The Relationship of CEO Gender and Age to Performance of Venture-Backed Startups

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Executive Summary

Data-based analyses on the effect of gender, age, and race on venture capital investment returns are needed to understand if biases in the investment community are supported by data. The investment decision process has resulted in funding entrepreneurs who are not representative of the overall demographic of startup company founders. In this report, the first of a multi-part study, we analyzed the effect of gender and age on the performance of startup companies.

We found that measures of value added by CEOs of VC-funded startups in the U.S. that exited over the last 20 years refute the notion that males or younger entrepreneurs perform better than females or older entrepreneurs. We also conclude that the presence of at least one female founder shortened the number of years required for startups to exit and that age has a positive impact on the value-added ratio of female biotech CEOs.

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Introduction

Gender inequities persist in entrepreneurship. Female startup founders raise less funding than males when capitalizing their companies. Investors appear to favor men over women when it comes to evaluating funding pitches.[1]

Females comprise 17% of all startup founders but all-female teams received only about 2.8% of all VC funding in 2019.[2] Morgan Stanley estimates that investors are missing out on businesses worth $4 trillion in revenue annually by not investing in more female- and minority-led enterprises.[3] The problem is compounded further by race-based biases. Black female founders raised less than 0.1% of all VC funding over an eight year period, yet Black women comprise 14% of women in the United States.[4]

A poll conducted by First Round Capital of startup founders in the United States found that age bias is even more pernicious than sexism or racism in the VC industry.[5] Pattern recognition in the VC industry has created a selection bias that favors males and non-minorities due to the perception of "fit" for purpose, a stereotype that has received increased attention in recent years.[6]

Pattern-recognition selection bias perpetuates investments in the same types of founders who receive VC funding year after year, in a cookie-cutter approach. This methodology ignores whether a more diverse set of founders — who do not fit the mold — might return different results compared to the traditional, homogenous group of funded founders.

The investor's gender matters too. When startups are funded by venture capital firms led solely by men, the male-led startups are 25% more likely to successfully exit through acquisition or IPO than female-led startups. However, if there is at least one female general partner on the investment team, there is no meaningful difference in the success rates of female- and male-led startups. The gap vanishes.[7]

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[1] Hassan, Kamal; Varadan, Monisha, and Zeisberger, Claudia. "How the VC Pitch Process is Failing Female Entrepreneurs" in Harvard Business Review. Jan. 13, 2020.

[2] The VC Female Founders Dashboard. Pitchbook, Feb. 28, 2019. https://pitchbook.com/news/articles/the-vc-female-founders-dashboard. Last updated on May 7, 2020. Data through April 30, 2020.
Zipkin, Nina. "Out of $85B in VC Funding, only 2.2% Went to Female Founders. And Every Year, Women of Color Get Less than 1% of Total Funding" in Entrepreneur. December 12, 2018.
https://www.entrepreneur.com/article/324743

[3] Morgan Stanley. "Beyond the VC Funding Gap."
https://www.morganstanley.com/content/dam/msdotcom/mcil/Morgan_Stanley_Beyond_the_VC_Funding_Gap_2019_Report.pdf

[4] Digital Undivided, Projectdiane.com

[5] Fessler, Leah. "Startup Founders Say Age Bias is Rampant in Tech by Age 36" In QUARTZ *at* Work. Jan. 5, 2019.
https://qz.com/work/1514739/startup-leaders-say-age-bias-is-rampant-against-founders-as-young-as-36/

[6] Applewhite, Daniel. "Founders and Venture Capital: Racism is Costing us Billions" In Forbes Feb. 15, 2018.

[7] Raina, Sahil. "VCs, Founders, and the Performance Gender Gap." Dec. 10, 2019.
https://hbr.org/2016/07/research-the-gender-gap-in-startup-success-disappears-when-women-fund-women

In 2019, 85% of all VC funding went to all male teams, and mixed-gender teams received 12.1% of VC funding.[8] That happened to be a historic year for female-led startups, with 21 reaching a $1 billion valuation - the most-ever female-founded unicorns in a single year.[9]

Male-female teams are a meaningful source of increase in female representation as startup founders. In 2019, female/male cofounders raised more (9%) of dollars vs female only 3%. Our initial objective was to explore the question, "do teams with a female CEO at the time of exit (as defined by PitchBook)[10] perform worse, equal to or better than those without?" We analyzed the correlation between age and gender on changes in startup valuation using data from PitchBook and from independent research. The dataset included angel and seed rounds, all VC stages, all series, mergers and acquisitions, change of control transactions and public investment deals on over *14,397* startups that, a) obtained venture capital funding, b) exited - defined as having been merged, acquired or going public - between January 1, 2000 and March 23, 2020 and c) were headquartered in the United States.

We initially sought to determine if the return-on-investment (ROI) to investors of each round of funding, for venture-backed startups with at least one female founder, was worse, equal to or better than the ROI of teams without a female founder. The available data did not enable such an analysis. The data did support analyses of CEO performance.We examined the value-added to the company of each CEO during her or his tenure.

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[8] The VC Female Founders Dashboard. PitchBook, Feb. 28, 2019. https://pitchbook.com/news/articles/the-vc-female-founders-dashboard. Last updated May 7, 2020. Data through April 30, 2020.

[9] Crunchbase Unicorn List. December 18, 2019. https://news.crunchbase.com/news/more-female-founded-unicorns-were-born-in-2019-that-before-data-shows/

[10] *n.b.:* 77% of all individuals identified in PitchBook's category "CEO at time of deal" in the Deal data set provided by Pitchbook were CEOs. Others held other "Chief" titles.

Analyses

From this dataset, we conclude:

171,276 startup companies were headquartered in the U.S. and received venture-capital funding from January 1, 2000 – March 2020.[11]

- Of those, **14,397 startups (~8%), exited**, having transacted 68,283 total deals.
- Of 14,397 startups, 83.5% achieved an ROI of ≥ 1X.
- 76.3% of the startups produced an ROI of ≤ 5X.
- **12% of exited companies had at least one female founder.**

The Effect of Founder and CEO Gender on Average Time to Exit.

As shown in Figure 1, the presence of at least one female founder **shortened the number of years** required for startups to achieve an exit. In view of the high burn rate of biomedicine startups this is a valuable finding with meaningful financial impact to investors.

Figure 1 - The Effect of At Least One Female Founder on the Average Time to Exit
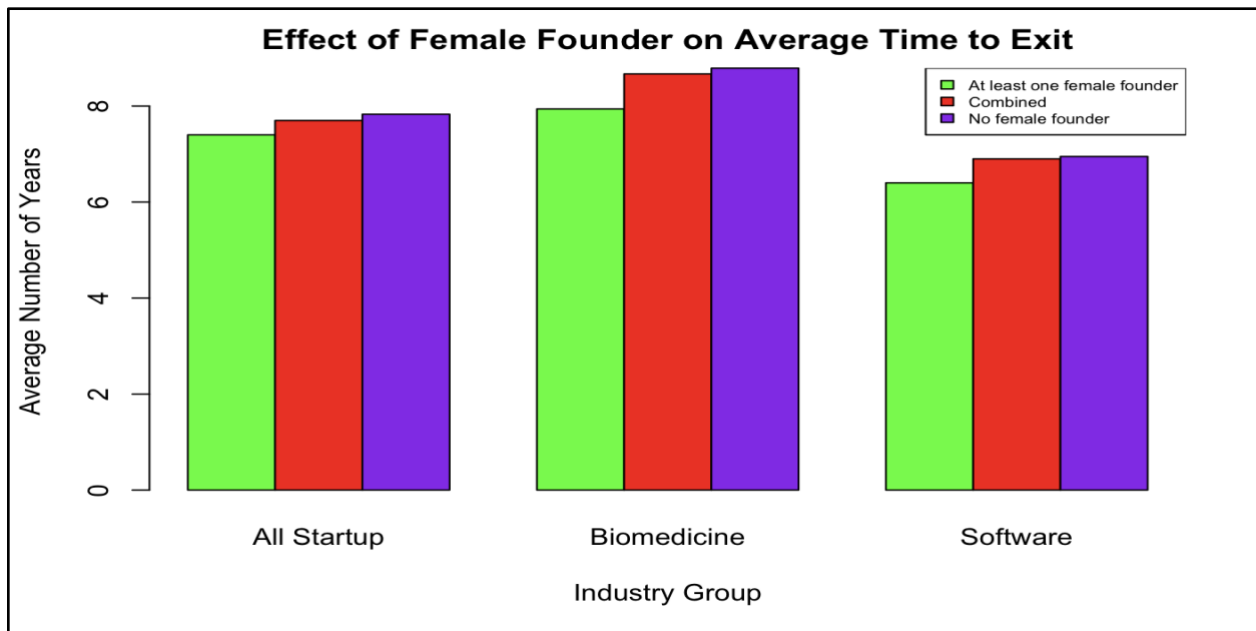
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The Effect of Founder and CEO Gender on ROI.

We conclude that the pronounced gender **bias in private capital funding is not justified** by the slight difference in ROI delivered by companies having had at least one female CEO, a combination of male and female CEOs or only male CEOs.

Figure 2A -The effect of at least one female founder on various ROI multipliers
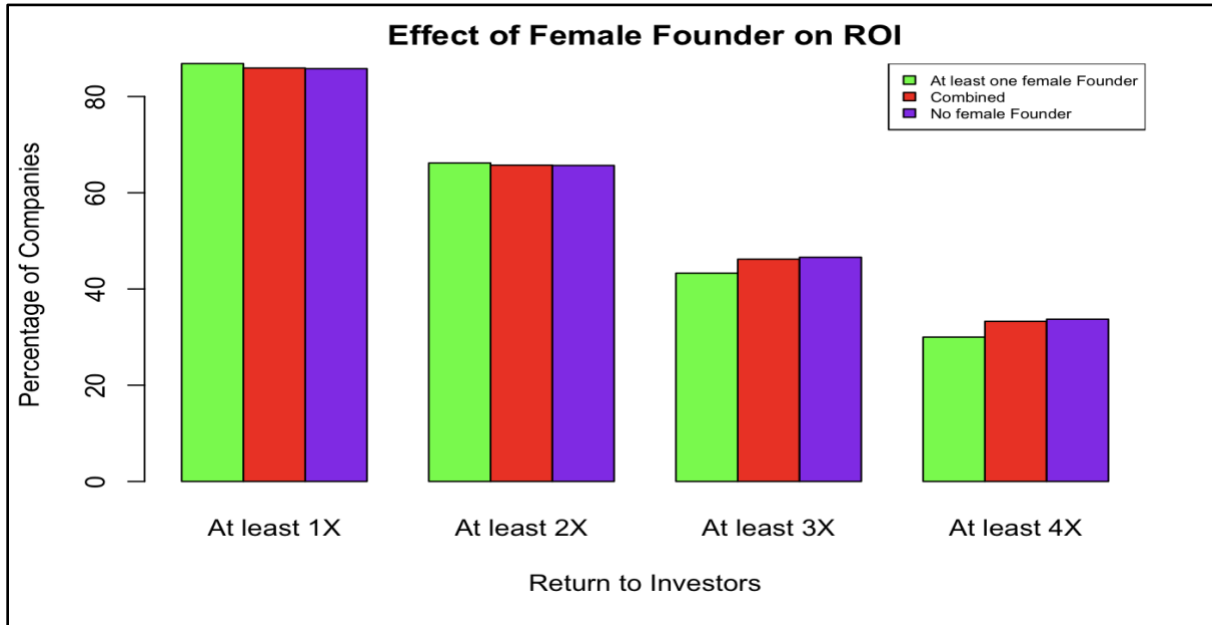
Figure 2B -The effect of at least one female chief on various ROI multipliers
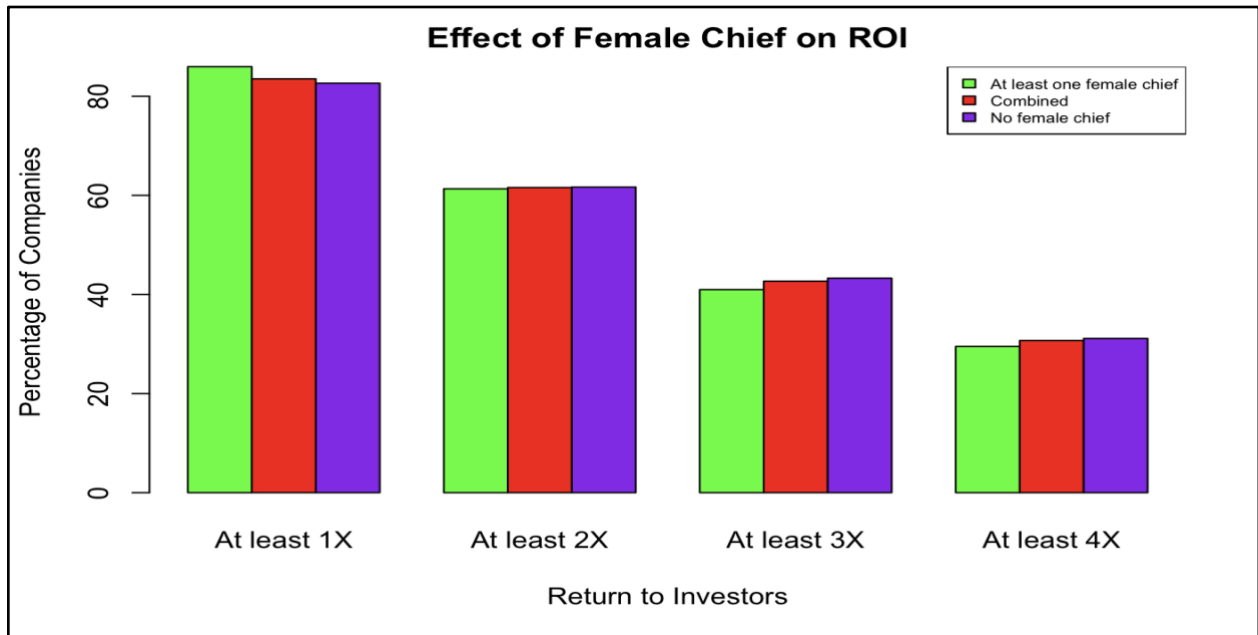
CEO gender and age observations:

- For the entire data set, the **CEO** age ranged from 18 to 74. The **average age was 44**, and the median was 44.
- The **female CEO** age ranged from 18 to 71, the **average was 43**, the median was 43.
- The male CEO age ranged from 18 to 74, the **average was 44**, the median was 44.
- The **median ROI was 4.7X for females, 5.4X for males**.

The Effect of CEO Age and Gender on ROI.

As shown in Figure 3 the slopes of the "least squares" regression lines through the data for both female and male CEOs are **nearly identical.** The impact of age on the Value Added Ratio (defined in Methods) of a CEO (not focusing on specific industries) is **negligible regardless of the gender** of the CEO.

Figure 3 - Gender and Age vs. Value Added Ratio for All CEOs
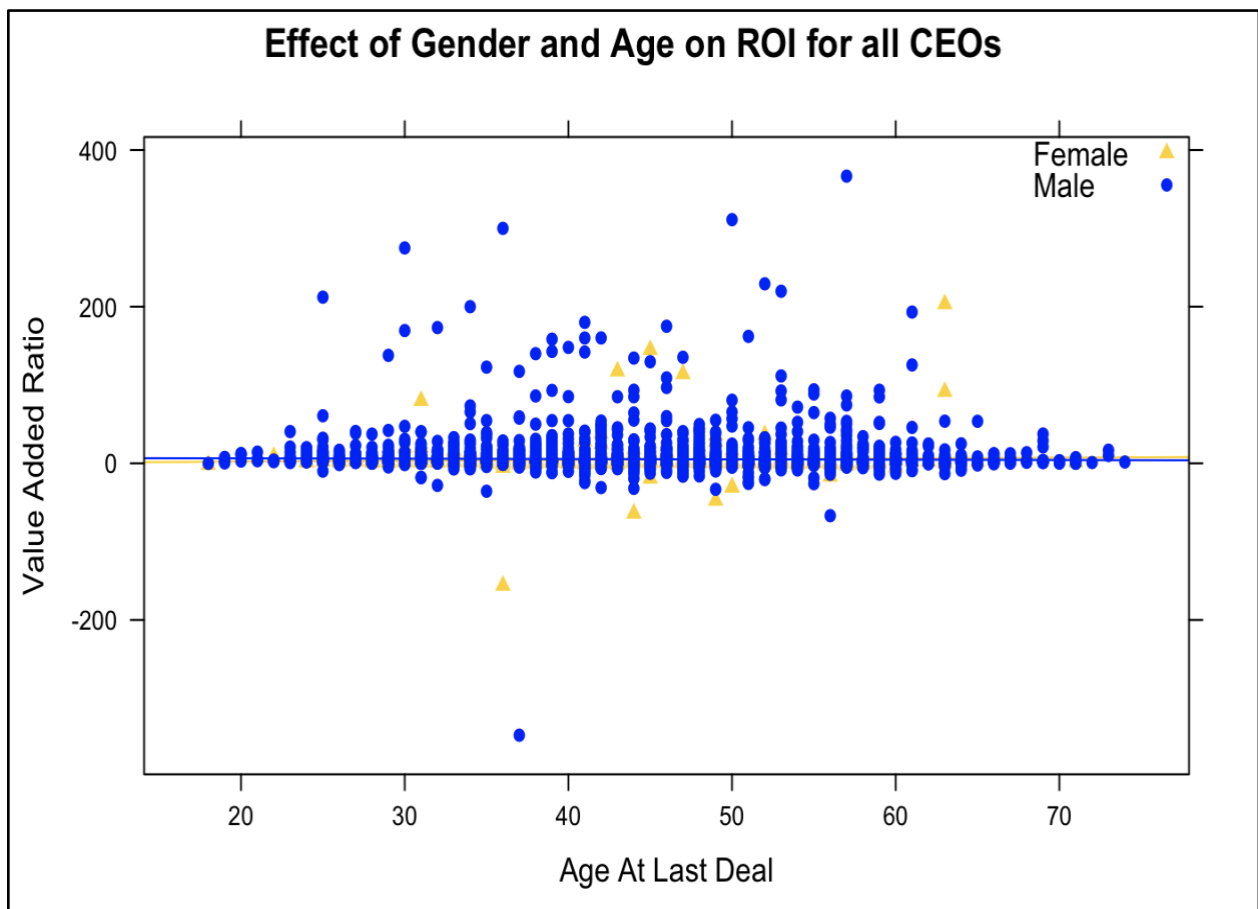
For companies in the dataset, the return on investment **differed across industry sectors** as shown in Figures 4A and 4B. The Biomedicine industry sector data are taken from the industry sector of the same name in Pitchbook nomenclature. The Software industry sector data are taken from the industry sector of the same name in Pitchbook nomenclature. As shown in Figure 4A, the ROI to investors in the Biomedicine sector is lower than the ROI in the Software sector.

Figure 4A - ROI by Industry Sector: Biomedicine, Software, and All Startups

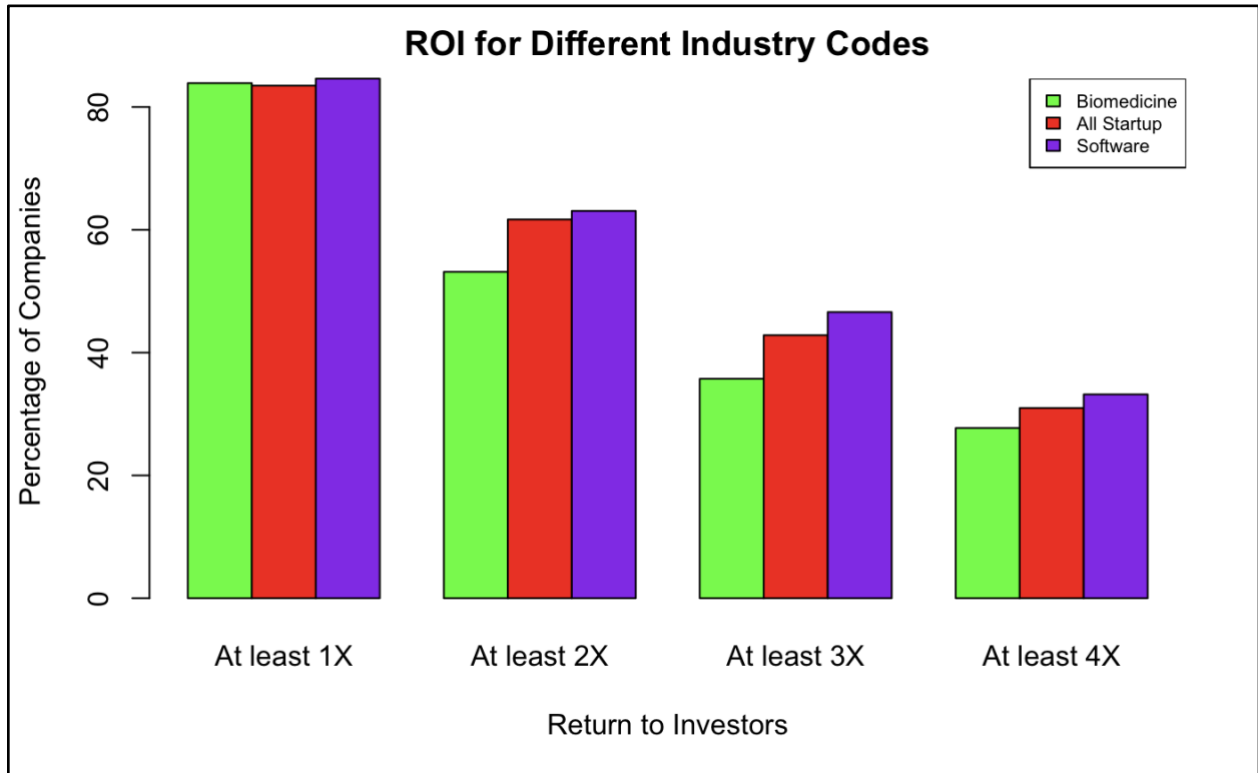Parsing the Biomedicine sector further, we defined Biotechnology as a subset of the Biomedicine industry sector codes. PitchBook codes included in the biomedicine sector definition include: Surgical Devices, Monitoring Equipment, Other Healthcare Services, Other Healthcare Technology Systems, Diagnostic Equipment, Other Devices and Supplies, Therapeutic Devices, Biotechnology, Drug Discovery, Enterprise Systems (Healthcare), Pharmaceuticals, Laboratory Services (Healthcare), Other Pharmaceuticals and Biotechnology, Discovery Tools (Healthcare), and Drug Delivery.

Application Software is a subset of the Software industry sector and has a defined sector code in Pitchbook nomenclature. As shown in Figure 4B, the ROI to investors from companies in the Biotechnology sector is lower than the ROI to investors from companies in the Application Software sector.

Figure 4B - ROI by Industry: Biotechnology, Application Software, and All Startups
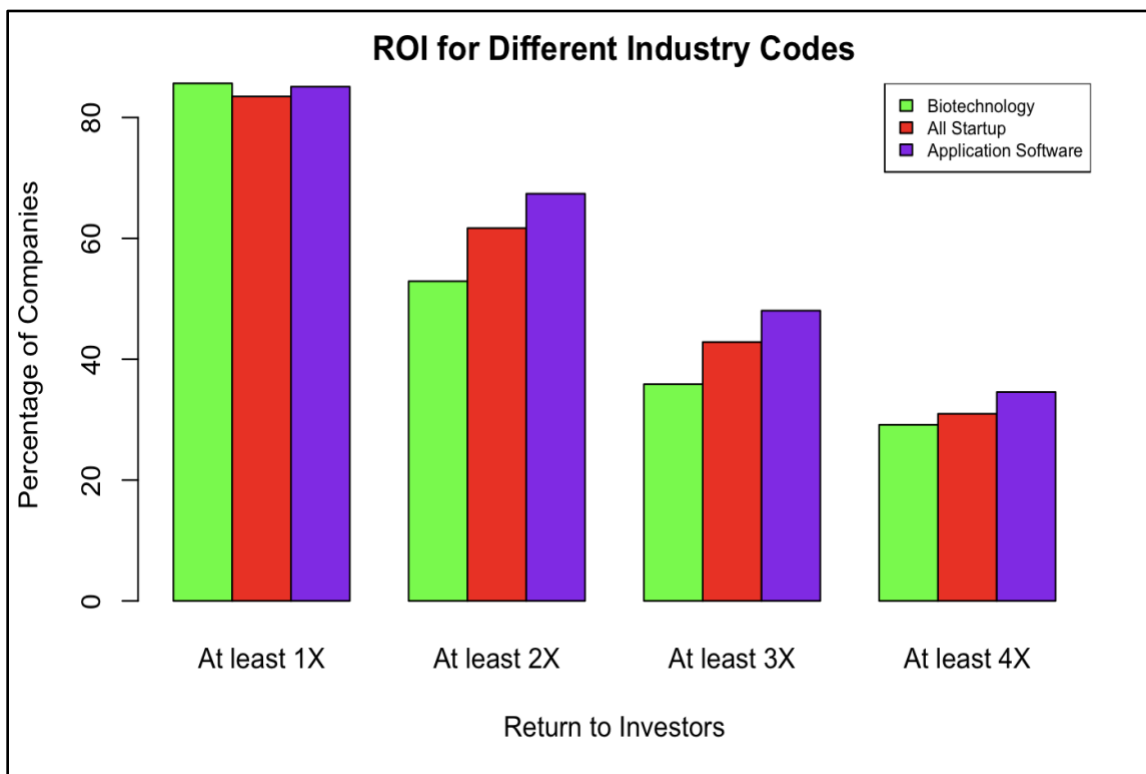
Of the companies that **exited in all fields**, the return to investors ranges from 0.0002X to 417X. **Mean = 5.9** and SD = 17.9.
Of the CEOs invested in, across all fields, the return to investors ranges from -347X to 400X. Mean = 5.3, SD = 17.9.

Returns for companies in the dataset differed according to technology field, as follows:
- **42.3% of all exited startups are in the Software industry.**
  - The return to investors for startups in the software industry ranges from 0.0003X to 417X. Mean = 5.9, SD = 18.1
  - Of the CEOs in the software industry, the return to investors ranges from -332X to 400. Mean = 5.3, SD = 17.8.
- **15.7% of all exited companies are in the Biomedicine industry.**
  - The return to investors for startups in the biomedicine industry ranges from 0.0002X to 342X. Mean = 6.1, SD = 19.1.
  - Of the biomedicine CEOs invested in, the return to investors ranges from -326X to 367X. Mean = 5.7, SD = 20.9.
- **10.9% of all exited startups are coded as being in the Application Software industry.**

- The return to investors for startups with application software industry code ranges from 0.012X to 417X. Mean = 6.1, SD = 19.7
- Of the application software CEOs invested in, the return to investors ranges from -47X to 275X. Mean = 5.5, SD = 15.9.
- The average age of an application software CEO at exit is 41. The median is 40.
- 5.8% of exited application software startups had a female CEO at the first round of financing.
- The average age of such female CEOs at exit was 39. The median age was 38.
- **2% of all exited companies are coded as being in the Biotechnology Industry** according to selected classifications in the PitchBook database.[12]
  - The return to investors for startups with the biotechnology industry code ranges from 0.01X to 311X. Mean = 8.9, SD = 31.9.
  - Of the biotechnology CEOs invested in, the return to investors ranges from -326X to 311X. Mean = 6.4. SD = 33.7.
  - The average age of a Biotechnology CEO at exit is 48. The median is 48.
  - 8.9% of the exited Biotechnology startups had a female CEO at the first round of financing.
  - The average age of such female CEOs is 48. The median age is 46.

The company with the largest ROI in the entire data set returned 417X to the investors.
The company with the largest ROI in the Biotech data set returned 54X to the investors.
The company with the largest ROI in the Application Software data set returned 58X to the investors.

59.5% of all exited company CEOs returned a Value-Added Ratio of 1X to 5X.

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[12] The Biotechnology designation used in this study is a subset of the broader BioMedical field as that term is defined in the PitchBook database. The Biotechnology industry classification in this study includes the following sectors from the PitchBook database: Surgical Devices, Monitoring Equipment, Other Healthcare Services, Other Healthcare Technology Systems, Diagnostic Equipment, Other Devices and Supplies, Therapeutic Devices, Biotechnology, Drug Discovery, Enterprise Systems (Healthcare), Pharmaceuticals, Laboratory Services (Healthcare), Other Pharmaceuticals and Biotechnology, Discovery Tools (Healthcare), Drug Delivery

As shown in Figure 5, the effect of CEO Age on the Value-Added Ratio is not as pronounced in the broader Biomedicine sector as it is in the Biotechnology sector.

Figure 5 - Gender and Age vs. Value Added Ratio for Biomedicine CEOs
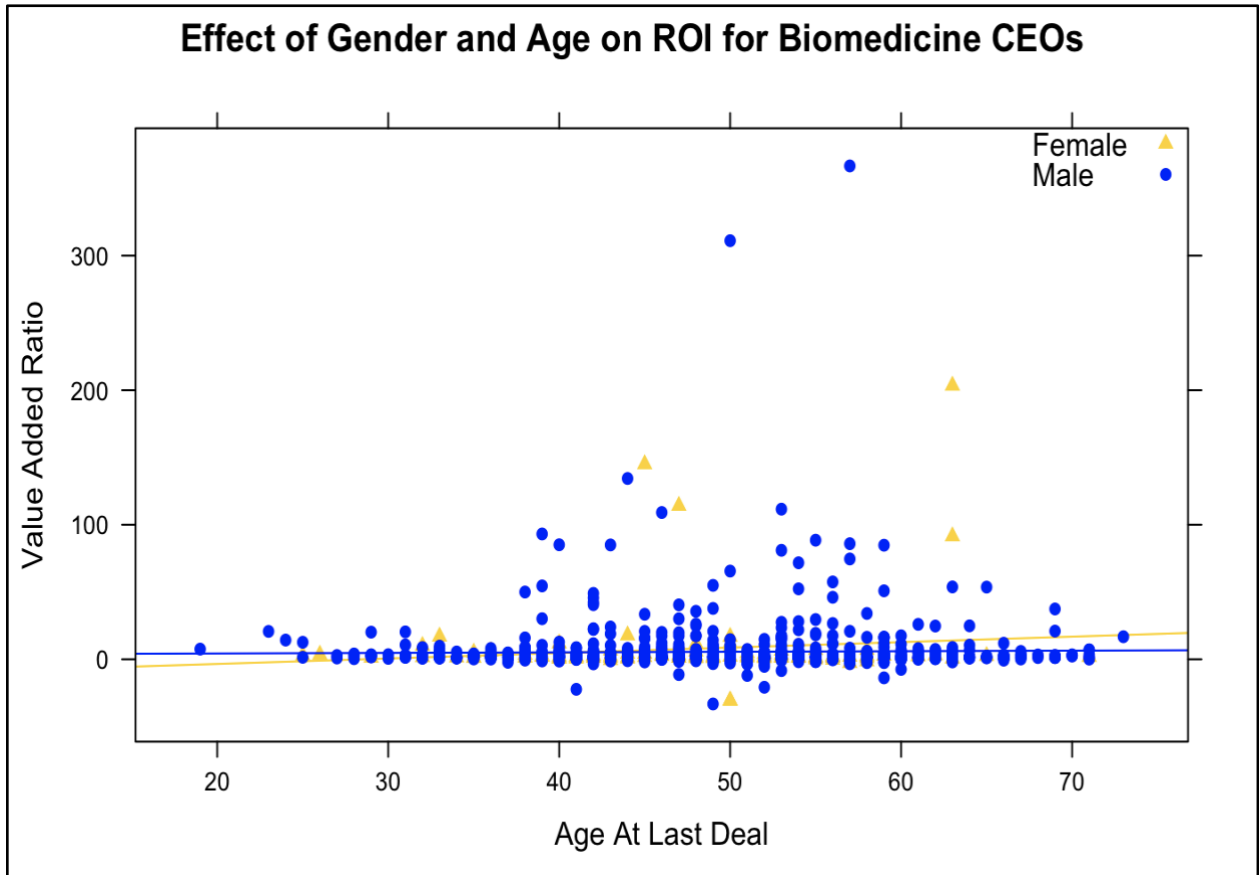
As shown in Figure 6, the slopes of the least squares line through the data for males and females in the software industry are nearly identical.

Figure 6 - Gender and Age vs. Value Added Ratio for Software CEOs
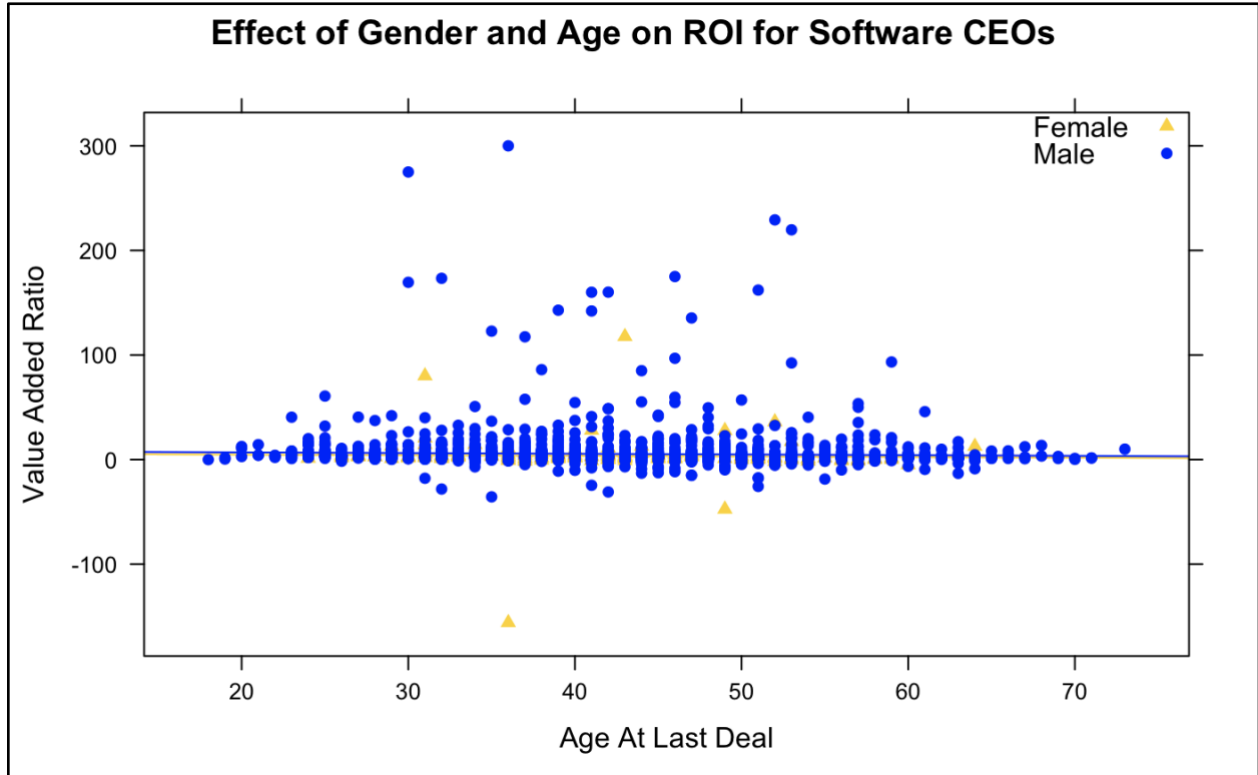
Geographical differences:

30.2% of exited startups are in the San Francisco Bay (see Appendix I for a list of cities).
- Of these, 5.6% had a female CEO at the first qualified round of financing.

9.6% of exited startups are in the greater Boston area (see Appendix I).
- Of these, 5.3% had a female CEO at the first qualified round of financing.

Cognitive Bias and Decision Making

Kahneman & Tversky (1972) introduced the concept of the representativeness bias whereby two things that are similar on one dimension are perceived to be correlated on other dimensions (this bias is discussed further by Bazerman & Moore, 2008 and Ball & LiPuma, 2012). The successful investor John Doerr famously said in 2008 that his ideal entrepreneur is a white male nerd who has recently dropped out of Harvard or Stanford. This description nearly fits several successful and famous entrepreneurs including Bill Gates, Steve Jobs, and Larry Ellison. Another well-known and successful investor, Vinod Khosla , said in 2012 that "people over 45 basically die in terms of new ideas." These are typical views in the venture community. Do these views represent representativeness bias? If this population of young white males is who gets funded, and future successes come from the same demographic, then the bias becomes self-perpetuating. In fact, then those that fit the demographic description can become part of "pattern recognition" which is described by some investors as a personal virtue.

More broadly, Paul Graham (2013) points out the time constraints of VCs, who make decisions very quickly in rejecting most entrepreneurs so they can allocate time to helping the small percentage they fund. In this environment, cognitive shortcuts become a necessity.

Kahneman (2012) also shows that in most domains, particularly those with a long feedback loop including venture investing, confidence increases faster than skill, and experts are often the most prone to error (he and Gary Klein establish in 2009 that this dynamic happens less frequently in domains with shorter feedback loops, like medicine, sports, firefighting, and piloting airliners). Jones (2010) showed that the average age of greatest academic innovation is 39. Azoulay-Jones-Kim-Miranda (2018) find that the average age of a successful startup founder is 45.

Existing research on age and gender in fundraising

There have been several relevant studies on the role of both gender and age in fundraising.

On the subject of gender inequality, before entrepreneurs even approach venture investors, women are half as likely to become entrepreneurs in the first place (Kauffman Foundation, 2016). Women own 36% of small businesses overall (Raina, 2016). Among the set of entrepreneurs who seek and successfully obtain investor capital, only 9% are women (Raina, 2016). Marom, Robb, & Sade (2014) found that, in crowdfunding, men seek higher levels of capital than women, but women enjoy a higher rate of success in funding their projects. Pitchbook All Raise (2019) finds that teams with at least one female founder exit six months faster than all-male teams.

Dow Jones ("Women at the Wheel", June 2015) demonstrated that male and female entrepreneurs are asked different questions by investors: men are asked more about achieving the upside projections and women are asked more about guarding against downside. Interestingly, these results do not depend on investor gender; that is, *increasing the proportion of female VCs does not address the tendency of investors to inquire about, and invest, in projects described as having a high upside.*

It may be that investors of both genders reward exaggeration, and that men on average exaggerate more. This is addressed by Mauria Finley (Venturebeat, 7/14/2013), who concludes that "VCs don't have a bias against women entrepreneurs; we [women] are just bad at pitching." Mollick & Kuppuswamy (2019) finds that men are less likely to stop after a failure and concludes that "overconfidence is the biggest psychological predictor of whether or not you're going to become an entrepreneur" and that women are less likely to be overconfident.

As of 2019, only 12% of venture capital decision makers in the US were women. A higher percentage of women among the investor ranks, may not help with the types of questions asked of women entrepreneurs, but should help in other ways. First, women venture investors provide better coaching of female entrepreneurs (Stout-Dasgupta-Hunsinger-McManus, 2011). Raina (2016) finds that women entrepreneurs have a lower chance of exit with investment from an all-male venture firm than from one with at least one female partner. Female VC partners lead more early rounds in female founding teams than male partners (West & Sundarmurthy, Kauffman Fellows Program, 2019).

Second, Vivek Wadhwa and Lesa Mitchell at Kauffman ("Women in Technology," 2013) conduct an online survey of 500 women in technology, and find that women-led tech companies are more capital efficient, achieve a higher return on investment, and bring in more revenue.

In terms of age, Wadhwa (2012) finds that the median age of founders of successful technology businesses is 39. The Kauffman Foundation (2013) finds that the average age of US entrepreneurs is rising with the highest move to the 55-64 age group.
In terms of interaction of gender and age, the Kauffman Foundation finds that, while the age of male entrepreneurs has moved up, the age of female entrepreneurs has moved down from 41 to 32. This report finds that 70% of venture capital in its sample goes to entrepreneurs under 30 and 92% to men. Neumark, Burn, & Button (2017) find that age discrimination is demonstrably more significant for women than for men.

In terms of team composition, Scott Page (2008) establishes that more diverse teams are more productive on average. Tom Malone (2014) concludes that collective intelligence rises with the percentage of women on a team.

Methodology

Using PitchBook, we identified the 14,397 venture-backed startups that have gone public or were acquired since 2000. Parameters from PitchBook:
CompanyID, CompanyName, IndustryCode,DealNo, DealID, DealDate, DealSize,DealType, DealType2, PreMoneyValuation, PostValuation, VCRound, CEOAtTimeOfDeal, CEOPBId, CEOGender, CEOEducation.

How we calculated Value Added

For the company approach, total Investment = sum of all deals.
For the CEO approach, total investment = sum of deals for each CEO's tenure.
1. For the company approach:
      a. ValueAdded = Last numeric PostValuation/Total Investment.
2. For the first or only CEO of a company:
      a. Value Added = Last numeric PostValuation/Total Investment.
3. For each different CEO's after the first if any:
      a. Value Added = (Last numeric PostValuation of current CEO - last numeric PostValuation of previous CEO) /Total Investment.

Determine the age of each CEO at each round.

1. Approach 1: From the CEO's Education provided by PitchBook, we looked at the college graduation dates of the founders. We prioritized based on the founder's associate's degree or bachelor's degree graduation date. We added 20 to the graduation date of obtaining an associate's degree and 22 to the graduation date of obtaining a bachelor's degree. If a master's or PhD graduation date was given and the former was not, we added 25 and 28, respectively, to the graduation date.
2. There were graduation dates missing from the education field for some CEOs. For these missing ages, we searched the internet using a founder's first name, last name and their company, and went through their LinkedIn, various news articles, SEC documents and websites like MarketScreener to find their official age. If their official age was not explicitly listed online, we made a prediction based on their graduation date and their earliest work experience on LinkedIn.

Determine the gender of each CEO at each round.
1. PitchBook provided genders for most CEOs (column title: CEOGender).
2. For the few CEOs with missing genders, we manually searched for publicly-available online information about each individual and categorized genders based on the pronouns used in these articles. All of these CEOs identified as either male or female, so we kept our analyses to male and female.

Steps common to both the CEO_ROI approach and the Company_ROI approach.

Create the RODPs column (Ratio of Deals Present — Deals with DealSize for each company).
Exclude Grants, Debt — General & Debt Refinancing.

Mark up to two IPOs before the last one. First one is marked IPO* & second one is marked IPO**.
Mark up to two Merger/Acquisition before the last one.
Mark up to two Buyout/LBO before the last one.
Mark IPOs Within Six Month of Merger with the acronym IPOWSMOM.
Exclude deals that occur after the exit: IPOs, Merger/Acquisition, and Buyout/LBO.
Exclude deals without DealSize.

For the CEO_ROI approach:

Replace some missing CEOAtTimeOfDeal with the highest ranked exec (based on position title) in the CompanyExecRelation file.
TotalInvestment for each CEO = Sum of all DealSizes until CEOAtDeal changes.
DealSizes for Merger/Acquisition & Buyout/LBO are excluded from the TotalInvestment.
For the first CEO of a company:
ValueAdded = Last numeric PostValuation/TotalInvestment.
For a different CEO after the first if any:
ValueAdded = (Last numeric PostValuation of current CEO - Last numeric PostValuation of previous CEO)/TotalInvestment of current CEO

Note: The CEOAtTimeOfDeal is used as the base for the CEO_ROI approach. When possible, missing CEOAtTimeOfDeal is replaced with the highest ranked exec present for that deal.

Assumptions used to fill 6.3% of the missing CEOAtTimeOfDeal:

If there is no DealDate, and there is a CEOAtTimeOfDeal, then DealDate = PositionSince of the CEOatTimeofDeal.
If there is no PositionSince, then assume staff has been present since DealNo 1.
If there is no PositionTo, then assume that PositionTo is 6/18/19 (Last Updated).
If PositionSince and PositionTo are missing, then assume that staff is present for the deals.
If DealDate for DealNo1 is missing, then assume that members of the founding team are present.

For the Company_ROI approach:

TotalInvestment for each company = Sum of all the DealSizes for each company.
DealSizes for Merger/Acquisition & Buyout/LBO are excluded from the TotalInvestment.
ValueAdded = Last numeric PostValuation/TotalInvestment.
Companies without ValueAddedRatio are excluded.

Note: ValueAdded, ROI, and ValueAddedRatio will be used interchangeably. The same for CEOAtDeal and CEOAtTimeOfDeal, as well as age and AgeAtDeal. Also, in all the plots below, outliers are considered as ValueAdded greater than 3 standard deviations (SD) + mean or less than mean - 3 standard deviations.

Mean ValueAdded for different Industry Codes

Do startups with female CEOs have a higher ROI than startups with male CEOs?

For the entire deal dataset after following the steps on the previous page:
Number of companies: 8,562
Mean ValueAdded (both genders combined) = 5.3. SD ValueAdded = 17.9.
Mean ValueAdded by males = 5.4. Mean ValueAdded by females = 4.6.

Do biomedicine startups with female CEOs have a higher ROI than those with male CEOs?

For biomedicine startups:
Number of companies: 1,599
Mean ValueAdded (both genders combined) = 5.7. SD ValueAdded = 20.9.
Mean ValueAdded by females = 7.6. Mean ValueAdded by males = 5.4.

Note: Startups with the following industry codes are considered as biomedicine: Surgical Devices, Monitoring Equipment, Other Healthcare Services, Other Healthcare Technology Systems, Diagnostic Equipment, Other Devices and Supplies, Therapeutic Devices, Biotechnology, Drug Discovery, Enterprise Systems (Healthcare), Pharmaceuticals, Laboratory Services (Healthcare), Other Pharmaceuticals and Biotechnology, Discovery Tools (Healthcare), Drug Delivery

Do biotechnology startups with female CEOs have a higher ROI than those with male CEOs?

For biotechnology startups:
Number of companies: 219
Mean ValueAdded (both genders combined) = 6.4. SD ValueAdded = 33.7.
Mean ValueAdded by females = 11.9. Mean ValueAdded by males = 5.9.

Do software startups with female CEOs have a higher ROI than those with male CEOs?

For software startups:
Number of companies: 3,650
Mean ValueAdded (both genders combined) = 5.3. SD ValueAdded = 20.9.
Mean ValueAdded by females = 3.9. Mean ValueAdded by males = 5.4.

Note: Startups with the following industry codes are considered as software: Educational Software, Social/Platform Software, Application Software, Other Software, Business/Productivity Software, Network Management Software, Software Development Applications, Database Software, Entertainment Software, Vertical Market Software, Automation/Workflow Software, Financial Software, Internet Software, Communication Software, Multimedia and Design Software, Operating Systems Software

Do Application Software startups with female CEOs have a higher ROI than those with male CEOs?

For application software startups:
Number of companies: 906
Mean ValueAdded (both genders combined) = 5.49. SD ValueAddedRatio = 15.93
Mean ValueAdded by females = 4.38. Mean ValueAdded by males = 5.56

What happens when the manually searched ages are excluded?

For startups with the biotechnology industry code, when the gender of the CEO is not taken into consideration and manually searched ages are excluded, the slope = 0.32 . When manually searched ages are included, the slope = 0.27.
For biotechnology startups with female CEOs, when manually searched ages are excluded, the slope = 3.2. When manually searched ages are included, the slope = 1.7.
For biotechnology startups with male CEOs, when manually searched ages are excluded, the slope = 0.12 . When manually searched ages are included, the slope = 0.18.
For startups with application industry code, when manually searched ages are excluded and when the gender of the CEO is not taken into consideration, the slope = -0.03. When manually searched ages are included, the slope = -0.05.
For application software startups with female CEOs, with manually searched ages excluded, the slope = -0.44. With manually searched ages included, the slope = -0.35
For application software startups with male CEOs, with manually searched excluded, slope = -0.008. With manually searched ages included, the slope = -0.04.
For startups with the application software industry code, we can see that the slopes are not too far from each other with or without manually searched ages included.

Conclusion: The direction of the slope does not change with or without manually searched ages. However, the magnitude of the slope might differ slightly.

Histogram of the ValueAdded (Company_ROI approach).

Total number of companies: 8,700. *Range = 0.00018X to 417X.*
16.8% of the companies had a valued-added ratio (VAR) of 1X or less, 21.7% had a VAR between 1X and 2X, 18.9% a VAR between 2X and 3X. 11.8% had a VAR between 3X and 4X. 7.1% had a VAR between 4X and 5X.
76.3% of the companies had a VAR of 5X or less.

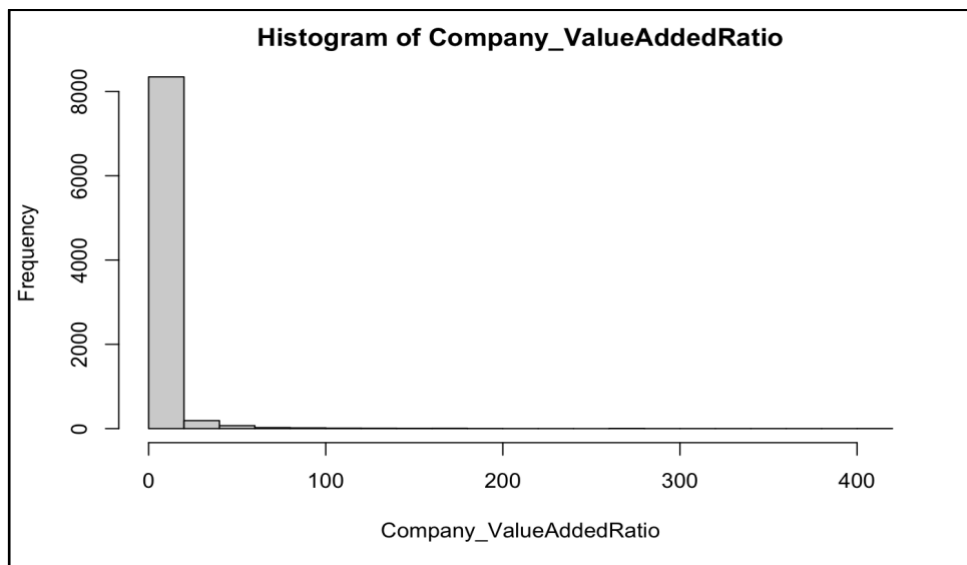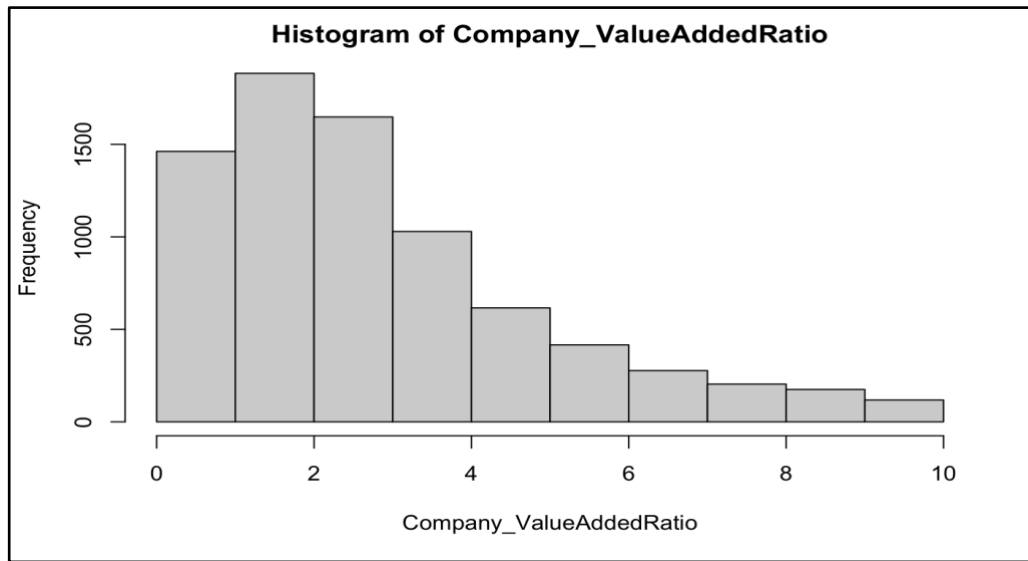**Figure 9A - Distribution of Company Value Added Ratios**

Figure 9B - Distribution of Company Value Added Ratios - Reduced Scale

Histogram of Company_ValueAddedRatio

Histogram of ValueAdded (CEO_ROI approach).

Total number of non-consecutive CEOs: 11,243
Range = -347X to 400X
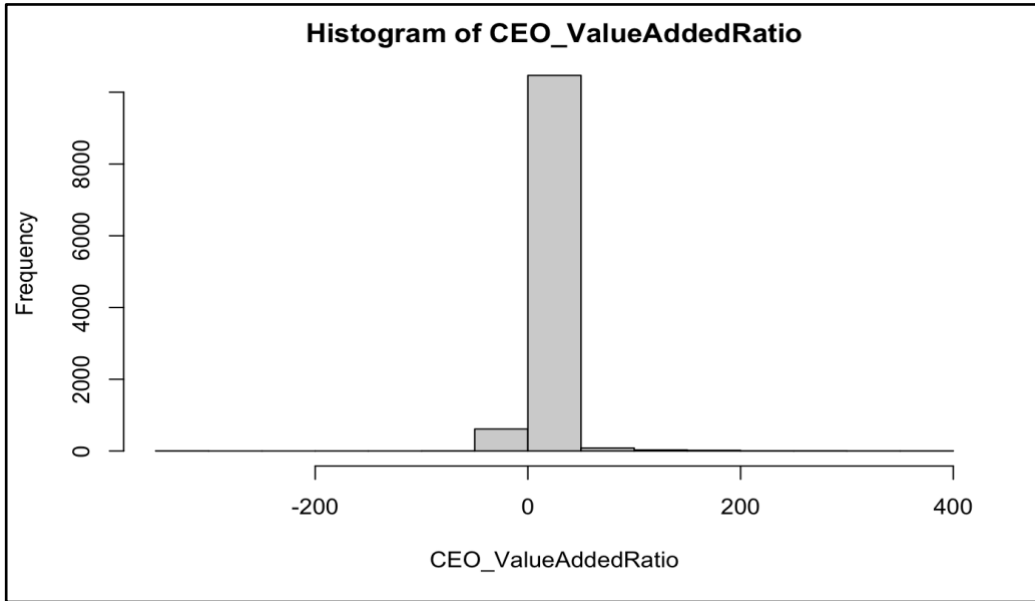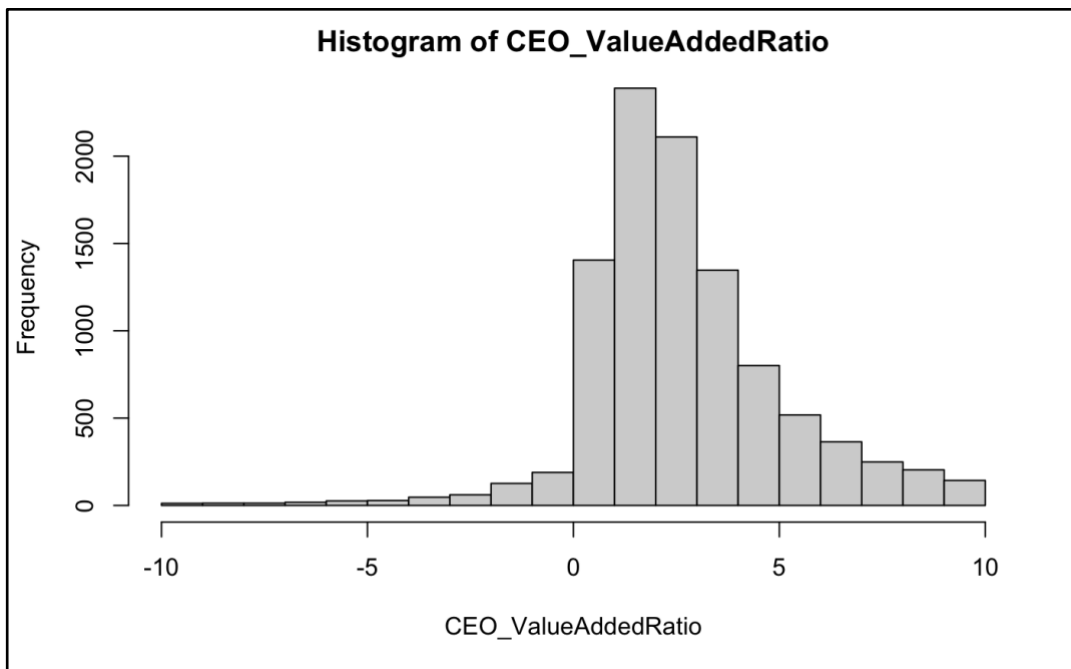
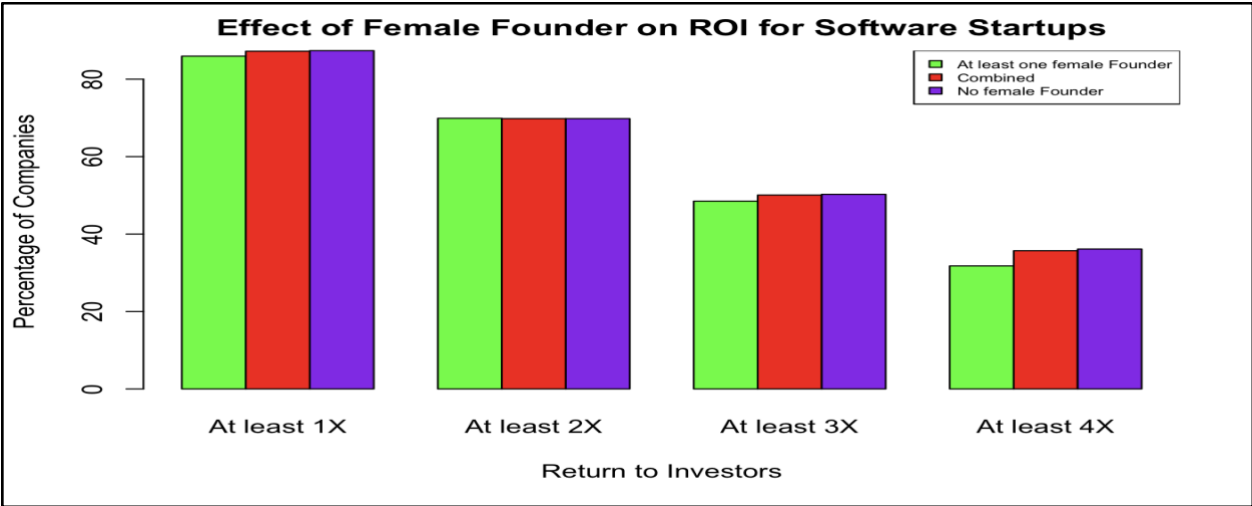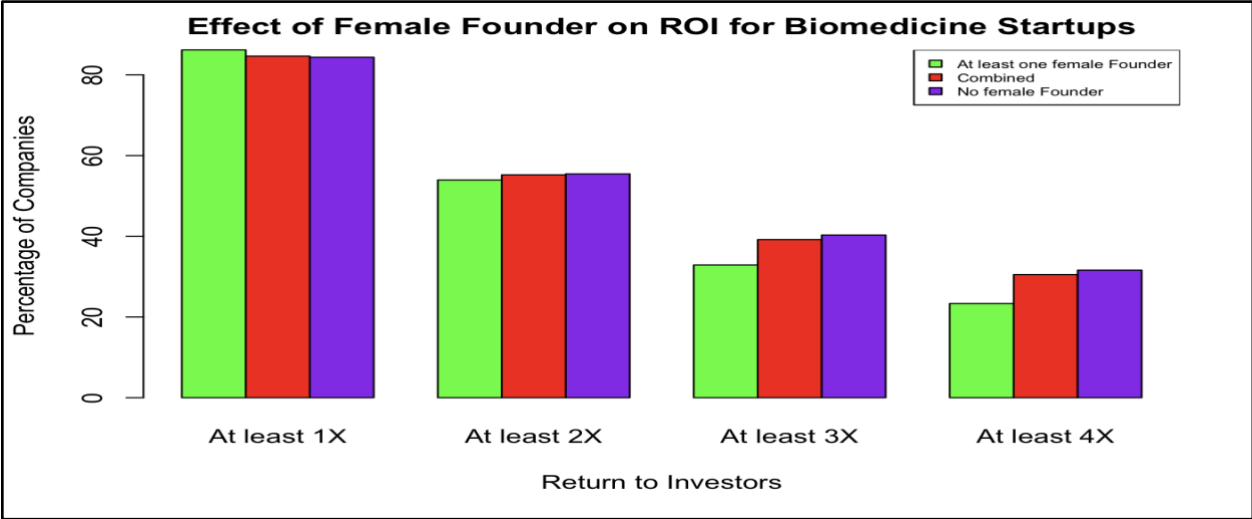**Figure 10A - Distribution of CEO Value Added Ratios**

Figure 10B - Distribution of CEO Value Added Ratios - Reduced Scale

Effect of Female Founder on ROI for All Startups

Effect of Female Founder on ROI for Biomedicine Startups

Effect of Female Founder on ROI for Software Startups

Effect of Female Chief on ROI

Effect of Female Chief on ROI for Biomedicine Startups

Effect of Female Chief on ROI for Software Startups

Effect of Gender and Age on ROI for All CEOs

Effect of Gender and Age on ROI for Biomedicine CEOs

Effect of Gender and Age on ROI for Software CEOs

Topics for future study in collaboration with others

Are the results different in the rest of the US vs. the Bay Area? In the rest of the world vs. the U.S.?
In which regions of the world is the correlation between having at least one female founder and ROI the most pronounced?

How do the timelines to exit differ in different fields and within each field, what are the trends in terms of time to exit and the presence of at least one female founder and by geographical region?

The available data do not enable us to easily impute an ROI of EACH round of financing and the gender of founders at each round. What is the composition of female founders, and their ages, at each round of financing? Do startups with at least one female founder raise more or less than all-male founders at each round of financing?

What percentage of those had at least one female founder?

What percentage of ALL startups in just the Bay Area over 20 years exited? Same analysis for other geographies.
        -What percentage of those had at least one female founder and what was the effect on ROI?

Trend analysis – for each team that originally had a female founder but had no females in the C-suite or with the title of "Chief" in the title, when in the timeline of the startup was the last such female displaced/jettisoned?

Determine the correlation between the URM vs. non-URM status of each founder (using National Science Foundation definition) and the team's success in returning an ROI.
How do teams with at least one URM founder compare to those without a URM founder?

Pipeline of STEM training from scientists and engineers to inventors to entrepreneurs: Females obtain nearly 50% of STEM graduate degrees, x% of inventors, y% of founders and z% of funded founders. What are the primary reasons for attrition through this pipeline?

What percentage of ALL startups in the US over 20 years exited? What percentage of those had at least one female founder and what was the effect on ROI? Same questions for Rest of World. This study is part of a broader analysis of the factors that affect the ROI on VC investments. We have defined a methodology by which we have produced certain data shown in the table below, designated as "Phase I deliverables." In future studies, we'll expand the variables.

	Gender	Age	URM	Only Berkeley	Only Bay Area
ROI achieved by CEO during his or her tenure	Phase I deliverables	Phase I deliverables			
Board Member					
Biomed Field					
ICT/Phys Sci					

Anticipated Impacts of this Research

Female entrepreneurs face biases when attempting to raise venture capital funds.
We expect our results to influence venture capital investment trends.
If bias is found to be irrational, and
- No one else acts: Then we have an arbitrageable market inefficiency
- Others emulate: Lasting change, better use of human capital across whole economies
- Either way, a win**.**

Acknowledgements

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Appendix I

List of cities and towns in the San Francisco Bay area:

Alameda, Albany, AmericanCanyon, Antioch, Atherton, Belmont, Belvedere, Beniciam, Berkeley , Brentwood,Brisbane, Burlingame, Calistoga, Campbell, Clayton, Cloverdale, Colma, Concord, Corte, Madera, ,Cotati,Cupertino,Daly City,Danville,Dixon,Dublin,East Palo Alto,ElCerrito,Emeryville,Fairfax,Fairfield†,Foster City,Fremont,Gilroy,Half Moon Bay,Hayward,Healdsburg,Hercules,Hillsborough,Lafayette,Larkspur,Livermore,Los Altos,Los Altos Hills,Los Gatos,Martinez†,Menlo Park,Mill Valley,Millbrae,Milpitas,Monte Sereno, Moraga,Morgan Hill,Mountain View,Napa ,Newark,Novato,Oakland,Oakley, Orinda, Pacifica,Palo Alto,Petaluma,Piedmont,Pinole,Pittsburg,Pleasant Hill,Pleasanton,Portola Valley, Redwood City,Richmond,Rio Vista,Rohnert Park,Ross,St. Helena,San Anselmo,San Bruno,San Carlos, San Francisco,San Jose†,San Leandro,San Mateo,San Pablo,San Rafael†,San Ramon, Santa Clara,Santa Rosa†,Saratoga,Sausalito,Sebastopol,Sonoma,South San Francisco,Suisun City,Sunnyvale,Tiburon,Union City,Vacaville,Vallejo,Walnut Creek,Windsor,Woodside and Yountville.

List of Cities and towns in the Greater Boston area:

Andover,Arlington,Attleboro Auburn, Avon,Ayer, Barnstable,Barre,Bedford,Bellingham, Belmont,Beverly,Billerica,Blackstone,Boston, Boylston, Braintree, Bridgewater, Brockton,Brookfield,Brookline, Burlington,Cambridge,Canton,Chelsea,Dedham, Dighton,Duxbury,East Brookfield,Easton, Edgartown,Everett,Fall River,Fitchburg, Foxborough,Framingham, Franklin,Gardner,Grafton, Haverhill,Hingham, Holbrook,Holden, Hopedale,Hopkinton,Ipswich, Kingston,Lancaster,Lawrence,Leicester,Leominster,Lexington, Lowell,Lynn,Lynnfield,Malden,Mansfield,Medfield, Medford, Medway,Melrose, Mendon,Methuen,Milford,Millbury, Millis,Millville,Milton,Nahant,Nantucket,Natick,Needham, New Bedford,New Braintree,Newton,Northborough, Northbridge,North Andover, North Reading,Norwood, Peabody,Pembroke,Petersham,Plymouth, Provincetown, Quincy,Randolph, Raynham,Reading,Rehoboth,Revere, Salem,Saugus,Scituate, Seekonk,Sharon,Shirley, Shrewsbury,Somerset,Somerville,Stoneham,Stoughton,Southborough,Southbridge, Spencer, Swampscott,Swansea,Taunton,Tewksbury, Townsend,Tyngsborough,Upton,Uxbridge,Wakefield, Walpole,Waltham,Watertown,Wayland, Webster,Wellesley,'Brookfield, West Tisbury, Westborough, Weston,Weymouth, Wilmington,Winchester, Winthrop,Woburn and Worcester

Additional Information:

Of the 14,397 startups that exited via IPO or acquisition: 12.1% had at least one female founder.[13] 6.8% had a female CEO at exit. 7.9% of the female founder(s) were the CEO at exit. 10% of the male founders were the CEO at exit.

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[13] From PitchBook data based on the Company Executive Relation file and titles of employees.