Founder-CEO Compensation and Non-Diversifiable Risk over the Life of Venture Capital-Backed Firms*

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Abstract

We use unique micro data to document the evolution of founder-CEO compensation over the life of private, venture capital-backed firms. Consistent with theories emphasizing asymmetric information, we find that founder-CEOs earn relatively little cash compensation early in the life of a new venture. However, the ability to commercialize a product is an important inflection point, beyond which VC-backed CEOs transition to "professionalized" compensation schedules where liquid cash compensation increases significantly in response to product and financial milestones. Since 80% of new startups either fail or hit transition milestones within three years of founding, we show that non-diversifiable risk borne by founder-CEOs is low enough for the vast majority of potential entrepreneurs to select into entrepreneurship even with standard levels of risk aversion.

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1 Introduction

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. 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 till they can access liquid cash, the greater their 'burden of non-diversifiable risk'.

It is widely believed that venture capital contracts *have* to leave founders bearing substantial non-diversifiable risk, because VCs need to screen entrepreneurs and align incentives and hence have to back-load the majority of liquid cash compensation. However, the value of screening or incentive alignment is likely to change after certain milestones—like developing a successful product or realizing revenue—are achieved. For example, Rajan (2012) models the lifecycle of firms, with venture capital investors seeking differentiated ideas, but after determining demand exists for the product, proceeding to standardize the firm. This 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 how the compensation contract between entrepreneurs and investors, and whether this also evolves in parallel over the lifecycle of the firm.

In this paper, we use unique individual data on executive compensation in venture capital backed startups to study both the level and evolution of entrepreneurial compensation in VC-backed firms. 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 founder or not, and we have rich covariates on industry, geography, and firm age. This enables us to document a number of facts about founder-CEO compensation and how it evolves over the life of firms.

First, exactly as predicted by financial contracting theories that emphasize adverse selection, we find that founder cash compensation is minimal at the birth of ventures. Second, however, we find that cash compensation changes substantially with respect to financial and product market milestones that signal the resolution of uncertainty. For example, total cash compensation is under $115,000 for pre-revenue firms on average, but jumps to nearly $250,000 annually for firms with between $0 and $10 million in revenue. This reflects what appears to be a transition in the contract between investors and CEOs, as cash pay is commensurate with firm size. For firms with between $10 million and $25 million in revenue, average CEO compensation exceeds $ 300,000 dollars annually; average cash compensation is $450,000 for firms with greater than $50 million in revenue. Third we highlight that revenue and product milestones are generally achieved within a short-time since the birth of the firm, at which point cash compensation grows rapidly. For example, we show that within 3 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 "professional" contract. Within 5 years, this number is nearly 100% of CEOs.

Like Manso (2016) and Dillon and Stanton (2018), we note that it is not the initial level of cash compensation, but rather the speed with which uncertain milestones may be unlocked that determines the extent of non-diversifiable risk facing entrepreneurs. We apply this insight to Hall and Woodward's (2010) analysis, to examine the degree to which risk averse individuals may still find it attractive to "experiment" with trying VC-backed entrepreneurship. Applying our milestone-based change in cash compensation to the Hall and Woodward consumption-saving problem, we find that the rapid transition to

higher compensation improves the certainty-equivalent value of entrepreneurship. In our analysis, the certainty equivalent is positive for nearly all reasonably risk-averse potential founders. This is because the minimal cash compensation for entrepreneurs is temporary and coincides with an exploration stage early in the life of the firm; thereafter venture contracts provide valuable liquidity for entrepreneurs.

Having documented that VC-backed entrepreneurship is feasible, if not attractive, for a number of potential entrepreneurs, we focus next on characterizing the margin of selection into VC-backed entrepreneurship by studying the pre-startup backgrounds of founder-CEOs of venture capital backed firms. In particular, we supplement our analysis of the compensation data with the biographies and work histories of a separate sub-sample CEOs drawn at random from the universe of startups in the US. We use this data to provide descriptive evidence on what types of jobs precede startup founding and where startup CEOs transition to work after their employment with the firm ends. The majority of individuals selecting into venture-capital backed entrepreneurship appear to be in jobs where they earn $300,000 or less, or those who would appear to have accumulated assets above $ 1 million. Our estimates suggest that fewer than 1% of all individuals in the population would have a negative certainty equivalent from entering the types of VC-funded technology firms in our sample. These are likely younger 'high flying' employees earning over $350,000 who have not yet accumulated sufficient wealth to make it worthwhile for them to experiment with VC-backed entrepreneurship. Our results therefore also put more structure to the question of *whose* inability to bear non-diversifiable risk will preclude them from starting new ventures.

Our paper is related 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 as

well as, more recently (Edmans et al. 2012), the importance of ongoing cash liquidity when writing dynamic contracts with agents. Our work provides the first evidence from private firms that suggests 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. Related to this point, although a substantial body of work has documented the important role played by Venture Capital investors in shaping the firms they back, including the role of professionalization (Hellmann and Puri 2000, 2002), monitoring (Bernstein, Giroud, and Townsend 2016) and control rights (Kaplan and Stromberg 2001), much less is known about the compensation contract for founders and top executives in VC-backed firms. Our work provides evidence of another 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.

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 the lead them to select into entrepreneurship (Gompers, Lerner, and Scharfstein 2005; Bhidé 2003; Babina, Ouimet, and Zarutskie 2017). While some theoretical work in this realm has examined the financial tradeoffs between entrepreneurship and paid employment (Hellmann 2007; Anton and Yao 1995), 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). Relative to this work, our paper rationalizes the large number of individuals selecting into VC-backed entrepreneurship without having to resort to behavioral drivers such as risk tolerance, optimism, overconfidence, or non-pecuniary benefits. We show that the relatively short duration of low salary before a transition to 'market salary' makes the certainty equivalent of VC-backed entrepreneurship positive for the vast

majority of potential entrepreneurs, even if they are risk averse. Nevertheless, our work also points to the very top end of the human capital distribution, who may have sufficiently high outside options such that the risk-adjusted return to VC backed entrepreneurship is negative. The degree to which their 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.

The rest of the paper is structured as follows. In Section 2, we briefly outline the relevant theories of financial contracting under asymmetric information, and how they relate to theories of compensation. Our goal is to motivate how the transition from a flat, low salary to one that responds to measures of firm size emerges from a change in the weight put on screening relative to dynamic incentives as the firm evolves. Section 3 provides an overview of the data we use in our analysis. We discuss results in Section 4 and the biographical histories of VC-backed founders in Section 5. Section 6 concludes.

2 Motivation and Theory Sketch

Canonical models of dynamic contracting, at least since Holmstrom and Milgrom (1987), motivate effort provision over the duration of a relationship through back-loaded rewards. A different rationale for contracts with large equity stakes and low immediate cash is that these features screen potential entrepreneurs. Entrepreneurs with negative private information about a project's quality or their own ability will not accept a contract that only pays for success (Lazear 1986).

The need to motivate and screen is so important that seminal papers take as given that venture capitalists provide entrepreneurs with limited cash pay prior to an acquisition or an IPO. For example, Hall and Woodward's (2010) now well-known study on the risk borne by entrepreneurs, note that: "entrepreneurs would benefit by selling some of the value they would receive in the best outcome ... in exchange for more wealth in the most

likely [event] of zero exit value. [...] A diversified investor would be happy to trade this off at a reasonable price, given that most of the risk is idiosyncratic and diversifiable. But venture capitalists won't do this–they don't buy out startups at the early stages and they don't let entrepreneurs pay themselves generous salaries. They use the exit value as an incentive for the entrepreneurs to perform their jobs. Moral hazard and Adverse selection bar the provision of any type of insurance to entrepreneurs - they must bear the huge risk [themselves]."

In many real-world scenarios, however, the value of screening to avoid adverse selection likely falls over time as additional data becomes available to an investor. An entrepreneur who can quickly develop a prototype that generates sales is less likely to be a low type than a different entrepreneur who languishes for years attempting to commercialize a product. Signals—like having a tangible product or achieving revenue— that indicate entrepreneurs' value creation potentially enable at least some insurance provision, in the form of immediate, liquid cash, for founders over the remaining life of a firm.

Recent work on the dynamics of compensation by Edmans et al. (2012) provides predictions consistent with this intuition. In their model, time is discrete and a principal contracts with a risk-averse executive. Importantly, incentives to provide effort are not purely back-loaded (paid at the end of the contract): they show that when the agent has a utility function with constant relative risk aversion, cash compensation responds to signals of firm performance. We omit technical details about the model, but the change in cash compensation with respect to firm value works according to the following description outlined in their paper: "When appointed, the CEO is given a "Dynamic Incentive Account" ("DIA"). The DIA contains the agent's wealth, that is, the NPV of his future pay. A given fraction of this wealth is invested in the firm's stock and the remainder in (interest-bearing) cash. Mathematically, the fraction of pay in stock equals the sensitivity of log pay to the stock return, and so it represents the level of incentives. As time evolves and firm value changes, this portfolio is constantly rebalanced to ensure

the fraction of stock remains sufficient to induce effort at minimum risk to the CEO. A fall in the share price reduces the equity in the account below the required fraction; this equity shortage is addressed by using cash in the account to purchase stock. If the stock appreciates, some equity can be sold without falling below the threshold, to reduce the CEO's risk."

Despite the perception that most real-world employment relationships feature intermediate performance rewards in response to signals of value creation,[1] the evolution of compensation arrangements inside startups has received scant attention. This is primarily due to the difficulty of observing the evolution of these relationships. As a result, benchmark models used to assess risk borne by startup founders assume flat (and relatively low) levels of pay over the life of the venture.

2.1 The Hall and Woodward Framework

One of the best-known benchmark models (Hall and Woodward, 2010) 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 papers to use realistic risk preferences while modeling entrepreneurs' consumption and asset accumulation decisions.

We revisit the Hall and Woodward consumption-savings problem where entrepreneurs face the stochastic evolution of entrepreneurial valuation. The entrepreneur's ex-ante problem is to choose consumption in the face of uncertain future assets. Future assets are uncertain because X is firm value that accrues to an entrepreneur in a liquidity event. π_{t+1} is the probability of a liquidity event at date $t+1$ and the stochastic payoff, X, is conditional on exit at $t+1$. Hall and Woodward write the entrepreneur's value function

[1]The literature on wage rigidity, however, suggests that real-world contracts may not feature symmetric reductions in cash compensation in response to bad news. For startups, the reduction in cash compensation usually comes as a result of the firm failing or a founders' departure.

in terms of utility over the total wealth controlled by the entrepreneur and assets as $U(W_t(A_t))$. We simplify their notation, leaving implicit the entrepreneur's control over human wealth, and write the ex-ante value function for an entrepreneur with assets A_t at time t as:

$$\begin{aligned} V(A_t) &= \max_{c_t<A_t} u(c_t) + \frac{1}{1+r}(1-\pi_{t+1})V((A_t-c_t)(1+r)+w) && (1) \\ &\quad + \frac{1}{1+r}\pi_{t+1}E_X V((A_t-c_t)(1+r)+X_{t+1}) && (2) \end{aligned}$$

This ex-ante value function is combined with 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 then they evaluate the certainty-equivalent value of entrepreneurship compared to different values of the non-entrepreneurial wage.

While the baseline level of pre-tax salary (\$150,000) does provide some ability for founders to consume, we show that actual compensation in surviving private firms increases significantly over the firm lifecycle. As we show below, this additional performance-contingent cash compensation changes the entrepreneur's anticipated need to maintain buffer savings and hence the implied attractiveness of entering entrepreneurship. We turn next to a description of these data.

3 Data and Summary Statistics

Our core dataset is based on two cross sections of compensation data from Advanced HR (AHR), a leading provider of such data for VC backed startups. AHR collects individual-level compensation data from private firms that have received investments from participating venture capital investors. 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 firm-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 partners are anonymous and are not linked by individual or firm over time.

Firms become eligible for survey inclusion if they have received investment from the venture-capital partners who cooperate with the survey. Completion of the survey by the portfolio company is strongly encouraged by venture capital investors, who are often typically members of the startup's board. Both VCs and startups get access to benchmarking data in exchange for startup 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 (excluding biotech and healthcare). The 2015 survey contains data from 933 portfolio companies that received funding from 70 VC firms; the 2017 survey has data on 1,552 portfolio companies for 115 venture capital firms.[2] Our core sample focuses on US based CEOs in firms founded after 1996.[3]

Table 1 shows how the AHR data for firms founded after 2009 compares to the universe of investments for firms founded after 2009 in VentureSource, a data provider that collects

[2]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.

[3]We drop 24 firms that are listed as having only growth capital or that have received 6+ rounds of funding. We also exclude firms if we do not know the location of the CEO (eliminating 2 observations).

records from incorporation filings.[4] In the pooled sample, the AHR data covers two-thirds of the VentureSource firms eligible for survey inclusion. Coverage does improve between survey years. Based on counts of firms, the survey also appears to include some investments that are not present in the VentureSource universe. It is possible that these are firms receiving small rounds (or non-priced rounds) that do not show up as equity transactions in the underlying VentureSource corporate records. As a result, our AHR data are slightly biased towards small firms compared to the VentureSource universe.[5] This bias appears to be driven by AHR having relatively more young firms as a share of the total sample. We then seek to assess whether the AHR sample matches other moments of the data after conditioning on firm age. When we condition on firms that are 4 years old, the distribution of total capital raised among 4 year old firms is remarkably similar between Venture Source and AHR (see Figure 1), suggesting that the AHR data matches the universe of venture firms quite well.

Table 2 then displays descriptive statistics for the AHR sample. The data are presented in three panels based on variables that capture variation in the information and milestones investors have about the state of the firm. The first, funding round, captures how many rounds of outside investment the firm has raised. The next two panels present data broken down for firms based on revenue and headcount, respectively. These measures capture product market and internal development. All panels are sorted from an earlier stage to a later stage for each variable, reflected in the column on average firm age. Note, however, that this progression is not linear, 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.

Across rows in each panel of Table 2, mean CEO cash compensation increases with firm

[4]We focus on firms borne after 2009 because to avoid so called 'zombie' firms that have not achieved an exit and not raised another round of financing. These firms may not be part of the survey but will be hard to systematically identify in the VentureSource data.

[5]Because we examine variation that results from milestones, any bias by firm age is only meaningful if sample inclusion is correlated with a milestone that is either more or less likely to have been achieved in the population of firms.

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, or with more than 50 employees), earn on average over $300,000 per year in cash compensation.

Table 3 documents that the large increases in cash compensation over the life of firm are driven in part by a compositional shift in the share of non-founders who transition to the CEO role. Importantly, however, it shows that even among founder-CEOs, compensation increases considerably after the firm has achieved initial product and financial milestones.

Figure 2 provides graphical evidence of the importance of resolving uncertainty prior to an increase in CEO-compensation. The top left panel of Figure 2 displays how average cash compensation and the interquartile range change with firm age. The sample in Figure 2 is restricted to CEOs who are founders or co-founders of the firm. Cash compensation for founder-CEOs increases dramatically with firm age. As firms age, information about the future prospects for the company is revealed, and later analysis attempts to separate whether milestones or age alone explain the upward pattern in Figure 2.[6] The other panels shed light on several alternate explanations. The top right panel of Figure 2 conditions on "Pre-Product" firms that have no revenue and have not yet achieved viable product definition. 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. 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 among Pre-Product firms, compensation remains low even for those firms that raise significant outside investment. These descriptive figures suggest that having a viable product that may produce revenue is a significant inflection point for firms.

Returning to Tables 2 and 3, another relevant feature for assessing the risk borne by

[6]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.

founders is their fraction of firm equity. The final column of Table 2 shows the CEO's 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] Average fully diluted equity for the CEO does fall with additional investment and hiring, with average fully diluted equity falling from 20% of the firm for Series A CEOs to 10% of the firm by Series C.[8] Table 3 also shows that part of the difference in total cash compensation between founder and non-founder CEOs is due to differences in equity ownership. Founder and Non-Founder salaries are closer to each other, but a higher share of the incentive compensation for founders comes from their equity ownership in the firm.

4 Results

With these summary measures in place, we now turn to multivariate analysis to assess what firm characteristics matter for cash compensation, while controlling for factors like age, geography, and industry. Table 4 displays regression results where the dependent variable is log total cash compensation for the founder-CEOs of VC backed firms. The regression is

$$\log(Comp) = X\beta + firmAge_t + Controls + \epsilon \tag{3}$$

where X is a matrix of milestone. 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 the baseline of pre-revenue firms. Subse-

[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.

[8]Note that these equity figures are for the individual executive, not the total founders' equity in the company.

quent 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 approximately 56% increase in pay ($\exp(0.447) - 1$) relative to pre-revenue firms. Column 3 includes an additional development-stage milestone, Post-Product Definition, which a dummy for whether the firm has a product already or is still working on developing the product. The results here are striking, showing that product definition/development is a significant milestone. 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. 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 $\exp(0.338) - 1 = 40\%$.

Note that the sample in Table 4 excludes firms with very low cash compensation, as cash compensation close to zero is an extreme outlier. Appendix Table A1 gets around this issue by using a Poisson regression, as suggested by Silva and Tenreyro (2006). We graphically display these results using 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. The results are in Figure 3. 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 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. The CEOs of these firms are paid accordingly. These results imply — in the framework proposed by Rajan (2012) — that the process of standardization by VCs begins relatively early in the life of a VC backed firm, and that resolving uncertainty around product demand appears to be a key inflection point beyond which this standardization occurs.

Figure 4 displays the relationship between log salary, log total compensation and log firm revenue. What is particularly striking is the very low pay (both log salary and log total cash compensation) 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).

Table 5 provides the regression analogue of this graphical presentation. This analysis suggests that milestones and compensation are positively related, with bonus increasing at a slightly greater rate so that it comprises a larger share of cash compensation in larger firms. The linear relationship between size and 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), again highlighting that the CEO compensation contract appears to migrate to a 'professionalized' contract that is based on size-related milestones relatively early in the life of firms, once basic uncertainty about 'product market fit' has been resolved.

4.1 The timing of milestones and selection

To explore how compensation and milestones evolve with time, ideally we would want to get the joint distribution of outcome timing for {exit, achieving milestones, failure}. This is difficult in the compensation survey because the de-identified data provided under our data use agreement do not contain firm and individual 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. Failure is not necessarily bad (see later tables on what happens to CEOs who exit/fail). Therefore, conditional on survival in the data, we examine the probability of not achieving 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 displayed in Table 4.

Figure 3 documents that some variation in cash compensation for very early stage firms does exist, which may indicate that there is a small amount of predictability in firm evolution that our estimates miss. 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, where surviving firms that develop a product are drawn from the

top of the distribution of compensation, we find an increase in log total compensation of 0.29 ($\approx 34\%$) due to having a tangible product (the standard error is .053).

4.2 Comparing Founders and Non-Founder CEOs

The analysis in Tables 4 and 5 shows that founder-CEOs' cash compensation increases significantly with firm milestones. We now examine how founders compare to non-founding CEOs who have quite similar roles. This exercise is intended to compare whether cash compensation is similar in levels and scales similarly with respect to firm size. In the process, through analyzing the compensation contracts of founders and non-founders, we begin to shed light on the selection of founders relative to their potential replacements.

It is possible that non-founder CEOs are drawn from a different pool of people, who have better outside options or less attachment to the firm. To fix ideas about how this might load on compensation, consider that in many models of incentive provision (e.g. the static Holmstrom agency model), cash compensation is set to satisfy the agent's participation constraint. Differences in cash levels might suggest varied bargaining positions. A different possibility is that a legacy of very high early equity ownership for founders constrains adjustment. VCs may be unable to increase non-founders' equity positions to match the equity held by founders. Cash compensation then would substitute for large equity holdings and large equity holdings themselves may limit founders' cash remuneration. Of course, large equity holdings at the expense of salary potentially means that founders are exposed to additional risk relative to non-founders. For relatively mature firms after product market fit, we cannot disentangle whether it is limits to VC investors' ability to adjust equity or founders' preferences to hold higher equity in the firm. We can only assess whether these instruments appear to be substitutes.

As noted above, Table 3 provides summary statistics on cash compensation and equity in the firm, split by firm revenue and founder-status. Within similar levels of revenue,

non-founders receive more cash and hold lower equity positions. Unfortunately, there are few experiment where a non-founder replaces a founding CEO. 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 also not clear. 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. 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. Complementary evidence that illustrates the sources of selection bias in having a non-founder CEO is provided in Figure 7, which displays differences in the distribution of log compensation residuals after adding controls for various firm milestones and life stages. The results from these linear regressions indicates 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 slightly upward for non-founders even after adding controls. Still, the similarity in the distribution suggests that many founders are receiving "market" like compensation as benchmarked by non-founder CEOs even though there are average differences in pay.

We rely on a matching strategy to try and disentangle the magnitudes of these differences using cross-sectional data. We implement coarsened exact matching, varying the set of matching covariates to assess sensitivity to different controls. Columns 1 through 3 of Table 6 present the matching estimates. Columns 1 matches on age, revenue, capital investment received, and the number of funding rounds, yielding an estimate that founders receive salary that is, on average, 40 log points lower than non-founders in similarly sized firms. The estimate for founders drops substantially in Column 2 when we control for the CEO's fully diluted equity, indicating minimal differences between founders and

non-founders.[9] The negative coefficient on fully diluted equity also indicates that equity and cash compensation appear to be substitutes. Column 3 excludes pre-revenue firms, with a negative but not statistically significant coefficient on the founder dummy.

We then turn to OLS estimates in Columns 4 and 5 to assess whether the elasticity of cash compensation with respect to firm revenue is similar for founders and non-founders. These specifications contain fixed effects for firm characteristics rather than using an estimator that takes mean-differences within matching strata.[10] Column 4 shows that founders earn about 45 log points less than non-founders after including fixed effects for different firm characteristics, but that the elasticity of cash compensation with respect to log firm revenue is no different for founders and non-founders. Founders who grow their firms will experience similar percentage increases in compensation compared to non-founders; founders simply appear to start at a lower baseline but receive similar percentage increases in salary with firm milestones. The results are similar in Column 5, which controls for the log of fully diluted equity in the firm. Here the coefficient on founder is -.36, suggesting that equity differences do not close the entirety of the founder gap. The elasticity of cash compensation with respect to revenue is 0.083, and this does not differ based on founder status. Taken together, the estimates suggest that while level differences between founders and non-founders arise because of different equity shares or potential differences in non-pecuniary benefit from leading the firm, the elasticity of cash compensation with respect to the firm's revenue milestones is no different across founder type.

[9] To assess how differences in equity holdings relate to founder or non-founder status, we ran a coarsened exact matching estimator where the log of fully diluted equity is the dependent variable and revenue, age, capital raised, and funding rounds are the matching variables. The point estimate on the founder coefficient is about 94 log points, suggesting that equity incentives differ substantially between founders and non-founders.

[10] As a result, the number of observations increases, as the sample for the OLS regressions does not condition on having at least 1 firm with a founder and non-founder in each strata.

4.3 The certainty equivalent of entrepreneurship for different types of founders

Table 4 documents how cash compensation in VC-backed firms is driven initially by resolving irreducible uncertainty – such as producing a product. Having resolved this uncertainty, CEO pay then increases substantially as firm revenue grows. This change in pay over the lifecycle potentially alters conclusions about the risk borne by entrepreneurs.

We return to the Hall and Woodward problem, making a very simple adjustment to their initial assumptions based on the results from Table 4. Instead of solving the entrepreneur's consumption-savings problem assuming that the pay over a venture's lifetime is a constant \$150,000, we make a simple adjustment to where we use mean compensation by firm age for founder-CEOs. This starts at around \$110,000 for new firms and is nearly \$400,000 for 10 year old firms.[11]

Table 7 displays the results. The top panel yields the Hall and Woodward baseline, but note that the numbers differ from their published paper because we use more recent data to estimate the joint distribution of exit values to the entrepreneur and the timing of exit. For details, see Appendix A. The bottom panel displays the certainty equivalent of the entrepreneurial opportunity using our modification. In both panels, entrepreneurship has a positive certainty equivalent when the agent is risk neutral $\gamma = 0$ that is invariant to the level of wealth and decreases with the entrepreneur's outside compensation. One can compare how the after-tax present value of entrepreneurship changes under our modified assumptions by using the risk-neutral figures and comparing them to Hall and Woodward.

For risk averse entrepreneurs, our modified problem changes the sign of the certainty equivalent of entrepreneurship for some combinations of the entrepreneur's outside compensation and level of wealth. Hall and Woodward's estimates imply that founders are

[11]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 unreported analyses, we find that there does not appear to be any systematic penalty from founding when returning to regular employment.

largely drawn from those with relatively low outside wages and somewhat high initial wealth. The lifecycle compensation changes that we document would imply that an entrepreneur with $0.1 million in starting wealth and a $300,000 pre-tax salary would have a certainty equivalent value of entrepreneurship of $ 0.1 million compared to $ -0.1 million dollars in the model with flat cash compensation. Potential founders with $450,000 salaries and at least $1 million in wealth also have a positive certainty equivalent relative to the negative Hall and Woodward benchmark.

Still, relative to the risk neutral figures, when individuals are risk-averse, founding implies a negative certainty equivalent for those with substantial salaries. A risk-neutral individual with a $900,000 annual salary would have a positive expected value of entrepreneurship, but in both the benchmark model and our modified estimates, these individuals would not enter entrepreneurship under standard levels of risk aversion and wealth levels under $ 20 million. Venture investors appear to provide some insurance, but not enough to get the very highest-paid employees to found companies. Table 7 makes clear, however, that the set of entrepreneurs screened out by the undiversifiable burden of risk is quite small. The third column of the table reports the population quantile corresponding to the level of pre-tax compensation in each row. 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. A salary of $450,000 likely also means that the individual has over $1 million in liquid assets if working for a reasonable horizon. Therefore, our estimates suggest that fewer than 1-.9944 = 0.56% of all individuals in the population would have a negative certainty equivalent from entering VC-funded entrepreneurship. Note however that fewer than several thousand firms receive VC funding in each year, yet the vast majority of the population would have a positive certainty equivalent from entrepreneurship. Factors other than illiquidity over the life of a startup are likely to determine which ideas get commercialized. These factors are likely to be the arrival rate of ideas, motivation, and VC diligence and network-based screening.

5 Founder Background and Entrepreneurial Ideas

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 important things. First, we are able to paint a more accurate picture of the individuals who are the founder-CEOs of VC-backed entrepreneurs today, not just in terms of wealth and 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 validate the empirical exercise conducted in Table 7, 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.

Our sample of founder backgrounds is sourced from public LinkedIn profiles. Given the extensive resources needed to collect this data manually (scraping is prohibited by LinkedIn), we focus our sample on founder-CEOs of startups first financed in 2010 and 2011.[12] Of the 1,665 startups that pass our sampling filters, we identified 1,415 Public LinkedIn profiles (85%) for at least one founder. 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. For profiles without an education listing, we assume the founder has a high-school level education. The profiles with job histories allow us to identify the startup and thus create variables measured before and after the founding date.

From the LinkedIn profile's education history, we identify whether the founder has a post-graduate degree and also use the undergraduate graduation year to calculate the

[12]The sample also requires that VentureSource has an identified founder for the startup and that – in order to remain consistent with our AHR sample – the startup is not in the healthcare industry.

founder's age at the time of firm founding. The job histories in the profile provide a measure of experience using either years since first listed job or a count of the unique number of employers.

The average age of founders at founding is 35 years old. Founders have 14 years of job experience across over 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 LinkedIn data detailed above do not provide salary or wealth data that are the relevant parameters for our re-analysis of the Hall and Woodward problem. To this end, we randomly select founders with LinkedIn profiles for a deeper biographical search, while attempting to estimate their salaries based on firm and job-title information. For each founder, we characterize their pre-founding career using the job histories listed on their LinkedIn profile. Such characterization includes identifying if and how quickly the founder progressed in her career, the nature of the industries in which the founder worked (e.g. started in banking and became a VC) and whether there is any evidence of past exits which could provide signals about wealth. Next, the analysis requires an outside option cash compensation. We approximated the outside earnings using the founder's pre-founding job title, industry and location using 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 including additional compensation (cash bonus, commissions and profit sharing). The data collection has thus far found information for 50 founders selected at random and we are proceeding to do more such analyses with an aim to get a 10% random sample.

Thus far, our results suggest that the vast majority of the founders have pre-founding job titles where their cash compensation is likely to be within the range where it would be attractive for them to try venture capital backed entrepreneurship even in the presence of standard levels of risk aversion.

6 Conclusion

A long literature on financial contracting as well as entrepreneurship has noted that in the presence of asymmetric information, investors need to screen potential entrepreneurs by offering them back-loaded compensation contracts, which may not meet the participation constraints for risk averse individuals. The implication of this work is that promising ideas can go uncommercialized because this burden of non-diversifiable risk faced by entrepreneurs is too high (Hall and Woodward 2010).

In this paper, we re-examine the degree of non-diversifiable risk borne by entrepreneurs by providing the first evidence of how founder-CEO compensation evolves over the life of venture-capital backed firms. Consistent with a view that VCs resolve a large amount of uncertainty through the experimentation process of staged financing (Kerr, Nanda, and Rhodes-Kropf 2014), we show that although founders initially earn a low salary, achieving 'product market fit' is an important inflection point beyond which founder-CEO compensation evolves with firm size in ways that are analogous to non-founder CEOs as well as CEOs of publicly traded firms.

Such experimentation by VCs also changes the certainty equivalent for risk averse entrepreneurs considering entrepreneurship since it implies they earn a 'below market' salary for only a few years, after which they either return to paid employment or shift to market compensation that grows with the success of their firm. Indeed, our estimates suggest that fewer than 0.56% of all individuals in the population would have a negative certainty equivalent from entering the types of VC-funded technology firms in our sample. Our work points to an important and under-appreciated role of venture capital investors as providers of intermediate liquidity to entrepreneurs, thereby greatly reducing the burden of non-diversifiable risk faced by potential entrepreneurs.

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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 startups last known VC financing.

Figure 1: Comparison of Capital Raised between the Venture Source universe of 4 year old firms and the AHR sample of 4 year old firms.

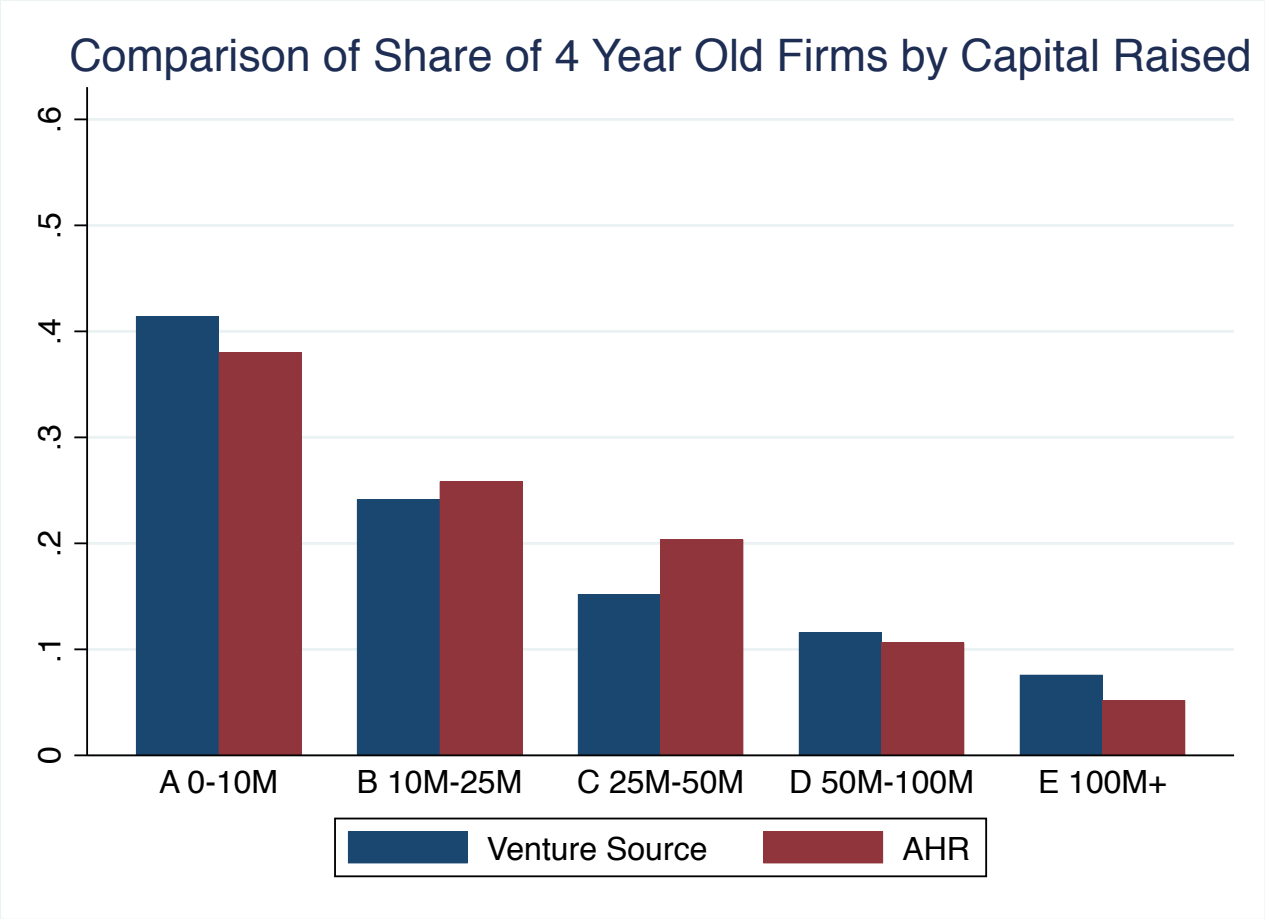


Figure 2: Founder-CEO Cash compensation by firm age and capital raised.

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.

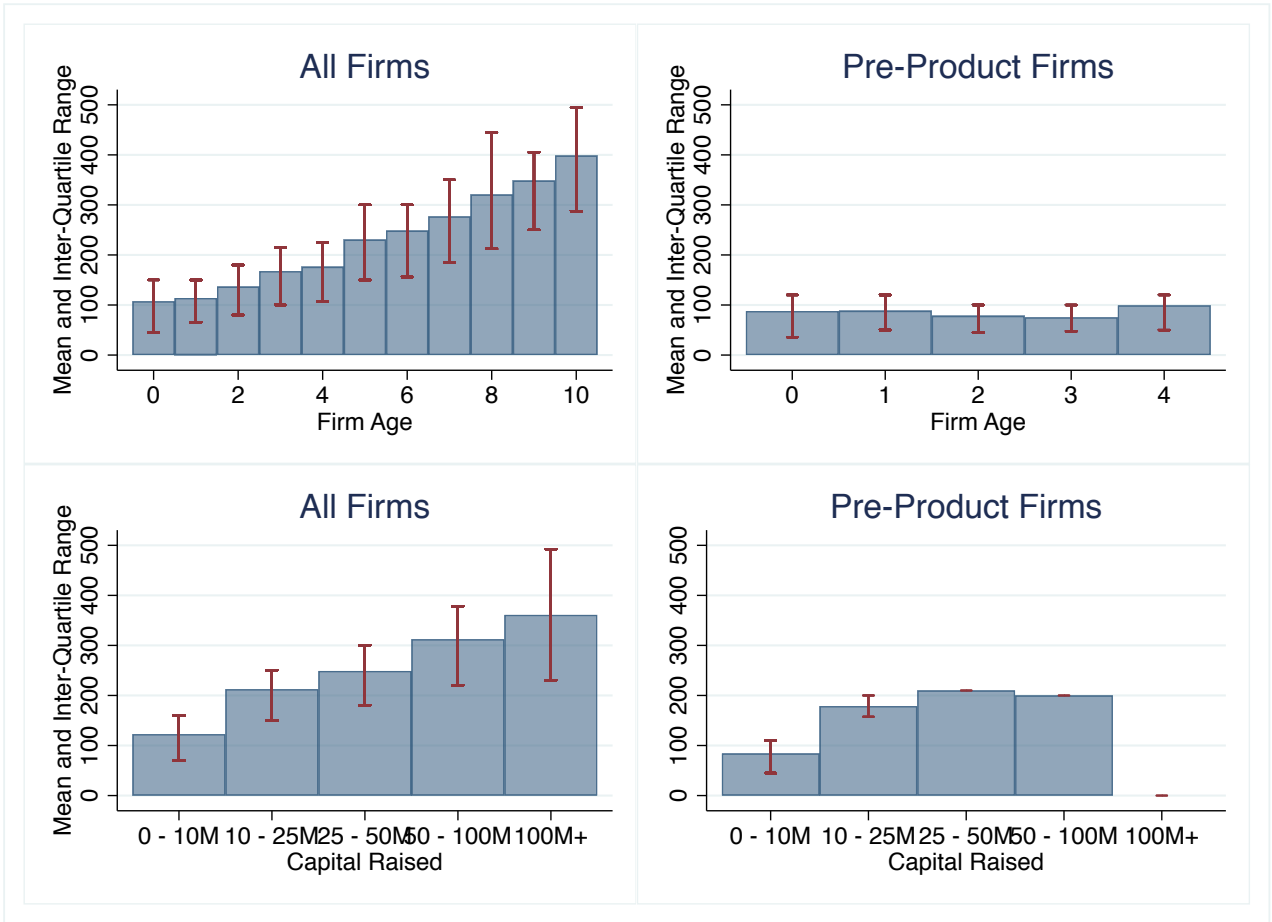


Figure 3: Predicted distributions of Founder-CEO cash compensation by funding round.

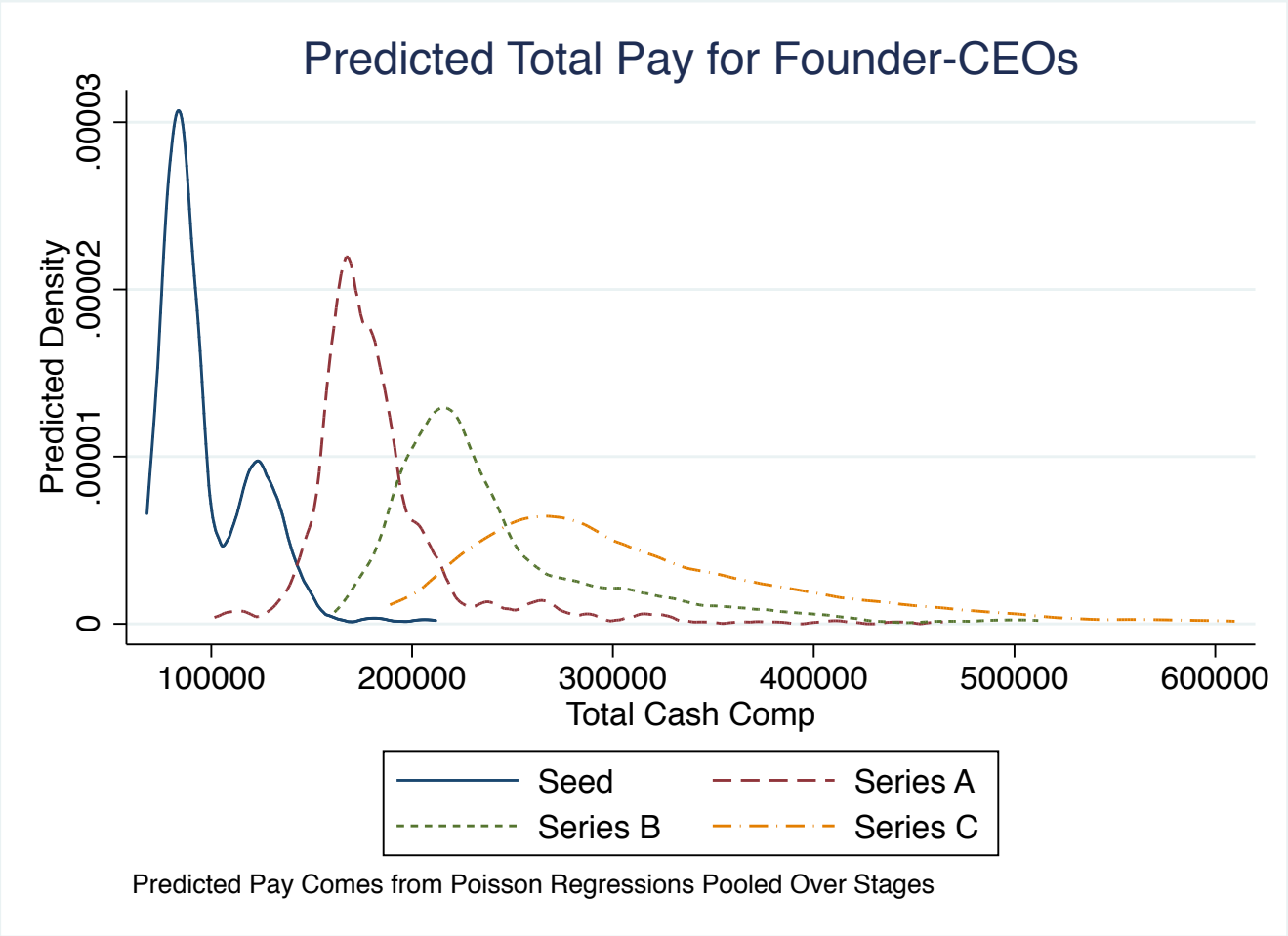
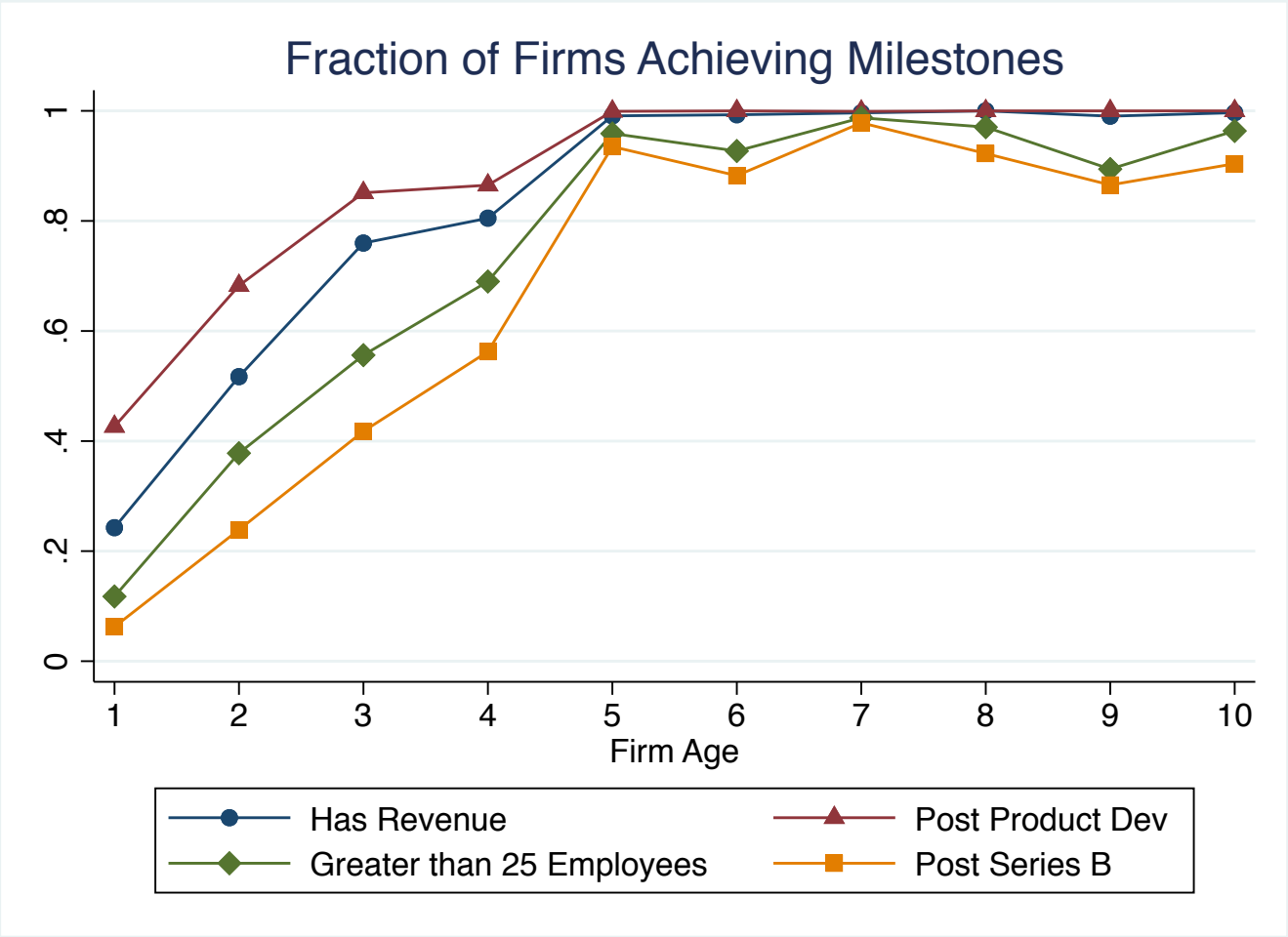


Figure 4: Founder-CEO Salary and Total Cash Compensation is Increasing in Firm Size

Figure displays 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 5: Revenue and other compensation milestones (from Table 2) 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

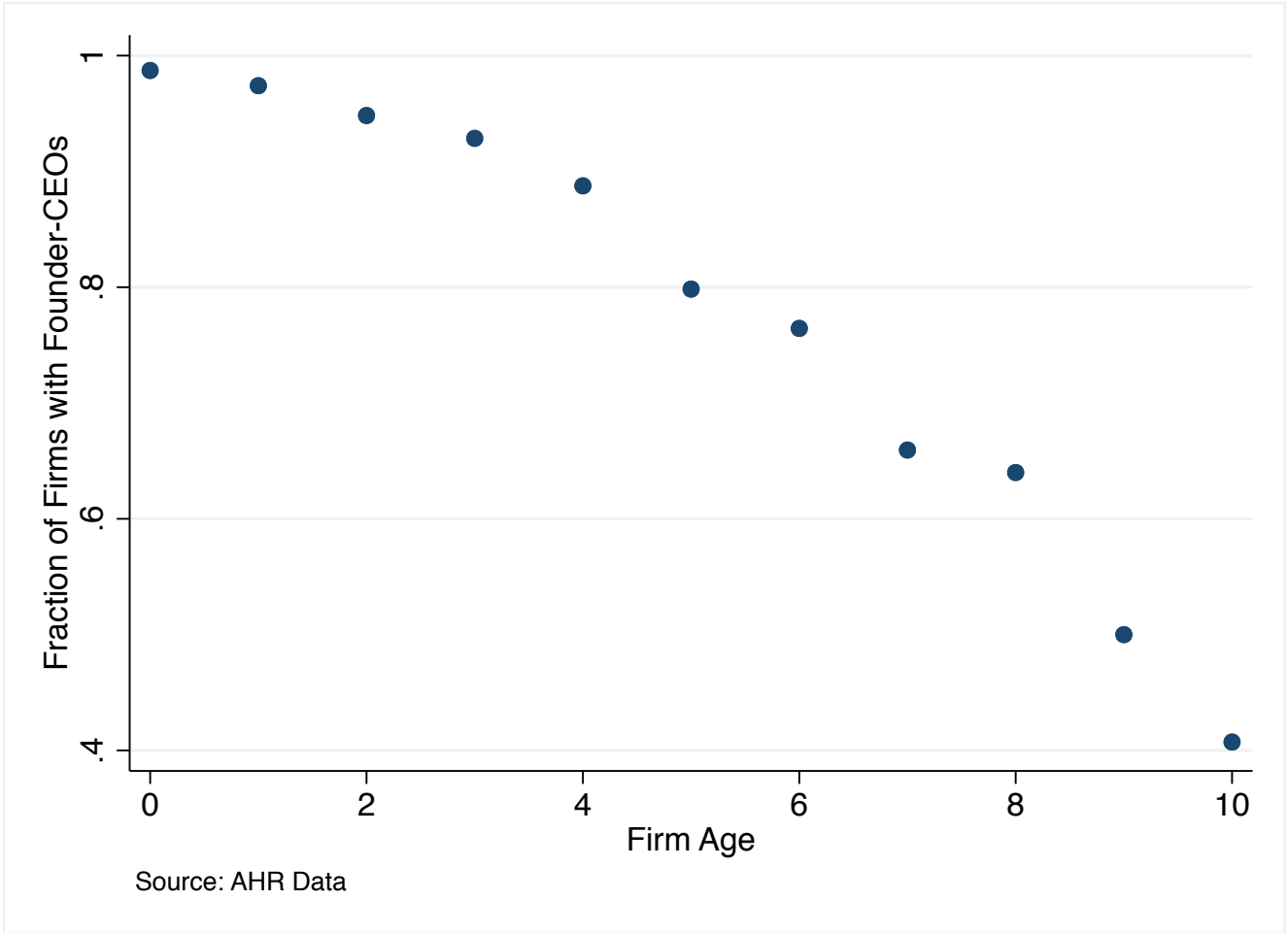
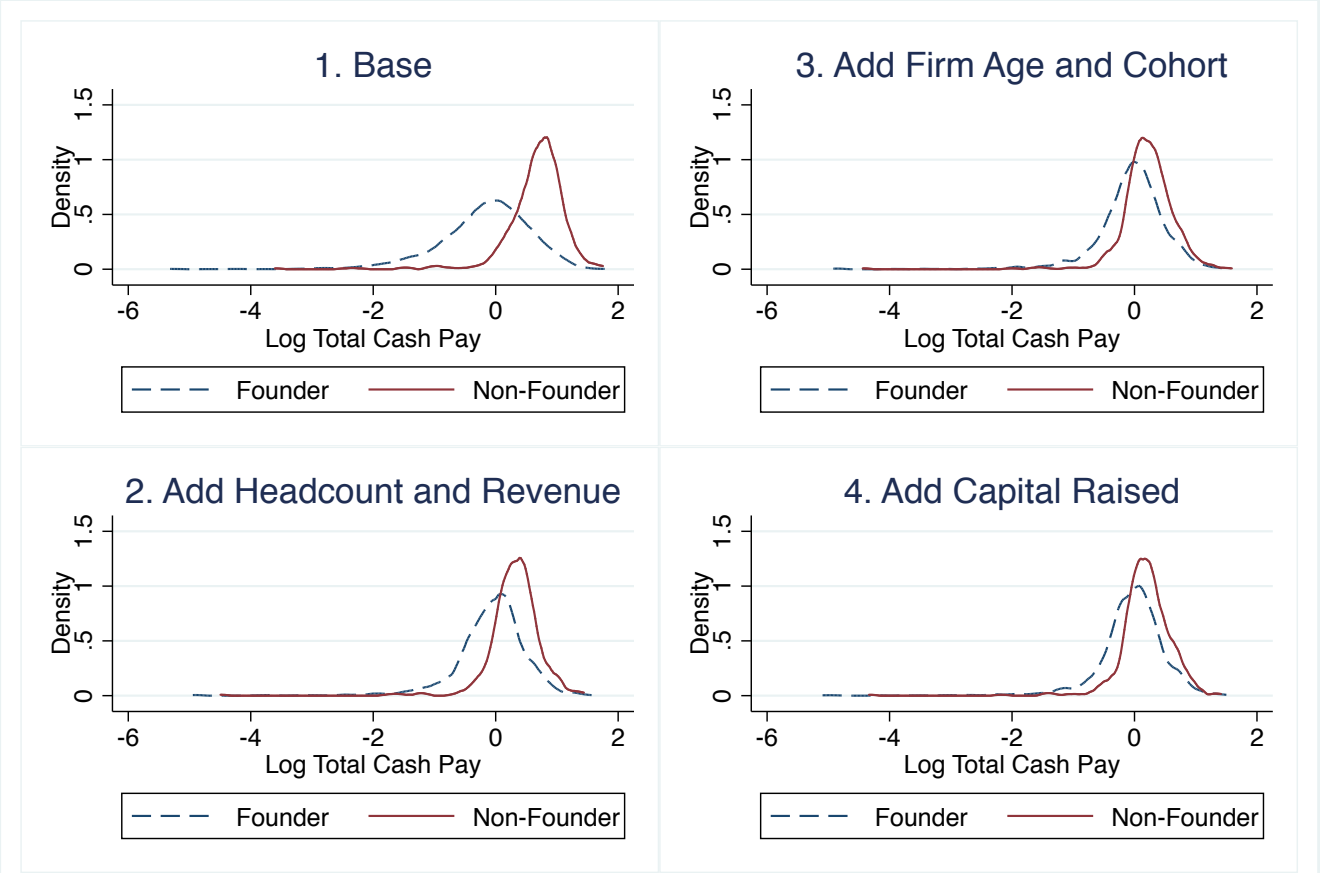


Figure 7: Level differences between founder CEOs and non-founder CEOs in VC backed startups exist, but there is significant overlap in the distribution of pay after accounting for observable firm differences.



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 A1: The cash compensation-size elasticity is remarkably similar 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.

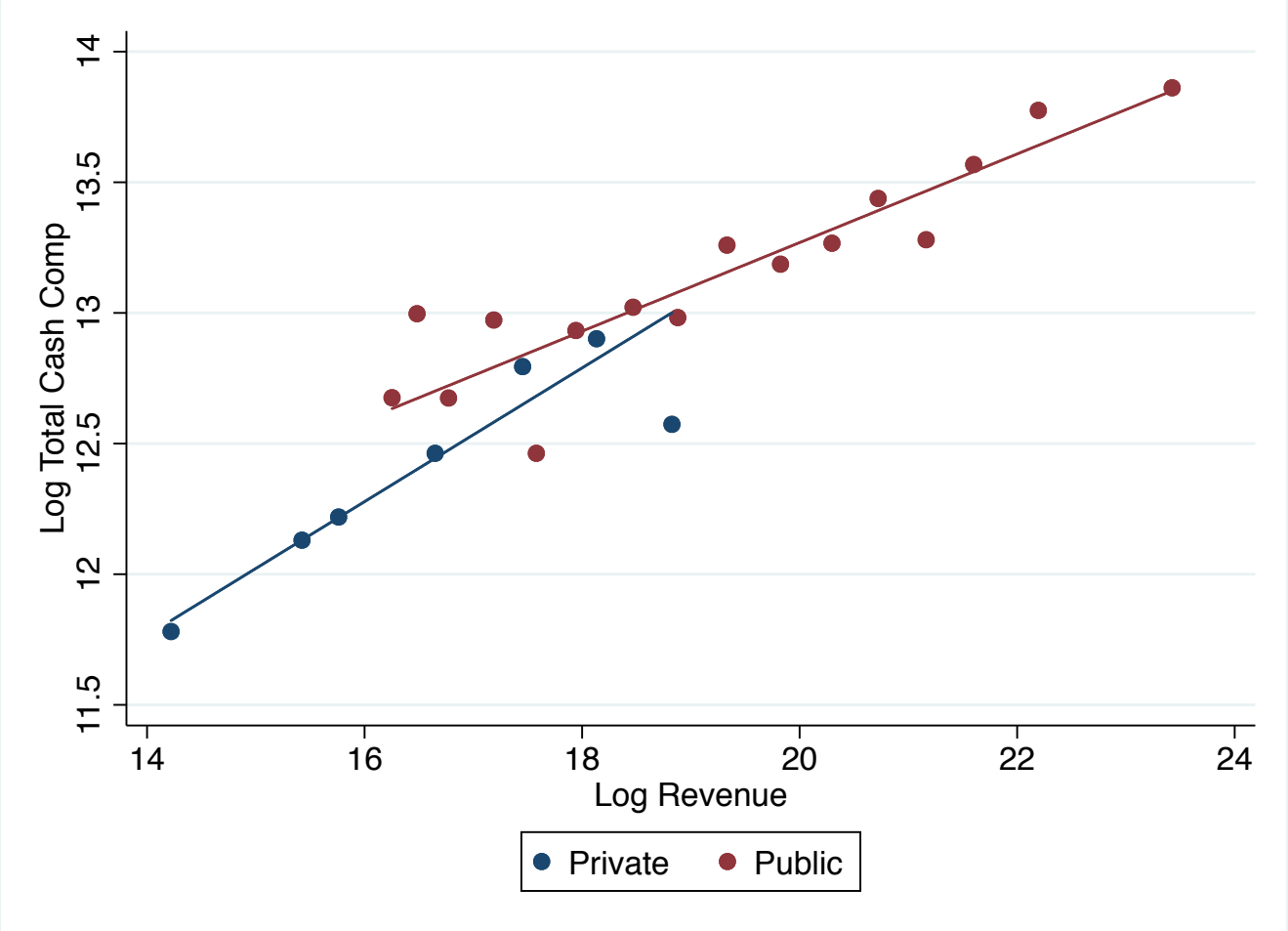


Table 1: Comparison between Compenation Data and the Universe of Venture Investments

This table compares the AHR data to an outside dataset, the universe of VC investment in Venture Source, regardless of whether the fund(s) participate in the AHR survey. The Venture Source data were downloaded in 2018 Q4 and for this comparison we exclude firms in healthcare, energy, industrial goods, and unknown industries. We exlcude 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 tradiional private equity (rather than VC) investors in the first round, large debt rounds in their first round of financing (greater than $3 million),and first rounds of financing with greater than $50 million in investment.

	Venture Source				Adanced HR (AHR)				
	2015 Total Count	2017 Total Count	Pooled Total Count	Share of Pooled Venture Source Sample	2015 Total Count	2017 Total Count	Pooled Total Count	Share of Pooled AHR Sample	AHR Fraction of Venture Source
Panel A: By Firm Age									
Founded This Year	62	37	99	4%	29	49	78	4%	79%
1 Year Old	146	103	249	9%	108	161	269	15%	108%
2 Years Old	240	206	446	16%	133	215	348	19%	78%
3 Years Old	291	208	499	18%	133	203	336	18%	67%
4 Years Old	293	248	541	20%	119	210	329	18%	61%
5+ Years Old	203	723	926	34%	63	401	464	25%	50%
Total	1235	1525	2760	100%	585	1239	1824	100%	66%
Panel B: By Total Venture Capital Raised (Millions of Dollars)									
$0 - $10 Million Raised	571	607	1178	43%	295	614	909	50%	77%
10--25	335	339	674	24%	129	238	367	20%	54%
25-50	180	287	467	17%	91	195	286	16%	61%
50-75	57	125	182	7%	33	72	105	6%	58%
75-100	34	53	87	3%	17	47	64	4%	74%
100+	58	114	172	6%	20	73	93	5%	54%
Total	1235	1525	2760	100%	585	1239	1824	100%	66%

Table 2: Descriptive Statistics for All CEOs

Notes: 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 technlogy (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 two survey years. The survey protects anonymity by coarsening revenue, number of employees (headcount), and total capital raised. Panels B and C report data by these coarsened categories. 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.

	Share of firms	Firm age (years)	Cumulative venture Capital Raised ($ M)	Average Headcount	CEO's Total Target Cash Compensation	CEO's Equity Ownership
Panel A: By round of financing						
Seed	26%	2.2	3.3	10	98,882	37%
Series A	24%	3.9	15.2	42	198,187	20%
Series B	20%	5.2	40.0	87	268,698	14%
Series C	14%	7.0	78.1	146	338,194	10%
Series D	9%	8.3	120.4	186	398,911	8%
Series E and beyond	8%	10.3	181.5	214	443,662	6%
Panel B: By revenue						
Pre Revenue	26%	2.0	9.7	13	114,033	34%
$0-$10M	40%	4.4	27.5	48	213,486	18%
$10M-$25M	14%	7.2	64.5	118	311,715	12%
$25M-$50M	10%	8.6	104.9	195	391,208	10%
$50M-$100M	6%	8.7	141.2	235	451,279	9%
$100M+	4%	9.1	161.5	274	449,043	12%
Panel C: By number of employees						
< 10 employees	20%	2.0	3.9	5	92,059	39%
10-25 employees	19%	3.3	10.9	18	168,609	22%
26-50 employees	17%	4.8	24.4	38	225,794	17%
51-100 employees	17%	6.2	50.2	76	297,784	12%
101-200 employees	14%	7.3	87.0	151	341,982	11%
> 200 employees	13%	8.8	156.3	300	428,649	9%

Table 3: 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 4: 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. Later, when we use continuous measures of revenue, we take the mid-point of the categories. 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. The sample excludes CEOs with under $5 in total cash compensation. Poisson regressions including these CEOs (Table A2) are very similar.

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

Table 5: Log Cash Compensation for VC-backed Founder-CEOs Appears Linear With Respect to Log Firm Revenue

Regressions of log cash copensation 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 6: Analysis of Founder and Non-Founder Log Total Compensation Compensation

This table compares compensation for founders and non-founders among revenue-generating VC backed startups. Columns 1-3 come from regressions after coarsened exact matching on the listed covariates at the bottom of the table. Different sample sizes in the matching columns compared to OLS reflect restricting to a common support over the matching covariates.

	Coarsened Exact Matching Estimates			OLS Regressions	
	(1)	(2)	(3)	(4)	(5)
CEO is a Founder	-0.406***	-0.0054	-0.123	-0.448**	-0.359*
	(0.108)	(0.0950)	(0.0763)	(0.164)	(0.165)
Log of CEOs Fully Diluted Equity		-0.374***	-0.360***		-0.084**
		(0.0305)	(0.0378)		(0.027)
Log of Firm Revenue				0.082***	0.083***
				(0.015)	(0.015)
Founder x Log of Firm Revenue				0.007	0.006
				(0.010)	(0.010)
Matching Variables or Fixed Effects:					
Firm Age	Y	Y	Y	Y	Y
Revenue	Y	Y	Y		
Capital Invested	Y	Y	Y	Y	Y
Number of Fundng Rounds	Y	Y	Y	Y	Y
Pre-Revenue and Post-Product				Y	Y
Excluding Pre-Revenue Firms			Y		
R-Squared	0.042	0.366	0.184	0.532	0.534
Observations	1897	1897	1350	2429	2429

Table 7: Certainty-equivalent of entrepreneurial opportunity, millions of dollars

Each cell in the table reports the certainty equivaent of an entrepreneurial opportunity in millions of dollars, akin to Hall and Woodward (2010) Table 3. Our calculations use updated data from VentureSource and Correlation Ventures for firm births from 2000-2006 (see data appendix). Panel B takes mean cash compensation for ounders by firm age as the flow pay. The certainty equivalent is reported for combinations of non-entrepreneurial compensation and asset holding. The percentiles of the income distribution from are taken from the NBER's SOI data. We use data items 85 and 86, which contain W2 earnings for individual filers and married joint filers. Individuals without W2 earnings are not included in the percentile estimates.

Coefficient of relative risk aversion, γ	*Pretax compensation at non-entrepreneurial job*	*Percentile of the Individual Income Distribution from W2 Filings*	*Assets at beginning*				
			$0.1 M	*$0.5 M*	*$1 M*	*$5 M*	*$20 M*
Panel A: Baseline HW with Entrepreneurial Cash = $150,000 year prior to exit							
0	$150,000	94.73	7.6	7.6	7.6	7.6	7.6
0	$225,000	97.85	7.3	7.3	7.3	7.3	7.3
0	$300,000	98.80	7.1	7.1	7.1	7.1	7.1
0	$450,000	99.44	6.6	6.6	6.6	6.6	6.6
0	$600,000	99.68	6.1	6.1	6.1	6.1	6.1
0	$900,000	99.85	5.2	5.2	5.2	5.2	5.2
2	$150,000	94.73	0.6	0.7	0.8	1.4	2.6
2	$225,000	97.85	0.3	0.5	0.7	1.2	2.4
2	$300,000	98.80	-0.1	0.3	0.5	1.1	2.2
2	$450,000	99.44	-1.2	-0.6	-0.2	0.7	1.7
2	$600,000	99.68	-2.4	-1.6	-1.0	0.3	1.3
2	$900,000	99.85	-4.9	-3.8	-2.9	-0.6	0.5
Panel B: Entrepreneurial Cash = Average Cash By Firm Age							
0	$150,000	94.73	7.8	7.8	7.8	7.8	7.8
0	$225,000	97.85	7.5	7.5	7.5	7.5	7.5
0	$300,000	98.80	7.3	7.3	7.3	7.3	7.3
0	$450,000	99.44	6.8	6.8	6.8	6.8	6.8
0	$600,000	99.68	6.3	6.3	6.3	6.3	6.3
0	$900,000	99.85	5.4	5.4	5.4	5.4	5.4
2	$150,000	94.73	0.8	0.9	1.0	1.6	2.8
2	$225,000	97.85	0.5	0.8	0.9	1.4	2.6
2	$300,000	98.80	0.1	0.6	0.8	1.3	2.4
2	$450,000	99.44	-0.9	-0.1	0.3	0.9	1.9
2	$600,000	99.68	-2.1	-1.0	-0.4	0.5	1.5
2	$900,000	99.85	-4.5	-3.0	-2.1	-0.3	0.7

Appendix Table 1: 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. Later, when we use continuous measures of revenue, we take the mid-point of the categories. 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)
Post Product Defin (Ideation stage)			0.616***	0.496***	0.365***
			(0.050)	(0.050)	(0.058)
Revenue (Baseline is Pre-Revenue)					
$0M-$10M	0.543***	0.401***	-0.054	-0.039	-0.074
	(0.033)	(0.037)	(0.054)	(0.052)	(0.051)
$10M-$25M	0.894***	0.609***	0.152*	0.049	0.001
	(0.040)	(0.048)	(0.063)	(0.061)	(0.061)
$25M-$50M	1.120***	0.783***	0.329***	0.192**	0.152*
	(0.046)	(0.053)	(0.067)	(0.066)	(0.067)
$50M-$100M	1.309***	0.945***	0.490***	0.327***	0.291***
	(0.047)	(0.055)	(0.069)	(0.071)	(0.072)
$100M+	1.261***	0.902***	0.445***	0.267**	0.273**
	(0.084)	(0.084)	(0.094)	(0.092)	(0.093)
VC Funding Round (Seed is Baseline)					
Post Series A					0.263***
					(0.048)
Post Series B					0.377***
					(0.064)
Post Series C					0.455***
					(0.074)
Firm Age Dummies		Y	Y	Y	Y
Cumulative VC Raised Dummies				Y	Y
Region and Industry Dummies				Y	Y
Unreported Venture Round Dummies					Y
Pseudo R-Squared	0.390	0.441	0.479	0.507	0.527
Observations	1976	1976	1976	1976	1976

Appendix Table 2: 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 inteactions 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