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ABSTRACT

We use individual-level data to shed light on the evolution of founder-CEO compensation in venture capital-backed startups. We document that having a tangible, marketable product is a fundamental milestone in CEOs' compensation contracts, marking the point at which liquid cash compensation begins to increase significantly — well before a liquidity event. “Product market fit” also coincides with key human capital in the startup becoming more replaceable, marking an apparent transition in the firm's lifecycle from ‘differentiation’ to ‘standardization’. Although substantial increases in cash compensation for founder-CEOs in response to milestones improves the certainty equivalent of attempting entrepreneurship relative to flat pay, low cash compensation in the very early years can still deter entrepreneurship for potential entrants. We characterize the types of individuals most likely to be impacted by this constraint and hence those whose ideas are unlikely to be commercialized through VC-backed entrepreneurship.

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1 Introduction

Venture capital (VC)-backed firms play a disproportionately important role in the economy in terms of innovation, job creation, and productivity growth (Kortum and Lerner 2000; Puri and Zarutskie 2012). However, despite the importance of VC-backed firms and the wealth of information about VC contracts (Hellmann 1998; Kaplan and Strömberg 2003; Ewens, Gorbenko, and Korteweg 2019), we know very little about the *compensation* contracts provided to founder-CEOs in private, venture capital-backed firms.

This gap is important for several, related reasons. First, most of the vast literature on CEO compensation is based on publicly-traded firms, where liquidity is abundant and compensation is often tied to measures of market performance. For private firms, cash compensation is often the only available form of intermediate liquidity, yet little is known about the level or the evolution of this important contractual element over the lifecycle of private firms. Since nearly half of publicly-traded firms were backed by VCs prior to going public (Ritter 2019), studying CEO compensation in VC-backed firms also provides a unique opportunity to systematically examine the evolution of CEO compensation across the firm's lifecycle for a large subset of firms that eventually go public.

Second, a question of particular interest pertains to when in the firm's life-cycle professionalized CEO contracts emerge. Theory suggests that venture capital contracts *have* to leave founders bearing substantial non-diversifiable risk at the birth of firms. This is because VCs need to screen entrepreneurs and hence back-load compensation through illiquid equity holdings. However, the value of screening or incentive alignment is likely to change as the firm matures. For example, Rajan (2012) models the lifecycle of startups, in which venture capital investors first seek differentiated ideas, and then proceed to standardize the firm. This process gradually reduces the dependence on soft assets like founder human capital. Although empirical research has documented the role of VCs in "professionalizing" firms along these lines (e.g., Hellmann and Puri (2002)), relatively

little is known about the compensation contract between entrepreneurs and investors, and its evolution over the lifecycle of the firm. Indeed, understanding the evolution of CEO contracts can also reveal when in the firm's life they transition, in Rajan's (2012) language, from *differentiation* to *standardization*.

Third, and related, since entrepreneurs are intricately tied to the ideas they commercialize at the birth of new ventures, the compensation contract they face, and the related risk they need to bear, are critically important for determining which ideas are brought to market (Knight 1921). Hall and Woodward (2010) highlight the extremely skewed distribution of outcomes among venture capital backed firms and discuss the risk-tolerance necessary to enter entrepreneurship.[1] A critical component of the risk borne by entrepreneurs is the amount of time between starting a firm and an entrepreneur's ability to access a liquid source of cash, either through salary, bonus compensation, or realized capital gains. The longer the delay until they can access liquid cash, the greater is their "burden of non-diversifiable risk." Understanding the level and evolution of founder-CEO compensation helps document the types people for whom the burden of non-diversifiable risk is likely to be greatest, and hence the sources of ideas that are most and least likely to be commercialized through VC-backed entrepreneurship.

In this paper, we first explore whether, and if so how, founder-CEO compensation in VC-backed firms responds to a dynamic information environment such as achieving key milestones. The nature of response sheds light on the tools used to incentivize the CEOs of high-growth entrepreneurial firms. To do so, we use unique individual data on executive compensation in venture capital-backed startups to study both the level and evolution of entrepreneurial CEO compensation. We link, at the individual executive-level, their salary, bonus, and equity holdings to firm-level information on financing, revenue, headcount, and product milestones. We also observe whether the executive is a

[1]Conditional on this entry decision, Hellmann and Wasserman (2017) highlight the important role of the founding teams' first split of equity for startup outcomes.

founder or not, and we have rich covariates on the startup firm's industry, location, and age.

We show that founder cash compensation is indeed minimal at the birth of ventures, exactly as predicted by financial contracting theories that emphasize screening in the face of adverse selection. However, development of a tangible, marketable product (colloquially referred to as "product market fit" among entrepreneurs and VC investors) stands out as a critical milestone that drives an apparent transition in the compensation contract between investors and CEOs to one that is more standard in mature firms. In Section 3, we document several facts related to CEO compensation that are consistent with product market fit – as opposed to correlates of unobserved firm or founder quality – being the point at which professional contracts emerge. Our results also point to this milestone being important in the lifecycle of firms, as it coincides with key human capital in the startup becoming more replaceable and marking an apparent transition in the firm's lifecycle from *differentiation* to *standardization*.

Having documented this milestone as a key inflection point in the compensation contracts of CEOs, we turn next to studying how quickly product market fit is achieved, as a means to quantify the attractiveness of the entrepreneurial career path. Most entrepreneurs transition to entrepreneurship from wage employment. In addition to being more risky than wage employment, entrepreneurship also entails starting off with minimal liquid cash compensation (even if paper wealth is large). Individuals' pre-entrepreneurship wages as well as their net wealth therefore play an important role in determining the degree to which they have the need and ability to smooth consumption. This in turn impacts whether they find it financially attractive to select into VC-backed entrepreneurship (Hall and Woodward 2010).

Importantly, however, because cash compensation increases substantially following product market fit, we note that it is not just the initial level of cash compensation, but rather the speed with which milestones are achieved (and hence uncertainty resolved)

that determines the extent of risk facing entrepreneurs (Manso 2016; Dillon and Stanton 2018). For example, within three years since firm birth, 80% of the founder-CEOs in our sample have either exited or have achieved the product-market and operating milestones that signal a transition to a *standardized* contract.

In Section 4, we apply this insight of relatively quick resolution of uncertainty to Hall and Woodward's (2010) analysis of the risk facing entrepreneurs, and use this to understand the types of individuals for whom VC-backed entrepreneurship makes financial sense versus those for whom it does not, given standard levels of risk aversion. Given the level and evolution of CEO compensation we observe in the data, the model suggests that individuals selecting into VC-backed entrepreneurship are likely to either have earned less than $400,000 in their pre-founding job or to have accumulated assets above $500,000 prior to entering entrepreneurship.

In the final part of the paper, we validate the predictions of the model by studying the biographies and work histories of a sub-sample of CEOs drawn at random from the universe of startups in the US. This provides descriptive evidence on what types of jobs precede startup founding and where startup CEOs transition to work after their employment with the firm ends.

Consistent with evidence that founders of high-growth ventures have typically worked for several years prior to entering entrepreneurship (Azoulay et al. 2020), we find that on average, founder-CEOs are 36 years old and have nearly 12 years of pre-founding experience. However, we also find that most founding CEOs of VC-backed startups were in mid-level positions in their firms immediately prior to entry. Those with senior job titles or those among the higher paying jobs in their firms prior to entry are rarely seen in our data, suggesting that these individuals find the opportunity cost too great to make it worthwhile to experiment with entrepreneurship.

Our findings relate to several strands of literature. First, our paper is related to the long literature on principal-agent problems for both CEO compensation and the optimal

contracts between investors and entrepreneurs (Holmstrom and Milgrom 1987; Aghion and Bolton 1992; Edmans, Gabaix, and Jenter 2017). This work has highlighted the importance of contracts that can screen entrepreneurs under asymmetric information. More recently, our work supports analysis in (Edmans et al. 2012), who derive dynamic contracts where past performance is rewarded with intermediate cash liquidity. Our work provides the first evidence from private firms suggesting that the class of contracts that are relevant for the CEOs of publicly traded firms extends back well before firms go public, consistent with Rajan's (2012) model of standardization by VC investors.[2]

Our results also highlight an under-appreciated role played by venture capital investors– that of intermediate liquidity providers – which they might be uniquely positioned to do as hands-on investors who are able to resolve information asymmetry more effectively than passive capital providers. This role of venture capitalists as liquidity providers may also help explain the sectors where VCs are more actively involved in financing innovation.

Finally, our paper is also related to the literature on selection into entrepreneurship. A long literature has documented the role of paid employment as a source of ideas and training for potential entrepreneurs and the conditions leading them to select into entrepreneurship (Bhidé 2003; Gompers, Lerner, and Scharfstein 2005; Babina, Ouimet, and Zarutskie 2017; Kim 2018). While some theoretical work in this realm has examined the financial trade-offs between entrepreneurship and paid employment (Anton and Yao 1995; Hellmann 2007), others have outlined the frictions associated with this entry decision in terms of non-diversifiable risk (Hall and Woodward 2010) and the potential behavioral drivers that might be required to justify the amount of entrepreneurial entry we see in the economy (Åstebro et al. 2014). We show that within Information Technology VC-backed ventures, the relatively short duration of low salary combined with liquid cash compensation thereafter makes the certainty equivalent of VC-backed entrepreneurship

[2]Bengtsson and Hand (2011) use a now-defunct CompensationPro database (run at the time by VentureSource) to show that VC-backed firm CEO compensation responds strongly to fundraising success. The data on compensation does not include equity ownership or options.

positive for a substantial share of potential entrepreneurs, even if they are risk averse.

Nevertheless, our work also points to frictions at the very top end of the human capital distribution, where potential entrepreneurs have sufficiently high outside options that the risk-adjusted return to VC-backed entrepreneurship is negative. It also highlights the greater frictions present in providing entrepreneurs intermediate liquidity in sectors were uncertainty is not revealed as quickly (Ewens, Nanda, and Rhodes-Kropf 2018) or in sectors where founder-CEOs require specialized experience or have higher outside options. The degree to which these individuals' ideas are not commercialized (or commercialized inside incumbent firms) as well as the aggregate impact of this selection remains an interesting area of further work.

2 Data and Summary Statistics

2.1 Description of Data

Our core dataset is based on two cross sections of compensation surveys from Advanced HR (AHR), a leading data provider for VC-backed startups and their investors. AHR collects individual-level compensation data from private startups that have received investments from venture capital investors who participate in the survey. We are aware of no other compensation data for startups that offers similar coverage on the scale that AHR provides. Each survey contains individual-level information on salary, bonus, fully diluted equity, and co-founder status. The individual-level records also contain a number of coarsened, categorical startup-level characteristics, such as revenue, total employment, cumulative venture financing raised, and product-related milestones. To protect confidentiality, our data and the data shared with venture capital investors are anonymous and are not linked by individuals or startups over time.

Startups become eligible for survey inclusion if they have received investment from

the venture-capital investors who cooperate with the survey. Completion of the survey by the startups in their portfolio is strongly encouraged by venture capital investors, who are typically members of the startup's board. Both VCs and startups get access to benchmarking data in exchange for responses. Many venture capital investors, including nearly all of the most prominent and well-known venture capital funds, participate in the survey.

We use data from AHR's 2015 and 2017 survey waves for technology companies (which do not include data on biotech and healthcare startups). The 2015 survey contains data from 933 portfolio companies that received funding from 70 VC investors; the 2017 survey has data on 1,552 portfolio companies associated with 115 venture capital investors.[3] Our core sample focuses on US based CEOs in startups founded after 1996.[4]

2.2 Validation of Survey Data

We validate the data in two ways using data from VentureSource, a data provider that collects records from incorporation filings, which is hence the near universe of VC-backed startups during the years in which the surveys were conducted. In a first exercise to assess any possible response bias among the portfolio companies from the VC firms that participate, we restrict the universe of startups to those that have received any funding from one of the VCs who cooperate with the survey. Table 1 displays this comparison between the AHR data and the eligible VentureSource startups.[5] In the pooled sample, the AHR data covers 58% of the VentureSource firms eligible for survey inclusion, indicating a strong response rate among startups. We also assess whether the AHR sample appears

[3]The increase in the number of portfolio companies arises largely from the increase in investors who participate in the 2017 wave, including earlier-stage seed funds, and corporate venture arms.

[4]We drop 24 startups that are listed as having only growth capital or that have received 6+ rounds of funding. We exclude 38 clean tech investments in 2015 and 35 clean tech investments in 2017. We also exclude startups if we do not know the location of the CEO (eliminating 2 observations).

[5]We focus on firms born within 10 years of a survey year. To avoid so called 'zombie' firms, we drop firms that have not achieved an exit and not raised another round of financing within four years of their last funding event.

to be a representative of the amount of investment and the age distribution. Across the firm age and investment amount distribution, the AHR data appear to match the eligible survey firms well. While the response rate remains high across survey waves, the number of firms in 2017 rises for two reasons. First, there are more startups receiving funding over time (see Table 2). Second, as noted above, a larger number of VC investors participate in the 2017 survey.

Table 2 then compares AHR coverage with the universe of startups in VentureSource in those years - to examine whether the types of firms backed by VCs who participate in the survey are similar to those backed by VCs who do not participate. Here the AHR data covers 25% of all VentureSource firms that are under 10 years old in the survey year. It is evident from Table 2 that the AHR data is tilted somewhat towards firms that have raised more capital than the VentureSource universe. This difference largely comes from the set of VC funds in the survey versus the universe of private investors. For example, survey-participating VC funds in 2017 had a median of $1.4 billion in assets under management whereas non-participating VC funds had a median of $85 million in assets under management. The funds in the survey managed 42% of total industry assets and deployed nearly 49% of the dollar-weighted investments in the VentureSource universe. Although our results may reflect the firms that receive funding from well-reputed investors, in later analyses we re-weight the AHR survey data to reflect the joint distribution of firm age and capital raised in the VentureSource universe; these results are very similar to un-weighted specifications, suggesting that the milestone based changes in compensation that we document are robust to the sample composition.

2.3 Summary Statistics

Table 3 displays descriptive statistics for the AHR sample. The data are presented in two panels based on variables that capture observable information and firm performance

milestones. The first, funding round, captures how many rounds of outside investment the firm has raised. The next panel presents data broken down for firms based on revenue. Both panels are sorted from an earlier stage to a later stage for each variable, which accords with the column on average firm age. Note, however, that this progression is not deterministic, and there is variation in firm age in each column. Later, we control for firm age when assessing how each of these factors influences compensation.

Focusing on Panel B, we distinguish pre-revenue firms that are "Pre-Product" and those that are "Post-Product". Pre-Product firms are those that report "Early / Product Definition" as their development stage. Post-Product firms report "Product Development, "Product in Beta", "Shipping Product" or "Profitable" as their product development stage. All firms with strictly positive revenue are "Post-Product" firms. There is a dramatic increase in compensation for "Post-Product" firms that have yet to realize any revenue.

Across rows in each panel of Table 3, mean CEO cash compensation increases with firm milestones. CEO compensation starts off at around $100,000 but rises quite considerably thereafter. Across panels, the CEOs of mature firms, (Post-Series B, with greater than $10 million in revenue), earn on average over $270,000 per year in cash compensation. Also relevant is the variability around these averages. The standard deviation of total cash compensation increases with milestones in each panel.[6] These early summary statistics thus suggest that startup CEOs earn intermediate liquidity in the form of cash after achieving milestones. Subsequent analyses evaluate the most plausible alternative channels that may explain the stylized facts in Table 2.

Table 4 is designed to assess whether the large increases in cash compensation over the life of the firm are driven in part by a compositional shift in the share of non-founders

[6]Note however that the coefficient of variation is actually quite high for firms that are in the first category. This is largely driven by a subset of CEOS of very early-stage, pre-product companies who take de-minimis salaries; in about 15% of these firms, the CEO earns less than $20,000 per year. Thus, the variation at very early stages comes from CEOs who earn significantly less than the mean.

who transition to the CEO role. Among pre-revenue firms, 96% of CEOs are founders or co-founders. This drops to 83% for firms with between 0 and $10 million in revenue. Importantly, while we find an increasing share of non-founders in the CEO role as milestones are achieved (and the firm becomes viable in the absence of its founders), Table 4 shows that even among founder-CEOs, compensation increases considerably after the firm has achieved initial product and financial milestones. While there is a gap between non-founders and founders, with non-founders receiving greater average cash compensation, what is essential is that founder-CEOs experience significant lifecycle growth in compensation that begins to resemble the compensation of outside professionals at later stages.

There are a number of possibilities for why a gap remains between founders and non-founders, but one possibility is that equity holdings and cash compensation are substitutes. Referring back to Table 3, the final column shows CEOs' mean fully diluted equity, or what fraction of the firm the CEO would own if a liquidity event occurred today and all options holders and venture investors converted into common shares.[7] While average fully diluted equity for the CEO is negatively correlated with firm stage in Table 3, Table 4 shows that non-founder CEOs hold considerably lower equity than founders on average. Although our focus is not on a causal analysis of the substitutability of these compensation instruments, the hypothesis that equity and cash compensation are partially substitutes would suggest that founder-CEOs have even more similar compensation to non-founders than indicated by the mean differences in their levels of cash pay.

[7]Most venture investors hold convertible preferred shares that convert into common stock after favorable firm outcomes. Employee options are assumed to have vested and are exerciseable. Average fully diluted equity is 20% of the firm for Series A CEOs; it falls to 10% by Series C.

3 Product Market Fit as a Fundamental Milestone

Having documented the general patterns around the evolution of CEO compensation, we turn next to a multi-variate analysis. The goal is to identify specific milestones associated with shifts in compensation. An important finding is that product market fit, even after controlling for its correlates (such as firm age, or a firm having raised substantial external finance), appears to be a significant inflection point both in the evolution of the firm and the evolution of the founder's compensation contract. We demonstrate this fact by looking at the evolution of (1) the level of cash compensation, (2) variation in cash compensation, (3) the bonus share of cash compensation for CEOs, and (4) founder vs. non-founder CEOs. We now turn to documenting these patterns in greater detail.

3.1 Evolution of the level of CEO cash compensation

We start by providing graphical evidence on the evolution of total cash compensation and its relationship with having a product. We focus on founder-CEOs as the unit of analysis to capture changes in cash compensation for those who begin their tenure at the earliest stages of the firm lifecycle. Figure 1 provides evidence on the importance of achieving product market fit as a pre-condition for increases in CEO-compensation. The top left panel of Figure 1 displays how average cash compensation and the interquartile range change with firm age. Similar to the patterns seen in Table 3, cash compensation for founder-CEOs increases dramatically with firm age.[8]

One explanation for this relationship is that information about the future prospects for the company is revealed as firms age, and cash compensation responds to this news. The other panels help to disentangle alternative explanations. The top right panel of Figure 1 conditions on "Pre-Product" firms that have no revenue and have not yet achieved viable

[8]Note that this analysis is conditional on surviving firms, but surviving firms are the relevant sample for assessing founder risk. Upon firm failure or an executive's exit, he or she earns their outside compensation. We later assess whether startup experience itself changes the outside option relative to other career paths.

product definition.[9] These firms have low total cash compensation and a flat gradient with respect to age. The panel itself is not truncated at 4 years of age–instead, firms that do not have a product rarely survive to their fifth year. This panel suggests that the overall increase in compensation with firm age stems from the increasing number of surviving firms that have achieved product market milestones and the death of firms that fail to achieve milestones with time.

The bottom panels plot similar figures, but instead of focusing on age, the x-axis is capital raised. Capital is related to firm milestones, yet conditional on capital raised, pre-product firms in the bottom right panel have lower average pay and a more compressed interquartile range of pay than the unconditional plots. These descriptive figures suggest that having a viable product is a significant inflection point for CEO compensation.

Table 5 displays regression results where the dependent variable is log total cash compensation for the founder-CEOs of VC-backed firms. The regression is

$$\log(\text{Comp}_i) = X_i\beta + \text{Firm Age}_i + Controls_i + \epsilon_i \tag{1}$$

where X is a matrix of milestones. The parameter $\hat{\beta}$ is the partial correlation between an increase in X on compensation after netting out the effects of controls and other characteristics.

The first column contains baseline results with the fewest possible controls. Log cash compensation is positively related to firm revenue, with substantial increases coming from firms that have positive revenue relative to the baseline of pre-revenue firms. Subsequent columns add additional controls to assess how other firm characteristics change the importance of development milestone. Column 2 adds firm age. While the parameter estimates on the revenue indicators fall, having positive revenue is still associated with an approxi-

[9]Pre-Product firms are defined in Table 3 and are those that report "Early / Product Definition" as their development stage. Post-Product firms report "Product Development, "Product in Beta", "Shipping Product" or "Profitable" as their product development stage.

mately 56% increase in pay ($\exp(0.447) - 1$) relative to pre-revenue firms.

Column 3 tests for the importance of product market fit, with striking results. This column includes the Post-Product Definition dummy for whether the firm has made it beyond the Pre-Product stage described in Table 3 and Figure 1. This separates the degree to which revenue is driven by the existence of a product from the degree of traction with customers due to pricing, marketing, and the like. The results here are striking, showing that product definition/development is a significant milestone in itself. In this column, the revenue gradient remains positive, but it is far less pronounced relative to Column 2, suggesting that the inflection point for cash compensation is around having a tangible product. The product definition dummy, revenue dummies, and firm age together explain 39.7% of the variance in log cash compensation. Subsequent columns add additional characteristics, as noted in the bottom of the table. Even controlling for cumulative venture capital investment, total rounds of funding, industry, region, and firm age, the coefficient on the Post-Product Definition indicator implies that having a tangible product is associated with a cash compensation increase of approximately $\exp(0.338) - 1 = 40\%$. Together these additional controls raise the r-squared, but product definition remains economically significant and meaningful. Column 6 addresses whether these results generalize to the universe of firms compared to those in the survey by re-weighting the data such that the AHR sample matches the cross-section of VentureSource in each survey year. We target firm age and capital raised in this re-weighting exercise. The results remain very similar to those without the re-weighting.

We further probe whether our estimates are robust to unobserved firm or founder quality, and conclude that unobservables would need to be implausibly large to explain our results. Note that we do not observe the evolution of CEO compensation within a firm, but rather trace out the evolution based on firms at different points in their lifecycles that were captured when the survey was conducted. Because of this, one might be concerned that our estimates omit firm or founder quality that investors may observe at early stages.

In other words, firms that survive to later stages are potentially of higher quality, and the difference in cash compensation may be driven by the selected sample of firms that progress to later stages, rather than a substantive evolution of firms to higher levels of cash compensation as they achieve milestones. To assess how selection on unobserved knowledge about a firm's ex-ante traction would change our conclusions, we conduct an approximate worst-case-scenario analysis in which we assume it is only the firms with the highest pay among pre-product firms that survive to reach subsequent milestones. The ingredients for this calculation are relatively simple: conditional on survival to year 3, 82% of surviving firms have hit revenue milestones. 20% of all firms have failed by year 3 (see Appendix Figure A2 which displays the cumulative hazards for different types of exits from the VentureSource universe). We then compute the difference in mean pay for the surviving 3-year-old firms that have positive revenue and the conditional distribution of pay for pre-revenue firms above the $.2 + .18/.82 = 42$nd percentile of the distribution. Even against this worst-case-scenario (that presumes surviving post-product firms are drawn from the top of the initial compensation distribution), we find an increase in log total compensation of 0.29 ($\approx 34\%$) due to having a tangible product (the standard error is .053). Thus, selection on unobserved quality is unlikely to explain the importance of milestones for compensation in the cross-section of firms.

A different question is whether our results are representative of a longer time series, especially one where VC funding was less "frothy." To assess whether we are simply capturing an ephemeral moment in VC history, we bring to bear hand-collected data on corporate filings of new IPOs among VC-backed startups.[10] Every firm filing an S-1 for an IPO must provide 3 years of compensation history for the CEO and other top executives. Using these recorded filings, Figure 2 displays median total cash compensation in 2015 dollars for firms that IPO over the time series.[11] At least among successful firms

[10]Baker and Gompers (1999) collected similar data for their analysis of the transition of VC-backed startups from private to public firms.

[11]If the S-1 does not contain compensation data, then we collect the first post-IPO DEF 14-A proxy

that eventually become public, compensation in this selected sample looks reasonably stable over time. This suggests we are capturing systematic features of the contracting environment, rather than a shift over time that reflects a new era of VC funding or a reduction in governance.

3.2 Variance of CEO Compensation

As shown above, the evolution of the level of CEO compensation has an inflection point around the product market fit milestone, suggesting a shift from a "screening" contract to a "professionalized" contract. If so, we might also expect that the variance of CEO pay is very low across firms prior to product market fit – as they are given a relatively similar screening contract. Variation in pay would be expected to rise after product market fit as firms achieve other size-based milestones. Figure 1 shows evidence of this because the interquartile range of cash compensation is much smaller for pre-product firms; compensation variability increases only after achieving milestones.

To more formally examine the variance of CEO compensation, we first note that the sample in Table 5 excludes firms with very low cash compensation, as cash compensation close to zero is an extreme outlier in logarithms. Appendix Table A1 gets around this issue by using a Poisson regression, as suggested by Silva and Tenreyro (2006). We graphically display these estimates from Poisson regressions as predicted densities of the level of cash compensation as a function of milestones on the firm's development stage. We then take the fitted values from these Poisson regressions and show how the distribution changes for firms with different rounds of funding and different product status and revenue levels. The results are in Figure 4. As displayed in Panel A, most firms at seed stage have relatively low predicted pay relative to other firms. The mean shifts up substantially for Series A firms, but the variability also increases significantly. Because these are predicted

statement filing.

densities, this variability comes from increased variance in the X matrix for Series A firms. Not all Series A firms have achieved relevant product market milestones, but those that do have significant increases in cash pay. By Series B, the mean shifts up again because most firms have hit funding milestones, while the lower tail of the distribution begins to disappear. The change becomes more stark for Series C firms, as nearly all firms at Series C have achieved basic operational milestones and the thick right tail of compensation comes from firms that have achieved significant size in terms of revenue. The CEOs of these firms are paid accordingly, as suggested by Rosen (1982) and Gabaix and Landier (2008). This progression as a function of product status and revenue is made more clear in Panel B of Figure 4. In this panel, pre-product firms have a narrow density with a low mean. Post-product but pre-revenue firms have a distribution that is shifted to the right and is more variable. Variability increases with revenue and the pay distribution continues to shift rightward.

Figure 4 and Table 5 also show that once product market fit has been achieved, variation in CEO pay across firms grows substantially. As has been documented in prior work on publicly-traded firms, variation in CEO pay appears strongly related to measures of firm size. For example, as seen in Table 5, dummies for firm revenue alone explain over 30% of the variance in log CEO compensation; adding product milestone and firm age increases the R-squared to about 40%. Interestingly, we find that adding VC financing round, funding amount, region, and industry dummies only increases the r-squared to 44%. Region fixed effects are jointly insignificant in a Wald test in Table 5, Column 5. Thus, among these firm-, industry- and region-level factors, the majority of the variation in pay is driven by variation in underlying *firm* fundamentals, swamping the geographic and industry differences that have been shown to be important in other contexts (Moretti 2010).

3.3 Evolution of the bonus share

The bonus share of total compensation increases significantly and systematically with milestones. It averages 5.5% for pre-product firms, 5.3% for post-product but pre-revenue firms, and 14.5% for post-revenue firms. The fact that bonus setting is explicit (the data captures target bonus) suggests that our results stem from changes at the board level rather than the CEO dictating pay unilaterally.

Figure 3 displays the relationship between bonus share, log total compensation and log firm revenue. What is particularly striking is the very low pay (and minimal bonus pay) for firms with minimal revenue. The leftmost data point is pre-revenue firms. After excluding these firms, the relationship between log compensation and log revenue looks nearly linear (Panels B and D). As revenue grows, the bonus share increases with it, suggesting that boards are setting objectives that trigger compensation liquidity at higher frequency than exit events.[12] This analysis suggests that milestones and compensation are positively related, with virtually no bonus prior to product market fit and total cash compensation increasing at a greater rate than salary with respect to firm size, so that bonus pay comprises a larger share of cash compensation in larger firms. The linear relationship between log size and log compensation, as well as the increasing share of bonus in overall compensation for larger firms has been documented in prior empirical work looking at CEO compensation in publicly traded firms (Shue and Townsend 2017). In fact, we show that the relationship between log cash compensation and log firm revenue among the firms in our sample looks quite similar to the relationship in publicly traded firms (see Appendix Figure A1 and Appendix Table A3). To be clear, our goal is not to document parity in the contracts between public CEOs and those in our sample, rather it is to show that several of the stylized facts we know about public company CEO contracts appear to emerge in VC-backed startups prior to going public but not before the existence

[12]Table A2 in the appendix provides regression versions of this graphical presentation but instead looks at coefficients on log salary and log total compensation separately.

of a tangible product. In other words, product market fit appears to be a key milestone where professionalized and standardized contracts emerge.

3.4 Founder and Non-Founder CEOs

3.4.1 Founder CEO Turnover vs. Firm Exit

Our third set of results looks at *founder turnover* before and after product market fit. Rajan (2012) theorized that at the birth of a new firm, the key human capital in a venture is not replaceable, requiring the entrepreneur to have significant control to allow her to create a *differentiated* idea/organization, but that this key human capital becomes more replaceable once the firm undergoes a transition from *differentiation* to *standardization*. If indeed product market fit is a key milestone for CEOs transitioning from "screening" to "professionalized" or standardized contracts, this suggests that it might also be the important inflection point in *firms' lifecycles* where they transition from differentiation to standardization.

We should therefore expect to have very few instances prior to a firm achieving product market fit where the founder is replaced but the firm survives. However, the hazards for founder-exit and firm-exit should diverge after product market fit.

Our next tests therefore examine the extent to which firms and founders are inseparable prior to product market fit. While the summary statistics in Table 4 reflect an increased likelihood of observing non-founders as firms gain revenue, the question is whether controlling for age, industry, and geography, are we more likely to observe non-founders as CEOs in post-product compared to pre-product firms? Table 6 contains this analysis, where we regress a dummy for having a non-founder in the CEO position on measures of product-market fit. We conduct this analysis separately on the AHR data and, via proxy measures, on the VentureSource Data. The first three columns include the Post-Product definition dummy along with different combinations of controls/fixed effects for

the AHR data. The coefficients are generally between 0.044 to 0.052 on the Post-Product definition dummy, indicating that founders are more likely to have been replaced as CEOs after product market fit compared to before. This analysis conditions on surviving firms, suggesting that firm failure is the source of dissolution among pre-product firms that are unable to achieve product market fit rather than a change in leadership. Columns 4 and 5 split the sample by the amount of VC investment raised. Column 4 shows a much smaller (and statistically insignificant) coefficient among firms with under $10 million in VC funding than the much larger estimate of 0.21 in Column 5. This is because very few firms have any CEO turnover in the absence of raising money, both pre and post-product firms, which makes it hard to distinguish between any turnover events early in the fundraising process. Among firms that have raised more than $10 million in VC funding, Column 5 shows that pre-product firms are much more likely than other firms to retain the CEO. This result is quite surprising, but is consistent with our narrative of standardization. That is, holding constant covariates, one might have expected that VC investors in firms that have raised substantial capital would have been more likely to replace CEOs prior to product market fit. Instead, consistent with the hypothesis that key human capital is hard to replace before standardization, these pre-product firms are much more likely to be observed with a founder as CEO. Finally, Column 6 shows that this relationship holds even when the sample is restricted to pre-revenue firms.

The last three columns of Table 6 report similar regressions using the VentureSource sample. The goals here are first to investigate whether the connection between turnover and product-market fit holds in a larger sample. Because VentureSource provides a view of the executive team at every financing event, we can accurately assign turnover events. Columns (7) and (8) report the regressions for the sample years 2015 and 2017, while the last column reports results for all years since 2015. The results have similar signs: product-market fit is positively correlated with a founder-CEO being replaced. The coefficients imply a 34% increase in the probability of founder-CEO replacement relative to the sample

mean.

3.4.2 Founder vs. Non-Founder CEO Compensation

The same shift in the firm lifecycle that enables founder replacement is associated with a steeply increasing cash compensation profile for founder-CEOs. We now explicitly examine how much founder-CEOs have compensation arrangements that mimic those of non-founders after product market fit. The clarification that this comparison is largely centered after product market fit is important because there are few pre-product firms with non-founder CEOs.

As noted above, Table 4 provides summary statistics on cash compensation and fully diluted equity holdings, split by firm revenue and founder-status. Within similar levels of revenue, non-founders receive more cash and have less equity. Unfortunately, our data do not allow us to compare how non-founders' contracts compare with the founders they replace, but we can assess whether firm characteristics explain some of these differences. Non-founding CEOs lead companies that are on average older and larger, indicating that turnover is not random (see Figure 6 for firm age and the share of founders in the CEO position). The source of selection is not clear from past work.[13] However, Figure 7 displays differences in the distribution of log compensation residuals after adding controls for various firm milestones and life stages. The results from these regressions indicate that non-founders are rare among young firms and firms with little capital investment. While there is a large region where founders and non-founders have the same pay, the distribution of compensation residuals is shifted somewhat upward for non-founders even after adding controls. Despite the differences in the averages, the overlap in the distribution suggests that many founders are receiving approximately "market like" or "professional-

[13]Prior studies about why founding CEOs are replaced point to bi-modal reasons for turnover (Wasserman 2003). Some turnover occurs in firms that are struggling (Ewens and Marx 2017). Other firms experience turnover when venture investors perceive the need for extremely fast growth for which founders are ill-equipped. The canonical example is Google, where Eric Schmidt was brought in to provide "adult supervision."

ized" compensation as benchmarked by non-founder CEOs as part of the standardization process of the firm.

Moreover, the data also show that firms either achieve product market fit or fail within a short period of time, which suggests that attempting entrepreneurship can be conceptualized as experimentation (Manso 2016; Dillon and Stanton 2018). Nevertheless, the length of time the CEO needs to face a screening contract as well as the CEO's outside options will determine the degree to which potential entrants find it financially attractive to experiment with entrepreneurship.

4 Founder CEO Compensation and Selection into Entrepreneurship

As noted above, VCs can and do provide founder-CEOs intermediate liquidity once they transition to a professionalized contract, but VCs cannot effectively screen entrepreneurs while their startups are differentiated (before they have achieved milestones) and thus do not provide them generous salaries. The expected time taken to achieve product market fit and the entrepreneurs' outside options therefore affect the risk of entrepreneurship for founders. Since, as noted above, founders and firms are indistinguishable at the birth of firms, the types of individuals who choose not to found ventures will impact the ideas that are commercialized through VC-backed entrepreneurship.

To understand the degree to which this risk impacts the ideas that are commercialized and the people who select into entrepreneurship, we first understand the time it takes to achieve product market fit. To explore how compensation and milestones evolve with time, we would ideally want to recover the joint distribution of outcome timing for {exit, achieving milestones, failure}. As noted above, this is difficult in the compensation survey because the data provided under our data use agreement do not contain firm and individ-

ual identifiers. For each cohort of firms, we would need to track outcomes from birth, but we don't have the ability to do so in the AHR data because it contains cross sections that condition on survival. However, for our purposes, the relevant exercise is whether firms persist without hitting a milestone, as limping along at low pay and prolonging failure is likely not a good outcome for the entrepreneur. Therefore, conditional on survival in the data, we examine the probability of failing to achieve a milestone (continuing to persist at low pay). The fraction of firms achieving different milestones is displayed in Figure 5, showing that nearly all firms that survive after the first few years have achieved the revenue milestones.

Together with this information, we then build on one of the best-known benchmark models in this literature, from Hall and Woodward (2010), which incorporates many realistic features of the financial contract between investors and entrepreneurs, including liquidation preferences, stochastic exit values and stochastic time to a liquidity event. Hall and Woodward are also among the first to use realistic risk preferences while modeling entrepreneurs' consumption and asset accumulation decisions.

One contribution of our compensation analysis is that it gives us the ability to revisit the Hall and Woodward consumption-savings problem, by building in the possibility that entrepreneurs who meet milestones may receive an increasing path of cash compensation while the firm remains private. The entrepreneur's ex-ante problem is to choose consumption in the face of uncertain future assets. Future assets are uncertain because the share of firm value that accrues to an entrepreneur in a liquidity event is a random variable with substantial variability. Prior to a liquidity event, these future assets do little for consumption, as there is substantial uncertainty over their value and borrowing against equity is likely to be difficult. As a result, the entrepreneur must consume out of either salary or more liquid forms of wealth. To fix ideas, let π_{t+1} be the probability of a liquidity event at date $t+1$ while the stochastic payoff to the entrepreneur, X, is conditional on exit at $t+1$. We simplify Hall and Woodward's notation, leaving implicit the entrepreneur's

control over human wealth, and write the ex-ante value function for an entrepreneur with liquid and semi-liquid assets A_t at time t as:

$$\begin{aligned} V(A_t) &= \max_{c_t<A_t} u(c_t) + \frac{1}{1+r}(1-\pi_{t+1})E_{w_t}V((A_t-c_t)(1+r)+w_t) \\ &\quad + \frac{1}{1+r}\pi_{t+1}E_X V((A_t-c_t)(1+r)+X_{t+1}) \end{aligned}$$

The entrepreneur solves for a consumption path with expected entrepreneurial wage sequence arising from the time-specific density $\{f(w_t)\}_t^T$ and takes into account the post-venture value function

$$V = \frac{1+r}{r}u(\frac{rA+w^*}{1+r})$$

where w^* is the non-entrepreneurial wage.

Hall and Woodward assume that the flow utility is isoelastic, with $u(c_t) = \frac{c^{1-\gamma}-1}{1-\gamma}$ where γ is the coefficient of relative risk aversion. They evaluate several values of γ, but a somewhat standard level of risk aversion would suggest that $\gamma \approx 2$ is reasonable. They also assume that entrepreneurs earn an annual pre-tax salary of \$150,000 over the entire life of the firm, and they then evaluate the certainty-equivalent value of entrepreneurship compared to different values of the non-entrepreneurial wage. However, Table 4 documents how cash compensation in VC-backed firms evolves after resolving irreducible uncertainty – such as producing a product. CEO pay then increases substantially as firm revenue grows.

The path of pay that we document over the lifecycle potentially alters conclusions about the risk borne by entrepreneurs. To assess what our data mean for the burden of non-diversifiable risk in entrepreneurship, we make a very simple adjustment to the Hall and Woodward baseline analysis. Instead of solving the entrepreneur's consumption-savings problem assuming that the pay over a venture's lifetime is a constant \$150,000, we

instead get the entrepreneurs expected value function using the time path of actual cash compensation in the data. To do so, we integrate over the distribution of value functions using the exact cash-compensation data for every cross-section by firm age.[14] Mean cash compensation starts at around $110,000 for new firms and is nearly $400,000 for 10 year old firms, but our approach accounts not only for the changing mean over a venture's lifetime but also for potential differences in higher-moments as well.[15]

Figure 8 displays our results and compares them to the Hall and Woodward benchmark. The region above and to the left of each line is the area in Outside Salary-Wealth space where the certainty equivalent of entrepreneurship is positive. The line itself traces out the identity of the marginal entrepreneur under each model. The shaded region indicates the individuals for whom the implied payoff from entrepreneurship is positive using our modified compensation moments compared to those in Hall and Woodward. For example, in the Hall and Woodward benchmark, a potential entrepreneur with an outside salary of $900,000 would require nearly $11 million in wealth to make entrepreneurship pay. In contrast, under our estimates, the wealth required for someone earning $900,000 per year falls to $7.25 million.

The threshold wealth required to enter entrepreneurship falls in our version of the problem despite the lower average pay in the early years compared to Hall and Woodward's results. This stems in part from entrepreneurship as experimentation (Kerr, Nanda, and Rhodes-Kropf 2014; Manso 2016; Dillon and Stanton 2018), where CEOs who do not achieve product market fit do not persist in entrepreneurship. A second difference is that after product market fit, pay surpasses the Hall and Woodward assumption of $150,000

[14]This small tweak may still remain too simple, as we abstract from founder-CEO replacement. However, upon replacement, if the founder earns his or her outside wage, the problem is no different from that analyzed here. In section 5 we provide evidence that is consistent with the view that there is no systematic penalty associated with trying entrepreneurship and returning to paid employment.

[15]Our approach requires that we compute the expected value function over the sequence of future densities of cash compensation using backwards recursion, solving for the agent's consumption policy rule. One limitation, however, is that we only build in cross-sectional differences in the densities, as our data does not allow us to account for serial correlation in pay. We also pool the compensation data for firms aged 10+, as we have somewhat thin cells for firms beyond 10 years of age.

in liquid compensation. Thus, entrepreneurship looks relatively more attractive for these reasons despite the lower initial salaries in our setup.

Despite this improvement, a clear region remains where the certainty equivalent is negative. How big is this region, or how many individual might we expect to be precluded from entrepreneurship? Below the x-axis in Figure 8 is the population percentile of the income distribution corresponding to the level of outside compensation. These estimates are taken from the NBER's version of the IRS Statistics of Income files and utilize data on W2s for a stratified random sample of tax filings.[16] The right y-axis contains percentiles of the wealth distribution corresponding to the required wealth cutoffs on the leftmost y-axis. These wealth percentiles are interpolated from data provided in Saez and Zucman (2016).[17] According to the figure, the vast majority of the population likely has a positive certainty equivalent from VC backed entrepreneurship. For example, under our calculations, an individual with an outside salary of $400,000 would require around $500,000 in liquid assets (about 1.6 times annual pre-tax salary), which seems like a quite reasonable level of wealth if the person in question has worked for several years. Because of progressive taxation, relatively fewer individuals earning $600,000 salaries are likely to be above the $1.8 million (3 times annual pre-tax salary) wealth threshold than those at $4 million. Therefore, our estimates suggest that a bound on the fraction of the population who have a negative certainty equivalent from VC backed entrepreneurship is than about 1-.9944 = 0.56% of all individuals. Those who might have a negative certainty equivalent are those in relatively high paying jobs (above $400,000 per year) but who have limited accumulated wealth. For example, these might be individuals who have progressed rapidly in their careers, earning high salaries, yet have limited wealth (possi-

[16] We use data items 85 and 86 from the SOI data, which contain W2 earnings for individual filers and married joint filers. Individuals without W2 earnings are not included in the percentile estimates.

[17] To perform this interpolation, we take the log of the minimum wealth at different percentiles of the distribution and the log of the percentile and then use linear interpolation. We then exponentiate the interpolated log percentile.

bly because of educational debt from obtaining professional degrees).[18] Since the value of ideas commercialized in entrepreneurship is extremely skewed, it is possible that these high flyers with limited wealth are exactly those who the social planner might want to encourage to experiment with VC backed entrepreneurship. The remainder of the paper takes up the question of whether there is evidence that potential founders in this category are less likely to appear in the data.[19]

5 Pre-Entry Background of Founders

To provide more color on the question of *who* is selecting into entrepreneurship, we turn next to providing a descriptive analysis of the pre-founding backgrounds of VC-backed founder-CEOs. While this analysis conditions on those who successfully raised VC finance for their venture (and hence does not appropriately account for the risk set of individuals seeking to select into VC-backed entrepreneurship) it nevertheless allows us to do two things. First, we are able to paint a more accurate picture of the individuals who are the founder-CEOs of VC-backed firms, not just in terms of salary but also in terms of their educational qualifications and prior work experience. Second, by examining and estimating the pre-entry compensation of founder-CEOs based on their job titles, we are able to partially validate the empirical exercise conducted in Section 4, namely that we should not see a large number of individuals in our sample with extremely large pre-entry salaries, unless they also seem to have substantial wealth.[20]

[18] Individuals who progress quickly in a career in consulting or finance can earn $ 1 million or more. We estimate that the wealth required for someone earning $900,000 a year needs to be at least $7.25 million to find it worthwhile to experiment with entrepreneurship.

[19] Note that our model assumes that outcomes in entrepreneurship are not correlated with a founder's outside salary, which allows us to isolate how contract features change the attractiveness of entrepreneurship for different founders who face the same prospects of resolving uncertainty. A different analysis of the self employed (who are not VC backed entrepreneurs) suggests that the returns to experimentation are positively correlated with general ability, or a common factor that is correlated across sectors (Dillon and Stanton 2018).

[20] An additional goal of the analysis, is to validate the assumption in the model of a stable "outside" salary that is not harmed by founding a venture.

5.1 Source of Biographical Data

Given the extensive resources needed to manually collect biographical data, we focus our analysis on the subset of firms in the Venture Source sample that received a first round of venture capital financing in 2010 or 2011.[21] Our primary source of biographical data are LinkedIn profiles. Of the 1,665 startups that pass our sampling filters and have a founder identified in Venture Source, we were able to collect 1,415 Public LinkedIn profiles (85%) for at least one founder. We use the LinkedIn profiles to estimate founder age (by assuming that they graduate from college at age 22) and details about higher education. Job history profiles allow us to calculate the number of prior jobs and years of pre-startup labor market experience the individual had as well as the job title they held right before starting their VC-backed venture.[22]

As noted above, the LinkedIn data allow us to isolate the firm that the founder worked at right before they started their VC-backed venture, and their title at that firm. Since the LinkedIn data detailed above do not provide salary data, we randomly select founders with LinkedIn profiles for a deeper biographical search, while attempting to estimate their salaries based on data from Glassdoor. Glassdoor collects anonymous salary and other compensation data from its users and provides salary estimates at the job title, geography and/or industry-level. We used the average salary reported by Glassdoor for the job title the individual held in the firm they worked at, including additional compensation (cash bonus, commissions and profit sharing). If the industry or geography salary estimate was unavailable, then we took the national average for the salary plus additional compensation as an estimate for that individual.

Glassdoor also provides its own list of titles and salaries for specific companies. We

[21] Note that in in order to remain consistent with our AHR sample, we restrict our sample to informational technology.

[22] Not all LinkedIn profiles are complete; about 20% of profile lack education data and 7% have no listed jobs. Both could be explained by a lack of public disclosure by the individuals or a true lack of these features.

collect the full set of title and average salary pairs for a founder's pre-founding employer when available. By comparing the salary associated with the individual's title to the maximum salary provided for individuals in that firm, we are able to provide an estimate of where in the corporate hierarchy the individual sat in the firm they worked at right before entering VC-backed entrepreneurship.

5.2 Characteristics of VC-backed Founder-CEO

Column 1 of Table 7 documents the characteristics of the 1,415 individuals we collected biographical data on. Founders were roughly 36 years old at founding with an estimated 12 years of job experience across four jobs prior to founding. These founders are also highly educated: almost a quarter have an MBA, 40% have a non-MBA Master's degree, 6% have a PhD and 3% have a JD.

The second column of Table 7 provides salary estimates for the individuals about whom we collected Glassdoor data. Although we selected a 10% random sample of individuals to examine further, we were only able to find information for 103 of these individuals. Comparing the age and educational background of those with salary information shows that these individuals were much less likely to have been founders before[23] and were more likely to have both an MBA or a non-MBA Masters degree. In other words, these were even more highly educated than the typical founder in our LinkedIn sample.

With this caveat of the selection among the founders whose salary we were able to locate, Column 2 of Table 7 shows that the average salary is about $232,000 and the 75th percentile is $248,000. Columns 3 and 4 split the sample of 103 founders for whom we have salary information into those whose salaries are below $300,000 vs. those that are not. We choose this as a conservative threshold assuming that these individuals may have other guaranteed income and unreported bonuses that could increase their total

[23]This is partly mechanical as sometimes the job right before was as a founder of another startup, and small startups are less likely to appear in Glassdoor.

cash compensation to be closer to $400,000. Column 3 shows that approximately 90% of the founders in this sample have cash compensation that was below $300,000 in the position they held prior to starting VC-backed entrepreneurship. For these individuals, the average salary in their prior job was approximately $175,000. Consistent with this, they were somewhat younger and had fewer years of labor market experience than those earning over $300,000. Column 4 of Table 7 documents that those earning above $300,000 had an average salary of over $650,000. These individuals were extremely highly educated, with all of them having a Master's or higher degree. They were also significantly older and had more years of labor market experience.

While we do not have wealth data available for these individuals, the estimates from our model suggest that an individual with a salary of $650,000 a year would need at least $3 million in wealth for them to find the risk of entrepreneurship worth undertaking. It is certainly plausible to expect that an individual earning $650,000 would have accumulated this amount of wealth, given the over 15 years in labor market experience these individuals have on average.

Put differently, the biographical data we collect appears very consistent with predictions of the model in that founders either appear to leave from jobs where their pre-entry salary was low enough to find it worthwhile to experiment with entrepreneurship or, in the event that their salary was very high, had quite plausibly accumulated sufficient wealth to undertake the risk of entry. In both cases, their cash compensation and/ or wealth is likely to be within the range where it would be attractive to try venture capital backed entrepreneurship even in the presence of standard levels of risk aversion.[24]

[24]The degree to which founding a firm and failing impacts an individual's salary if they return to paid employment is also decision-relevant for founders. In Table Appendix A4, we show that among individuals in our overall sample of 1,415 founders, those whose startups failed appeared to face minimal systematic penalties in terms of the job title they had post startup failure relative to the title they had right before entry. This analysis is suggestive only, as it is based on founders for whom we could establish a job title post-failure, but is consistent with other research on experimentation with entrepreneurship (e.g. (Manso 2016; Dillon and Stanton 2018) that finds little penalty for trying entrepreneurship and returning to wage employment.

While we do not observe the full risk set of individuals who were considering entrepreneurship, our results appear to suggest that the modal individual starting VC-backed entrepreneurship is in a mid-level position in their firm prior to entry. This is not only seen from the overwhelming majority of entrants in our biographical sample who earn below $300,000 but also seen in Figure 9 which compares the average salary for individuals' titles in Glassdoor with the maximum salary available for their firm. As can be from Figure 9, 58% of the individuals in our sample have an estimated salary above the median salary, yet their salary is on average 43% of maximum reported salary in Glassdoor for their prior employer.

Our biographical data also suggest that those with a career in finance or other industries where salaries are often higher than the thresholds examined here (e.g. Shu (2016)) may not find it attractive to select into entrepreneurship based on standard levels of risk aversion. To the extent that this precludes individuals from entering entrepreneurship, the analysis also helps pinpoint the industry and job backgrounds of potential founders whose ideas are more likely to be commercialized inside large firms as opposed through VC-backed entrepreneurship.

6 Conclusion

Despite the importance of VC-backed firms for the economy and the wealth of information about VC contracts, we know very little about the *compensation* contracts provided to founder-CEOs in private, venture capital-backed firms. Understanding the evolution of CEO compensation in VC-backed firms not only helps us learn about when in a startup's life the professionalized contracts seen in publicly traded firms emerge, but also sheds light on evolution of liquid cash compensation a founder-CEO receives – which has a direct bearing on the degree to which different individuals will find it worthwhile to leave paid employment and commercialize their ideas using sources of finance such as venture

capital.

We address this gap by using novel survey data on the salary, bonus and equity holdings for CEOs of Venture Capital-backed startups. Although the data are anonymous in order to protect the confidentiality of the individual executives, compensation data is matched to firm-level information on founding date and coarsened milestones related to financing, revenue, headcount, and product development.

We have several key findings. First, we document that having a tangible, marketable product is a fundamental milestone in terms of CEO compensation, marking a shift from a "screening contract" where the CEOs have minimal cash compensation to a "professionalized contract" comprising a substantial salary and bonus that grow with firm size in a manner akin to that of professional CEOs of both private and publicly traded firms. Second, we highlight that the reason "product market fit" may mark a shift in CEO compensation is that it also marks an apparent inflection in the lifecycle of the firm – from *differentiation* where human capital in a venture is not replaceable (and is synonymous with the firm) to *standardization*, where key human capital becomes more replaceable.

Third, we show that the vast majority of startups either fail or achieve product market fit within three years. This improves the certainty equivalent of attempting entrepreneurship. Our estimates suggest that fewer than 0.56% of all individuals have a negative certainty equivalent of entrepreneurship. Finally, we note that individuals who might have a negative certainty equivalent are those in relatively high paying jobs (above $450,000 per year) but who have limited accumulated wealth. For example, these might be individuals who have progressed rapidly in their careers, earning high salaries, yet have limited wealth. Indeed an examination of biographical data suggests that the modal founder of a VC-backed startup was in middle-management prior to starting their firm.

Our results highlight an under-appreciated role played by venture capital investors– that of intermediate liquidity providers – which they might be uniquely positioned to do as hands-on investors who are able to resolve information asymmetry more effectively

than passive capital providers. Nevertheless, our work also points to frictions at the very top end of the human capital distribution, where this intermediate liquidity provision may not be sufficient for the risk-adjusted return to VC-backed entrepreneurship to be positive. It also highlights the greater frictions present in providing entrepreneurs intermediate liquidity in sectors were uncertainty is not revealed as quickly (Ewens, Nanda, and Rhodes-Kropf 2018) or in sectors where founder-CEOs require specialized experience or have higher outside options. The degree to which these individuals' ideas are not commercialized (or commercialized inside incumbent firms) as well as the aggregate impact of this selection remains an interesting area of further work.

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Appendix A Data for Hall and Woodward replication

We use data from VentureSource and Correlation Ventures (a quantitative VC fund) to create the sample of financings for the Hall and Woodward extension. Startups first financed between 2000 and 2006 with a known exit valuation form the main sample. Exit valuations include acquisition prices, zeros for failed firms, or public market capitalizations 7.5 months after IPO if the startup went public. As in Hall and Woodward, the non-failure exit data skew towards positive exits. The age at exit is calculated as the number of years from firm founding (sourced from incorporation filings) to the exit date. Failure dates are assumed to be one year after the startup's last known VC financing.

Figure 1: Founder-CEO Cash compensation by firm age and capital raised.

Figure displays founder-CEO cash compensation by firm age and capital raised. The left panels include all firms and the right panels restrict the sample to firms that are still in the product definition or ideation phase. Firm age for pre-product firms ends at 4 because there are no older pre-product firms in the AHR data. There are also no pre-product firms with over $100 million in venture capital raised.

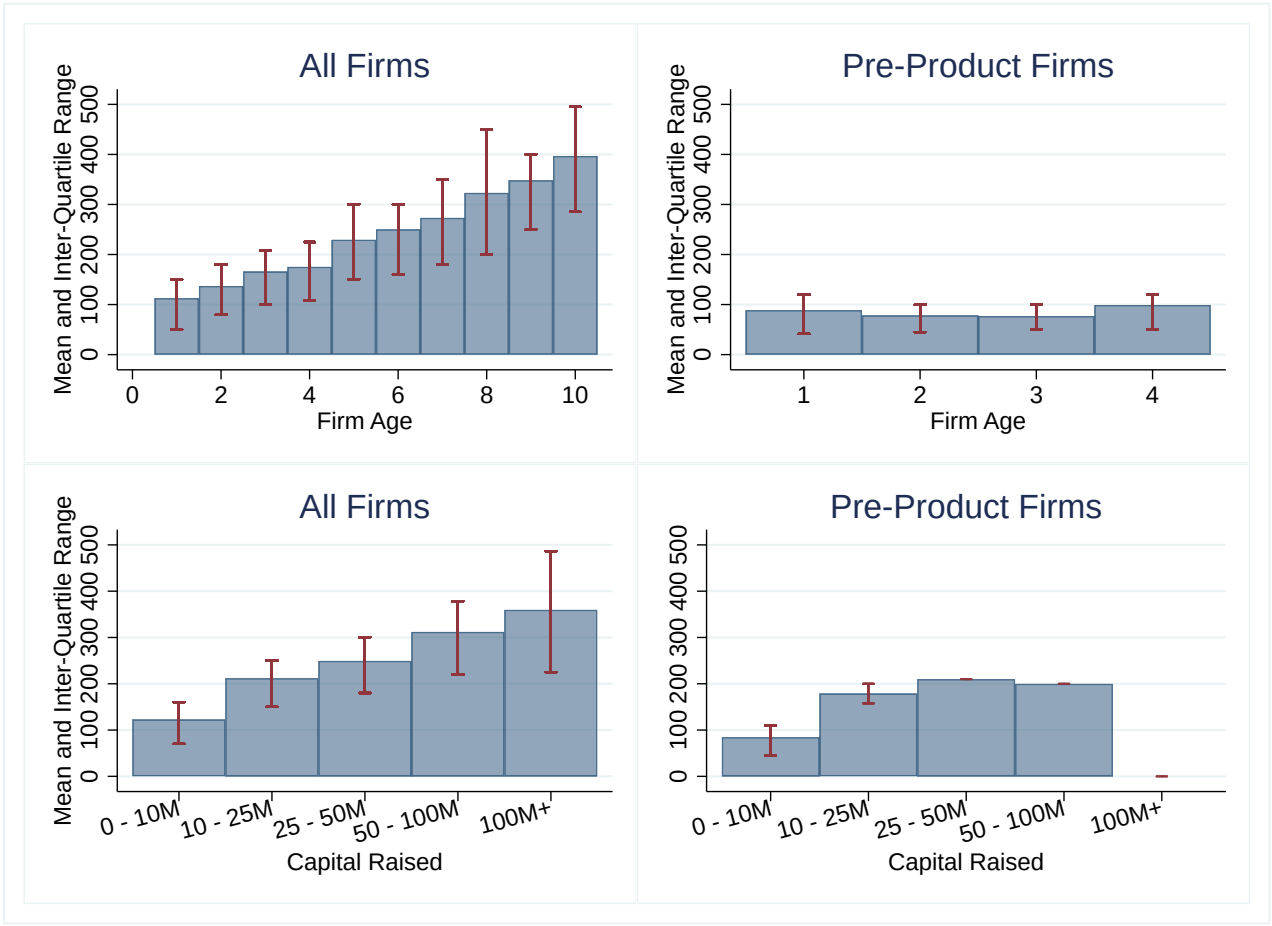


Figure 2: Compensation for Highest Paid Executives for Newly Public VC-Backed Startups

Figure displays the median salary for the CEO listed on a VC-backed firm's S-1 filing at IPO. If a CEO is not listed, then we take the individual at the top of the table. Some S-1s do not have enough information about compensation, so in these cases we collect the firm's first 14-A filing to get CEO compensation. All dollars are real, 2015 dollars. The median age at IPO (dashed line) reports the median age of VC-backed firms that went public over the sample period. Age is defined as years from first VC financing to IPO date.

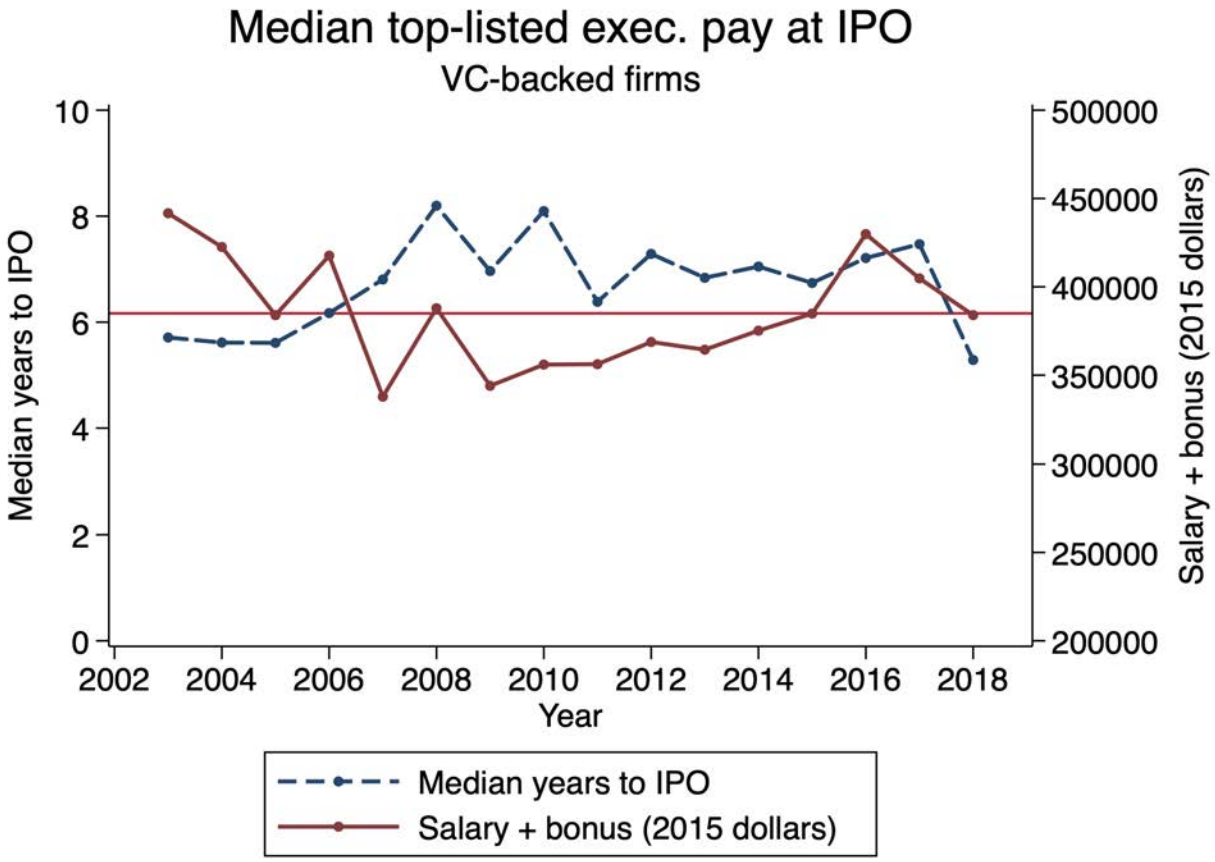


Figure 3: Founder-CEO Salary and Total Cash Compensation is Increasing in Firm Size

Figure displays components of founder-CEO cash compensation as a function of log revenue. Pre-revenue firms form the left dot in Panels A and C and include pre-product firms. Panels B and C exclude pre-revenue firms.

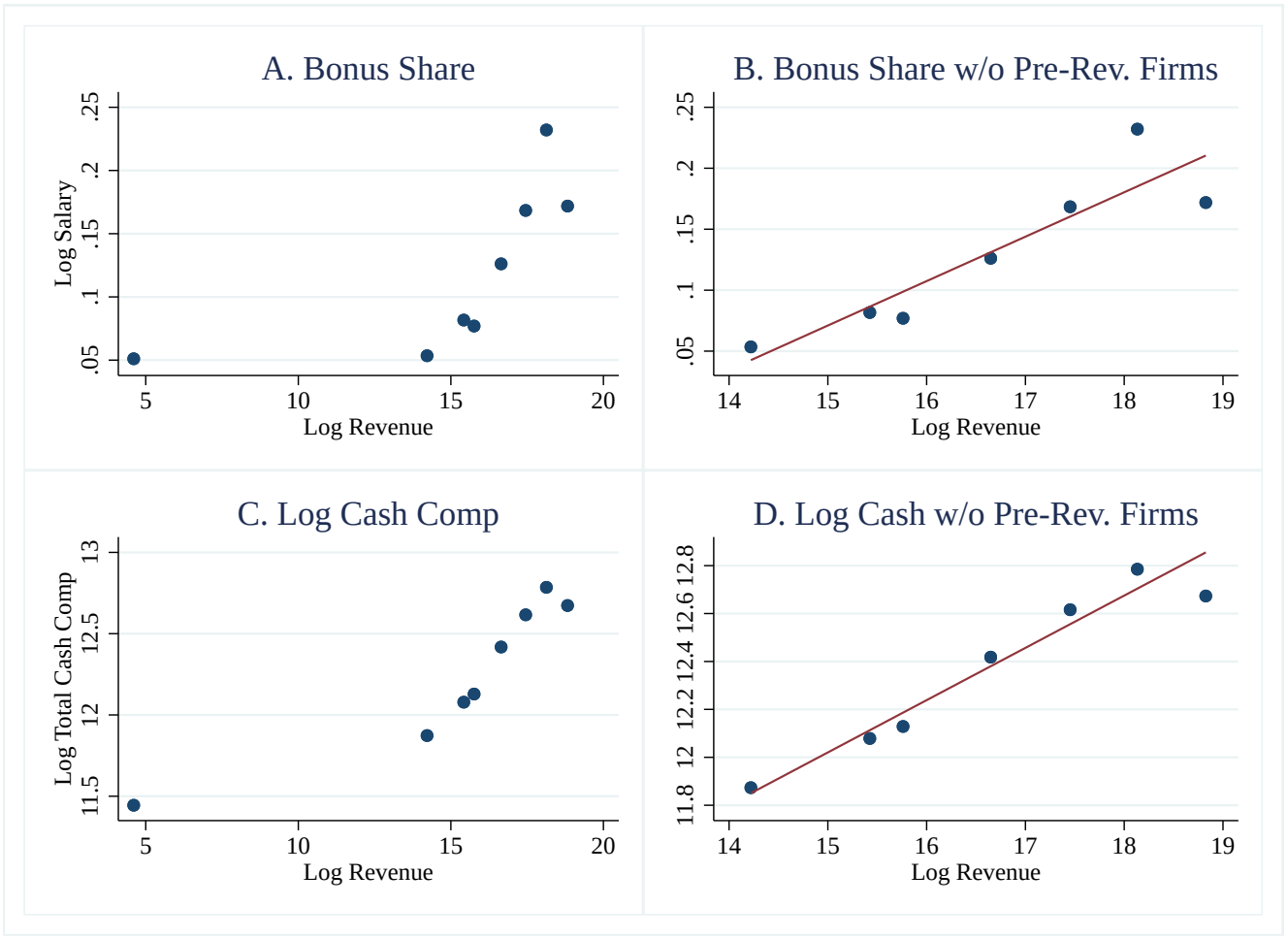


Figure 4: Predicted distributions of Founder-CEO cash compensation by funding round, product, and revenue.

This figure displays density plots using predicted cash compensation in levels from the Poisson regression analog of Equation (1). For readability, firms with greater than $100 million in revenue or above Series D or greater are not included in the plots despite being in the regression.

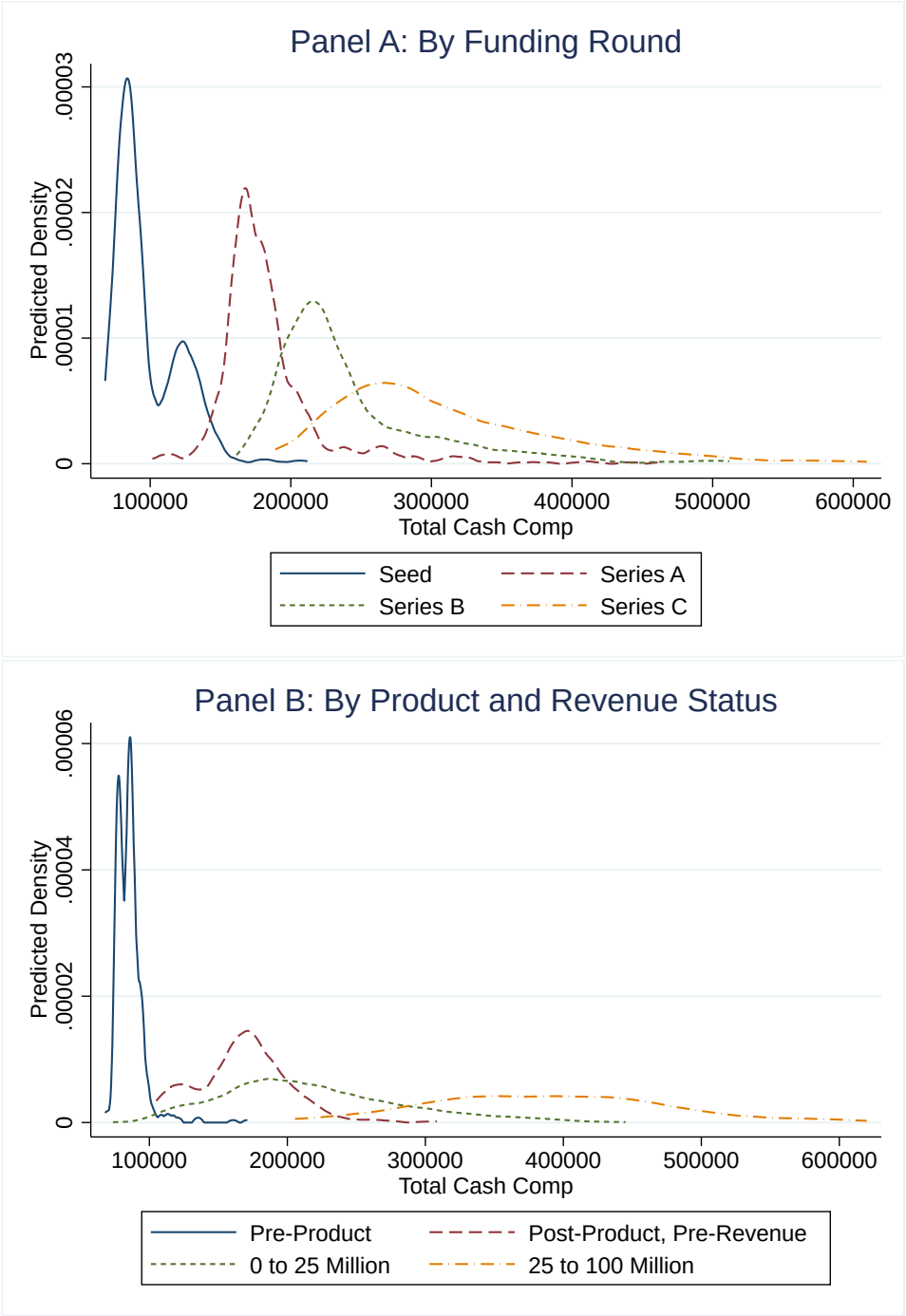


Figure 5: Revenue and product milestones are either achieved early or not at all.

Data from the pooled AHR sample. The figure displays the fraction of surviving firms by age that have achieved various milestones.

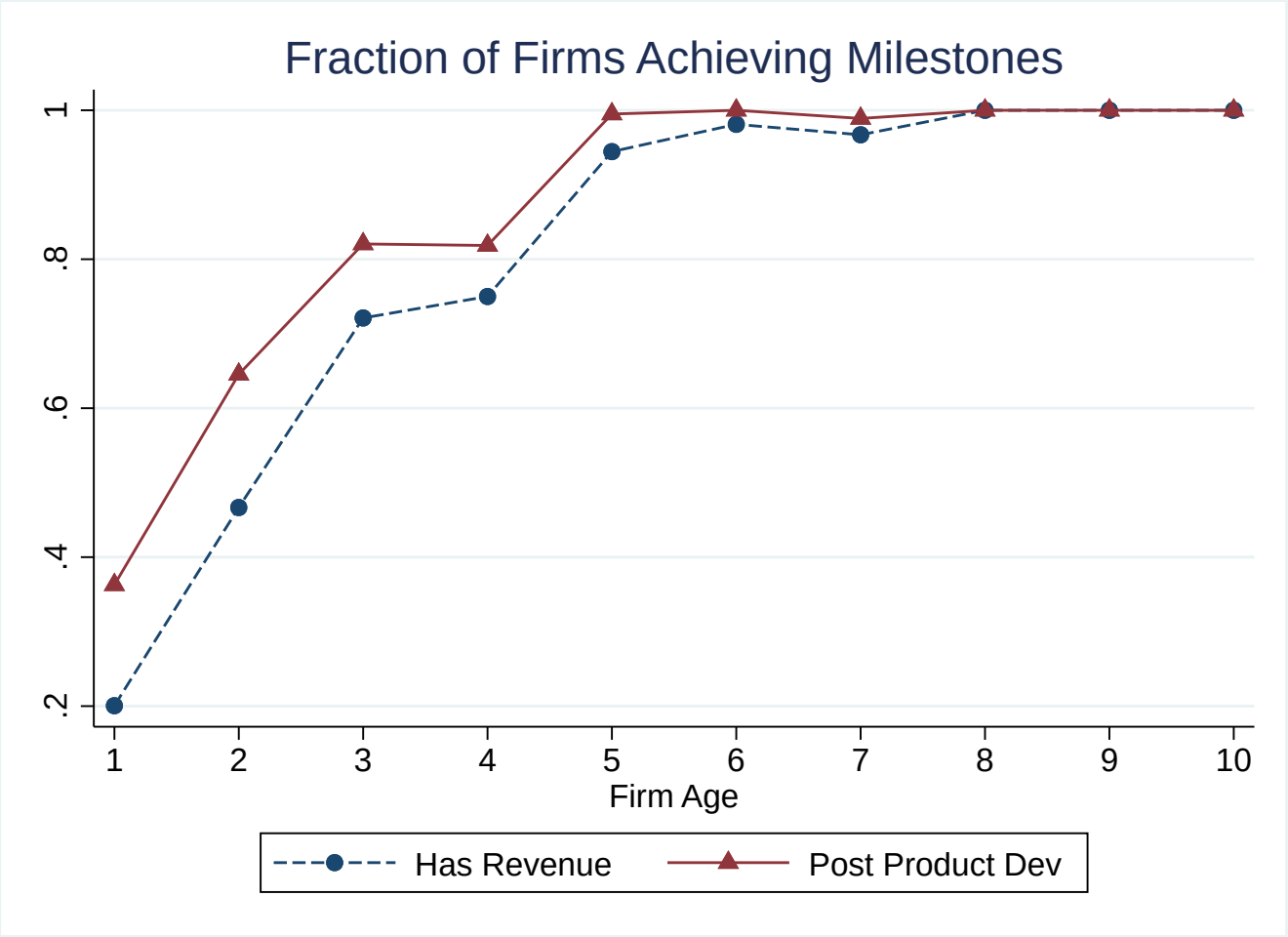


Figure 6: Fraction of Firms Lead by Founder-CEOs in the AHR Data

Figure plots the fraction of surviving firms in the AHR data that have founder-CEOs. The sample is pooled over survey waves.

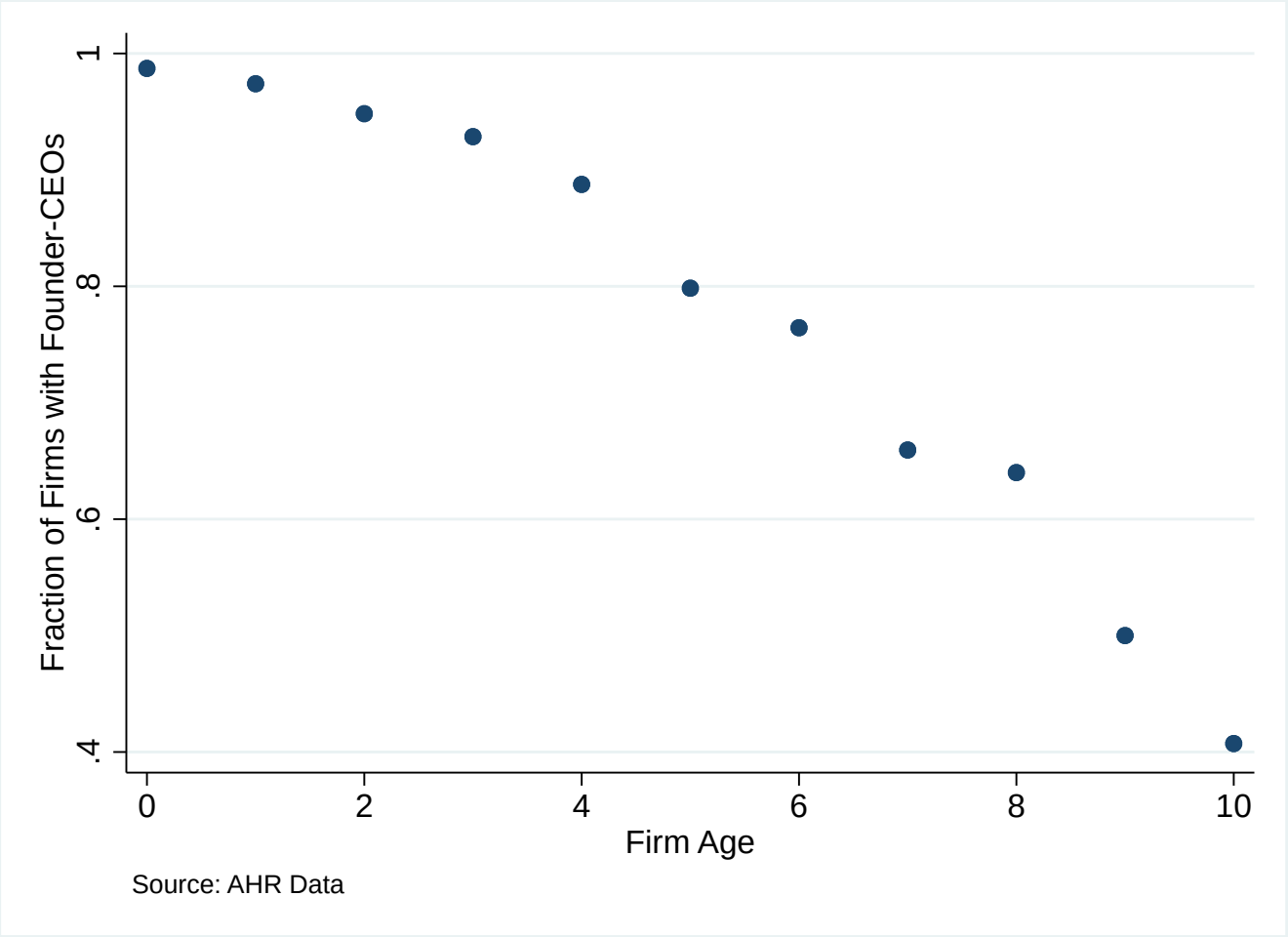
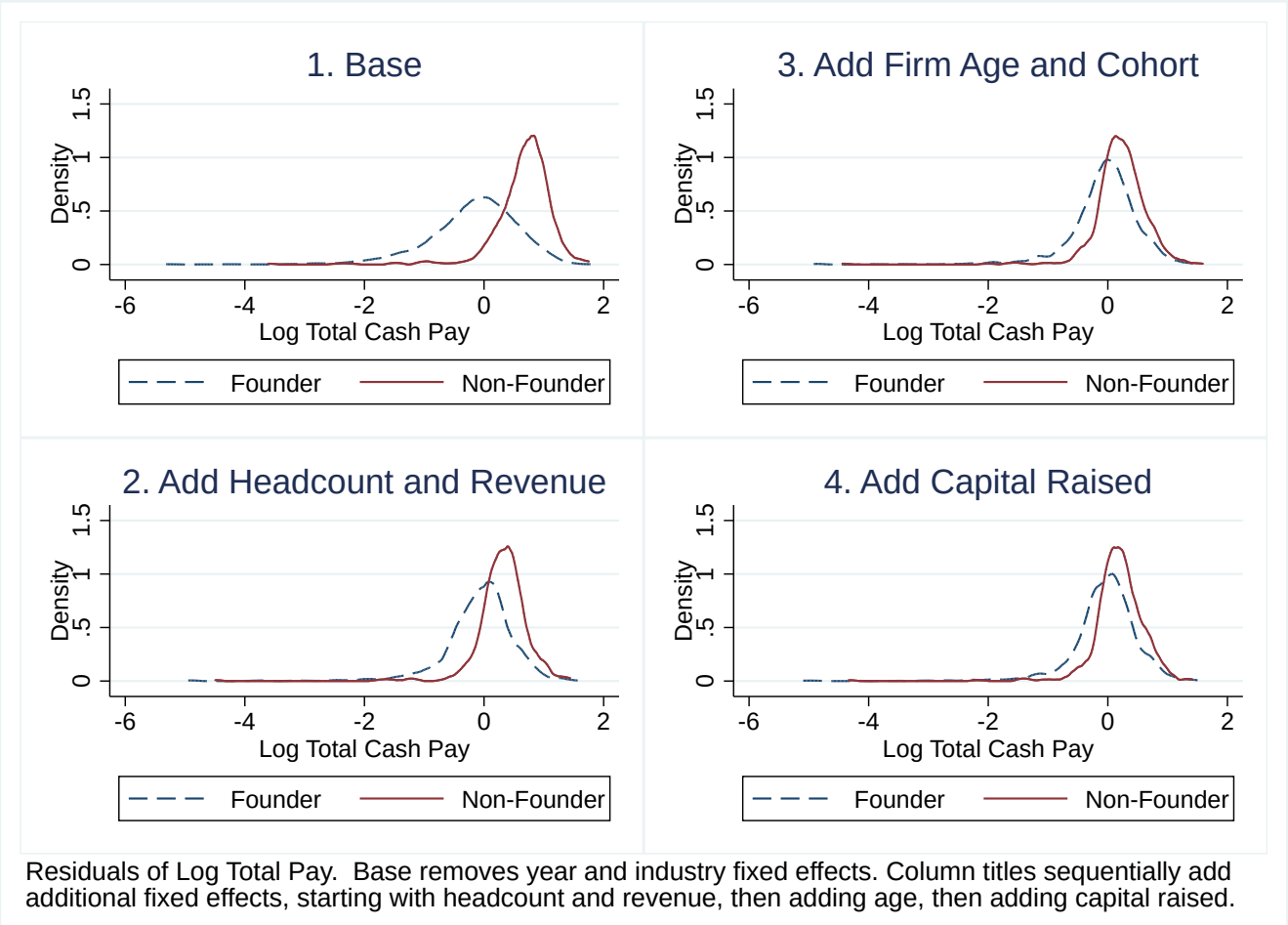


Figure 7: Differences in Residual Log Cash Compensation between founder CEOs and non-founder CEOs in VC-backed startups

Figure plots residuals of regressions of log total pay separately for founder and non-founder CEOs. Each plot corresponds to a different regression. Base removes year and industry fixed effects, while subsequent specifications add categorical fixed effects as given in the column titles.



Residuals of Log Total Pay. Base removes year and industry fixed effects. Column titles sequentially add additional fixed effects, starting with headcount and revenue, then adding age, then adding capital raised.

Figure 8: Comparison of Entrepreneurship Attractiveness Under Different Scenarios

This figure compares the certainty equivalent of entrepreneurship under a fixed contract with $150,000 in pay over the life of a venture (top line) to a contract where compensation increases with firm age due to milestones, taking moments from the Advanced HR data (bottom line). The coefficient of relative risk aversion is assumed to be 2. The area above each line is the region where the certainty equivalent is positive. Hall and Woodward's fixed contract is the solid line. The certainty equivalent based on the contract using observed compensation moments is the line with blue circles. The shaded region gives the additional entrepreneurship under our estimates. The percentiles of the outside salary distribution from are taken from the Statistics of Income (SOI) data stored at the NBER. We use data items 85 and 86 from the SOI data, which contain W2 earnings for individual filers and married joint filers. Individuals without W2 earnings are not included in the percentile estimates. Wealth percentiles are interpolated from data provided in Saez and Zucman (2016).

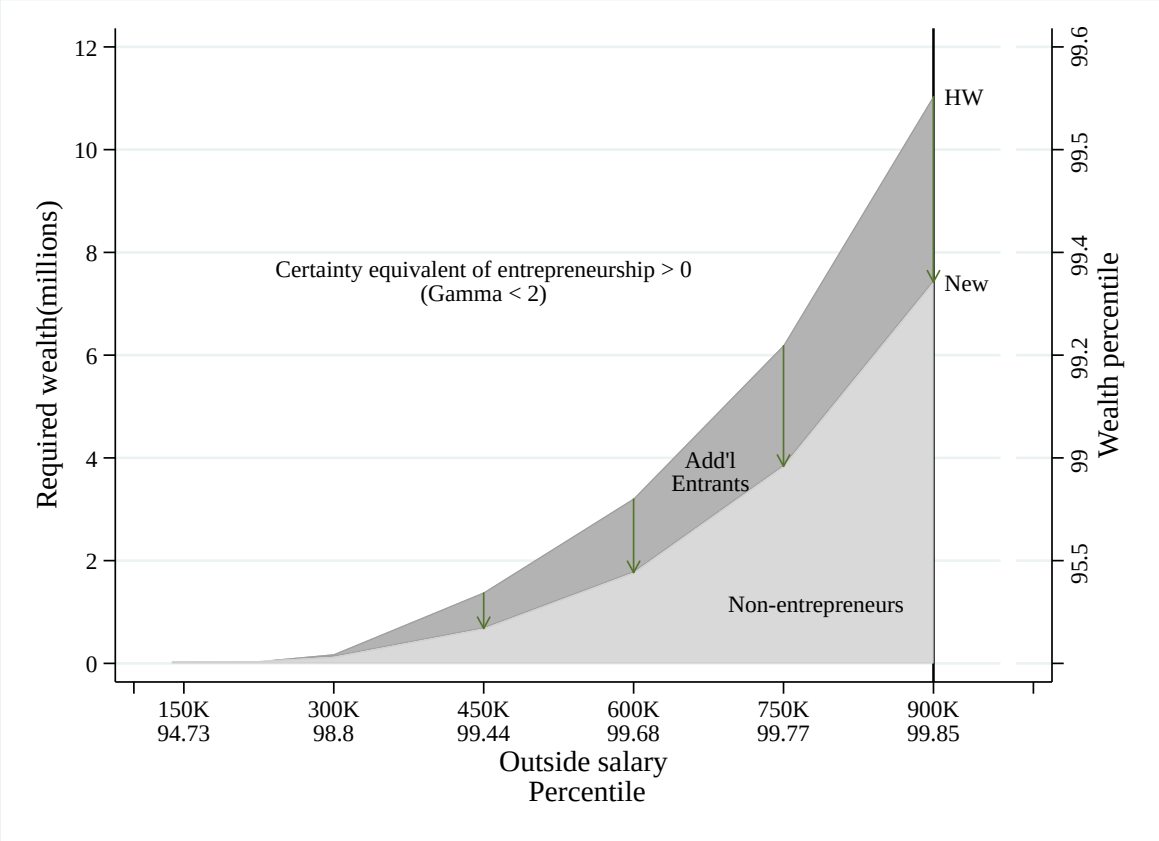


Figure 9: Distribution of pre-founding salary as a percentage of the maximum salary found in Glassdoor

This figure reports summary statistics of the founder's pre-founding salary and the salary data for other positions at their pre-founding employer. For each such employer, we collect the full set of titles and average salaries from Glassdoor. From this, we compute the maximum salary. We next find the best match for the founder's pre-founding title within this Glassdoor title list and use it to assign the founder a pre-founding salary. The figure reports the distribution of the ratio of the founder's pre-founding salary and the maximum.

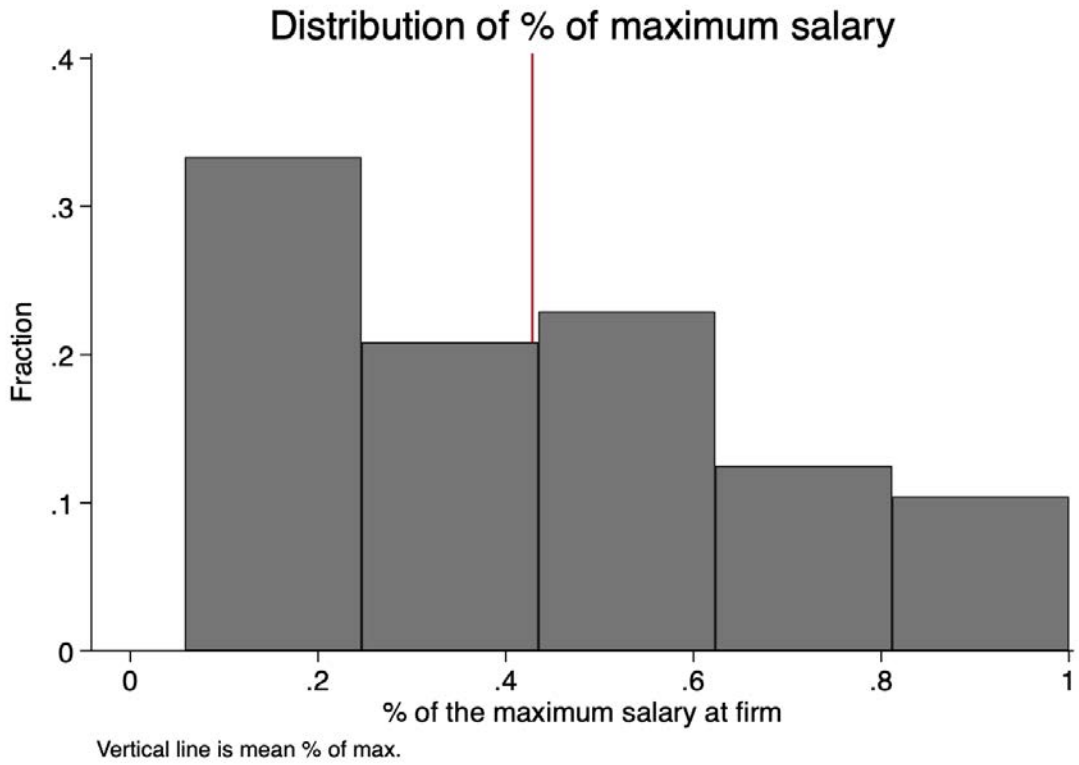


Table 1: Comparison of Compensation Data and Venture Investments by Eligible Funds

This table compares the AHR data to an outside dataset, the VC investments in VentureSource, conditioning on the fund(s) participating in the AHR survey in each year. The Venture Source data were downloaded in 2018 Q4 and, to match the AHR sample, we exclude firms in healthcare, energy, industrial goods, and unknown industries. We exclude firms in both samples that are greater than 10 years old. We drop Venture Source firms that have more than 4 years elapsed since raising their last round of capital. We exclude non-standard financings (e.g. Initial Coin Offerings, spinoffs, or restarts) and also attempt to exclude mature firms that access private capital later in their lifecycle by dropping firms that have traditional private equity (rather than VC) investors in the first round, large debt rounds in their first round of financing (greater than $3 million), or first rounds of financing with greater than $50 million in investment.

	2015 Count	2017 Count	Pooled Count	Share of Pooled Venture Source Sample	2015 Count	2017 Count	Pooled Count	Share of Pooled AHR Sample	AHR Fraction of Venture Source
Panel A: By Firm Age									
Founded This Year	74	51	125	3%	29	49	78	3%	62%
1 Year Old	159	181	340	9%	108	161	269	12%	79%
2 Years Old	256	323	579	15%	133	215	348	15%	60%
3 Years Old	311	334	645	17%	133	203	336	15%	52%
4 Years Old	291	332	623	16%	119	210	329	15%	53%
5 Years Old	187	320	507	13%	63	185	248	11%	49%
6 Years Old	161	253	414	11%	72	136	208	9%	50%
7 Years Old	114	164	278	7%	58	80	138	6%	50%
8+ Years Old	150	238	388	10%	112	190	302	13%	78%
Total	1703	2196	3899	100%	827	1429	2256	100%	58%
Panel B: By Total Venture Capital Raised (Millions of Dollars)									
$0 - $10 Million Raised	649	929	1578	40%	320	628	948	42%	60%
10--25	419	464	883	23%	163	265	428	19%	48%
25-50	296	373	669	17%	151	245	396	18%	59%
50-75	125	176	301	8%	80	108	188	8%	62%
75-100	76	74	150	4%	45	69	114	5%	76%
100+	138	180	318	8%	68	114	182	8%	57%
Total	1703	2196	3899	100%	827	1429	2256	100%	58%

Table 2: Comparison of Compensation Data and the Universe of Venture Investments

This table compares the AHR data to an outside dataset, the universe of VC investment in Venture Source. The Venture Source data were downloaded in 2018 Q4 and, to match the AHR sample, we exclude firms in healthcare, energy, industrial goods, and unknown industries. We exclude firms in both samples that are greater than 10 years old. We drop Venture Source firms that have more than 4 years elapsed since raising their last round of capital. We exclude non-standard financings (e.g. Initial Coin Offerings, spinoffs, or restarts) and also attempt to exclude mature firms that access private capital later in their lifecycle by dropping firms that have traditional private equity (rather than VC) investors in the first round, large debt rounds in their first round of financing (greater than $3 million), or first rounds of financing with greater than $50 million in investment.

	2015 Count	2017 Count	Pooled Count	Share of Pooled Venture Source Sample	2015 Count	2017 Count	Pooled Count	Share of Pooled AHR Sample	AHR Fraction of Venture Source
Panel A: By Firm Age									
Founded This Year	230	133	363	4%	29	49	78	3%	21%
1 Year Old	573	418	991	11%	108	161	269	12%	27%
2 Years Old	757	691	1448	16%	133	215	348	15%	24%
3 Years Old	833	753	1586	18%	133	203	336	15%	21%
4 Years Old	692	727	1419	16%	119	210	329	15%	23%
5 Years Old	462	643	1105	12%	63	185	248	11%	22%
6 Years Old	315	503	818	9%	72	136	208	9%	25%
7 Years Old	236	334	570	6%	58	80	138	6%	24%
8+ Years Old	341	383	724	8%	112	190	302	13%	42%
Total	4439	4585	9024	100%	827	1429	2256	87%	25%
Panel B: By Total Venture Capital Raised (Millions of Dollars)									
$0 - $10 Million Raised	2851	2817	5668	63%	320	628	948	42%	17%
10--25	757	779	1536	17%	163	265	428	19%	28%
25-50	427	499	926	10%	151	245	396	18%	43%
50-75	158	208	366	4%	80	108	188	8%	51%
75-100	89	87	176	2%	45	69	114	5%	65%
100+	157	195	352	4%	68	114	182	8%	52%
Total	4439	4585	9024	100%	827	1429	2256	100%	25%

Table 3: Descriptive Statistics for All CEOs

Data come from a survey of startups who are encouraged to participate by their investors. The sample includes cross-sections for U.S. based CEOs in technology (consumer, enterprise, hardware, other technology) firms for 2015 ($N = 933$), and 2017 ($N = 1552$). Changing numbers of observations across years arise because 1) there are more investments, especially in seed and early-stage rounds, and 2) new funds are added to the survey (although top tier VC firms are included in every survey wave). Cell means are reported on data that pool the survey years. The survey protects anonymity by coarsening revenue, number of employees (headcount), and total capital raised. Panel B reports data for the coarsened revenue category. Among pre-revenue firms we distinguish those that are "Pre-Product" and those that are "Post-Product". Pre-Product firms are those pre-revenue firms that report "Early / Product Definition" as their development stage. Post-Product firms report "Product Development, "Product in Beta", "Shipping Product" or "Profitable" as their product development stage. All firms with strictly positive revenue are "Post-Product" firms. Average cumulative venture capital raised and average headcount are computed using the mid-point of each category. For averages involving the top category, we use the conditional mean for the category calculated from uncensored data in VentureSource. The survey reports the exact value of each executive's salary, target bonus, and fully diluted equity in the firm. Total target cash compensation is the sum of salary and target bonus. CEO's equity ownership is calculated using fully diluted equity in the firm on an as-converted basis, including any option pools and convertible preferred stock. Fully diluted equity is reported for the CEO, it is not the total founders' equity in the firm.

	Share of firms	Firm age (years)	Cumulative Venture Capital Raised ($ M)	Average Headcount	Mean of CEO's Total Target Cash Compensation	Std. Dev of Total Target Cash Compensation	CEO's Equity Ownership
Panel A: By round of financing							
Seed	26%	2.2	3.3	10	98,882	70,344	37%
Series A	24%	3.9	15.2	42	198,187	118,598	20%
Series B	20%	5.2	40.0	87	268,698	129,529	14%
Series C	14%	7.0	78.1	146	338,194	155,783	10%
Series D	9%	8.3	120.4	186	398,911	136,367	8%
Series E and beyond	8%	10.3	181.5	214	443,662	154,707	6%
Panel B: By revenue							
Pre-Product, Pre-Revenue	18%	1.8	3.8	7	85,049	62,479	39%
Post-Product, Pre-Revenue	8%	2.5	22.7	26	178,168	91,884	22%
$0-$10M	40%	4.4	27.5	48	213,486	115,812	18%
$10M-$25M	14%	7.2	64.5	118	311,715	131,300	12%
$25M-$50M	10%	8.6	104.9	195	391,208	140,105	10%
$50M-$100M	6%	8.7	141.2	235	451,279	164,594	9%
$100M+	4%	9.1	161.5	274	449,043	242,598	12%

Table 4: Summary Statistics on Founder vs. Non-Founder CEOs of VC Backed Firms

Notes: Descriptive Statistics are drawn from the proprietary survey data and pool years 2015, and 2017. Non-founders make up 20.5 percent of the overall sample.

		Founder CEOs				Non-Founder CEOs			
Firm Revenue	Share of CEOs that are founders or co-founders	CEO's Total Target Cash Compensation	CEO's Base Salary	Base Salary Share of Cash Compensation	CEO's Equity Ownership	CEO's Total Target Cash Compensation	CEO's Base Salary	Base Salary Share of Cash Compensation	CEO's Equity Ownership
Pre Revenue	96%	108,701	103,150	95%	35%	247,098	214,286	87%	9%
$0-$10M	83%	186,898	173,982	93%	21%	347,876	277,574	80%	6%
$10M-$25M	67%	265,516	232,021	87%	15%	406,546	306,610	75%	5%
$25M-$50M	53%	333,789	277,579	83%	14%	456,903	329,827	72%	5%
$50M-$100M	61%	402,382	308,999	77%	13%	529,358	358,834	68%	4%
$100M+	64%	382,422	316,696	83%	15%	569,796	380,341	67%	5%

Table 5: Regressions of Log Cash Compensation on Milestones for VC Backed Founder-CEOs

This table reports regressions of Log Cash Compensation (salary + bonus) on firm characteristics and milestones from the AHR survey. The sample is restricted to founder-CEOs. Survey data are coarsened to protect firm anonymity, so we use indicators for different milestone categories. The regression in Column 6 is re-weighted to reflect the Venture Source distribution of firm age and capital raised within each survey year. Robust standard errors in parentheses. Post Series D and Post Series E (omitted due to space) are similar to Post Series C. The Post Product Definition indicator is a dummy that the firm has moved past early stage product definition into: product development, a beta product, shipping product, or profitable sales. The sample excludes CEOs with under $5 in total cash compensation. Poisson regressions including these CEOs (Table 1) are similar.

	(1)	(2)	(3)	(4)	(5)	(6)
Post Product Definnition			0.596***	0.477***	0.338***	0.364***
			(0.059)	(0.057)	(0.068)	(0.076)
Revenue (Baseline is Pre-Revenue)						
$0M-$10M	0.565***	0.447***	-0.003	0.013	-0.014	0.054
	(0.037)	(0.045)	(0.084)	(0.083)	(0.084)	(0.098)
$10M-$25M	0.975***	0.714***	0.263**	0.144	0.094	0.188
	(0.042)	(0.055)	(0.092)	(0.090)	(0.091)	(0.107)
$25M-$50M	1.170***	0.849***	0.401***	0.242*	0.202*	0.281*
	(0.054)	(0.064)	(0.097)	(0.097)	(0.097)	(0.117)
$50M-$100M	1.340***	0.988***	0.540***	0.357***	0.314**	0.436***
	(0.069)	(0.080)	(0.109)	(0.107)	(0.106)	(0.128)
$100M+	1.230***	0.875***	0.424**	0.228	0.226	0.124
	(0.118)	(0.123)	(0.145)	(0.139)	(0.137)	(0.178)
VC Funding Round (Seed is Baseline)						
Post Series A					0.284***	0.259***
					(0.062)	(0.064)
Post Series B					0.454***	0.393***
					(0.080)	(0.079)
Post Series C					0.544***	0.475***
					(0.092)	(0.096)
Firm Age Dummies		Y	Y	Y	Y	Y
Cumulative VC Raised Dummies				Y	Y	Y
Region and Industry Dummies				Y	Y	Y
Unreported Venture Round Dummies					Y	Y
Re-weighted						Y
R-Squared	0.318	0.354	0.397	0.422	0.444	0.357
Observations	1920	1920	1920	1920	1920	1920

Table 6: Analysis of Having a Non-Founder as CEO Among Surviving Firms

This table reports regression results where a dummy for the presence of a non-founder as CEO is regressed on measures of product market fit. Columns (7)-(9) repeat the analysis of columns (1)-(6) using VentureSource. VentureSource allows us to track executive replacement from 2010 to the present, the dates of the replacement and the identity of the new CEO. In columns (7) and (8) we consider the sub-sample of years where startups are alive in 2015 and 2017. "Post-product Definition" is equal to one if VentureSource reports that the company "Has Revenues" or "Profitable" (observed at every new financing). Column (9) takes advantage of the full panel and all years. Here a unit of observation is a startup-year, where startups are tracked from first VC financing to either exit, founder-CEO replacement or end of sample (whichever comes first)." All specifications have year fixed effects. Robust standard errors in parentheses.

	AHR Sample						Venture Source		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post Product Definition	0.0512***	0.0518***	0.0435*	0.0114	0.2080**	0.0603**	0.0138*	0.0134*	0.0101***
	(0.0120)	(0.0126)	(0.0204)	(0.0173)	(0.0658)	(0.0204)	(0.0074)	(0.0074)	(0.00458)
Firm Age	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry		Y	Y	Y	Y	Y		Y	Y
Region		Y	Y	Y	Y	Y		Y	Y
Revenue			Y	Y	Y				
Capital Invested				< $10M	> $10M				
Only Pre-Revenue Firms						Y			
All Years									Y
R-Squared	0.242	0.252	0.256	0.133	0.210	0.151	0.0196	0.0337	0.0282
Observations	2485	2485	2485	963	1522	649	3,293	3,293	11,030

Table 7: Characteristics of Founder-CEOs at time of founding

The table reports the summary statistics of biographical data collected for 2011–12 startups with founders outside the healthcare sector (described in Section 2). Column (1) reports the summary statistics for the full sample of founders. Column (2) reports the statistics of a smaller sample where we have collected and categorized a founder's pre-founding employment history. Column (3) is the subset of founders in (2) that have a pre-founding salary less than $300,000. Column (4) reports the summary statistics for the sub-sample of founders that have salary greater than $300,000.

		Random sub-sample with detailed biographies		
	Full LinkedIn sample	Sub-sample with pre-entry cash comp estimates	Those in sub-sample with pre-entry cash comp < $300,000	Those in subsample where pre-entry cash comp is > $300,000
Number of Founder CEOs	1,415	103	91	12
Share of Founder CEOs		100%	88%	12%
Age at founding (yrs.)	35.9	36.0	35.2	42.3
# years pre-founding job exp.	11.9	11.4	10.9	15.5
# jobs pre-founding	4.4	4.5	4.4	4.9
Founder of Startup before?	0.10	0.05	0.05	0.00
Non MBA masters degree	0.40	0.51	0.51	0.50
MBA	0.22	0.31	0.32	0.25
Ph.D.	0.06	0.04	0.02	0.25
JD	0.03	0.00	0.02	0.08
Ivy league (any level)	0.02	0.01	0.01	0.00
Pre-Founding Salary (avg)		231,906	174,410	667,942
Pre-Founding Salary (25th percentile)		134,000	125,900	341,200
Pre-Founding Salary (50th percentile)		181,500	176,000	403,900
Pre-Founding Salary (75th percentile)		247,900	235,900	539,500

Appendix

Figure A1: The cash compensation-size elasticity for post-revenue VC-backed and publicly traded firms.

Data on private firms come from the AHR survey. Data on public firms is taken from Execucomp and scraped Proxy statement filings. For public firms, we drop financials and utilities. The sample of public firms in the compensation data over-weights large firms relative to the Compustat universe of publicly traded firms, so we re-weight the compensation data to reflect the Compustat universe. The sample excludes CEOs with under $5 insalaryorunder 5$ in total cash compensation.

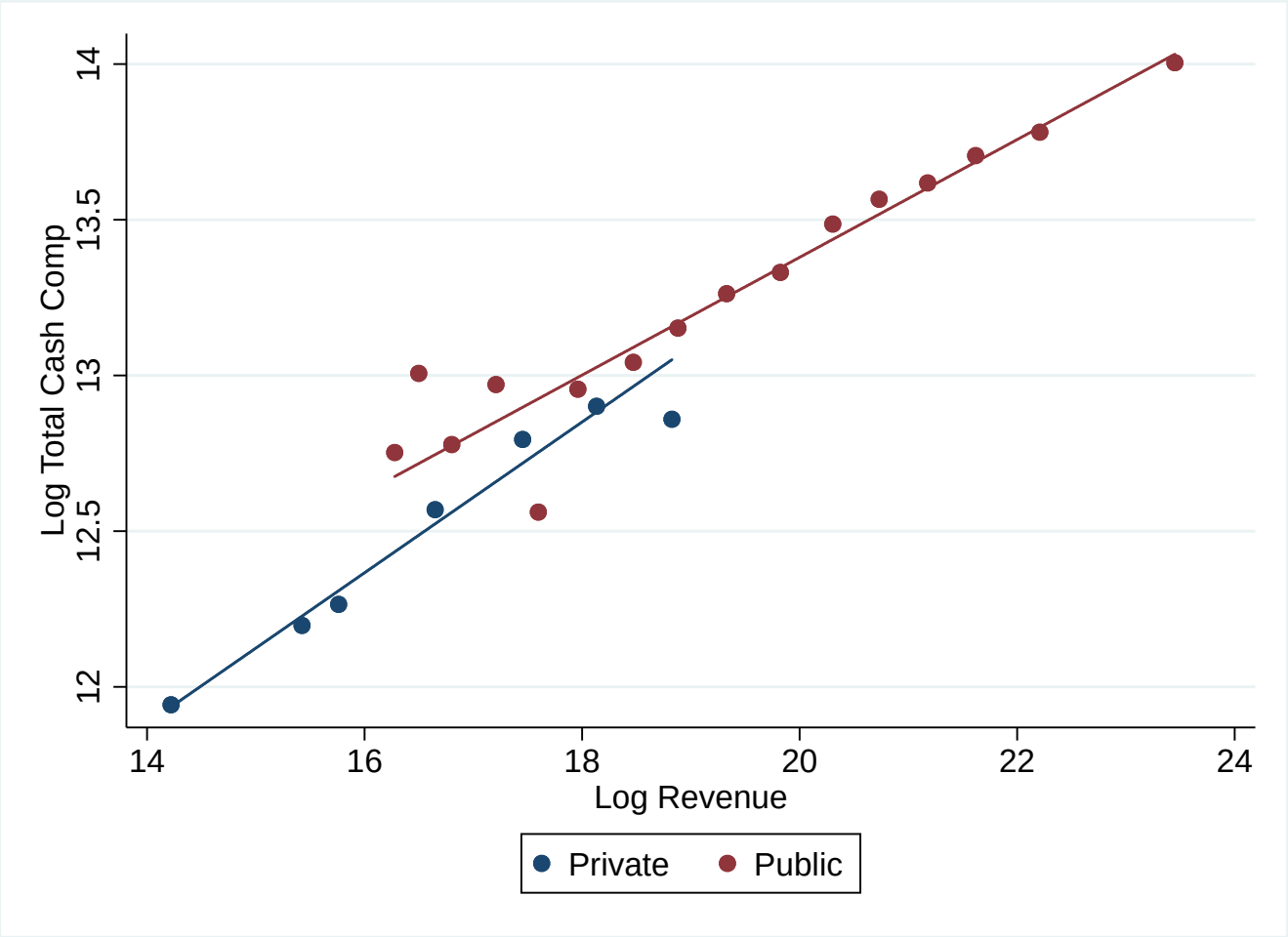


Figure A2: Cumulative Hazards for Different Outcomes in the VentureSource universe.

The figure reports the hazard of exits for startups financed between 2002 and 2010 excluding firms in the cleantech or biotech spaces. All startup exits are defined as of 8 years after their first VC financing (so each year has the same time to exit). "Failed/Low acq." are exits where there startup has failed or has a reported acquisition value less than 1.5X capital invested. A startup listed as still private as of the end of the sample, but who has not raised a new round of capital in three years (as of year 8) is set to failed. "Acq." includes all other acquisitions.

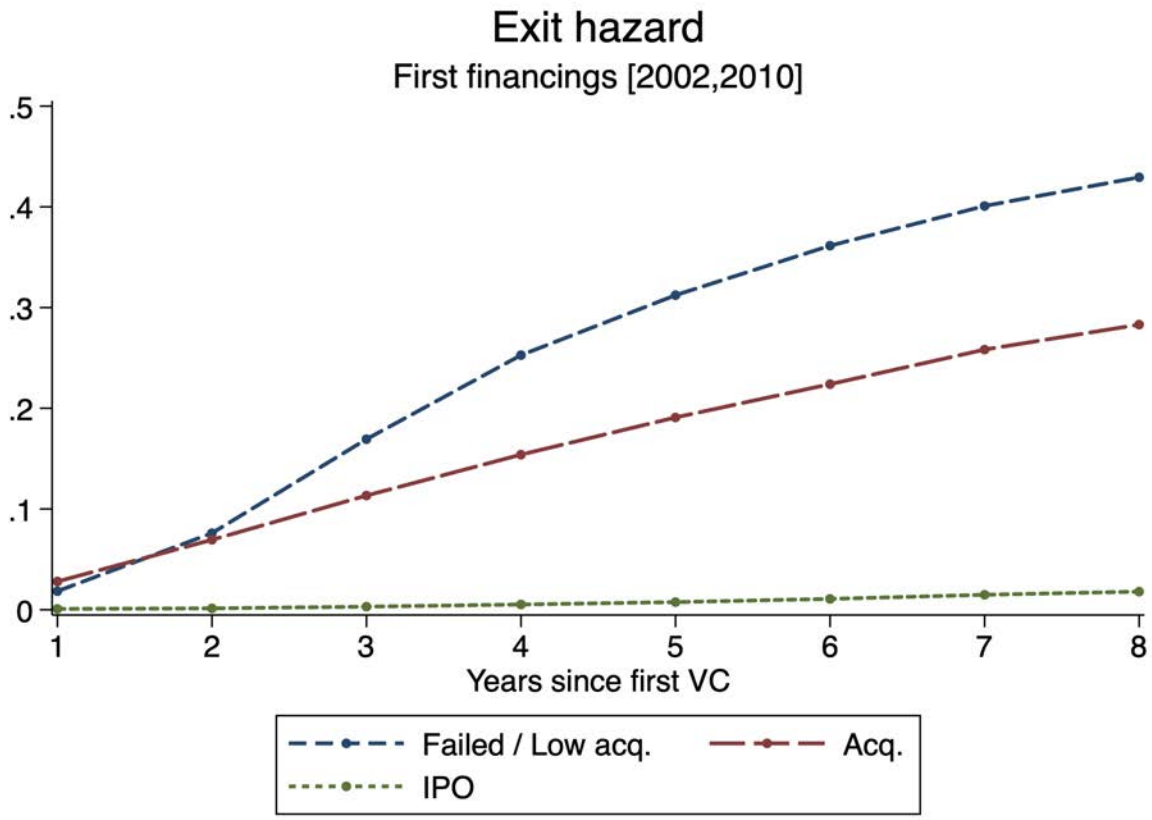


Table A1: Poisson Regressions of Cash Compensation on Milestones for VC Backed Founder-CEOs

This table reports Poisson regressions of cash compensation (salary + bonus) on firm characteristics and milestones from the AHR survey. The sample is restricted to founder-CEOs. Survey data are coarsened to protect firm anonymity, so we use indicators for different milestone categories. The regression in Column 6 is re-weighted to reflect the Venture Source distribution of firm age and capital raised within each survey year. Robust standard errors in parentheses. Post Series D and Post Series E (omitted due to space) are very similar to Post Series C. The Post Product Definition indicator is a dummy that the firm has moved past early stage product definition into: product development, a beta product, shipping product, or profitable sales.

	(1)	(2)	(3)	(4)	(5)	(6)
Post Product Defin (Ideation stage)			0.616***	0.496***	0.365***	0.363***
			(0.050)	(0.050)	(0.058)	(0.068)
Revenue (Baseline is Pre-Revenue)						
$0M-$10M	0.543***	0.401***	-0.054	-0.039	-0.074	-0.014
	(0.033)	(0.037)	(0.054)	(0.052)	(0.051)	(0.060)
$10M-$25M	0.894***	0.609***	0.152*	0.049	0.001	0.095
	(0.040)	(0.048)	(0.063)	(0.061)	(0.061)	(0.073)
$25M-$50M	1.120***	0.783***	0.329***	0.192**	0.152*	0.221**
	(0.046)	(0.053)	(0.067)	(0.066)	(0.067)	(0.082)
$50M-$100M	1.309***	0.945***	0.490***	0.327***	0.291***	0.408***
	(0.047)	(0.055)	(0.069)	(0.071)	(0.072)	(0.096)
$100M+	1.261***	0.902***	0.445***	0.267**	0.273**	0.188
	(0.084)	(0.084)	(0.094)	(0.092)	(0.093)	(0.131)
VC Funding Round (Seed is Baseline)						
Post Series A					0.263***	0.230***
					(0.048)	(0.054)
Post Series B					0.377***	0.306***
					(0.064)	(0.070)
Post Series C					0.455***	0.359***
					(0.074)	(0.086)
Firm Age Dummies		Y	Y	Y	Y	Y
Cumulative VC Raised Dummies				Y	Y	Y
Region and Industry Dummies				Y	Y	Y
Unreported Venture Round Dummies					Y	Y
Re-weighted						Y
Pseudo R-Squared	0.390	0.441	0.479	0.507	0.527	0.419
Observations	1976	1976	1976	1976	1976	1975

Table A2: Log Cash Compensation for VC-backed Founder-CEOs Appears Linear With Respect to Log Firm Revenue

Regressions of log cash compensation on log revenue. Columns 1 and 5 contain year, industry, and headcount fixed effects. Columns 2 and 6 add region, funding series, and cumulative capital raised fixed effects. Columns 3 and 7 add indicators for product development stage milestones. Columns 4 and 8 restrict the sample to firms with positive revenue that have moved beyond the product development stage.

	Log Salary				Log Total Cash Compensation (Salary + Bonus)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full Sample			Without Pre-Revenue firms	Full Sample			Without Pre-Revenue firms
Log of Firm Revenue	0.180***	0.0845***	0.0899***	0.0965***	0.227***	0.117***	0.122***	0.128***
	(0.0117)	(0.0129)	(0.0128)	(0.0133)	(0.0132)	(0.0151)	(0.0150)	(0.0158)
Post Product Definition			0.332***				0.339***	
			(0.0884)				(0.0897)	
Fixed Effects								
Pre-Revenue Dummy	Y	Y	Y		Y	Y	Y	
Region		Y	Y	Y		Y	Y	Y
Funding Series		Y	Y	Y		Y	Y	Y
Cumulative Capital Raised		Y	Y	Y		Y	Y	Y
R-Squared	0.306	0.412	0.421	0.301	0.330	0.422	0.429	0.325
Observations	1918	1918	1918	1339	1920	1920	1920	1339

Table A3: The Elasticity of Cash Compensation with Respect to Revenue in Mature VC-backed and Publicly Traded Firms

Table reports regressions of log salary and log total cash compensation on the log of firm revenue and interactions for publicly traded firms. Data on private firms come from the AHR survey. Data on public firms is taken from Execucomp and scraped Proxy statement filings. For public firms, we drop financials and utilities. The sample of public firms in the compensation data over-weights large firms relative to the Compustat universe of publicly traded firms, so we re-weight the compensation data to reflect the Compustat universe. The sample excludes CEOs with under $5 in salary or under $5 in total cash compensation. All columns contain year fixed effects.

	Log Salary			Log Total Cash Compensation		
	(1)	(2)	(3)	(4)	(5)	(6)
Log of Firm Revenue	0.181***	0.183***	0.181***	0.191***	0.242***	0.239***
	(0.00956)	(0.00962)	(0.00967)	(0.00978)	(0.0111)	(0.0112)
Public Firm	0.243***	0.299	0.258	0.129*	1.383***	1.333***
	(0.0481)	(0.302)	(0.303)	(0.0512)	(0.318)	(0.319)
Public Firm * Log Revenue		-0.00327	-0.000916		-0.0724***	-0.0695***
		(0.0160)	(0.0160)		(0.0170)	(0.0170)
Post Product Definition			0.731***			0.740***
			(0.0709)			(0.0716)
Pre-Revenue Dummy	Y	Y	Y	Y	Y	y
R-Squared	0.318	0.318	0.327	0.313	0.314	0.323
Observations	4729	4729	4729	4734	4734	4734

Table A4: Transition Matrix of Job Titles for Founder CEOs of Failed Startups

Notes: This table reports the transition matrix of title changes (i.e. job moves) for the subset of founders who have at least one pre- and one post-founding job title. The sample of founders is described in Section 5.1. The titles are found in the founder's LinkedIn profile and are associated with distinct companies, rather than moves within-firm. Titles are coded as a hierarchy that takes the top position available. If the founder has "CEO" anywhere in their title, then that is coded as a 1 and all others titles are 0. If a founder has "Founder, CTO" in pre-founding history, then she will be listed as "C-level" rather than "Founder." "Other title" captures a set of over 100 different titles not contained in the other categories that we cannot classify hierarchically.

		Share of post-founding titles			
Pre-founding job Titles	Share of pre-founding job titles	C-level, founder or investor	VP / Mid career	Associate / Analyst	Other title
C-level, founder or investor	41%	53%	13%	5%	29%
VP / Mid career	28%	47%	11%	3%	39%
Associate/Analyst	9%	50%	8%	0%	42%
Other title	22%	50%	11%	3%	36%
Total	135	67	15	5	48