payoff coincides with the NPV.

3.3.1 Security Choice

At time $t = 0$ investors observe c_i, the project-specific per unit of capital extra cost of debt, and decide what security S to use with $S \in (E, D)$.

When choosing the security type, investors face a trade-off between the firm's liquidation value $(V_{L,i})$ and the incremental cost of debt. The difference between value V_i and $V_{L,i}$ is that the liquidation process destroys the portion of firm value generated by managerial talent, i.e. $\lambda_T \mu = 0$, as talent is arguably inalienable.

Firm value in liquidation value is then

$$V_{i,L} = \alpha_i \beta K$$

Intuitively, projects that rely more on the business concept (the "horse") can be sold for higher prices since they can be run by a different "jockey" without loosing value.

In case of failure in the experimentation phase debt-holders receive the liquidation value $V_{i,L}$ at $t = 1$, while, in case of success, they receive the continuation value $V_{i,T}$ but pay the renegotiation cost. The expecte d difference between the payoffs of debt and equity investors at $t = 0$ is then

$$\Delta = (1-p)\,\hat{V}_{L,i} - pc_i K$$

Therefore, investors choose debt over equity if $\Delta > 0$, that is if

$$\hat{\alpha}_i \geq \frac{p}{1-p}\frac{c_i}{\beta} \equiv \delta_i \tag{1}$$

We refer to the result above as the debt optimality condition. Intuitively, since liquidation destroys value created by talent, liquidation rights are more valuable for more capital-intensive projects, that is for projects with high values of α.

3.3.2 Funding

Let us denote with X_S^T investor's expected payoff from investing in project i. The subscript S and the superscript T indicate that that the payoff depends on the security used and on project type, with $X_D^T = X_E^T + \Delta$ and

$$X_E^T = p\left[\left(\hat{V}_{i,T} - (1+\gamma)\,K\right)\right] - (1-p)\,K$$

Investor's participation constraint requires $X_s^T \geq 0$.

First, notice that, by assumptions 1 and 2, $\frac{\partial X_S^{LS}}{\partial \hat{\alpha}} < 0$ and $\frac{\partial X_S^{SB}}{\partial \hat{\alpha}} > 0$, implying that the participation constraint for long shots (safe bets) is satisfied for relatively low (high) values of $\hat{\alpha}$. The exact cut-off values of $\hat{\alpha}$ above or below which investors are willing to provide capital depend on the security used, and, therefore, on the debt optimality condition in 1.

For simplicity and without loss of generality, we assume that δ_i can be either high or low, withδ_H and δ_L satisfing the following conditions

- $X_E^{SB}\left(\hat{\alpha}_i = \delta_H\right) > 0$ and $X_D^{LS}\left(\hat{\alpha}_i = \delta_H\right) \leq 0$
- $X_E^{LS}\left(\hat{\alpha}_i = \delta_L\right) > 0$ and $X_D^{SB}\left(\hat{\alpha}_i = \delta_L\right) \leq 0$

We study the optimal financing decision by project type (long shots and safe bets) and cost of debt (high and low). The results that follow are derived in the Appendix.

Long Shot Projects. Long shot projects are funded if

$$\hat{\alpha}_i \in \left(0, \alpha_S^{LS}\right) \tag{2}$$

When $\delta_i = \delta_H$, these projects are financed with equity only and for $\hat{\alpha}_i \in \left(0, \alpha_E^{LS}\right)$. When $\delta_i = \delta_L$ some projects are financed with equity, i.e. the ones with $\hat{\alpha}_i \in (0, \delta_L)$, while projects with $\hat{\alpha}_i \in \left(\delta_L, \alpha_D^{LS}\right)$ are financed with debt. Moreover, $\alpha_D^{LS} \geq \alpha_E^{LS}$.

Safe Bet Projects. Safe bet projects are funded if

$$\hat{\alpha}_i \in \left(\alpha_S^{SB}, 1\right) \tag{3}$$

When $\delta_i = \delta_H$, some projects are financed with equity, i.e. the ones with $\hat{\alpha}_i \in \left(\alpha_E^{SB}, \delta_H\right)$, while projects with $\hat{\alpha}_i \in (\delta_H, 1)$ are financed with debt. When $\delta_i = \delta_L$ safe bets are all financed with debt and for $\hat{\alpha}_i \in \left(\alpha_D^{SB}, 1\right)$. Moreover, $\alpha_D^{SB} \leq \alpha_E^{SB}$.

Figure 1 illustrates this equilibrium.

Long shot project's value is increasing in the share of managerial talent contribution, therefore, intuitively, NPV is higher as α_i approaches zero. These projects receive funding for relatively low levels of $\hat{\alpha}_i$. The opposite is true for safe bets, which get funded for relatively high levels of $\hat{\alpha}_i$. Moreover, when the cost of debt δ_i is relatively large, that is when $\delta_i = \delta_H$, long shots cannot be financed with debt as the debt optimality condition requires $\hat{\alpha}_i > \delta_i$, which translates into too large share of capital contribution and thus negative NPVs. Safe bets with $\hat{\alpha}_i > \delta_H$ instead can be profitably financed with debt. As δ_i approaches the lower bound (zero), that is with $\delta_i = \delta_L$, all safe bets are financed with debt and part of the long shots (the ones with $\hat{\alpha} > \delta_L$) are financed with debt. Finally, the funding sets for both project types expand with the use of debt. This is because if $\Delta > 0$ then $X_D^T > X_E^T$. In other words, debt funding, if viable, relaxes investors participation constraints, thus allowing less profitable projects to be initiated.

3.4 Exit

At $t = 1$, if the experimentation phase is successful, debt investors convert their debt into equity and both investor types contribute follow-on equity capital in order to start commercialization and generate positive cash flows. We assume that an exit event occurs at $t = 2$ if the final firm value $V_{i,T}$ is above a certain (fixed) threshold V^* , that is if

$$\alpha_i \left[\beta \left(1+\gamma\right) K\right] + \left(1-\alpha_i\right) \left[\lambda_T \mu\right] \geq V^*$$

We additionally assume that, although the threshold is the same, the type of exit differs across project types. Long shots exit with IPOs and safe bets only with acquisitions.[14]

It follows that, at $t = 0$ and conditionally on a project being funded in the first stage, the probability of exit is

$$Pr\left(Exit_i \mid 1^{st} Round\right) = \underbrace{p\pi Pr\left[\alpha_i < \Psi_{i,LS} \mid \hat{\alpha}_i \in \left(0, \alpha_S^{LS}\right)\right]}_{Pr(IPO)} + \underbrace{p\left(1-\pi\right) Pr\left[\alpha_i > \Psi_{i,SB} \mid \hat{\alpha}_i \in \left(\alpha_S^{SB}, 1\right)\right]}_{Pr(Acquisition)} \tag{4}$$

[14]When we take the model to the data, the exit threshold can vary over time, and it need only be the case that long shots are more likely to go IPO and safe bets more likely to be acquired. Further, since we examine IPOs and acquisitions separately, the thresholds can vary by exit type.

with $\Psi_{i,T} = \frac{V^* - \lambda_T \mu}{\beta(1+\gamma)K - \lambda_T \mu}$ and the participation constraint compatible funding sets are defined in 2 and 3. Notice that the funding sets depend on investors *perception* of capital share $\hat{\alpha}_i$, while the unconditional exit probability depends on *actual* share α_i.

Intuitively, IPO probability is decreasing in α_i while acquisition probability is increasing in α_i. This is simply a consequence of the fact that long shot project's value increases in the share of talent contribution, while the opposite is true for safe bets. Moreover, these relationships are affected by security choice in so far as the boundaries of the funding sets depend on δ_i.

3.4.1 Bias: Effects on Security Choice and Outcomes

Suppose now that investors generate beliefs over α_i in the following way

$$\hat{\alpha_i} = \alpha_i + bF_i$$

where $b \geq 0$ and $F_i = 1$ if there is an entrepreneurial characteristic associated with bias. In our context, it is if project i has a female founder. In other words, investors systematically underestimate the share of entrepreneurial talent contribution in female-founded firms and tend to attribute the success of a venture to capital contributions. Such bias can arise, for example, if investors believe that female managers are more likely to engage in "labor hoarding" (Matsa and Miller (2013)), less confident and aggressive in pursuing profits (Barber and Odean (2001)), worse at building and leveraging networks for business purposes (Howell and Nanda (2019)). From equation 1 we can express the probability of firm i issuing debt as

$$Pr\left(S_i = D\right) = Pr\left(\alpha_i \geq \delta_i - bF\right)$$

which is clearly increasing in b. In other words, any investor bias is revealed in the data by a systematically higher propensity to finance female enterprises with debt rather than equity. Moreover, we can split equation 4 into its two components as follows

$$Pr\left(IPO_i\right) = p\pi Pr\left[\alpha_i < \Psi_{i,LS} \mid \hat{\alpha}_i + bF \in \left(0, \alpha_S^{LS}\right)\right]$$

$$Pr\left(Acquisition_i\right) = p\left(1-\pi\right) Pr\left[\alpha_i > \Psi_{i,SB} \mid \hat{\alpha}_i + bF \in \left(\alpha_S^{SB}, 1\right)\right]$$

The bias affects the selection of projects that receive funding, i.e. it creates a wedge between the equilibrium funding sets of female and male entrepreneurs. Consider, for example, an equity funded long shot project, for which we can infer that $\hat{\alpha}_i < \alpha_E^{LS}$. In the presence of a bias, this condition requires $\alpha_i < \alpha_E^{LS} - bF$, implying that, conditional on receiving funding, female-led projects have on average lower capital share. For any value of "actual" capital share,α_i, female entrepreneurs are (weakly) more likely to receive funding for safe bets and less likely to receive funding for long shots. Therefore, IPO probability is systematically higher for female entreprenerus while the opposite is true for acquisition probability. To summarize, regardless of distributional assumptions on α, η, and δ, the model predicts that, with bias $b > 0$

Prediction 1: $Pr\left(S_i = D \mid F = 1\right) > Pr\left(S_i = D \mid F = 0\right)$

Prediction 2: $Pr\left(IPO_i \mid F = 1\right) > Pr\left(IPO_i \mid F = 0\right)$

Prediction 3: $Pr\left(Acquisition_i \mid F = 1\right) < Pr\left(Acquisition_i \mid F = 0\right)$

Notice that, since final enterprise value is increasing in both capital (β) and talent (λ) productivity, gender biases on these two dimensions would not generate the asymmetric effects in IPOs and acquisitions exits. In other words, the gender stereotype is penalizing women in long shots but it facilitates them in raising funds for safe bets.

The model delivers additional testable implications:

Implication 1: **Security choice and exits.** Since $E\left[\alpha_i \mid \hat{\alpha}_i \in \left(\delta_L, \alpha_D^{LS}\right)\right] \geq E\left[\alpha_i \mid \hat{\alpha}_i \in \left(0, \alpha_E^{LS}\right)\right]$, the probability of IPO is negatively correlated with use of debt in early stages. This is because long shots' firm value is decreasing in the share of physical capital, while only firms with a relatively high share raise capital in the form of debt in early stages. Instead, the relationship between use of debt and exit via acquisitions is ambiguous and depends on the distribution of δ_i. On the one hand, a higher share of pysical capital increases success probability for safe bets. On the other hand, because of its embedded liquidation option, debt financing allows investors' participation constraint to be satisfied for lower values of $\hat{\alpha}_i$. Which of the two forces dominates depends on the level of δ_i, with lower (higher) values associated with lower (higher) acquisition probability.

Implication 2: **The long shot-safe bet distinction in early stages.** Because long shots and safe bet projects have different observable features and different "natural" exit avenues, the relationship between early stage firm characteristics (e.g. revenues, patents, etc.) and subsequent success depends on the exit event considered. For example, a starup that is already in the revenue generating phase or has been awarded patents at the time of the first funding round is more likely to be based on a proven business model, suiting the definition of "safe bet" and, according to our framework, it is more likely to exit via an acquisition rather than an IPO.

4 Empirical Evidence

In what follows, we present evidence on security choice and outcomes as implied by the model. In addition, we provide more detailed evidence on combination securities as well as funding characteristics outside the model.

4.1 Security Types

The first prediction of our model is that, in presence of a gender bias, female led firms are more likely to raise debt rather than equity in early rounds of funding. In order to ease interpretation of interaction coefficients, we test this prediction with a linear probability model, where the dependent variable takes value 1 if at least one of the securities used in the first funding round is debt, and zero otherwise.[15] Results are reported in Table 5. The coefficient of interest is that of variable $F\,Founder$, which takes value 1 if at least one of the founders of the firm is female, and zero otherwise. Consistent with both the univariate startistics and our model's prediction, we find that female-founded firms are approximately 3% more likely to issue debt in their first funding rounds (Column 1). This is a non-negligible difference since debt is used in 16% of the recorded funding events for the full sample.

In Columns 2 and 3, we delete observations for which we do not have information on industry or reported revenues, respectively, showing the initial result is not an artifact of incomplete controls for industry or firm stage. In Column 4, we add an interaction term between the female founder indicator and an indicator that takes value 1 if the firm had a second round after the first one (along with the indicator for the follow-on round). This variable is meant to provide an ex-post measure of success, unknown to investors at the time of the first round but potentially correlated with firm characteristics unobservable to the econometrician. The coefficient on the interaction is not different from zero, and the coefficient of $F\,Founder$ remains substantially unchanged. This last test suggests that there are not unobservable characteristics of the founding teams with female members in terms of the types of firms that would require staged finance or in the underlying probability of achieving a milestone that drives the choice of debt for female-founded firms.

[15] The magnitude and significance of all our results remain unchanged when we use different specifications, e.g. probit.

Across specifications, control variables have intuitive signs and reveal additional interesting aspects of startup security choice. Debt is more commonly used by more mature firms, i.e. older, revenue generating firms incorporated in Delaware. It has been argued that female entrepreneurs experience difficulties in establishing relationships with potential investors due to their lack of networking opportunities or abilities (see Howell and Nanda (2019)). Since most of the deal flow of professional venture capital investors is sourced through personal networks, smaller social circles may affect the funding choices of female entrepreneurs. For example, due to limited access to experienced financiers, women may choose "simpler" debt securities that do not require complex valuation assessments. Smaller networks should be reflected in smaller number of investors per round, and perhaps in a larger propensity of using informal finance (family and friends) rather than professional investors. To avoid confounding network effects with potential gender bias, we control for number of investors and the presence of non-accredited investors participating in the offering. As expected, debt issues involve fewer investors and are more likely to include family and friends, but the inclusion of these controls does not alter the significance and magnitude of the $F\,Founder$ coefficient. We find no particular realtion between patents and the use of debt, nor do we observe a significant relation between the use of debt securities and our proxy for family firms.

In the conceptual framework that guides our empirical analysis, the size of a funding round is not a choice variable, and for simplicity we assume it is fixed. The reason for making this assumption is that we characterize the bias as a misperception on the relative importance of human versus physical capital contribution to firm value. In the context of our model, this characterization cannot provide predictions on round size.[16]

Prior literature, however, has documented an association between feamle entrepreneurs and smaller round sizes. In particular, Ewens and Townsend (2020) show that female-led startups seek considerably smaller funding amounts in early stages. Similarly, Hellmann, Mostipan, and Vulkan (2019) show that female-led firms raising equity through crowdfunding 1) seek smaller amounts, 2) are equally likely to successfully close the campaign, and 3) ultimately raise less capital. Therefore, it is possible that gender bias impacts funding amounts. For example, investors may be reluctant to fund women, and, consequntly, female led startups may raise smaller rounds in early stages. On the other hand, it is also possible that women engage in business projects of smaller scale, in which case smaller funding

[16]We omit round amount as a control in the previous specifications since it is a simultaneous choice variable, but results are robust to its inclusion. Round amount is negatively associated with the use of debt in all but the third specification, where it is statistically not different from zero.

amounts are uninformative of potential bias.

In Table 6, we repeat the specifications from Table 5, substituting the size of the first round (in log of dollar amounts) as the dependent variable. Coefficients on control variables are as expected, with age, Delaware incorporation, team size, and patents all associated with larger first rounds. We also find that startups with female founders raise smaller first round amounts, consistent with recent literature.

Thus, both round size and security choice show significant correlation with the gender composition of the founding team. To understand whether these results follow additional patterns plausibly associated with gender bias among investors, we perform two sets of preliminary tests. In the first, we examine whether the relationship between funding characteristics and female founders changes depending on sectors, location, and firm age. Discrimination against women, if present, should be weaker in sectors where female entrepreneurs are more common (healthcare and retailing), in more politically liberal states (such as California and New York), and for older, less opaque startups. In the second test, we analyze these relationships across firm life-cycle. As firms mature and move from a initial funding to the follow-on stage, more information is revealed to investors, and prior beliefs are replaced with evidence-based assessments. Results are reported in Tables 7 and 8. The relationship between gender and use of debt is weaker in "liberal" states (CA and NY) and for older firms (Table 7, Columns 3 and 5), whereas we do not observe any changes when isolating industries where teams with female founders are relatively more common.[17]

In Table 8, we report results for Debt regressions expanding beyond first rounds. In Column 1, we include the first follow-on round in the sample. In the regression, we add an indicator for the follow-on round and its interaction with the female founder indicator. The coefficient on the interraction term is of opposite sign and similar in absolute value to the coefficient on the female founder variable, indicating that the differential use of debt by female-founded teams does not extend to second rounds. In Column 3, we show results for all rounds beyond the first. The coefficient on the indicator for female founded firms is not statistically different from zero.

The same is not true for round size. The relation between female-led teams and funding amount remains negative and significant across specifications in Tables 7 and 8. That is, female-led startups raise less capital independently of sector, firm age, and funding stage.[18] This suggests that the rela-

[17] We note that the Hebert (2019) result relies on the gender of entrepreneurs across all businesses to define female-dominated sectors, not only those raising external capital. In our sample, founding teams with women do not represent the majority in any sector.

[18] We do observe in Column 4 of Table 7 that the negative relation is largely driven by CA and NY.

tionship between gender and funding amounts may be due to demand-side factors, perhaps similar to negotiation and 'ask gap' behavior documented in the literature on differential pay (Roussille (2020)). Therefore, we continue focus on the nexus between security choice and the gender composition of founding teams.

Our conceptual framework proposes an explanation for this nexus based on investor bias and the specific features of debt contracts. When funding female entrepreneurs, investors *a priori* tend to attribute a larger share of future firm value creation to physical capital rather than entrepreneurial talent. Since the liquidation process substantially destroys value created by human capital (e.g. organizational processes, customer and supplier networks) but (partially) preserves existing assets, investors are willing to finance women using securities that offer higher liquidation rights, that is, debt securities. This suggests that the correlations between gender of the founders and security choice should be stronger when debt is the dominant contract used in the financing event. In Table 9 we show that our results are driven by use of debt alone or in combination with non-equity securities (Columns 2 through 4), e.g. convertible debt, while it is still positive but not significant when debt is used in combination with equity.

4.2 Outcomes

In our framework, the probability of achieving a milestone is independent of labor and capital productivity. Thus, any investor bias with respect to the relative contribution of labor and capital for female-led startups should not have implications for short-run outcomes like follow-on funding. However, investor bias will have implications for observed exits, as described by implications 2 and 3. In what follows, we examine how the gender composition of founding teams relates to firm outcomes.

To investigate outcomes in the shorter-run, we analyze the probability of receiving follow-on funding (Table 10 Columns (1) and (4)). We also consider the size of incremental capital injections (Columns (2) and (5)), and the length of time in between rounds (Columns (3) and (6)) as additional outcomes, conditional on receiving follow-on funding. We restrict our sample to firms incorporated before January 2017, as we observe funding events up to mid 2018. We find that none of the outcomes is related to the gender of the firm founders, as the coefficient of $F\,Founder$ is not significantly different from zero across specifications. This is consistent both with the view that either investors are unbiased, or, if they are, it does not affect intermediate firm outcomes, as predicted by our model. This result also suggests that the presence of female founders is not correlated with average firm quality or a difference in suitability for staged finance, as measured by access to later funding. The relationship between short-run outcomes and other controls is as expected. Firms that raise larger amounts in first rounds are more likely to receive follow-on funding, and, conditional on receiving follow-on capital, the larger the first round the smaller is the increase in the follow-on round and the later the follow-on round occurs. Issuing debt in the first round is also associated with higher probability of receiving additional capital and in a shorter period of time as compared to equity first rounds. That we do not observe significant differences in intermediate funding characteristics by gender of the founders offers some validation for our approach.

We next examine exit events, namely IPOs and acquisitions. We restrict our sample to firms incorporated before January 2015, as we observe exit events up to mid 2019.[19] In a most basic model of (taste-based) discrimination, one might imagine fewer female-founded firms receive funding, and those that do get funded then outperform in both the intermediate and later stages given tougher screening. Table 11 shows coefficient estimates from a linear probability model where the dependent variable is equal to 1 if either (Columns (1) and (4)) or one of the two outcomes (IPOs in Columns (2) and (5), and acquisitions in Columns (3) and (6)) occur. In Columns 1 and 4, we observe that having a female founder bears no relation to overall exit probability. Similar to intermediate outcomes, this result may seem to suggest that, on average, female entrepreneurs are not at a disadvantage in accessing capital since they are neither more nor less successful than other founders.

Results differ when we distinguish between the two exit types, however. In our model, projects for which the human capital of the founder is more important will exit via IPO, whereas those that are more capital-oriented will exit with acquisition. Therefore, a bias in assessing the relative contribution of entrepreneurial talent will lead to a greater probabilty of IPO for female-founded firms and a lower probability of acquistion. This pattern is borne out in the data. The probability of an acquisition is significantly smaller for female firms (-0.7%), while the probability of an IPO increases by 0.5%. Given the rarity of exits in our rather recent sample, these differences are meaningful.

Control variables also indicate substantial differences in the exit routes' firm characteristics. In general, the probability of acquisition seems related to firm "maturity" at the time of first round. Older, Delaware incorporated, revenue generating, patent-holding firms are more likely to be acquired (Columns (3) and (6)). The opposite is true when we examine IPOs (columns (2) and (5)). These discrepancies are consistent with implications 3) and 4) from our model, i.e. different types of firms

[19] Results are similar if we restrict to earlier cutoff years.

pursue different exit strategies, and in particular, successful startups that rely more on human capital are more likley to stay independent by going public rather than being acquired. Note also the negative coefficient on Debt in Column (5) in predicting IPO outcomes, consistent with Implication 4 in the model. Overall, the data are consistent with the idea that gender-based discrimination depends on project type; that is, female-led firms are at a (dis)advantage when project's success depends more heavily on physical (human) capital.

In untabulated results, we verify that there are no discernable diferences in the quality of the observed IPOs or acquisitions in our data on the basis of gender. Using information from S-1 and 424-B filings, we compare IPO applications of female-led and male-only startups. Firms with female founders are more likely to apply for listing on a formal exchange (42% vs 37%), and, at the time of the application, have higher employment, revenues, and net income (with smaller book assets). Among priced IPOs, equity market capitalizations have similar distributions (with a median value of $321 million for female-founded firms and $234 million for the rest of the sample), and we find no differences in the average ratio of IPO price over per-share equity book value. Interestingly, out of the 15 "unicorns" in our sample, 3 have a female founder. Thus, gender differences in IPO filing rates are not driven by lower quality applications for female-led firms. Similarly, in cases for which acquisition prices are disclosed, there are no statistical differences in means or medians across gender. Also, time to acquisition and IPO are statistcally equivalent for firms with female founders and wihtout. Threfore, we do not think it likely that a different exit threshold that varies by gender composition of the founding team contributes to these outcome results.

5 Classic Capital Structure Theories and Additional Evidence

Our model and empirical inference hinge on the idea that investors are biased in their assessment of expectated liquidation values for female-led firms, which drives the preference for debt funding. Alternative explanations that rely on classic capital structure theory arguments, rather than gender-biased beliefs for firm value, can be advanced. These theories typically center on asymmetric information, tax adavantages, or manager behavior. We address these in turn below.

In a classic Myers and Majluf (1984) framework, equity can be undervalued when information between firm insiders and investors is asymmetric, and firms may then prefer to issue less information-sensitive securities, such as debt. Debt allows firms to postpone valuation to later stages after more information is produced. It is possible that female-led firms are perceived to be more opaque, possibly because investors have less experience in sceening female entrepreneurial ability. Under this interpretation, however, the use of debt across all firms should be associated with better fundamentals, which are revealed to the market as the firm matures. Instead, our data show that use of debt in initial rounds is negatively correlated with exits in general, and IPOs in particular.

Tax based arguments are unlikely to apply in this setting, but perhaps some firms are profitable and taking advantage of tax benefits from debt. We observe, for example, that debt is more likely at the first round if firms are older and less likely if they are pre-revenue. Perhaps female-based firms are more likely to be profitable at the initial funding due to tougher screening standards. If so, there is no reason to suppose that these effects would become less pronounced in high-tax states such as CA or NY, however, or that the effects would decline with firm age.

In terms of behavior, debt securities can act as a disciplining device, affect the provision of effort, or alter risk-taking. Debt as a discipling device usually operates under the notion that there is available cash flow to tunnel into non-optimal investments or otherwise. Again, we do not think this likely in the early-stage setting. We, can, however, check to what extent debt might substitute for other disciplining or monitoring efforts. Table 12 shows the relation between female-founded firms and the presence and size of the board of directors. In Column 1, we observe that female-backed firms are more likely to have a board, and, conditional on having a board, they have more directors (Column 3). Thus, it appears female-backed firms have greater monitoring from sources other than through security selection, such that the use of debt in this capacity would be redundant. Moreover, these differences disappear in later stages (Columns 2 and 4). The transitory nature of these differences is once again consistent with bias that resolves with more informtion.

It is possible founding teams with women are simply less experienced, such that the board is adding valuable advice (and, the firms, though more mature, are more difficult to value, using debt to push off valuation.) If this were the case, we would expect investors, who are often board members, to demand equity securities so that they are rewarded for the upside from their contributions. We can also test whether, ex post, it seems teams with female founders were less experienced by examining managerial replacements and expansion of the management team over time. We define the variable $Turnover_{i,r}$ as a dummy that takes value 1 if all founders of firm i are replaced by outside managers in round $r > 1$, that is, in second or later rounds. Turnovers are uncommon, with only 10% of firms in the sample undergoing a complete replacement of the original management team, and no significant difference between female-led and other firms (Column 5). However, conditional on not experiencing a complete turnover, the proportion of non-founders in the executive team is smaller for female-led startups (Column 6). In other words, founders of female-led firms are less likely to share executive power with professional managers in late stages, which is consistent with positive selection in early rounds of funding.

One of the most frequntly documented gender differences in the literature is relative underconfidence or greater risk aversion for females. Female founded firms are more mature at the first round as well, so an obvious explanation for the greater use of debt securities might include arguments about the nature of the assets at the firm. For example, perhaps there are fewer future investment opportunities, and debt-overhang problems are therefore less severe (Myers (1977)). However, the follow-on investment and overall exit rates are the same as for all male teams, and the probability of an IPO exit is greater. Thus, these facts argue against such an explanation and leave open the question of why gender would have an opposite empirical relationships with IPOs and acquisitions.

Along the same lines, it can be argued that investors leave female teams with more equity ownership to induce greater risk-taking. It is important to note that our results lie in contrast with previous literature showing that female managers (of listed companies) are less likely than their male colleagues to use debt and leverage their firms (Faccio et al. (2016)). This relationship between gender and leverage can be interpreted as an additional piece of evidence for higher risk aversion among women (Croson and Gneezy (2009)). The use of debt funding to "induce" risk taking and accelerate growth, however, should be associated with more failures (in terms of follow-on probability, for example) and higher-value exits on average for debt-financed firms. Our data show the opposite. Overall, none of these alternate explanations is consistent with the data.

6 Conclusion

In this paper, we present new evidence on gender differences in early-stage finance. Using information on the security type issued by young, private firms in the US, we find that female-founded firms are more likely to issue debt when compared to male-only founded firms, with a relative increase in prevalence of over 18%. There are no differences in follow-on funding or exit rates for these firms, but exits where the contribution of human capital is likely larger, namely IPOs, are more common among founding teams with female members.

To reconcile these findings, we propose a simple model of staged finance in which investors can underestimate the relative contribution of entrepreneurial talent to firm value in the initial funding stage. Specifically, investors tend to believe that human capital plays a smaller role than physical capital in the valuation of female-led firms. This form of bias produces two main predictions. The first is that, in line with our empirical evidence, female-led firms are more likely to issue debt rather than equity in early stages. The intuition is that debt contracts provide investors with liquidation rights that are more valuable when a larger part of firm value is based on alienable assets, such as physical capital. The second is that the market under(over)-invests in female-run "long shot" ("safe bet") projects, that is projects relying more on human (physical) capital for success. Thus, female founders may have easier or harder access to startup capital, depending on the capital intensity of their projects. To test this implication, we employ a differentiated outcome test that relies on the notion from previous literature that startups' exit strategies depend on the importance of specialized human capital, with more talent-intensive businesses opting for IPOs rather than acquisitions.

Traditional theories of capital structure do not explain the data, and there is corroborating evidence consistent with mistake-based bias among investors. Differences in preference for debt are less pronounced for older firms and in less conservative states, and disappear in later financing events. That the bias resolves quickly is perhaps a bit of good news; bias does not appear taste-based or of the classically statistical form. It is unclear to what extent bias can be attenuated without direct experience with a paticular entrepreneurial project, however. Since high growth entrepreneurship that attracts attention from professional VC often involves "long-shot" projects dependent on entrepreneurial ability, our approach partially explains the entrepreneurship funding gap in the VC and other high-growth settings.

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Table 1: Variables Definition

Variable Name	Type	Description
Round Size	Continuous	Total amount sold in the offering ($ Mil)
# Investors	Continuous	Total number of investors participating in the offering
Non Accr. Investors	Dummy	Takes value 1 if the offering is open to non-accredited investors
Follow-on	Dummy	Takes value 1 if the offering is followed by a subsequent round
Days to Next Round	Continuous	Number of days between the current and the next round (if any)
Step Up	Continuous	Ratio of round size of follow-on (if any) and current round
Debt	Dummy	Takes value 1 if one of the securities offered is debt
Debt + Equity	Dummy	Takes value 1 if the securities offered are debt and equity
Debt + Other Non Equity	Dummy	Takes value 1 if the securities offered are debt and other non-equity
Straight Debt	Dummy	Takes value 1 if the only security offered is debt
Convertible Debt	Dummy	Takes value 1 if the securities offered are debt and options to acquire other securities
# Founders	Continuous	Total number of executives in first round
Age	Continuous	Difference between offering year and year of incorporation
Family	Dummy	Takes value 1 if 2 or more founders have the same surname
De Inc	Dummy	Takes value 1 if firm is incorporated in the state of Delaware
Patent at 1st Rd	Dummy	Takes value 1 if firm has been awarded a patent by the year of the first round

Figure 1: Security Choice and Funding Sets

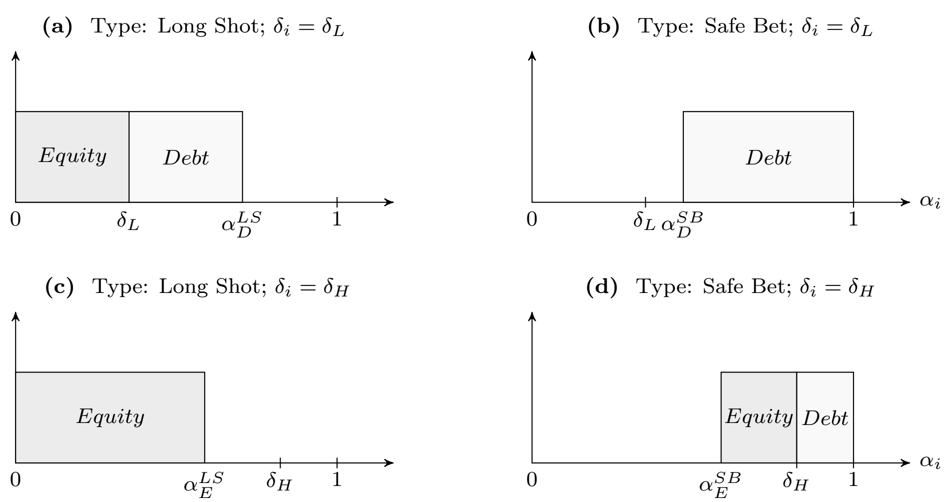

Figure 2: Funding Round Distribution by Stage and Year

These graphs show the distribution of funding events in our sample across funding stage (Panel (a)) and the distribution of first funding rounds over time (Panel (b)). The graph in Panel (b) also reports the share of female co-founded firms in the sample over time (right axis).

Figure 3: Observations by Round Stage

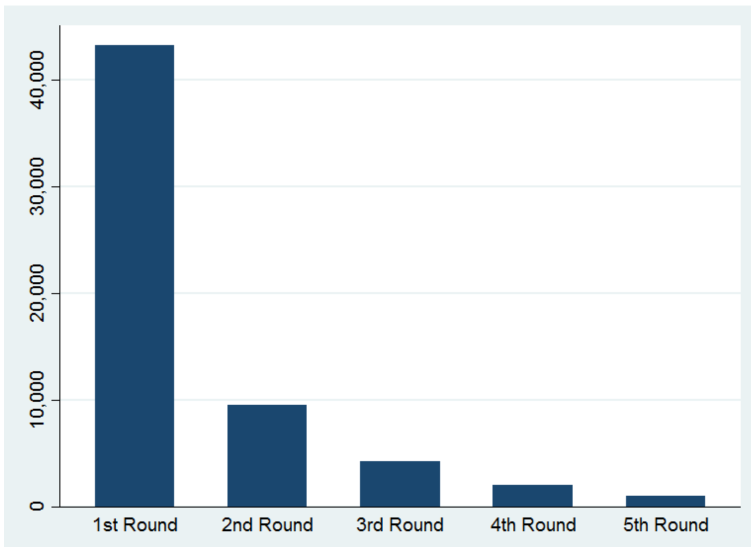

Figure 4: First Rounds over Time, and Share of Female Co-founded Firms

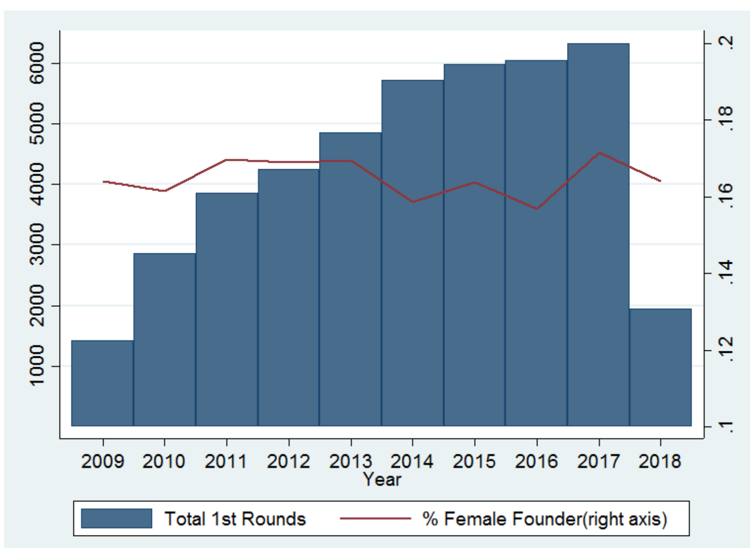

Figure 5: Funding Choices

These graphs show the distribution of round size (Panel (a)) and use of debt securities (Panel (b)) for male-only and female founded firms. The sample consists of first rounds only. The definitions of different debt types can be found in Table 1.

Figure 6: Size of First Round

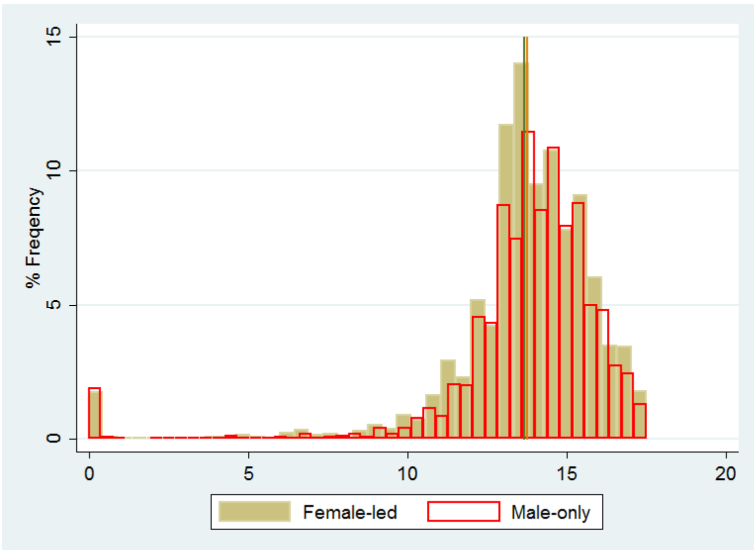

Figure 7: Use of Debt

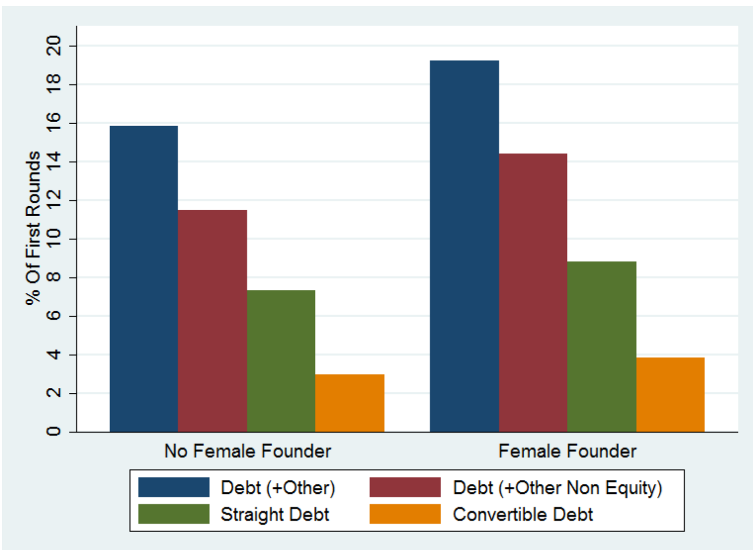

Figure 8: Exits by Gender

These graphs shaw the share of firms in the sample that were subsequently acquired (Panel (a)) or filed for public listing (Panel (b)) by year of their first funding round and gender of the founders.

Figure 9: Acquisitions

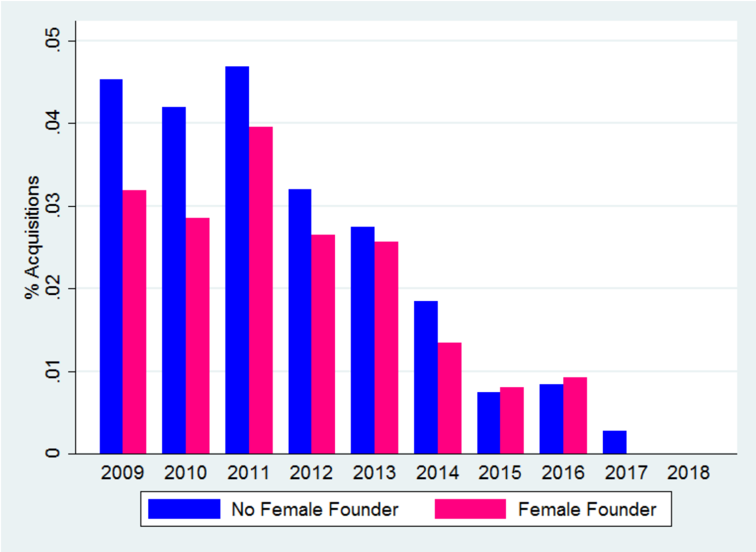

Figure 10: IPOs

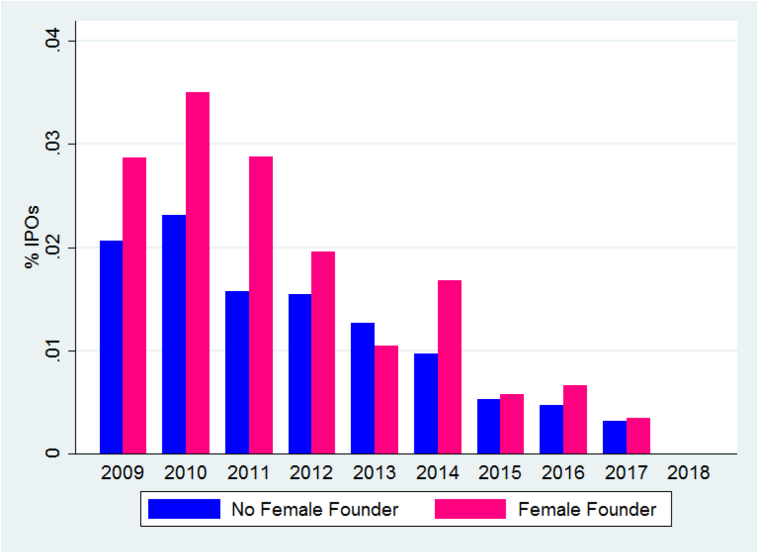

Table 2: First Round Characteristics

This table reports distributional summary statistics for the sample of first funding rounds. All variable definitions can be found in Table 1.

	Mean	Median	Min	Max	Obs
Round Size	3.49	1.35	0.00	40.00	43,238
Debt	0.16	.	.	.	43,238
Num Investors	7.19	4.00	0.00	41.00	43,238
Non Accr Investors	0.14	.	.	.	43,238
Follow-on	0.22	.	.	.	43,238
Days to Next Round	456.04	372.00	31.00	3085.00	9,468
Step Up	5.19	1.25	0.01	188.33	9,388

Table 3: First Round Firm Characteristics by Gender

This table reports summary statistics for firms in the sample by gender of the founders. All variable definitions can be found in Table 1.

	No Female Founder		Female Founder	
	Mean	Obs.	Mean	Obs.
Num. Founders	1.879	36,092	2.649	7,120
Age (years)	0.859	36,092	1.020	7,120
Family	0.070	36,092	0.194	7,120
DE_Inc	0.471	36,092	0.489	7,120
Patent at 1st Rd	0.058	36,092	0.069	7,120
NoRev	0.246	36,092	0.224	7,120
RevUpTo1M	0.122	36,092	0.130	7,120
RevOver1M	0.047	36,092	0.043	7,120
RevNonDisc	0.563	36,092	0.594	7,120
CA	0.194	36,092	0.214	7,120
MA	0.040	36,092	0.045	7,120
NY	0.096	36,092	0.127	7,120
TX	0.076	36,092	0.064	7,120
Industry_Broad==Technology	0.257	36,092	0.238	7,120
Industry_Broad==Health	0.089	36,092	0.128	7,120
Industry_Broad==Real Estate	0.214	36,092	0.125	7,120
Industry_Broad==Energy	0.039	36,092	0.031	7,120
Industry_Broad==Financial	0.055	36,092	0.051	7,120
Industry_Broad==Manufacturing	0.028	36,092	0.034	7,120
Industry_Broad==Retailing	0.019	36,092	0.046	7,120
Industry_Broad==TravelLeisure	0.034	36,092	0.039	7,120
Industry_Broad==Other	0.265	36,092	0.309	7,120
Observations	36092		7120	

Table 4: Related Persons

This table shows the distribution of related persons across genders. Related persons are executives, directors, and promoters of the offering. We define founders as the firm executives at the time of the first round. Other roles refer to non-executive positions, that is directors and promoters.

	Female	Male	Total
Founders	0.10	0.90	79668
Other Roles (Round=1)	0.08	0.92	29437
Executives (Round>1)	0.11	0.89	34662
Other Roles (Round>1)	0.07	0.93	31302
Mean Roles (Round=1)	1.61	1.67	79668
Mean Roles (Round>1)	1.65	1.79	34662

Table 5: Debt Securities

This table reports coefficients, standard errors, and statistical significance from OLS regressions of security choice in first rounds. The outcome variable $Debt$ takes value 1 if one of the securities offered is debt. The key explanatory variable is $FFounder$ which takes value 1 if at least one of the firm founders is identified as female; regressions also include round- and firm-level control variables (all variable definitions can be found in Table 1), a set of location controls, industry-fixed effects, and year-fixed effects. The location controls consist of 4 indicator variables that take value 1 if the firm is located in California, New York, Massachusetts, or Texas. Columns 2 and 3 are estimated after dropping firms in unclassified industries and with undisclosed revenues respectively. In Column 4 the estimation includes the variable $Follow - on$ and its interaction with $FFounder$ as controls. Robust standard errors are reported in parentheses. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

	(1) First Rounds	(2) Industry Classified	(3) Revenue Disclosed	(4) Unobservbles Test
F Founder	0.0316***	0.0362***	0.0373***	0.0337***
	(0.00523)	(0.00638)	(0.00800)	(0.00578)
Ln(Age at 1st rd)	0.0486***	0.0405***	0.0723***	0.0467***
	(0.00384)	(0.00460)	(0.00606)	(0.00385)
DE Inc.	0.0180***	0.0122**	0.0342***	0.0150***
	(0.00401)	(0.00479)	(0.00612)	(0.00402)
No Revenues	-0.0304***	-0.0272***	-0.0276***	-0.0292***
	(0.00402)	(0.00472)	(0.00522)	(0.00402)
Family	-0.00118	-0.00642	-0.00332	-0.00114
	(0.00621)	(0.00715)	(0.00928)	(0.00620)
Ln(# Founders)	-0.0411***	-0.0297***	-0.0358***	-0.0421***
	(0.00506)	(0.00598)	(0.00770)	(0.00506)
Patent at 1st Rd	-0.00888	-0.0220**	-0.00390	-0.0136
	(0.00844)	(0.00941)	(0.0155)	(0.00845)
Ln(# Investors)	-0.0257***	-0.0289***	-0.0222***	-0.0267***
	(0.00155)	(0.00180)	(0.00217)	(0.00155)
Non Accredited Inv.	0.0130**	0.0235***	0.0267***	0.0146***
	(0.00514)	(0.00624)	(0.00648)	(0.00513)
F_follow				-0.00976
				(0.0124)
Tot Rounds>1				0.0416***
				(0.00544)
Location Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	43212	31446	18679	43212
adj. R^2	0.036	0.044	0.037	0.038

Robust standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 6: First Round Amounts

This table reports coefficients, standard errors, and statistical significance from OLS regressions of first rounds size. The key explanatory variable is $FFounder$ which takes value 1 if at least one of the firm founders is identified as female; regressions also include round- and firm-level control variables (all variable definitions can be found in Table 1), a set of location controls, industry-fixed effects, and year-fixed effects. The location controls consist of 4 indicator variables that take value 1 if the firm is located in California, New York, Massachusetts, or Texas. Columns 2 and 3 are estimated after dropping firms in unclassified industries and with undisclosed revenues respectively. In Column 4 the estimation includes the variable $Follow-on$ and its interaction with $FFounder$ as controls. Robust standard errors are reported in parentheses. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

	(1) Full Sample	(2) Industry Classified	(3) Revenue Disclosed	(4) Unobservbles Test
F Founder	-0.147***	-0.114***	-0.213***	-0.159***
	(0.0337)	(0.0391)	(0.0562)	(0.0401)
Ln(Age at 1st rd)	0.197***	0.216***	0.138***	0.193***
	(0.0253)	(0.0295)	(0.0423)	(0.0253)
DE Inc.	0.433***	0.387***	0.300***	0.425***
	(0.0284)	(0.0330)	(0.0461)	(0.0285)
No Revenues	-0.0496	-0.0508	0.0501	-0.0462
	(0.0312)	(0.0355)	(0.0391)	(0.0313)
Family	-0.0965**	-0.127**	-0.123*	-0.0961**
	(0.0441)	(0.0520)	(0.0693)	(0.0441)
Ln(# Founders)	0.614***	0.583***	0.817***	0.612***
	(0.0373)	(0.0420)	(0.0573)	(0.0373)
Patent at 1st Rd	0.401***	0.414***	0.394***	0.389***
	(0.0394)	(0.0456)	(0.0837)	(0.0395)
Ln(# Investors)	0.431***	0.410***	0.282***	0.429***
	(0.0134)	(0.0154)	(0.0188)	(0.0134)
Non Accredited Inv.	-0.721***	-0.708***	-0.715***	-0.717***
	(0.0412)	(0.0489)	(0.0523)	(0.0412)
X Tot Rounds>1				0.0463
				(0.0692)
Tot Rounds>1				0.0962***
				(0.0304)
Location Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	43212	31446	18679	43212
adj. R^2	0.096	0.094	0.086	0.096

Robust standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 7: Discrimination and Funding Choices

This table reports coefficients, standard errors, and statistical significance from OLS regressions of use of debt (Columns 1,3,and 5) and first rounds size (Columns 2,4,and 6). The key explanatory variable is $FFounder$ which takes value 1 if at least one of the firm founders is identified as female. $XHealthorRetailing$ indicates interactions between $FFounder$ and a dummy variable that takes value 1 if the firm operates in the health or retailing industries. $XCaorNY$ indicates interactions between $FFounder$ and a dummy variable that takes value 1 if the firm operates in the states of California or New York. $XLn(Ageat1strd)$ indicates interactions between $FFounder$ and the (log of) firm's age. Regressions also include round- and firm-level control variables , a set of location controls, industry-fixed effects, and year-fixed effects. The location controls consist of 4 indicator variables that take value 1 if the firm is located in California, New York, Massachusetts, or Texas. Robust standard errors are reported in parentheses. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

	(1) Debt	(2) lnAmt	(3) Debt	(4) lnAmt	(5) Debt	(6) lnAmt
F Founder	0.0404***	-0.128***	0.0457***	-0.0680	0.0498***	-0.0995*
	(0.00722)	(0.0453)	(0.00768)	(0.0465)	(0.00841)	(0.0588)
X Health or Retailing	-0.0182	0.0622				
	(0.0145)	(0.0872)				
X CA or NY			-0.0302**	-0.147*		
			(0.0130)	(0.0835)		
X Ln(Age at 1st Round)					-0.0246**	-0.0265
					(0.0112)	(0.0683)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Location Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	31446	31446	31446	31446	31446	31446
adj. R^2	0.044	0.094	0.044	0.094	0.044	0.094

Robust standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 8: Persistence of Funding Choices

This table reports coefficients, standard errors, and statistical significance from OLS regressions of use of debt (Columns 1 and 3) and (log of) rounds size (Columns 2 and 4). The key explanatory variable is $FFounder$, which takes value 1 if at least one of the firm founders is identified as female. Columns 1 and 2 include observations from first and second funding rounds. Columns 3 and 4 exclude first rounds. $FFounderXRound = 2$ indicates interactions between $FFounder$ and $Round = 2$, that is, a dummy variable that takes value 1 for the second round. Regressions also include round- and firm-level control variables (see definitions in Table 1), a set of location controls, industry-fixed effects, and year-fixed effects. The location controls consist of 4 indicator variables that take value 1 if the firm is located in California, New York, Massachusetts, or Texas. Robust standard errors are reported in parentheses. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

	(1) Debt TwoRnds	(2) Ln(Round Size) TwoRnds	(3) Debt LateRnds	(4) Ln(Round Size) LateRnds
F Founder	0.0298***	-0.140***	0.0134	-0.119***
	(0.00520)	(0.0335)	(0.00876)	(0.0388)
F Founder X Round=2	-0.0225*	-0.0165		
	(0.0121)	(0.0624)		
Round=2	0.0175***	0.242***		
	(0.00562)	(0.0268)		
Ln(Age)	0.0389***	0.233***	-0.0330***	0.427***
	(0.00356)	(0.0224)	(0.00785)	(0.0359)
Ln(# Founders)	-0.0337***	0.559***	-0.0289***	0.311***
	(0.00474)	(0.0329)	(0.00968)	(0.0474)
DE Inc.	0.0181***	0.429***	0.000881	0.443***
	(0.00378)	(0.0249)	(0.00799)	(0.0356)
No Revenues	-0.0345***	-0.0703**	-0.0630***	-0.314***
	(0.00387)	(0.0294)	(0.0115)	(0.0698)
Family	0.000738	-0.0907**	-0.00518	-0.0959*
	(0.00577)	(0.0383)	(0.0114)	(0.0557)
Ln(# Investors)	-0.0249***	0.446***	-0.0394***	0.536***
	(0.00149)	(0.0119)	(0.00334)	(0.0179)
Non Accredited Inv.	0.00367	-0.718***	-0.0473***	-0.748***
	(0.00496)	(0.0383)	(0.0135)	(0.0804)
Ln(Round Size)	-0.00594***			
	(0.000690)			
Location Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	52710	52710	16777	16777
adj. R^2	0.034	0.101	0.016	0.152

Robust standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 9: Female Founded Firms and Security Choice: Use of Debt

This table reports coefficients, standard errors, and statistical significance from OLS regressions of security choice in first rounds. In Column 1, the outcome variable $Debt + Equity$ takes value 1 if the securities offered are debt and equity. In Column 2, the outcome variable $Debt + OtherNonEquity$ takes value 1 if the securities offered are debt and other non-equity. In Column 3, the outcome variable $StraightDebt$ takes value 1 if the only security offered is debt. In Column 4, the outcome variable $ConvertibleDebt$ takes value 1 if the securities offered are debt and options to acquire other securities. The key explanatory variable is $FFounder$ which takes value 1 if at least one of the firm founders is identified as female; regressions also include round- and firm-level control variables (all variable definitions can be found in Table 1), a set of location controls, industry-fixed effects, and year-fixed effects. The location controls consist of 4 indicator variables that take value 1 if the firm is located in California, New York, Massachusetts, or Texas. Robust standard errors are reported in parentheses. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

	(1) Debt + Equity	(2) Debt+Other Non Equity	(3) Straight Debt	(4) Convertible Debt
F Founder	0.00398	0.0276***	0.0175***	0.00628**
	(0.00285)	(0.00468)	(0.00382)	(0.00258)
Ln(Age at 1st rd)	0.0104***	0.0382***	0.0214***	0.0131***
	(0.00217)	(0.00338)	(0.00280)	(0.00176)
DE Inc.	0.00134	0.0166***	0.00202	0.0116***
	(0.00226)	(0.00353)	(0.00287)	(0.00194)
No Revenues	-0.00529**	-0.0251***	-0.0125***	-0.0100***
	(0.00240)	(0.00343)	(0.00294)	(0.00163)
Family	0.00195	-0.00314	-0.00152	-0.00650**
	(0.00356)	(0.00541)	(0.00442)	(0.00272)
Ln(# Founders)	-0.00939***	-0.0318***	-0.0290***	-0.00170
	(0.00292)	(0.00439)	(0.00360)	(0.00235)
Patent at 1st Rd	-0.00291	-0.00597	-0.00120	0.00112
	(0.00449)	(0.00762)	(0.00592)	(0.00469)
Ln(# Investors)	-0.00776***	-0.0179***	-0.0132***	-0.00351***
	(0.000943)	(0.00132)	(0.00111)	(0.000651)
Non Accredited Inv.	0.0221***	-0.00904**	0.00635*	-0.0118***
	(0.00338)	(0.00422)	(0.00375)	(0.00176)
Location Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	43212	43212	43212	43212
adj. R^2	0.007	0.032	0.014	0.020

Robust standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 10: Short-Run Outcomes: Follow-on Funding

This table reports coefficients, standard errors, and statistical significance from OLS regressions of short-run outcomes. In Columns 1 and 4, the outcome variable $Follow-on$ takes value 1 if the firm raised funding a second time after the first round. In Columns 2 and 5, the outcome variable $Ln(Step-Up)$ is the log of the ratio between first and second round size. In Columns 3 and 6, the outcome variable $DaystoNextRound$ measures the distance in days between the first and the second round. The key explanatory variable is $FFounder$ which takes value 1 if at least one of the firm founders is identified as female; regressions also include round- and firm-level control variables (all variable definitions can be found in Table 1), a set of location controls, industry-fixed effects, and year-fixed effects. The location controls consist of 4 indicator variables that take value 1 if the firm is located in California, New York, Massachusetts, or Texas. Robust standard errors are reported in parentheses. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

	(1) Follow-On	(2) Ln(Step Up)	(3) Days to Next Round	(4) Follow-On	(5) Ln(Step Up)	(6) Days to Next Round
F Founder	0.00385	0.0149	2.491	0.00273	-0.0421	5.460
	(0.00585)	(0.0438)	(9.940)	(0.00585)	(0.0366)	(9.861)
Ln(Age at 1st rd)	0.0576***	-0.0433	19.77***	0.0549***	0.0937***	15.69**
	(0.00464)	(0.0363)	(7.154)	(0.00465)	(0.0303)	(7.083)
DE Inc.	0.0811***	0.0380	4.877	0.0789***	0.281***	0.275
	(0.00468)	(0.0410)	(8.673)	(0.00469)	(0.0358)	(8.620)
No Revenues	-0.0331***	0.0555	-31.91***	-0.0312***	-0.119***	-30.78***
	(0.00460)	(0.0536)	(10.63)	(0.00460)	(0.0425)	(10.61)
Family	0.0000294	-0.0331	2.269	0.000501	-0.0897*	4.888
	(0.00731)	(0.0612)	(13.67)	(0.00729)	(0.0534)	(13.60)
Patent at 1st Rd	0.112***	0.0172	17.50	0.111***	0.141***	14.49
	(0.0101)	(0.0447)	(11.27)	(0.0101)	(0.0377)	(11.14)
Ln(# Founders)	0.0219***	-0.260***	-22.94**	0.0220***	0.0455	-32.51***
	(0.00602)	(0.0513)	(11.13)	(0.00605)	(0.0461)	(11.11)
Ln(# Investors)	0.0295***	-0.112***	4.224	0.0296***	0.0735***	-4.722
	(0.00182)	(0.0189)	(4.134)	(0.00185)	(0.0163)	(4.251)
Non Accredited Inv.	-0.0462***	0.0960	34.60**	-0.0447***	-0.271***	47.12***
	(0.00540)	(0.0785)	(15.09)	(0.00541)	(0.0616)	(15.20)
lnAmt				0.00302***	-0.568***	14.09***
				(0.000737)	(0.0223)	(1.796)
Debt				0.0497***	-0.0155	-78.52***
				(0.00594)	(0.0336)	(8.098)
Location Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	38992	9217	9334	38992	9217	9334
adj. R^2	0.131	0.017	0.065	0.133	0.335	0.079

Robust standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 11: Long-Run Outcomes: IPOs and Acquisitions

This table reports coefficients, standard errors, and statistical significance from OLS regressions of long-run outcomes. In Columns 1 and 4, the outcome variable *Exit* takes value 1 if the firm is either acquired or filed for an IPO. In Columns 2 and 5, the outcome variable *IPO* takes value 1 if the firm filed for an IPO. In Columns 3 and 6, the outcome variable *Acquired* takes value 1 if the firm is acquired. The key explanatory variable is *FFounder* which takes value 1 if at least one of the firm founders is identified as female; regressions also include round- and firm-level control variables (all variable definitions can be found in Table 1), a set of location controls, industry-fixed effects, and year-fixed effects. The location controls consist of 4 indicator variables that take value 1 if the firm is located in California, New York, Massachusetts, or Texas. Robust standard errors are reported in parentheses. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

	(1) Exit	(2) IPO	(3) Acquisition	(4) Exit	(5) IPO	(6) Acquisition
F Founder	-0.00129	0.00520**	-0.00690**	-0.00147	0.00473**	-0.00661**
	(0.00350)	(0.00230)	(0.00270)	(0.00350)	(0.00229)	(0.00270)
Ln(Age at 1st rd)	0.0248***	0.0111***	0.0138***	0.0254***	0.0122***	0.0133***
	(0.00326)	(0.00205)	(0.00260)	(0.00327)	(0.00204)	(0.00261)
DE Inc.	0.0186***	-0.00492***	0.0242***	0.0196***	-0.00273	0.0231***
	(0.00271)	(0.00178)	(0.00210)	(0.00273)	(0.00181)	(0.00210)
No Revenues	0.00117	0.0125***	-0.0109***	0.000922	0.0121***	-0.0107***
	(0.00271)	(0.00207)	(0.00184)	(0.00271)	(0.00205)	(0.00184)
Family	-0.0120***	-0.00585**	-0.00641**	-0.0123***	-0.00652***	-0.00605**
	(0.00380)	(0.00244)	(0.00297)	(0.00381)	(0.00245)	(0.00297)
Patent at 1st Rd	0.000237	-0.00757***	0.00728	0.000954	-0.00598**	0.00642
	(0.00592)	(0.00262)	(0.00538)	(0.00592)	(0.00262)	(0.00538)
Ln(# Founders)	0.000272	-0.000606	0.000830	0.00128	0.00173	-0.000482
	(0.00374)	(0.00252)	(0.00285)	(0.00374)	(0.00248)	(0.00288)
Ln(# Investors)	0.0134***	0.00668***	0.00698***	0.0141***	0.00836***	0.00604***
	(0.00130)	(0.000974)	(0.000889)	(0.00133)	(0.00102)	(0.000900)
Non Accredited Inv.	0.00601*	0.0171***	-0.0108***	0.00459	0.0140***	-0.00905***
	(0.00335)	(0.00287)	(0.00181)	(0.00327)	(0.00276)	(0.00180)
Ln(Round Size)				-0.00196***	-0.00428***	0.00228***
				(0.000595)	(0.000539)	(0.000271)
Debt				-0.00515	-0.00739***	0.00210
				(0.00345)	(0.00174)	(0.00303)
Location Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	28765	28765	28765	28765	28765	28765
adj. R^2	0.031	0.015	0.043	0.032	0.022	0.044

Robust standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 12: Monitoring and Managerial Turnover

This table reports coefficients, standard errors, and statistical significance from OLS regressions of governance variables. $Round = 1$ and $Round > 1$ indicate first and subsequent funding rounds respectively. In Columns 1 and 2, the outcome variable $Board?$ takes value 1 if the firm has a board of directors at the time of the funding event. In Columns 3 and 4, the outcome variable $Directors$ is the number of directors and the sample includes only firms with a board of directors. In Column 5 the outcome variable $ManagerialTurnover$ takes value 1 if all initial founders are replaced as executives of the firms by the time of its last recorded funding round. In Column 6 the outcome variable $\%NonFounderExecutives$ is the share of non-founders executives in the firm at the time of its last recorded funding round. The key explanatory variable is $FFounder$ which takes value 1 if at least one of the firm founders is identified as female; regressions also include round- and firm-level control variables (all variable definitions can be found in Table 1), a set of location controls, industry-fixed effects, and year-fixed effects. The location controls consist of 4 indicator variables that take value 1 if the firm is located in California, New York, Massachusetts, or Texas. Robust standard errors are reported in parentheses. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

	(1) Board?, Round=1	(2) Board?, Round>1	(3) Directors, Round=1	(4) Directors, Round>1	(5) Managerial Turnover	(6) % Non Founder Executives
F Founder	0.0182***	0.00724	0.0759**	0.0649	-0.0260	-0.0164**
	(0.00595)	(0.0119)	(0.0355)	(0.0570)	(0.0510)	(0.00775)
Ln(Age)	0.0892***	0.149***	0.278***	0.625***	0.0623	0.116***
	(0.00433)	(0.0136)	(0.0245)	(0.0631)	(0.0380)	(0.00929)
DE Inc.	0.160***	0.177***	-0.0848***	0.0335	0.0214	-0.00360
	(0.00466)	(0.0114)	(0.0316)	(0.0580)	(0.0426)	(0.00708)
lnAmt	0.0192***	0.0304***	0.0547***	0.107***	-0.0145	0.00427***
	(0.000811)	(0.00239)	(0.00777)	(0.0139)	(0.00953)	(0.00151)
Debt	-0.0904***	-0.0626***	-0.289***	-0.217***	-0.159***	-0.00534
	(0.00575)	(0.00952)	(0.0335)	(0.0396)	(0.0476)	(0.00585)
No Revenues	-0.0898***	-0.138***	-0.191***	-0.128	0.0560	-0.0000510
	(0.00449)	(0.0180)	(0.0387)	(0.0903)	(0.0487)	(0.00952)
Family	0.124***	0.0809***	0.191***	0.225***	-0.194**	0.00870
	(0.00796)	(0.0154)	(0.0446)	(0.0802)	(0.0755)	(0.0101)
Ln(# Founders)	0.0635***	0.0802***	0.306***	0.336***	-0.592***	0.0465***
	(0.00621)	(0.0132)	(0.0431)	(0.0680)	(0.0626)	(0.00906)
Patent at 1st Rd	0.0958***	0.0144	0.0307	0.0478	-0.0325	-0.0132
	(0.00974)	(0.0127)	(0.0384)	(0.0565)	(0.0566)	(0.00926)
Ln(Age at 1st rd)		-0.0219**		-0.119**		-0.0669***
		(0.0107)		(0.0487)		(0.00788)
Time First-Last Round					0.157***	
					(0.0116)	
lnDir						0.0833***
						(0.00489)
Location Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Round FE	No	Yes	No	Yes	No	Yes
N	43212	16722	13456	11519	9476	13884
adj. R^2	0.190	0.173	0.074	0.103		0.121
pseudo R^2					0.077	

Robust standard errors in parentheses. Standard errors are clustered at firm level in columns 2 and 4
* p<0.05, ** p<0.01, *** p<0.001

Appendix

We study the optimal financing decision by project type (long shots and safe bets) and cost of debt (high and low).

1. $T = LS$ and $\delta_i = \delta_H$. Since the project's NPV with debt funding is (weakly) negative when $\alpha = \delta_H$, and given $\frac{\partial X_D^{LS}}{\partial \alpha} < 0$ (by assumption 1), the project can only be finance when $\alpha < \delta_H$, and, therefore, only with equity. This is because the cost of debt δ_H is too high for long shot projects. Equity financing is possible with

$$\alpha_i \in \left(0, \alpha_E^{LS}\right)$$

where α_E^{LS} is such that $X_E^{LS} = 0$ and has the following expression

$$\alpha_E^{LS} = \frac{\left(\frac{1-p}{p} + p\left(1+\gamma\right)\right) K - \lambda\mu}{\beta\left(1+\gamma\right) K - \lambda\mu}$$

2. $T = LS$ and $\delta_i = \delta_L$. Since the project's NPV with equity funding is strictly positive when $\alpha = \delta_L$, then debt financing is optimal when

$$\alpha_i \in \left(\delta_L, \alpha_D^{LS}\right)$$

where α_D^{LS} is such that $X_D^{LS} = 0$ and has the following expression

$$\alpha_D^{LS} = \frac{\left(1+p\gamma\right) K + \left(1-p\right)\delta_L K - p\lambda\mu}{p\left[\beta\left(1+\gamma\right) K - \lambda\mu\right] + \left(1-p\right) K}$$

while equity financing is optimal when

$$\alpha_i \in \left(0, \delta_L\right)$$

Moreover, since $\frac{\partial X_D^T}{\partial \alpha} \geq \frac{\partial X_E^T}{\partial \alpha}$, i.e. the value of debt claims always increases in α, we have that $\alpha_D^{LS} \geq \alpha_E^{LS}$. This implies that the "quality" threshold for receiving funding decreases when the cost of debt is low.

3. $T = SB$ and $\delta_i = \delta_H$. Since the project's NPV with equity funding is strictly positive when

$\alpha = \delta_H$ and $\frac{\partial X_D^{SB}}{\partial \alpha} > 0$ (by assumption 2), then debt financing is optimal when

$$\alpha_i \in (\delta_H, 1)$$

while equity financing is optimal with

$$\alpha_i \in \left(\alpha_E^{SB}, \delta_H\right)$$

where α_E^{SB} is such that $X_E^{SB} = 0$ and has the following expression

$$\alpha_E^{SB} = \frac{\left(\frac{1-p}{p} + p\,(1+\gamma)\right) K - \mu}{\beta\,(1+\gamma)\,K - \mu}$$

4. $T = SB$ and $\delta_i = \delta_L$. Since the project's NPV with debt funding is (weakly) negative when $\alpha = \delta_L$ and $\frac{\partial X_D^{SB}}{\partial \alpha} > 0$ (by assumption 2), then the project can only be financed with debt when

$$\alpha_i \in \left(\alpha_D^{SB}, 1\right)$$

where α_D^{SB} is such that $X_D^{SB} = 0$ and has the following expression

$$\alpha_D^{SB} = \frac{(1+p\gamma)\,K + (1-p)\,\delta_L K - p\mu}{p\,[\beta\,(1+\gamma)\,K - \mu] + (1-p)\,K}$$

Moreover, since $\frac{\partial X_D^T}{\partial \alpha} \geq \frac{\partial X_E^T}{\partial \alpha}$, i.e. the value of debt claims always increases in α, we have $\alpha_D^{SB} \leq \alpha_E^{SB}$. This implies that the "quality" threshold for receiving funding decreases when the cost of debt is low.