Dilution vs. Risk Taking: Capital Gains Taxes and Entrepreneurship*

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Abstract

Recent proposals to tax unrealized capital gains or wealth have sparked a debate about their impact on entrepreneurship. We show that accrual-based taxation creates two opposing effects: successful founders face greater dilution from advance tax payments, whereas unsuccessful founders receive tax credits that effectively provide insurance. Using comprehensive new data on U.S. venture capital deals, we find that founder returns remain extremely skewed, with 84% receiving zero exit value while the top 2% capture 80% of total value. Moving from current realization-based to accrual-based taxation would reduce founder ownership at exit by 25% on average but would also increase the fraction receiving positive payoffs from 16% to 47% when tax credits are refunded. Embedding these distributions in a dynamic career choice model, we find that founders with no or moderate risk aversion prefer the current realization-based tax system, while more risk-averse founders prefer accrual-based taxation. We estimate that a 2% annual wealth tax has a similar impact on dilution as taxing unrealized capital gains, but produces no risk-sharing benefits due to the absence of tax credits in case of down rounds.

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1 Introduction

Many countries have experienced rising income and wealth inequality over the last decades. Capital gains play a crucial role in these dynamics because they represent the largest component of income at the top, including notably the payoffs to the founders of successful businesses. The tax treatment of capital gains has therefore been at the front and center of the policy debate in the last few years. While capital gains are typically taxed on realization in practice (i.e., when assets are sold), a classic idea in public finance, going back to von Schanz (1896) and later popularized by Haig (1921) and Simons (1938), is to tax comprehensive economic income, which includes unrealized gains.

Recently, this debate has been reinvigorated by the wealth accumulation of the super-rich, many of whom are company founders and who can delay their tax liability under the current, realization-based tax system.[1] To address this, several reform proposals have advocated for the taxation of unrealized capital gains (including by the Biden administration in the U.S.) or wealth (see, for example, Zucman (2024), which has been prominently discussed in France recently).[2]

In the context of entrepreneurship, these ideas have raised concerns about discouraging risk taking and creating an "ownership distortion" (Kopczuk, 2019): founders of companies whose valuations increase over time would face tax liabilities due to the resulting accrued gains. If entrepreneurs are illiquid and forced to reduce their ownership stake in order to pay the tax, this dilution of control rights could have adverse effects on their incentive to start a new business. Indeed, during the 2024 presidential election, strong opposition voiced by the Venture Capital (VC) community echoed these concerns.[3]

Despite this ongoing debate, there has been no systematic analysis of the impact of

[1] For instance, Leiserson and Yagan (2021) and Balkir et al. (2025) calculate that the wealthiest 400 families in the U.S. pay a lower average tax rate than the full population when including unrealized capital gains in their measure of economic income. One particular standard tax provision, allowing for basis step up at death, avoids realization-based taxes on bequeathed wealth. That provision can be addressed without switching to accural taxation (Penn Wharton Budget Model, 2022).

[2] In the U.S. context, see e.g. Saez and Zucman (2019), Wyden (2019), Saez et al. (2021), U.S. Office of Management and Budget (2022), U.S. Department of the Treasury (2024). Whether these proposals would be constitutional in the U.S. remains an open question because the Supreme Court has not ruled whether unrealized capital gains constitute income under the 16th Amendment (Fox and Liscow, 2024). In the Netherlands, an accrual-based capital gains tax has been proposed since their "box 3" wealth tax was ruled unconstitutional (Gerritsen, 2025).

[3] The National Venture Capital Association (NVCA) called the unrealized capital gains tax in Kamala Harris's tax plan "a direct attack on the entrepreneurial ecosystem" and warned that it would slow down startup formation (The Times, 2024). Similarly, Marc Andreessen, co-founder of the VC firm Andreessen Horowitz, claimed that it "makes startups completely implausible" and would "kill startups and kill venture capital" and cited it as "the thing that tipped me" to support Donald Trump (Matthews, 2024). In the French debate about the so-called "Zucman tax," Aghion (2025) warned that, "Mistral AI [a leading French AI startup] will have to find financiers to pay its taxes instead of being able to fund innovation."

accrual-based taxation of capital gains on entrepreneurship. Our paper examines how capital gains taxation affects venture-backed startups, both theoretically and quantitatively. These companies are central to U.S. entrepreneurship, innovation, and growth.[4]

We make three contributions. First, we build a stylized model to identify the key tradeoffs that accrual taxation creates for entepreneurs. The model allows for a continuous degree to which capital gains taxes are required to be "pre-paid," which we refer to as the *accrual tax level*. One extreme is the status quo of a purely realization-based tax regime where no taxes are due pre-exit. The opposite extreme is a fully accrual-based system where any unrealized gains immediately trigger a tax liability. Intermediate cases flexibly capture a variety of hybrid implementations, such as a wealth tax, capital gains tax withholding (Saez et al., 2021), or "smoothed" versions of mark-to-market based taxation (Toder and Viard, 2016).[5]

A central issue with accrual-based taxation is how to handle capital losses. Most startups see their valuations rise at some stages but ultimately fail, so losses are common even when interim gains occur. When capital gains taxes are required to be (partially) pre-paid, subsequent declines in value generate tax credits. However, founders may not fully benefit from these credits, for example, because they cannot immediately use them to offset other income or carry them forward indefinitely. We allow for varying degrees of credit realizability, from the full-refund case where losses are completely recognized to partial-credit regimes that reflect limited loss offset provisions.

For a given after-tax rate of return required by investors, we show that the accrual tax level does not affect company valuations. With complete tax credits, accrual taxation is also neutral for government revenue—holding the tax rate constant—since it only changes the timing of revenue collection. Accrual-based taxation, however, influences founders in two opposing ways. It dilutes the ownership of successful founders, reducing their eventual payoff at exit; but, it also provides tax credits to founders whose companies first rise and later fall in value, offering partial insurance against downside risk. The value of this insurance depends on how fully these losses are refunded and can be realized by the founder.

Importantly, this insurance actuarially *unfair*. Accrual-based taxation makes founders cash out early, which compresses their payoff distribution while reducing expected pay-

[4]VC-funded firms accounted for 58% of U.S. IPOs in 2017-2021 (Dotolo and Fox, 2025). Gornall and Strebulaev (2021) estimate that VC-funded companies account for 62% of the total public company R&D spending.

[5]Several recent proposals, both for taxing unrealized gains and wealth, include provisions to effectively exempt some startup companies (see, e.g., Yagan, 2023). Our focus is on the conceptual understanding of the dilution effects of accrual-based taxation rather than an evaluation of specific policy reforms. Nonetheless, we discuss some of these provisions in Section 7.

offs. Hence, the overall welfare effect on risk-averse founders is, perhaps surprisingly, theoretically ambiguous and becomes a quantitative question, which we examine in the rest of the paper.

Our second contribution, therefore, provides a comprehensive measure of the full distribution of returns to VC-backed entrepreneurship in the United States, building on the seminal work of Hall and Woodward (2010). We assemble a more recent dataset covering roughly 96,000 startup companies, including about 48,000 exits, 167,000 venture capital funding rounds, and 180,000 founders, spanning 1987 to 2021. The data are drawn from U.S. Securities and Exchange Commission (SEC) filings and financial data providers including PitchBook, CB Insights, PrivCo, Capital IQ, and Compustat. Using the VC deal information, we estimate the gradual ownership dilution experienced by founders under the status quo of a realization-based tax regime, allowing us to derive the ex-ante distribution of after-tax payoffs that founders face.

Our results reveal a highly skewed distribution of returns. Roughly 84% of founders end up with a zero exit value, reflecting the high risk of failure in VC-backed entrepreneurship. This outcome arises from two distinct mechanisms. First, founders are collectively wiped out in 74% of cases, either because the company fails outright or because investors capture all proceeds in poor exits. Second, even among startups that achieve successful exits—through acquisitions or IPOs—there remains a 38% chance that an individual founder departs before exit and receives no payoff.

Among founders who do realize positive payoffs, outcomes are extremely concentrated. The top 2% capture 80% of the total exit value, and the top 1% account for 45%. The upper tail follows a Pareto distribution with a coefficient near one (approximately 1.03), implying far greater inequality than in the U.S. income or even wealth distributions. Consequently, while average returns appear high—comparable to an annual after-tax income of about $460,000—potential founders face extraordinary risk when choosing to start a company.

Our third contribution combines theory and data to evaluate how accrual-based capital gains taxation affects entrepreneurship. We first compute founders' ownership dilution, and hence their payoff distribution at exit, under varying accrual tax levels. Moving to a fully accrual-based tax regime reduces the average founder ownership share at exit by about 25%. As a result, holding the capital gains tax rate fixed, the average founder payoff declines by 15%. The effect is even stronger at the top of the distribution: the top one percentile of payoffs falls by more than a factor of three. At the same time, with complete tax credits, the fraction of founders receiving positive returns rises from 16% to 47%, illustrating the strength of the risk-sharing effect.

We then embed these simulations in a dynamic career-choice model to assess the implications for founders' welfare and, in turn, for entry into entrepreneurship. Individuals choose between working for a wage only versus becoming an entrepreneur. Workers earn a deterministic market wage, whereas founders accept a lower startup wage in exchange for a chance of a random jackpot payoff upon exit. Founders optimally smooth consumption, taking into account both the stochastic timing of exit and the stochastic distribution of exit payoffs, subject to a borrowing constraint. The jackpot payoff is drawn from our simulated distribution of exit payoffs under alternative tax regimes.

In the calibrated model under the status-quo (realization-based) tax system, the extremely skewed exit distribution leads risk-averse founders to value entrepreneurship at a steep discount. A risk-neutral individual would always choose entrepreneurship unless her annual worker earnings exceed her founder wage by at least \$460,000. By contrast, an individual with a coefficient of relative risk aversion equal to one values entrepreneurship at only 13% of the average exit payoff and would be willing to accept at most a \$60,000 reduction in her annual wage to become a founder.

Introducing accrual-based taxation changes this calculus. Because of the lower mean payoffs, risk-neutral founders are always worse off relative to the status quo. However, the insurance effect implies that the impact on the wage cut founders are willing to accept depends on risk aversion. For a coefficient of relative risk aversion around 0.5, an interior accrual tax level (a hybrid of both systems) is optimal, as the dilution and risk-sharing effects roughly offset one another. More risk-averse founders strictly prefer a fully accrual-based tax system.

These results reveal that, when analyzing the effect of taxing unrealized capital gains on entrepreneurship, it is not enough to observe that it may hurt successful founders. Instead, the more nuanced effects on risk sharing also need to be accounted for. Perhaps surprisingly, at least in the case of complete tax credits, these insurance effects can be quantitatively important, potentially even outweighing the additional dilution.

The remainder of the paper considers several extensions. The first extension shows how incomplete tax credits significantly reduce the insurance value of accrual-based taxation. Limiting loss offsets to carry-forward provisions, as is often the case in practice, exacerbates the ownership dilution of successful founders while largely eliminating tax refunds to failed founders. As a result, accrual-based taxation harms even risk-averse founders. This result highlights the importance of loss provisions when designing capital tax regimes. A sufficient amount of pre-paid taxes must be refunded after losses following a down round for accrual-based taxation to be preferred by risk-averse entrepreneurs.

We also compare our results to a wealth tax. Like a tax on unrealized gains, an annual wealth tax also dilutes founders' ownership shares in their companies, with the key difference that taxes are due every year, independent of whether the company's valuation changes. We find that a 2% annual wealth tax would have a similar effect on founders' dilution as moving to fully accrual-based capital gains taxes. However, similar to the case with incomplete tax credits, a wealth tax would not produce any insurance benefits due to the lack of tax refunds in the event of down rounds.

Our baseline analysis holds fixed the empirical distributions of company valuations and investments as well as the structure of VC contracts when evaluating alternative capital taxation regimes. This approach isolates the mechanical effect of accrual-based taxation, which is quantitatively meaningful and can be computed without strong additional modeling assumptions. As a final extension, however, we also consider the case in which optimal VC contracts adjust endogenously to tax reforms, for example, via agency problems such as moral hazard or adverse selection. While contracts will generally respond to mitigate the dilution and altered risk-sharing introduced by accrual taxation, such adjustments are not always fully feasible in equilibrium. We provide conditions under which the net impact of taxing unrealized gains is, qualitatively, still well captured by the mechanical effects identified in our analysis

Related literature. Our paper contributes to several strands of literature. First, as noted at the outset, we revisit the classic literature on capital gains taxation, which has typically emphasized the lock-in effect on portfolio choice under realization-based tax regimes and compared these to approaches closer to the Haig-Simons standard (Auerbach, 1989, 1991). Instead, we study how the timing of capital gains taxation affects entrepreneurship, focusing on the risky payoff distribution and, hence, on the entry incentives of startup founders.[6] In the context of wealth taxation, Kopczuk (2019) and Scheuer and Slemrod (2021) highlight the potential effects on founders' risk taking and ownership dilution but do not attempt to quantify them. Our paper tackles this question.

Second, we contribute to the large body of work measuring the returns to entrepreneurship (see, e.g., Hamilton, 2000; Hall and Woodward, 2010; Kerr et al., 2014; Korteweg and Nagel, 2016; Dillon and Stanton, 2017; Bhandari et al., 2025). Our analysis builds directly on Hall and Woodward (2010) by collecting novel, comprehensive data on venture-backed startups and by providing new evidence on the distribution of founders' payoffs,

[6] Chari et al. (2005) study the under-diversification of business owners post-exit due to realization-based capital gains taxes. There is also a large literature on the behavioral responses to changes in capital gains tax *rates*; see, e.g., Poterba (1989), Edwards and Todtenhaupt (2020), and Agersnap and Zidar (2021). Aguiar et al. (2024) compare realization- and accrual-based approaches in the presence of varying asset prices, and Hourani and Perret (2025) provide a recent overview of actual capital gains tax systems in OECD countries.

including its skewness and extremely thick Pareto tail. As such, our findings are related to the broader literature on income and wealth inequality. For instance, Smith et al. (2019, 2023) highlight the importance of entrepreneurial income at the top, which is also evidenced by the fact that most individuals on the Forbes 400 list of wealthiest Americans are founders (Scheuer and Slemrod, 2020). Even in terms of aggregates, Bhandari and McGrattan (2021) suggest that sweat equity, i.e., the value of founders' time and expenses to build intangible assets in their businesses, is of comparable magnitude to annual GDP and public market capitalization. Gocmen et al. (2025) show how the expansion of private equity markets has contributed to rising top inequality.

Third, our paper is related to the literature on optimal taxation and entrepreneurship. Building on classic work that studies the effects of taxes on portfolio choice under risk (Domar and Musgrave, 1944; Kaplow, 1991, 1994), a growing line of research has explored optimal entrepreneurial taxation theoretically (Albanesi, 2011; Scheuer, 2013, 2014; Shourideh, 2014; Jaimovich and Rebelo, 2017; Bell et al., 2019), and several quantitative studies of taxation at the top incorporate important features of entrepreneurship (Cagetti and De Nardi, 2006; Brueggemann, 2021; Dyrda and Pugsley, 2022; Kindermann and Krueger, 2022; Guvenen et al., 2023; Bhandari et al., 2024; Boar and Knowles, 2024). None of these papers, however, estimates entrepreneurs' ownership dilution under different tax regimes, even though this has been a key issue in the recent policy debate. Our paper fills this gap by aiming to account for the full extent of risk sharing between founders, VC investors, and the government and to quantify how capital gains taxation alters this sharing.[7]

Recent work has incorporated entrepreneurs who generate positive externalities, for example through innovation, into models of optimal taxation (Jones, 2022; Akcigit et al., 2022a,b). While we do not model such externalities explicitly, their presence would further amplify the importance of our results: when the design of capital gains taxation affects the attractiveness of entrepreneurship—something we directly measure—it may also influence long-run economic growth more broadly.

Roadmap. Section 2 characterizes the dilution and risk-sharing effects of accrual-based capital gains taxation in a stylized model of VC-funded startups. Section 3 extends this framework to a dynamic occupational choice model for entry into entrepreneurship that we can take to the data. Section 4 describes our data construction, and Section 5 uses

[7] Cullen and Gordon (2007) and Gordon (2018) consider the effects of corporate tax systems on entrepreneurship with a focus on organizational form. In his recent overview article, Kaplow (2024) calls for a systematic analysis of entrepreneurship in the context of top income taxation—we view our paper as contributing to this agenda.

these data to compute the empirical founder payoff distribution and the value of entrepreneurship, through the lens of our career-choice model, under the status-quo tax system. Section 6 then quantifies the counterfactual effects of accrual-based tax reforms. Finally, Section 7 concludes and discusses several extensions that are developed more formally in the Appendix.

2 Capital Taxation of Startups in a Simple Model

We first develop a stylized model to illustrate the effects of changing the architecture of capital gains taxation over the life of a startup firm.

2.1 Companies, founders, and investors

We begin with a three-period setting: At $t = 0$, a company is founded and initially owned by an entrepreneur (who we also refer to as the founder). We normalize the initial value of the company to zero. Subsequently, the company requires two inputs to operate: a flow of labor by the founder and an investment d in period $t = 1$. The investment is made by a VC investor through a funding deal (where d is referred to as the deal size). Finally, the company exits at time $t = 2$, producing a random exit value $y \in \{0, Y\}$. That is, y might be zero, which captures the modal scenario in which the company fails and the investment is all but lost, or take a positive value $Y > 0$ in case of success. We denote the success probability by p.[8]

The incentives to investors and founders are a central issue. Consider incentives to founders. In practice, founders work in exchange of a relatively small salary plus equity claims that result in a random after-tax payoff x paid upon an exit. Founder behavior depends on two main components. The first component is the distribution of the founder jackpot x. The allure of entrepreneurship is the possibility of a large x, sometimes of billions of dollars. The dread of entrepreneurship is the modal outcome of $x = 0$ after years of effort. The second component are preference factors: risk preferences, perceived probabilities, impatience, and the ability to smooth consumption. Section 3 shows the importance of these factors in a model of founder labor supply and Sections 4 to 6 take the model to the data. For now, we focus on the determinants of the founder's after-tax jackpot x.

[8]In Section 3, we will expand this to an infinite-horizon model where a company's time to exit is stochastic, there is a flow of investments, and the exit value is drawn from a continuous distribution.

Consider next the incentives of investors. In practice, investors are made up of different groups. A VC fund is run by a VC firm, termed the general partner. However, most of the fund's capital comes from outside investors, termed limited partners. A significant portion of the limited partners are tax exempt entities such as pension funds, foundations and endowments. VC firms, however, are not tax exempt. They pay capital gains taxes both on capital gains and on most of the fees they receive. Due to the large number of tax-exempt investors, VC funds are by and large pass-through tax entities, meaning that tax liabilities are paid by the partners and not by the fund itself.

Given this complex ecosystem of investors, there are many choices of how to model investor behavior. We begin with the simplest benchmark case: competitive investors with perfectly elastic supply of capital. We assume that VC investors are risk-neutral and indifferent between an investment of 1 at $t = 1$ and an expected after-tax payoff of $\Psi = 1 + \psi$ at $t = 2$.[9]

2.2 Venture Capital contracting

At first glance, venture capital contracting is equity finance. In the investment round at $t = 1$, investors invest d dollars in exchange for a share of the company equity. We denote the share of the company held by the founder after period $t = 1$ by s and the share held by investors by $1 - s$. The terms of the investment are often quoted as a pre-money valuation v and post-money valuation $u = v + d$ such that $s = v/u$. In practice, contracting is more complex. Contracts give considerable protection to investors in case of bad performance. Some of the protection is financial, in that investors receive a larger share of companies that exit at a low valuation. Other protections involve control rights that tend to shift to investors in case of poor performance. While we will incorporate these features in the next sections, for transparency we restrict attention, for now, to pure equity finance, a single funding round, and a simple exit process.[10]

The key endogenous variables of the model are the share of the company retained by the founders s and their after-tax payoff x. We will introduce taxes in the following subsection and first consider the situation without taxes. In this case, we have $x = sy$. Moreover, because investors require a return Ψ and are risk neutral, the share acquired

[9]This reflects the fact that VC funds are typically more diversified than founders. Moreover, the benchmark assumption of perfectly elastic supply of capital does not apply to an individual investor but only to the VC industry as a whole.

[10]A classic literature in corporate finance has studied optimal VC contracting, justifying the prevalence of equity financing and the resulting under-diversification of founders (Leland and Pyle, 1977; Ross, 1977; Admati and Pfleiderer, 1994; Casamatta, 2003; Repullo and Suarez, 2004; Schmidt, 2003) .

by the investors $1-s$ solves

$$\Psi d = (1-s)\mathbb{E}[y].$$

From this we can calculate the jackpot payoff to the founders in case of success as

$$x = sY = \left(1 - \frac{\Psi d}{\mathbb{E}[y]}\right) Y.$$

Therefore, the expected founder jackpot is

$$\mathbb{E}[x] = \underbrace{\mathbb{E}[y] - d}_{\text{expected surplus}} - \underbrace{\psi d.}_{\text{cost of capital}}$$

Founders receive on average the expected value they create, $\mathbb{E}[y] - d$, minus the cost of capital to compensate investors. Founders are risk averse and we will consider their expected utility later on.

2.3 Capital gains taxes

We are interested in comparing the impact of accrual- versus realization-based regimes of capital taxation on the payoffs to founders and investors. Under a pure realization-based tax regime, there are no taxes due at the time $t = 1$ of the funding round (since all gains at this point are still unrealized). VCs and investors must pay a tax rate τ on their capital gains upon exit at $t = 2$, in case there are any.

By contrast, under an accrual-based tax regime, taxes are due already at time $t = 1$ on any unrealized gains at that point. When the company exits at $t = 2$, founders and VCs only have to pay the remaining capital gains taxes. More generally, we allow for intermediate tax regimes where a fraction α of capital gains taxes have to be paid in advance.[11] $\alpha = 0$ corresponds to the status quo of a purely realization-based tax and $\alpha = 1$ corresponds to a fully accrual-based tax. We refer to $\alpha \in [0, 1]$ as the accrual tax tax level.

A key question is how advance tax payments under an accrual-based tax regime are financed. This is important because founders of companies whose valuation increases would potentially face large tax bills, far beyond their liquid assets. We consider the benchmark case where the VC investors put up an additional investment T at time $t = 1$

[11] As discussed in the introduction, this could capture, for instance, a wealth tax, which would ensure that some taxes are due already pre-exit when the company becomes valuable, similar to a tax on unrealized capital gains, or other hybrid implementations, such as capital gains tax withholding or smoothed variants of mark-to-market taxation.

to pay for the tax advance. In other words, founders sell shares in their companies in order to pay for taxes due.[12]

Formally, at the time of the investment round, the founder has unrealized capital gains v because the (pre-money) valuation of the company increased from 0 in $t = 0$ to v in $t = 1$. Under an accrual tax level α, she owes advance taxes $\alpha\tau v$ at this point. She must sell a dollar value T of shares to investors to pay for this liability. When doing so, the founder realizes capital gains, which triggers further capital gains taxes under a realization-based tax regime, of the amount $(1-\alpha)\tau T$. Hence, T must satisfy

$$T = \alpha\tau v + (1-\alpha)\tau T.$$

Equivalently, the after-tax value of equity sold must be enough to pay for the accrual-based taxes on the equity retained:

$$(1-\tau)T = \alpha\tau(v-T), \tag{1}$$

which we can solve for T:

$$T = \frac{\alpha\tau}{1-(1-\alpha)\tau}v. \tag{2}$$

The extreme cases of a purely realization- or accrual-based tax regime are particularly simple: In the former case ($\alpha = 0$), we have $T = 0$ because no advance taxes are due; in the latter ($\alpha = 1$), we have $T = \tau v$ because the full unrealized gains v are taxable in period $t = 1$.

At the time of exit, if an investment goes down in value, the accrual tax payments may be partially refunded as tax credits. Individuals value each dollar of tax credit at $\phi \leq 1$ (conversely, the cost to the government of giving such a credit is ϕ). The assumption of $\phi < 1$ is appropriate if some failed founders or their investors never have enough lifetime capital gains to utilize their entire tax credit, or if the extent to which these tax credits can be carried forward is limited, as is typically the case in practice.[13]

[12] Various alternatives can be considered (see also Section 7). For instance, founders may pay the tax liability by effectively transferring company shares to the government, which would have the same effects on their dilution. Founders may issue different share classes or non-voting shares to retain control. However, these shares would trade at different prices, potentially even exacerbating economic dilution. For the sake of transparency, our analysis abstracts from these complications. Another approach would let founders pay advance taxes through loans provided by the government. In this case, the economic effects depend on the interest rate and collateral requirements associated with such loans. Under a high enough interest rate, for example, some founders may prefer to sell shares rather than bearing the borrowing costs, and vice versa. Thus, this approach can also be captured by our general measure $\alpha \in [0,1]$ of the accrual tax level.

[13] Loss carry-forward means that losses can only be deducted from future gains, which is typically limited by some maximal amounts, not inflation-indexed, and not interest-bearing, making such tax credits

2.4 The impact of tax regimes on startups

We are now ready to determine how the valuation of the company v in period 1, the share retained by the founders s, the after-tax founder payoff x and tax revenues depend on the tax regime. The next three propositions summarize the key results of the model, which is solved in Appendix A.

Valuations and dilution. Proposition 1 begins with the first two variables.

Proposition 1. 1. *[Neutrality of valuations] The pre- and post-money company valuations do not depend on the accrual tax level α but decrease with the tax rate τ. Specifically, the post-money valuation equals the expected exit value discounted by a tax-adjusted return:*

$$u = v + d = \frac{\mathbb{E}[y]}{\tilde{\Psi}}$$

where

$$\tilde{\Psi} \equiv 1 + \frac{\psi}{1-\tau} + \frac{\tau}{1-\tau}(1-p)(1-\phi)$$

is the investors' required pre-tax return.

2. *[Neutrality of investor welfare] Investors are indifferent between the tax regimes and always receive an after-tax rate of return Ψ.*

3. *[Dilution of founders] Total investment is $d + T$, where T is given by (2), which increases with the level of accrual α. Accordingly, the share of the company acquired by investors*

$$1 - s = \frac{d+T}{\mathbb{E}[y]}\tilde{\Psi}$$

also increases with α.

The proposition shows that, while accrual-based taxation increases the quantity of venture capital investment, it does not, perhaps surprisingly, change company valuations for a given tax rate τ. The extra investment T is needed to help illiquid founders pay for advance tax liabilities. This extra investment has the same risk properties as the original investment d and thus valuations do not change. Therefore, the first key effect of accrual-based taxation is to swell the venture capital sector. Moreover, it dilutes the founders since their ownership share s decreases.

incomplete. One exception is Section 1244 in the U.S. tax code, which allows investors to treat capital losses as ordinary losses under some conditions.

Holding the accrual tax level α constant, the higher the tax rate τ and the lower the extent to which tax credits can be used in case of losses (i.e., lower ϕ), the lower will be company valuations. This is intuitive because the investors' required pre-tax return $\tilde{\Psi}$ increases. It also implies that the effect of a higher tax rate τ on total investment $d + T$ (and hence the founders' ownership share s) is generally ambiguous: the direct effect is that a higher tax forces founders to sell more shares during the funding round (by equation (2)) but, at the same time, the company valuation v decreases.

Founder jackpots. The next proposition turns to the distribution of the founders' payoffs x.

Proposition 2. 1. *[Lower jackpot to successful founders] The after-tax payoff of successful founders is*

$$x = \underbrace{(1-\tau)\left(Y - \frac{\tilde{\Psi}}{p}d\right)}_{\text{jackpot in realization regime}} - \underbrace{(1-\tau)\left(\frac{\tilde{\Psi}}{p} - 1\right)T}_{\text{additional cost of capital}}$$

where T is given by (2). Thus, the payoff in case of success is decreasing in the level of accrual tax α.

2. *[Insurance to failed founders] Failed founders receive a payoff equal to the value of tax credits*

$$x = \phi(1-\tau)T,$$

which is increasing in α.

3. *[Lower average founder jackpot] The founders' expected jackpot is*

$$\mathbb{E}[x] = \underbrace{(1-\tau)(\mathbb{E}[y] - \tilde{\Psi}d)}_{\text{mean jackpot in realization regime}} - \underbrace{(1-\tau)(\tilde{\Psi}-1)T}_{\text{mean additional cost of capital}} - \underbrace{(1-\phi)(1-p)(1-\tau)T}_{\text{unused tax credits}},$$

which is decreasing in α.

Proposition 2 shows that accrual-based taxation provides founders with a form of insurance. Accrual taxation forces founders to effectively cash out early, by selling shares and acquiring tax credits in return during the investment round. This compresses their payoff distribution at exit: it lowers the jackpot in case of success due to the additional dilution, but provides them with tax credits in case of failure (whereas the payoff under a purely realization-based regime would be zero in this case). However, this insurance is actuarially unfair. The mean after-tax payoff decreases with the level of accrual tax for two reasons: First, because founders are forced to pay for additional, costly, venture capital finance, and second, because the tax credits are not fully valued if $\phi < 1$.

Thus, whether accrual-based taxation encourages or discourages entrepreneurship is generally ambiguous and depends on whether the cost of having to pay for more VC finance is greater than the insurance effect of implicitly cashing out early.

Tax revenue. Finally, Proposition 3 establishes a neutrality result for government revenues.

Proposition 3. *Expected government revenue equals*

$$\underbrace{\tau(\mathbb{E}[y]-d)}_{\text{revenue in realization regime}} + \underbrace{(1-\phi)(1-p)(1-\tau)T}_{\text{unused tax credits of founders}} + \underbrace{(1-\phi)(1-p)\tau(d+T)}_{\text{unused tax credits of VCs}},$$

where T is given by (2). Hence, government revenue does not depend on the tax regime α if founders fully utilize their tax credits ($\phi = 1$). Otherwise ($\phi < 1$), expected revenue is increasing in the accrual tax level α.

The case of fully valued tax credits ($\phi = 1$) would apply, for instance, if the government were to fully refund the advance taxes paid by founders in case of failure at exit (and if it gives a tax credit to the VC investors for their lost investment). In this case, the government is indifferent between accrual- and realization-based taxation: it always raises a total of the tax rate τ times the expected surplus $\mathbb{E}[y] - d$ from the startup company; the only difference is in the timing of when these tax revenues are collected.[14] Taking this together with Proposition 1, since both the government and investors are indifferent, this implies that the total welfare effect of accrual-based taxation only depends on its impact on founders, which is generally ambiguous by Proposition 2. This insight motivates our focus on founders in the rest of the paper.

When tax credits are incomplete ($\phi < 1$), for instance because of imperfect loss carry-forward, then the government obtains additional tax revenue from a shift to accrual-based taxation. The reason is that failed founders and their investors overpay taxes on average in this case because of the limited loss offsets. However, the additional taxes paid by investors are fully borne by founders through a higher pre-tax rate of return $\tilde{\Psi}$ required by the VCs. Hence, this is a pure transfer from founders to the government, which cancels out in aggregate.[15]

[14] This assumes that the government does not discount later tax payments, which is natural when thinking of a steady state with different startup companies at different lifecycle stages.

[15] To see that the unused tax credits by founders cancel out in aggregate, simply compare the last term

In Appendix D, we extend our analysis to the case of endogenous VC contracting under moral hazard and adverse selection. We identify conditions under which contracts still move in the direction of the effects that we have isolated so far. For instance, accrual-based taxation can be good for founders in the case of adverse selection where current contracts are inefficiently high-powered. But it can be bad for founders in the cases of moral hazard, not very risk averse founders, or adverse selection where lower powered contracts lead to market breakdown.

3 Career Choice Model

The previous section shows that taxation regimes have a theoretically ambiguous effect on entry into entrepreneurship. We now embed this analysis in a richer model of founders' career choice, which will allow us to take it to the data. Specifically, entrepreneurs face a consumption-savings problem under risk, with a stochastic time to exit and exit payoffs, similar to Hall and Woodward (2010). The exit payoffs will then be affected by capital taxes as described in the previous section.

3.1 Consumption-savings problem

The founder decides between getting a fixed outside wage, or to accept a lower wage at a startup in the hopes of receiving a large jackpot at exit. She has expected utility

$$\mathbb{E}\sum_{t=0}^{\infty}(1+r)^{-t}u(c_t) \tag{3}$$

from a random consumption flow $\{c_t\}_{t=0}^{\infty}$ with discount rate $r > 0$.

The founder's initial assets are denoted by a_0. She earns a wage w while working at her startup company. The startup may exit with a rate of exit π per period. If the startup does not exit, the founder's assets evolve according to

$$a_{t+1} = (1+r)a_t + w - c_t. \tag{4}$$

in Proposition 2 part 3 with the second term in Proposition 3. To see that the unused tax credits by VCs are fully borne by founders and thus also cancel out, collect the terms with $\tilde{\Psi}$ in Proposition 2 part 3 and use the definition of $\tilde{\Psi}$ in Proposition 1 to obtain

$$-(1-\tau)\tilde{\Psi}(d+T) = -[(1-\tau+r)(d+T) + \underbrace{(1-\phi)(1-p)\tau(d+T)}_{\text{unused tax credits by VCs}}],$$

so the unused tax credits by VCs reduce the founders' expected payoff one for one.

If the startup exits, the founder receives a one-time exit payoff equal to the random variable x with distribution F. This is the after-tax value characterized in the previous section. In Section 5, we will estimate its empirical distribution under the status quo tax system using data on VC funding rounds. In Section 6 we will simulate its counterfactual distribution under varying accrual tax levels α.

After an exit, the founder becomes a worker earning a fixed worker wage $w^* > w$, so that assets from then on evolve according to

$$a_{t+1} = (1+r)a_t + w^* - c_t. \tag{5}$$

We assume that this is an absorbing state, abstracting from repeat entrepreneurship.[16]

The founder's problem is to choose consumption to maximize expected utility (3) subject to the sequential budget constraints (4) and (5) and the No-Ponzi condition

$$\lim_{t\to\infty}(1+r)^{-t}a_t \geq 0.$$

In our quantitative simulations, we may also impose a borrowing constraint $a_t \geq 0$ for the founders.

3.2 Recursive formulation

Founders' Bellman Equation. We set up the founder's and the worker's problem recursively. Since the worker faces no uncertainty and the discount rate equals the interest rate, it is optimal to perfectly smooth consumption. This is achieved by setting consumption equal to $ra + w^*$, i.e., the flow of capital and wage income, which leaves assets constant. Hence, letting $R = 1 + r$, the worker's value function is

$$V_w(a) = \frac{R}{r}u(ra + w^*). \tag{6}$$

The entrepreneur's value function $V(a)$ is then given by the solution to the Bellman equation

$$V(a) = \max_{c,a'} u(c) + \frac{\pi\mathbb{E}[V_w(a'+x)] + (1-\pi)V(a')}{R} \tag{7}$$

subject to the budget constraint

$$a' = Ra + w - c.$$

[16]Still, the worker wage w^* can capture benefits to entrepreneurship other than the exit jackpot x, such as the skills acquired by founders that are valuable on the labor market or management positions obtained by founders after exit.

In the problem with a borrowing constraint, the maximization is constrained to $c \leq Ra + w$.

Critical paycut. We are interested in how the tax regime, through the distribution of the after-tax exit payoff x, affects the founders' career choice and thus entry into entrepreneurship. A particularly useful way to summarize the founders' incentives is the critical paycut she is willing to take in her startup wage w relative to being a worker at wage w^*. Formally, we define the critical paycut as the smallest $\Delta \geq 0$ such that the founder is indifferent between being a worker with worker wage w^* and being a founder with startup wage $w = w^* - \Delta$. Using (6) and (7), Δ solves

$$\frac{R}{r} u(ra + w^*) = \max_{a'} u(Ra + w^* - \Delta - a') + \frac{\pi \mathbb{E}[V_w(a' + x)] + (1 - \pi) V(a')}{R}. \quad (8)$$

Hence, Δ is a simple measure of the attractiveness of entrepreneurship. In general, it will depend on the asset level a and the wage levels w^* and w in addition to the other model parameters. In Sections 5 and 6, we will compute critical paycuts by solving the Bellman equation (7) numerically and calibrating it using the empirical distribution of x. However, to build intuition, we show in the next subsection that, in the case of preferences with constant absolute risk aversion (CARA), there is a closed-form solution for Δ that is independent of asset and wage levels and can be easily taken to the data.

3.3 Closed-form solution with CARA preferences

Suppose the utility function takes the CARA form, i.e.,

$$u(c) = -\exp(-\gamma c)$$

where γ is the coefficient of absolute risk aversion. Then the critical paycut is characterized in closed form as given by the next proposition.

Proposition 4. *Under CARA preferences without a borrowing constraint, the critical paycut Δ is given by*

$$u(r\Delta) = \pi \mathbb{E} u(rx) - (1 - \pi). \quad (9)$$

In this case, Δ is only determined by risk aversion γ, the discount rate r, the exit rate π, and the distribution of founder jackpots x. For instance, it is evident that a higher exit rate π and a better distribution of x (in the sense of first-order stochastic dominance) increase

Δ: intuitively, they make entrepreneurship more attractive. Indeed, applying a first-order approximation to the left-hand side of (9) yields

$$\Delta \approx \frac{\pi}{\gamma r}[\mathbb{E}u(rx) + 1],$$

which also reveals that Δ is decreasing in the risk-aversion coefficient γ.[17]

The next proposition derives a simple upper bound for Δ based on this closed-form solution.

Proposition 5. *The critical paycut from* (9) *is bounded above by*

$$\Delta \leq \underbrace{\overline{\beta}}_{\text{static risk discount}} \cdot \underbrace{\pi}_{\text{exit rate}} \cdot \underbrace{\mathbb{E}x}_{\text{average jackpot}} \tag{10}$$

where the static risk discount $\overline{\beta}$ is defined such that the founder is indifferent between a lottery with consumption rx or the safe payoff $\overline{\beta}r\mathbb{E}x$:

$$\mathbb{E}u(rx) \equiv u(\overline{\beta}r\mathbb{E}x).$$

To understand the proposition, consider first the case of a risk-neutral founder. For each year working in the startup, the founder expects to receive a jackpot x with probability π. Therefore, she would be willing to take a paycut equal to $\Delta = \pi \cdot \mathbb{E}x$ to work in the startup. Intuitively, the right-hand side is how much the founder produces by working for one year. For example, in our empirical analysis in Section 5, we find that the exit rate $\pi = 6.4\%$ and the average after-tax exit value $\mathbb{E}x = \$7.2$ million. This means that the founder "earns" about \$460,000 per year in expected exit value. Thus, entrepreneurship is very attractive for risk-neutral founders.

Risk aversion considerably changes this calculation. The bound (10) is the same as the equation for a risk-neutral founder, but with the additional static risk discount $\overline{\beta}$. The static risk discount takes into account the fact that the jackpot is uncertain. In practice, as we will show in Section 5, the jackpot distribution is extremely skewed, with the largest values in the billions of dollars and a median of zero. Thus, the static risk discount $\overline{\beta}$ can make entrepreneurship significantly less attractive.

A simple calibration. To illustrate this, suppose the founder has constant relative risk aversion (CRRA) with coefficient $\sigma = 1$ (i.e., log utility). Since our closed-form solution

[17] This approximation would hold exactly if the problem was formulated in continuous time (see e.g. Shimer and Werning (2008) in the context of unemployment insurance).

works with CARA preferences, we can translate this into a coefficient of absolute risk aversion $\gamma = \sigma/c$ where c is consumption. Expressing consumption in multiples of \$1 million and using the yearly expected exit value as a measure of average consumption, this implies $\gamma = 1/.46 \approx 2.2$. Furthermore, let us approximate the jackpot distribution with a binary distribution as in the previous section. Our empirical evidence in Section 5 implies that the probability of obtaining a positive payoff $x > 0$ is roughly $p \approx 16\%$ whereas with probability $1 - p \approx 84\%$ the founder receives 0. The expected payoff conditional on being greater than 0 is therefore about \$45 million. Using this in the definition of the static risk discount $\overline{\beta}$ yields

$$16\% \cdot \exp(-\gamma r \cdot \$45\text{m}) + 84\% \cdot 1 = \exp(-\gamma \overline{\beta} r \cdot \$7\text{m}).$$

Assuming a discount rate of $r = 5\%$, we can solve this for $\overline{\beta} \approx 21\%$. Hence, the bound in Proposition 5 yields $\Delta \leq \$97{,}000$, much lower than in the risk-neutral case.[18]

This simple back-of-the-envelope calculation still underestimates the risk faced by founders since the binary distribution abstracts from uncertainty in x conditional on receiving a positive payoff. In particular, we will show in Section 5 that this conditional distribution features a thick tail, which makes it less attractive for a risk-averse founder.

The bound for Δ in Proposition 5 differs from the exact formula (9) because the jackpot comes after a random delay. In the case of an immediate exit, $\pi = 1$, the two formulas are the same. Otherwise, the critical paycut is strictly lower because the founder faces the additional risk that the time to exit might be long, which makes working in the startup less attractive. In other words, defining the *dynamic risk discount* β such that $\Delta \equiv \beta \pi \mathbb{E} x$, i.e., taking the random delay into account, Proposition 5 implies $\beta \leq \overline{\beta}$.

Finally, our simple formulas in Propositions 4 and 5 depend on CARA preferences and no borrowing constraints. Borrowingconstraints further reduce the value of entrepreneurship and thus further lower Δ. Moreover, when the utility function does not take the CARA form (e.g. with CRRA preferences) there is no closed-form solution of equation (8) for Δ because how much the jackpot is discounted varies with consumption.

3.4 Mapping the model to the data

In the next sections, we will use the approach developed so far to evaluate the attractiveness of entrepreneurship under various capital gains tax regimes. In particular, we can

[18] In Section 6, we will return to this example to offer a first glimpse at how accrual-based capital gains taxation changes this calculation.

compute critical paycuts Δ for given preferences, initial assets and wage levels using empirical estimates of the exit rates π and the distribution $F(x)$, thus relaxing the parametric assumptions in Propositions 1 to 5. Recall that x is the after-tax payoff to founders, which we can construct by computing the dilution of the founders' ownership share using data on the deal rounds of VC-funded startups.

Under the status quo system of a realization-based capital gains tax, this will provide a new measure of the value of entrepreneurship similar to Hall and Woodward (2010), which we will update with more extensive and recent data in Section 5. Building on this, we will quantify how accrual-based capital gains taxation affects dilution and thus the distribution of founder jackpots x in Section 6. As our stylized model in Section 2 shows, an increase in the accrual tax level α lowers the average payoff $\mathbb{E}x$ but effectively provides insurance to founders. We will use our career choice model to quantify the net effect on the risk discount β and critical paycut Δ.[19]

4 Data Construction

In order to calibrate our career-choice model and quantify the impact of tax reforms on entrepreneurship, we first expand Hall and Woodward's (2010) measurement of the returns to startup founders with modern data. We construct a novel dataset of VC-funded companies with information on their funding deals, valuations, exit performance, and founders from a variety of sources. We summarize the data construction here and provide details in Appendix B.

4.1 Company Funding Deals and Exits

Our main data source is PitchBook, which is currently the leading provider of data on VC-funded startups. PitchBook aims to collect data on the universe of these companies in the United States, including the deals funding them, their exits, and the key people involved with them. The data is obtained from public filings, interviews, and news clippings. Thus, some deals may not be reported, and there is a natural tendency for successful deals and companies to be overrepresented. To reduce this selection bias, we use alternative industry datasets (provided by Capital IQ, CB Insights, and PrivCo) to fill in gaps in PitchBook's data whenever possible. Moreover, we use information from CRSP/Compustat to fill in missing data on exit values.

[19] Propositions 1 and 3 conceptually justify our focus on founders since both VC investors and the government are indifferent across tax regimes under the provided conditions.

To construct the company dataset, we start with the universe of venture capital funded companies in PitchBook, founded between 1987 and 2021.[20] We deflate all values by the CPI for all urban consumers, and report values in 2025 dollars. We assign one of four possible exit statuses to each firm: exit in an initial public offering (IPO), exit due to a merger or acquisition (M&A), shutdown, or ongoing.[21] We observe the company exit value (the total value received by the shareholders at the time of exit), founding date, and exit date.

For each company, we use the data on funding deals to iteratively compute the percentage of the company owned collectively by the founders at exit. We explain this dilution calculation, which is similar to that in Hall and Woodward (2010), in the next section. It requires information about the capital injected by the VC-investors as well as the company valuation before or after the funding round (pre- or post-money valuation). Our combined sources from PitchBook, Capital IQ, CB Insights and PrivCo allow us to collect this information for many of the funding rounds in our data. When valuation information is missing, we impute it as detailed in Appendix B.

4.2 Founders

For each company, we construct a list of founders based on the text description of the relationship of key people to the firm. In particular, PitchBook provides information on employees and other individuals related to the companies including descriptions of their positions (such as founder or co-founder). PrivCo and Capital IQ also provide lists of founder names. We construct different combinations of these founder lists and cross-check them against a subset of 445 companies for which we hand-collected the accurate founder information from Wikipedia. We pick the combination of founder names across the different data sources that achieves the best fit in the Wikipedia subsample.

4.3 S-1 Sample

The data sources described so far, together with our dilution calculations explained in the next section, allow us to compute the share of the company owned collectively by all

[20] We choose 1987 for comparability with Hall and Woodward (2010) since this is the first year in their data. Some of our founder datasets were extracted in 2021, which is why we restrict the analysis to companies founded up to 2021 (but we use updated PitchBook data for these companies to the present).

[21] As detailed in Appendix B, the exit classification "shutdown" comprises both cases of a confirmed bankruptcy or liquidation reported in our data and cases where we infer an effective shutdown when no funding activity is observed for at least 5 years.

founders at exit. However, it does not include information on how individual founders split this value among themselves.

To construct data on relative founder ownership, we therefore use the capitalization tables included in form S-1, which is filed with the U.S. Securities and Exchange Commission (SEC) when a company goes public. We obtain these filings for $1,077$ IPOs in our data. We refer to these companies as the S-1 sample. S-1 filings report the amount of shares owned by each major shareholder, including the founders we identified as described above. Thus, in the S-1 sample, we observe the distribution of ownership between founders. We define a founder's relative ownership share as the fraction of shares she owns out of all shares collectively owned by the founders. We use this distribution for all M&A and IPO exits in our data, as explained in the next section.

5 Entrepreneurship under Status Quo Taxation

The goal of this section is to quantitatively evaluate the attractiveness of entrepreneurship under the current, realization-based system of capital gains taxation. This will then serve as the benchmark for the analysis of alternative, accrual-based systems in the next section.

We proceed as follows. First, we construct the distribution of company-level exit values in our universe of VC-funded startups. Second, we use our data on VC-funding rounds to calculate the dilution of the founders' collective ownership share until exit. Third, we construct the within-founder split of this collective ownership share using our S-1 sample. Taking all this together delivers the distribution $F(x)$ of after-tax exit payoffs faced by individual founders, our object of interest. This is the distribution we ultimately feed into our career-choice model from Section 3 to compute values of the critical paycut Δ and the risk discounts β that founders are willing to accept when starting a company.

5.1 Company Exit Values

Table 1 gives summary statistics of the company dataset, split by exit status. The data includes $95,968$ companies with $185,678$ founders. The S-1 sample includes $1,077$ companies with $2,370$ founders.

Building a company takes time. The sample average lifetime of exited companies is 7.4 years. However, the dataset is right-censored. To correctly measure the time it takes for a company to exit, we fit an exponential hazard model. The estimated rate is 6.4% per year, corresponding to a fitted average lifetime of 15.6 years.

Table 1: Summary Statistics of the Companies Dataset

Variable	IPO	M&A	Ongoing	Shutdown
N	2,046	17,536	48,010	28,376
Year Founded	2000.3	2005.0	2013.4	2009.4
Number of Founders	1.9	2.0	2.0	1.8
Lifetime (years)	7.2	7.7	—	6.8
Company Exit Value	1,305	111	—	0

Notes: Mean values of selected variables according to company exit status. Monetary values are in millions of US dollars

The fraction of exits with a nonzero exit value is 41%. This is slightly lower than the 50% in Hall and Woodward's data.[22] Still, this number is likely to be an overestimate, due to favorable reporting bias. Nevertheless, the fraction is broadly consistent with industry averages.[23]

Company exit values are large and their distribution is skewed. Our data includes $15,870$ companies with non-missing, positive exit values. The median exit value is $44 million and the mean is $258 million. The distribution is extremely right-skewed, with a 90th percentile of $417 million and a 99th percentile of $\$3,313$ million. The top 1% of exit values account for 40% of the total exit value.

Figure 1a plots a histogram of the positive company exit values. The distribution spans several orders of magnitude and is relatively similar to a lognormal, but with a right skew and fatter right tail.

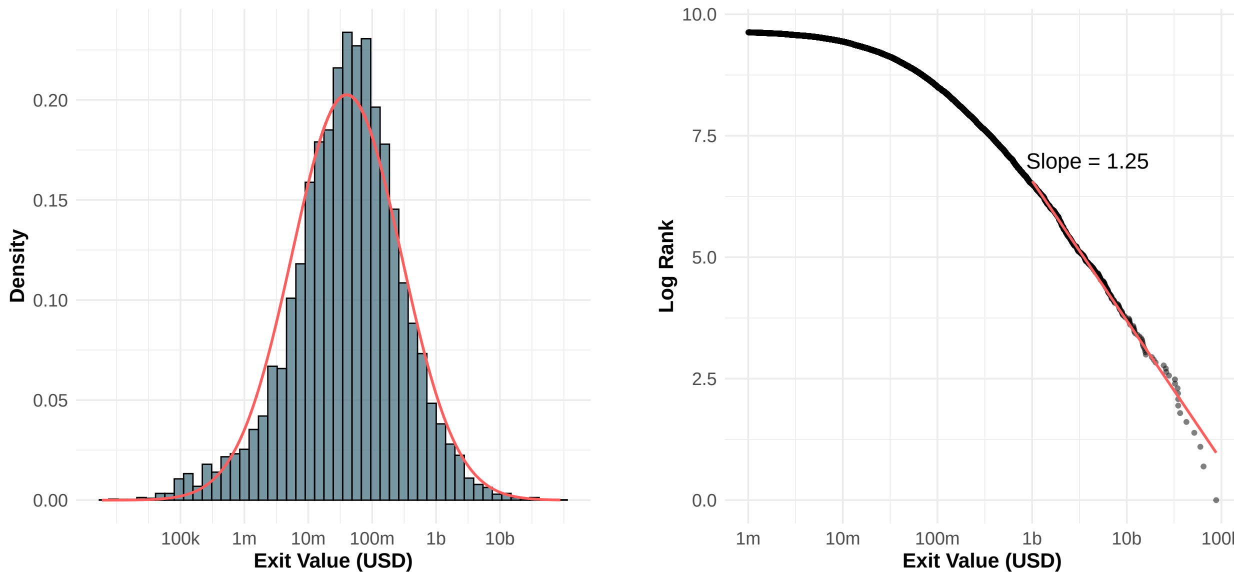
The distribution displays power law tails. This can be seen in the log-log plot in Figure 1b. The red line is a linear fit to the values above $1 billion. In an infinite, power law distributed sample, the slope would equal the Pareto tail coefficient. The figure suggests power law behavior, with a Pareto tail coefficient of about 1.25.

The exact value of the Pareto tail coefficient is difficult to estimate, because we only have 667 observations above $1 billion, and only 42 of these are above $10 billion. Following Clauset et al. (2009), we estimate the Pareto tail coefficient by maximum likelihood. Applied to all values above $1 billion, the estimated Pareto tail coefficient is 1.18, with a 95% confidence interval of $[1.11, 1.21]$.[24]

[22] Their data has 2,015 IPOs, 5,625 M&As, 3,352 confirmed shutdowns, and 4,220 inferred shutdowns.

[23] For example, the European Investment Fund performed a study of all of their portfolio companies (Prencipe, 2017). Their data had 709 complete write-offs, 829 unprofitable sales, and 527 profitable sales. This adds up to 65% of companies with nonzero exit value, and 25% of investments turning into a profit.

[24] We also considered a flexible fit, where the lower bound is chosen to maximize goodness of fit (Clauset et al., 2009). The fitted threshold value is $\$1,318$ million. The estimated Pareto tail coefficient is 1.28, with a 95% confidence interval of $[1.17, 1.36]$.



(a) Histogram of positive company exit values

(b) Log-rank vs. log-value Power Law fit

Figure 1: Company exit value distributions

Notes: The figure plots the distribution of positive company exit values. Left: The red line is a log-normal fit to the distribution of positive company exit values. Right: The red line is fit to the values above $1 billion.

5.2 Collective Founder Ownership Shares

Having constructed the distribution of exit values at the company level, our next step is to calculate how much of these values accrue to the founders at exit. As described in our stylized model in Section 2, their ownership share is diluted in each funding round since some company equity is allocated to the VC-investors to compensate them for their investment. Let $i = 0, 1, ..., I$ index the deal round (where I denotes the exit round) and consider a deal with investment d_i, pre-money valuation v_i and post-money valuation $u_i = v_i + d_i$. In the status quo with a purely realization-based capital gains tax ($\alpha = 0$), no taxes are due pre-exit, so the founders' collective ownership share evolves according to

$$s_i = \frac{v_i}{u_i} s_{i-1}. \tag{11}$$

In line with Kaplan and Stromberg (2003), we assume $s_0 = 80\%$ reflecting the fact that, even before the first funding round observed in our data, some of the company is already owned by non-entrepreneur and non-venture investors, such as angels, family and friends.[25] Based on our deals data, we then use the recursion in equation (11) to calculate

[25] When we observe angel investments in our data, we take them into account in addition.

the gradual decline in the founders' collective ownership share until exit.

In practice, there are multiple complications to this benchmark scenario. In particular, VC-contracts typically offer the investors insurance against adverse events, such as down rounds where the valuation of the company decreases (so $v_i < u_{i-1}$). This takes the form of anti-dilution provisions that effectively assign additional shares to the investors in this case in order to (partially) compensate them for the losses on their shares, further diluting the founders. Moreover, preferences ensure that the VC-investors are guaranteed some minimal return on their investments, which in the case of a disappointing exit performance also comes at an additional expense to the founders. Similarly, some funding rounds take the form of debt rather than equity deals (or intermediate configurations). We incorporate all these complications, which modify the benchmark recursion (11) in our dilution calculations as detailed in Appendix C.

The end result of these calculations is a collective founder ownership share at the time of exit of each company, which together with the company exit values constructed in the preceding subsection delivers a distribution of collective founder exit values.

The average collective founder share at exit, among all IPOs and M&As, is 36%.[26] This high average is likely an overestimate due to missing data on deals. Appendix B explains how we account for missing data to the extent possible. There is considerable heterogeneity in the collective founder share. Even among IPO and M&A exits, 24% of companies have a collective founder share of zero. This is due to the investor protection provisions in term sheets, which can wipe out founders in companies that have sufficiently bad down rounds prior to the exit. The distribution is displayed in Figure 2a.

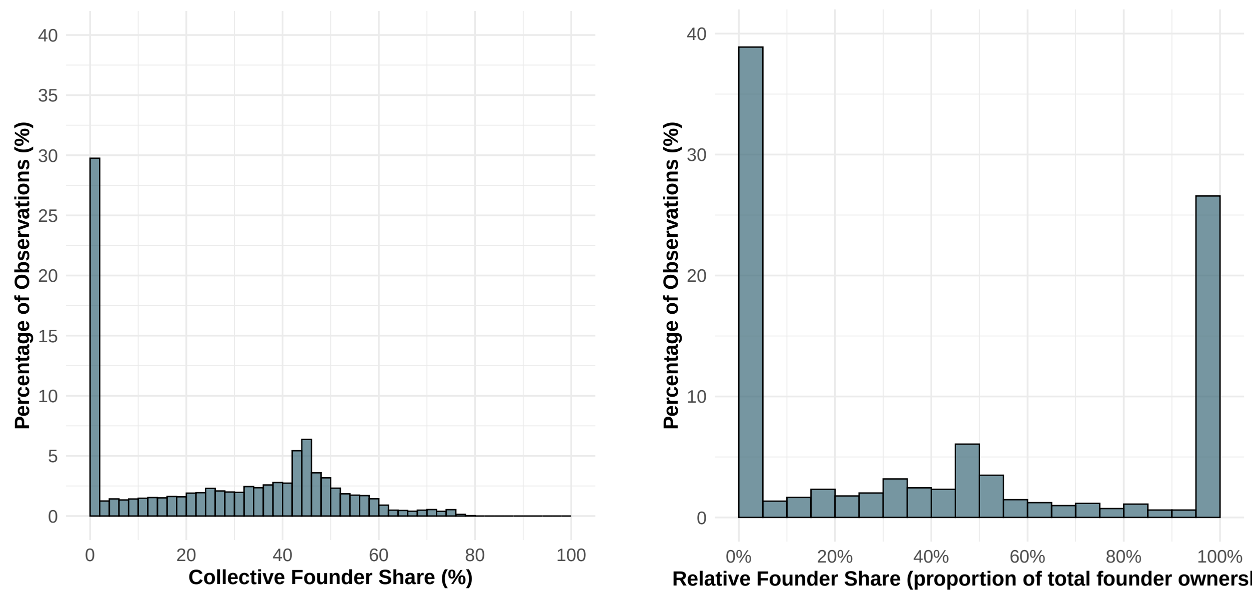
5.3 Distribution of Ownership Among Founders

Our object of interest is the distribution of the value received by individual founders. To obtain this, as a last step we need a measure of how the collective founder exit values are distributed among individual founders.

To do this, we use the S-1 filings to generate a distribution of ownership share among founders. We begin with the simplest possible specification. We consider all companies with at least one founder in the S-1 sample. We then calculate the percentage of the share among all founder shares owned by each individual founder. This yields an empirical distribution of relative founder shares. Figure 2b plots the distribution.

26% of founders own 100% of the total founder shares in the company (e.g. because

[26] When including failed company exits, this average drops to 20%. When we limit the sample to firms with information about at least one pre-exit deal round, it further drops to 10%.



(a) Collective founder share at exit

(b) Relative founder share distribution

Figure 2: Founder share distributions

Notes: The figure plots the distribution of founder ownership shares. Left: Distribution of collective founder share at exit among all IPOs and M&As with at least one pre-exit funding round. Right: Distribution of relative founder shares within companies in the S-1 sample.

there is just one founder). Another common situation is that two founders each own half of the founder shares, which happens 5% of the time. The most surprising result is that 38% of founders in our S-1 sample do not own any shares in the company at exit. These are founders that are present in the company data, having been tagged as founders by PitchBook or other data providers. However, they are not listed in the S-1 filings even though other founders are.

Part of these dropouts are accurately described as receiving little compensation. There are well-known anecdotes of founders who left companies early and received little compensation.[27] However, some of the dropouts may have received significant compensation. They may either have avoided reporting requirements in the S-1 filings, or have made a profitable private sale prior to the IPO. For example, while most of Facebook's five founders left prior to the IPO, all of them accrued significant wealth.

For simplicity, as a benchmark we assume that dropouts receive zero compensation. This assumption does not affect the entire value received by all founders, which we cal-

[27]Ronald Wayne famously sold his stake in Apple for $800 to Steve Jobs and Steve Wozniak. Twitter co-founder Noah Glass was pushed out in 2006. The press reported that he stood "to make as much as Dorsey's secretary" from Twitter's IPO (Carlson, 2013). Tesla's Martin Eberhard was ousted as CEO in 2007 and sold most of his shares (Ohnsman, 2021).

culate only based on the company data. However, it makes our distribution of individual founder exit values more dispersed.

5.4 Distribution of Individual Founder Exit Values

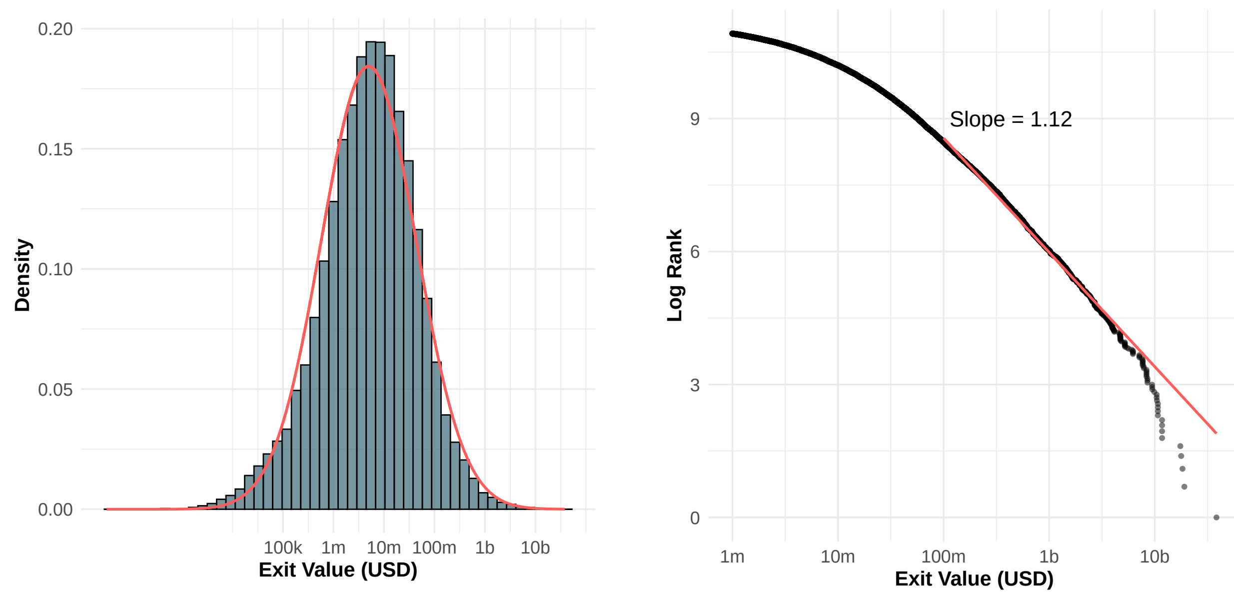
We can now construct the distribution of individual founder exit values. For each company, we observe the collective exit value received by all founders. We then draw ten values of the distribution of relative values among founders. Multiplying these values, we get a simulated distribution of individual founder exit values. Because, in this section, we consider the current tax code, we assume that founders pay 20% capital gains tax on their exit value, and report after-tax values.[28]

The individual founder exit value is, on average, high, but extremely skewed. The average individual founder exit value is $7.2 million. However, 84% of founders receive zero exit value. This is due to a combination of two factors. First, there is a probability of 74% that founders are collectively wiped out, either due to failed companies, or due to bad exits where venture capitalists receive all of the proceeds. As explained in Appendix B, venture capital contracts are favorable to investors in cases where company valuations go down. Our dilution calculation takes this into account, so that founders are wiped out significantly more often than companies are a complete failure. Second, even if founders are not wiped out as a whole, there is the 38% probability that an individual founder drops out. These factors combine to reach the 84% probability that an individual founder receives zero exit value.

There is even more extreme dispersion among the positive values. Conditional on a positive exit value, the mean is $45.6 million. However, the median is only $5.6 million. The 90th percentile is $66.0 million, and the 99th percentile is $620.6 million. The top 1% of exit values account for 45% of the total exit value.

A vivid illustration is the fact that 80% of the individual founder exit value comes from the top 2% of founders (including zeros). This is an extreme version of Pareto's 80/20 principle. Figure 3 plots the distribution. Figure 3a shows the histogram of positive

[28]The federal top marginal tax rate on long-term capital gains is 20% plus, potentially, an additional 3.8% net investment income tax. In addition, there are state-level taxes. However, there are several base reductions that have become more popular over time. Section 1202 of the U.S. tax code exempts the first $10 million the capital gains from selling Qualified Small Business Stock (QSBS) from taxation, a cap that was expanded in 2025. It also appears that more founders are leaving higher tax states for no tax states at least one year before realizing their gains after an IPO. Moreover, while tax strategies such as "hold-borrow-die" are not common in aggregate, they have become more prominent, especially in higher tax states, during the last decade, especially with founders with substantial gains. These three strategies can help reduce both federal and state taxes. Using a higher effective tax rate than 20% would only reinforce our conclusions since we are finding a low value to entrepreneurs even at 20%.



(a) Histogram of positive individual founder exit values

(b) Log-rank vs. log-value Power Law fit

Figure 3: Individual founder exit value distributions

Notes: The figure plots the distribution of positive individual founder exit values. Left: The red line is a log-normal fit to the distribution of positive individual founder exit values. Right: The red line is fit to the values above $100 million.

individual founder exit values. Like company exit values, the distribution is roughly log-normal, but with a right skew and much fatter right tail. Figure 3b shows the log-log plot of the distribution. The red line is a linear fit to the values above $100 million. The maximum likelihood estimate of the Pareto tail coefficient in this range is 1.03, with a 95% confidence interval of $[1.01, 1.04]$. Thus, the tail of the individual founder payoff distribution is even fatter than that of company exit values described at the beginning of this section.

5.5 Value of Entrepreneurship

How attractive is entrepreneurship through the lens of our career choice model? As in Section 3, we focus on the critical paycut Δ that an agent would be willing to accept to become an entrepreneur.

The risk-neutral case provides a useful benchmark. As previewed in Section 3, the expected gain in a year is the product of the exit rate $\pi = 6.4\%$ and the average exit value $\mathbb{E}x = \$7.2$ million. Thus, the expected gain per year of work is $\pi\mathbb{E}x = \$462,719$.

These gains are subject to considerable risk, both from the 84% probability of a zero

Table 2: Value of Entrepreneurship under the Current Tax System

Parameters			
risk aversion σ	worker wage	critical paycut Δ	risk discount β
0.0	\$194,126	\$462,719	100.0%
0.0	\$367,212	\$462,719	100.0%
0.0	\$1,128,001	\$462,719	100.0%
0.9	\$194,126	\$57,947	12.5%
0.9	\$367,212	\$77,083	16.7%
0.9	\$1,128,001	\$123,721	26.7%
2.0	\$194,126	\$23,731	5.1%
2.0	\$367,212	\$35,031	7.6%
2.0	\$1,128,001	\$67,226	14.5%

Notes: This table shows the value of entrepreneurship under the current capital gains tax system. σ is the coefficient of relative risk aversion. We assume initial assets of \$1 million. The critical paycut Δ is the maximum paycut that makes a founder indifferent between entrepreneurship and being a worker. The dynamic risk discount factor β is the factor by which Δ is lower than what a risk-neutral agent would accept.

exit value, and the vast dispersion in exit values. Thus, the critical paycut in the risk-averse case is considerably lower. In Section 3, we defined the static risk discount $\overline{\beta}$ and showed in Proposition 5 that, under CARA preferences, the critical paycut Δ is bounded above by $\Delta \leq \overline{\beta}\pi\mathbb{E}x$. Recall that β denotes the dynamic risk discount factor, defined such that

$$\Delta \equiv \beta\pi\mathbb{E}x = \beta \cdot \$462,719,$$

which takes into account that the jackpot is not only risky but also comes after a random delay.

This allows us to calculate the critical paycut Δ, and hence the dynamic risk discount β, using the empirical distribution of founder payoffs we have constructed so far. We do so by numerically solving equation (8) under the assumption of CRRA preferences and the borrowing constraint. Table 2 displays both Δ and the dynamic risk discount β for different levels of risk aversion, as captured by the coefficient of relative risk aversion σ. In contrast to the CARA example from Section 3.3, both Δ and β now also depend on the founder's resources, namely the level of initial assets a_0 and the wage they could obtain as a worker w^*. We consider initial assets of \$1 million and the same after-tax worker wages w^* as Hall and Woodward's (2010) main scenarios.

Our results show that, for risk-averse agents, the value of entrepreneurship is considerably lower than the expected gain. For the case of $\sigma = 0.9$ and worker wage of \$367,212, the critical paycut is $\Delta =$\$77,083, with a dynamic risk discount factor of $\beta =$

Table 3: Comparison with Hall and Woodward (2010)

Parameters		Certainty Equivalent	
risk aversion σ	worker wage	our estimate	HW estimate
0.0	$194,126	$3,327,246	$5,800,000
0.0	$367,212	$1,810,976	$5,100,000
0.0	$1,128,001	$-4,853,696	$2,300,000
0.9	$194,126	$-268,477	$900,000
0.9	$367,212	$-2,097,123	$300,000
0.9	$1,128,001	$-12,142,240	$-4,000,000
2.0	$194,126	$-670,059	$200,000
2.0	$367,212	$-3,047,006	$-600,000
2.0	$1,128,001	$-16,702,975	$-8,900,000

Notes: This table shows the value of entrepreneurship calculated as defined in Hall and Woodward (2010) and assuming, like them, an after-tax startup wage of $w = \$111,220$. The value of entrepreneurship is the certainty equivalent a worker would need to be indifferent between entrepreneurship and employment. We use the same parameters as in our Table 2, including initial assets of $1 million. These combinations can be directly compared to Table 3 in Hall and Woodward (2010).

16.7%, both lower than in our simple CARA approximation from Section 3.3. With these risk preferences, the risk of entrepreneurship is a significant deterrent, as entrepreneurs value payoffs at a small fraction of the expected gain.

Finally, we compare our results to Hall and Woodward's (2010). We chose the same cases as in their own Table 3. We report the certainty equivalent that leaves a worker indifferent between choosing entrepreneurship and employment, the main measure reported by Hall and Woodward's (2010). Our results are noticeably less favorable to entrepreneurship.[29] Table 3 reports the results for easy comparison. The main reason for these differences is that we cover a more recent time period. When restricting our analysis until 2008, the last year in Hall and Woodward's (2010) data, we find more similar results. However, our data includes more unsuccessful company exits, which is partly due to better coverage in more recent years.

6 Entrepreneurship under Accrual-Based Taxation

We are now in a position to evaluate the effects of accrual-based capital gains taxation on entrepreneurship. We first compute the additional dilution in the founders' owner-

[29] As noted earlier, we assume a 20% capital gains tax rate in our calculations. In contrast, Hall and Woodward's (2010) assume a 25% capital gains tax rate. The difference between the results shown in Table 3 would grow even more at 25%.

ship shares from the resulting advance tax payments in each funding round, leading to a modified payoff distribution at exit. We then embed these after-tax payoffs in our career-choice model to re-compute the critical paycuts founders would be willing to accept when entering entrepreneurship.

6.1 Dilution under Accrual-based Capital Gains Taxes

Our stylized model in Section 2 showed that accrual-based taxation leaves company valuations and VC-investors unaffected while the effects on founders are ambiguous: it reduces their payoff in case of success due to the additional dilution, but in return it may offer tax credits in case of failure. Accordingly, we now demonstrate how to generalize our dilution calculations from the previous section to accrual tax levels $\alpha > 0$.

Let the founders' accrued capital gain in funding round i be denoted by

$$g_i \equiv s_{i-1}(v_i - u_{i-1}).$$

Then the founders' advance tax liability in round i under an accrual tax level $\alpha \in [0, 1]$ is given by $\alpha\tau g_i$. It is useful to distinguish between the cases of positive and negative unrealized gains $g_i \lessgtr 0$, corresponding to up or down rounds.[30]

Up rounds. As explained in Section 2, if the founders pay the tax liability by selling additional shares in their company to the VC-investors, the dollar value of these shares must satisfy

$$T_i = \alpha\tau g_i + (1 - \alpha)\tau T_i$$

where the second component is due to the fact that the founders must pay realization-based capital gains taxes on the shares sold (with weight $1 - \alpha$). This can be solved for

$$T_i = \frac{\alpha\tau g_i}{1 + (1 - \alpha)\tau},$$

which is the analogue of equation (2) for the case with multiple investment rounds. Hence, the founders' ownership share evolves according to

$$s_i = \frac{v_i s_{i-1} - T_i}{u_i}.$$

[30] In the stylized model in Section 2, the accrued gains at the time of the single funding round were always positive since we normalized the initial value of the company to zero.

Clearly, in the case of a purely realization-based tax with $\alpha = 0$, this collapses back to the usual recursion (11) since $T_i = 0$. With $\alpha > 0$, the founders lose additional ownership share each funding round, which we will compute in the following.

Down rounds. In the case of a down round with $v_i < u_{i-1}$, the founders' unrealized capital gains $g_i < 0$ are negative, so the advance taxes $\alpha\tau g_i < 0$ in fact constitute a tax credit. The effect on the founders then depends on whether these tax credits are (partially) refunded. In the case of fully refunded tax credits ($\phi = 1$), the founders' ownership dilution in round i is given by

$$s_i = \frac{s_{i-1}v_i - \alpha\tau g_i}{u_i}.$$

Effectively, founders can use the tax credit to buy back shares in their company, counteracting the dilution from the VC investment. For illustrative simplicity, this formula abstracts from anti-dilution provisions for the VC investors (from the previous rounds) protecting them against such down rounds, which we incorporate in our actual calculations as explained in Appendix C.

As in Section 2, we also allow for incomplete tax credits ($\phi < 1$). An important case is loss carry-forward, where tax credits are not refunded but can be used against future tax liabilities (in future up rounds). This gives rise to another state variable, the founders' tax shield L_i accumulated up until round i. In a down round, the founders' ownership dilution is given by the standard formula (11) but the tax shield is updated by $L_i = L_{i-1} - g_i$. In an up round, the accrued gains subject to taxation are given by $g_i - L_{i-1}$ since the tax shield can be deducted. We provide the details in Appendix C. In general, loss carry-forward makes the tax credits incomplete because there might not exist future rounds with sufficient gains to fully use the tax shield. This is notably the case for failed companies where the capital losses occur in the last round.

Exit round. With accrual-based taxes, the exit round requires special treatment. With full tax credits ($\phi = 1$), the founders must pay taxes

$$\tau g_I + (1 - \alpha)\tau s_{I-1}u_{I-1},$$

where the first term are the taxes on the gains in the exit round (in case of failure, this is a tax credit) and the second term adds the taxes on the gains from the previous rounds that have not been pre-paid. It is instructive to consider the extreme cases with $\alpha = 0$ or $\alpha = 1$. In the first case, using the definition of g_I, it simplifies to τv_I, which are just the taxes on the realized gains at exit (and there is never a tax credit). In the second case with full accrual-based taxation, we obtain τg_I. I.e., if the exit round is successful ($g_I > 0$), the founders simply pay tax on those gains since all previous gains have already been fully taxed. Otherwise, they obtain a tax credit. We relegate the case with incomplete tax credits (such as loss carry-forward) to Appendix C.[31]

6.2 Founder Exit Values

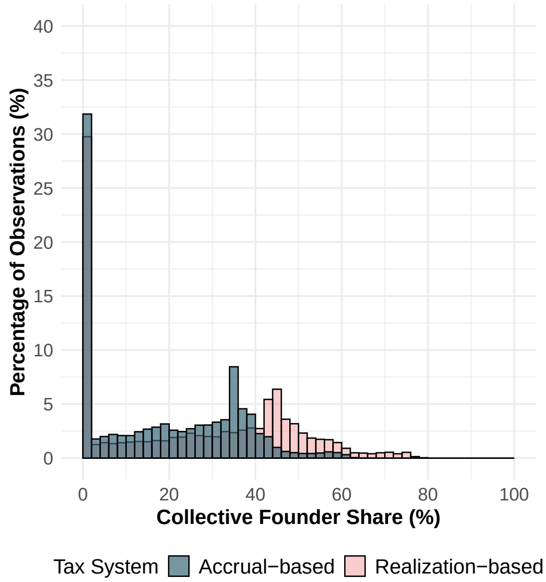
Collective founder ownership shares. We now compute how an increase in the accrual tax level affects the founders' collective ownership share in their companies at exit. To isolate the effect of the tax regime, we maintain a tax rate of $\tau = 20\%$ and increase α starting from zero. Figure 4 displays the distribution of collective founder shares under $\alpha = 1$ in comparison to the status quo with $\alpha = 0$. With fully refunded tax credits, the average collective founder share at exit, among all IPOs and M&As, falls from 36% at $\alpha = 0$ to 27% at $\alpha = 1$, corresponding to a 25% drop. This illustrates the additional dilution from the advance tax payments. Accordingly, the share of companies with a collective founder share of zero, again among IPO and M&A exits, slightly increases, from 23.5% to 24.8%. However, even though they end up with a zero equity value in their company, some founders now exit with strictly positive tax credits. Indeed, only 8% of companies now have both a zero collective founder share *and* zero tax credits. This illustrates the insurance value from accrual-based taxation.

Figure 4 also shows the case of incomplete tax credits, specifically the loss carry-forward scenario. As anticipated, the founders' ownership dilution is slightly worse compared to full tax credits, although not much. The biggest difference is that, with loss-carry-forward, failed founders (with a zero equity value at exit) do not obtain a tax refund, so the insurance value of accrual-based taxation is greatly diminished.[32] In the following, we focus on the full tax credit case as our benchmark and present results for the case of loss carry-forward in Appendix D.

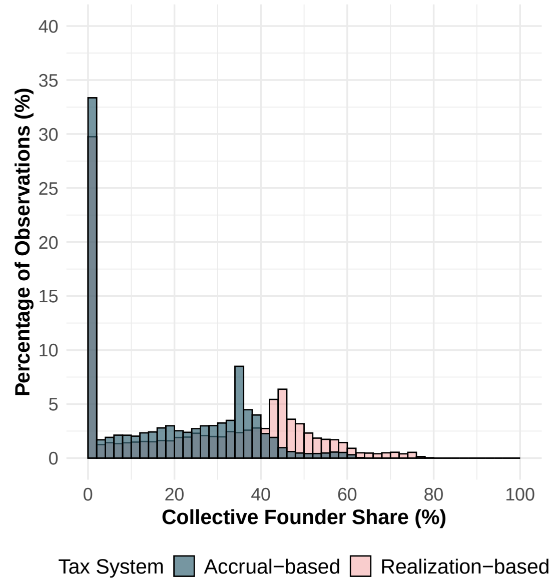
Individual founder payoff distribution. Figure 5 plots the distribution of individual founder exit payoffs (conditional on the payoff being strictly positive) and Table 4 presents various descriptive statistics for increasing accrual tax levels α. Both reveal a large change in the distribution as α increases from zero to a positive value. The reason is a compo-

[31]Moreover, in addition to anti-dilution provisions, we also account for preferences, which guarantee the VC investors some minimal return on their investments if the company exit valuation allows it. This may come at the additional expense of the founders as detailed in Appendix C.

[32]For instance, in the loss carry-forward scenario with $\alpha = 1$, even among IPOs and M&As, the share of companies with both a zero collective founder share and zero tax refunds is 26%.



(a) Fully refunded tax credits



(b) Loss carry-forward

Figure 4: Distribution of collective founder shares at exit under full accrual-based taxation ($\alpha = 1$)

Notes: Teal: collective founder share at exit under full accrual-based taxation. Red: collective founder share at exit under current realization-based taxation.

sitional effect: Under a fully realization-based tax system ($\alpha = 0$), the only chance for a founder to achieve a positive exit value is to have a positive equity value in her company. As discussed in Section 5, this requires both a successful company exit and a positive ownership share, resulting in a low overall probability.

By contrast, when a small degree of accrual-based taxation ($\alpha = 10\%$) is introduced, a founder's overall exit payoff can consist of two components: her equity value in the company and a tax credit. In particular, as Figure 5 starkly illustrates, many failed founders, whose equity value is zero and who would thus have had an overall exit payoff of zero under $\alpha = 0$, now exit with a tax refund, making their overall exit payoff strictly positive. Their companies had a positive valuation during earlier VC-rounds (triggering advance capital gains tax payments under an accrual-based regime) but the value ultimately dropped to zero at exit (resulting in a tax credit). Indeed, as Table 4 shows, the average tax credit is about $43,000 even with $\alpha = 0.1$. Thus, the probability of obtaining a positive overall payoff drastically increases (from 15.8% to 46.6%), giving rise to an additional mass in the conditional distribution (the red bars in Figure 5). This transparently demonstrates the insurance effect of accrual-based taxation.

On the other hand, Figure 5 and Table 4 also make clear that this insurance is actuari-

Table 4: Individual Founder Payoff Distribution Statistics by Accrual Tax Level α

	All Exit Values			**Positive Exit Values**			
Accrual Level α	Average Tax Refund	Probability Positive	Mean	Mean	Median	99th Percentile	Pareto Tail Coefficient
0%	0.000	16%	7.2	45.6	5.558	621	1.03
10%	0.043	47%	7.1	15.2	0.070	236	1.03
20%	0.085	47%	7.0	14.9	0.126	227	1.03
30%	0.124	47%	6.8	14.6	0.177	220	1.04
40%	0.162	47%	6.7	14.3	0.220	214	1.05
50%	0.198	47%	6.6	14.1	0.259	206	1.05
60%	0.232	47%	6.5	13.8	0.296	202	1.06
70%	0.265	47%	6.4	13.6	0.330	198	1.07
80%	0.293	47%	6.3	13.4	0.360	194	1.07
90%	0.321	47%	6.2	13.2	0.389	191	1.08
100%	0.347	47%	6.1	13.0	0.416	187	1.08

Notes: Dollar values are in millions. Pareto tail coefficient is the maximum likelihood fit over values above $100m. The table uses the refund tax scenario.

ally unfair. In particular, since successful founders lose ownership in their companies due to the additional dilution from the advance tax payments, the mean payoff monotonically decreases from $7.2 to $6.1 million as we increase α from 0 to 1. Effectively, increasing the accrual tax level compresses the after-tax payoff distribution for founders, drastically reducing top payoffs but putting a floor at the bottom, while shifting the entire distribution down. This compression effect is particularly stark at the very top: the cutoff for the highest one percent of payoffs decreases from $621 million to $187 million and the Pareto tail coefficient increases, indicating reduced inequality at the top end of the distribution.

6.3 Value of Entrepreneurship

The preceding discussion already makes clear that a risk-neutral founder dislikes accrual-based taxation. Indeed, with $\sigma = 0$, the critical paycut Δ drops from approximately $460,000 under realization-based taxation to $390,018 under fully accrual-based taxation. This is simply the result of the lower mean payoff.

However, a risk-averse founder faces a tradeoff between this lower mean and the additional insurance value from the compressed payoff distribution. To illustrate this, we first return to our simple approximation based on CARA preferences and a binary distribution from Section 3.3 and then present the full-fledged numerical results for CRRA

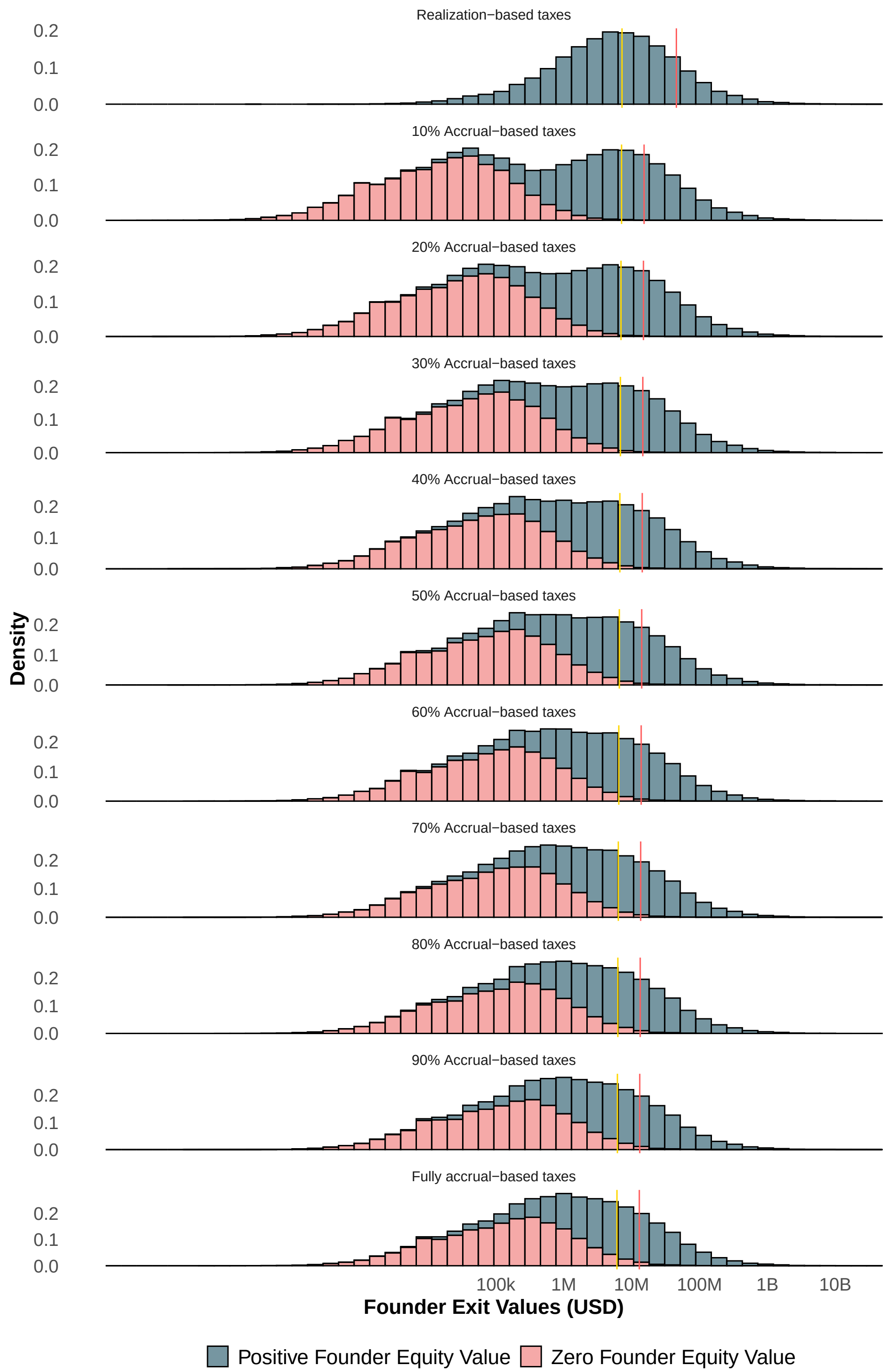


Figure 5: Effects of accrual-based taxation on founder exit values

Notes: The figure plots the distribution of *non-zero* founder exit payoffs as a function of the degree of accrual taxation, under the benchmark refund scenario. The top panel corresponds to the current realization-based system, and the other histograms gradually increase the percentage of the tax liability that is paid upfront. The yellow line is the unconditional mean (including zero) and the red line is the mean of the non-zero payoffs. The large change between the realization-based system and the 10% accrual system is due to the composition effect of many founders going from zero (red bars) to positive exit values (teal bars).

utility and the empirical payoff distribution discussed above.

CARA approximation. With $\alpha = 1$, the probability for a founder to have a strictly positive equity value in her company at exit is $p \approx 15\%$ whereas with $1 - p \approx 85\%$ the equity value is zero. These values are similar to the case with $\alpha = 0$. However, even when the equity value is zero, founders now receive an average tax credit of $410,000 whereas with probability p their conditional mean payoff is $37 million. This illustrates the compression effect of accrual-based taxation (recall that, in the case of realization-based taxation, the payoffs were on average $45 million with probability $p = 16\%$ and zero with probability $1 - p = 84\%$). Leaving all other parameters the same as in the calibrated example in Section 3.3, we obtain a static risk discount of $\overline{\beta} = 23\%$. This is slightly higher than the 21% we obtained for $\alpha = 0$, which suggests that a founder with risk aversion $\sigma = 1$ values the additional insurance. By Proposition 5, the critical paycut is bounded by

$$\Delta \leq \overline{\beta}\pi\mathbb{E}x = 23\% \cdot 6.4\% \cdot \$6.1\text{m} \approx \$90,000.$$

Hence, the lower mean payoff, making the insurance unfair, dominates the calculation in this approximation, which makes entrepreneurship on net slightly less attractive (recall that, with $\alpha = 0$, we obtained $\Delta \leq \$97,000$). However, the net effect is small, indicating that the two opposing effects happen to roughly cancel out and the founder is, perhaps surprisingly, almost indifferent across tax regimes.

Numerical results. Figures 6 and 7 display the critical paycuts Δ and the dynamic risk discounts β for different accrual levels α and risk aversion coefficients σ between 0 and 2. The calculation is based on the respective after-tax payoff distributions from the preceding subsection and CRRA preferences with a borrowing constraint. The case with $\alpha = 0$ replicates our results for the status quo system in Section 5. Whether increasing the accrual tax level benefits or hurts founders crucially depends on risk aversion. In fact, for $\sigma = 0.4$, an interior accrual tax level of $\alpha = 0.1$ is optimal, and for $\sigma = 0.5$, the optimal level is $\alpha = 0.4$. For all lower levels of risk aversion, both Δ and β monotonically decrease with α, and vice versa for higher levels of risk aversion. For instance, with $\sigma = 1$, $\alpha = 1$ is optimal and we obtain $\Delta = \$58,000$ and $\beta = 15\%$. However, in this case, founders are roughly indifferent across tax regimes because the opposing effects from better insurance versus a lower mean payoff largely cancel out (for $\alpha = 0$, we have $\Delta = \$51,000$ and $\beta = 11\%$). This explains why the CARA approximation with $\sigma = 1$, while providing valid upper bounds, indicates the reversed ranking. As Figure 6 shows, the preference

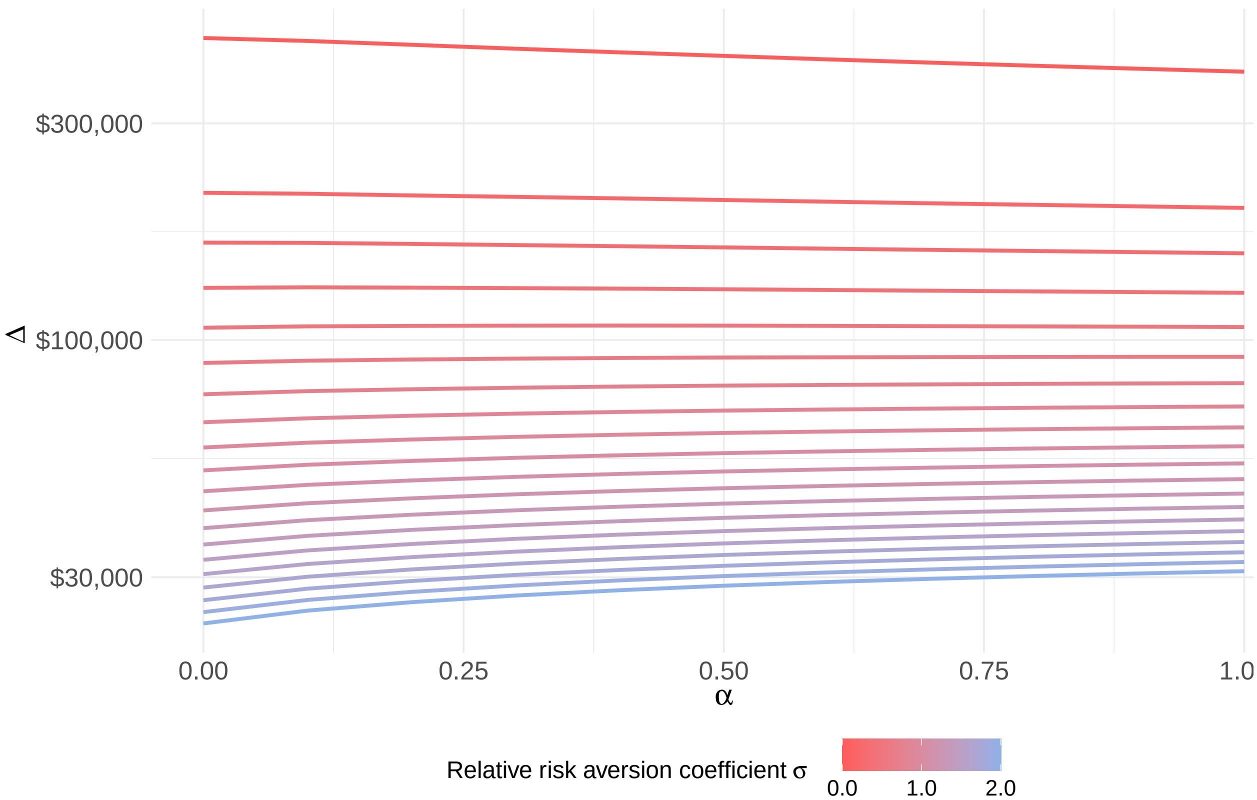


Figure 6: Critical paycut Δ as a function of the accrual level α and risk aversion σ

Notes: The figure shows the critical paycut Δ that makes an agent indifferent between entrepreneurship and wage work. Parameters: worker wage $w^* = \$194,126$, initial wealth $a_0 = \$1,000,000$.

for either $\alpha = 0$ or $\alpha = 1$ is more pronounced for risk aversion levels closer to 0 or 2 (note that the graph uses a log-scale).

Figure 7 illustrates the insurance value of accrual-based taxation. For the risk-neutral benchmark ($\sigma = 0$), $\beta = 1$ by construction, independent of the tax regime. The dynamic risk discount then quickly falls with risk aversion due to the enormous risk faced by founders and approaches zero for higher risk aversion coefficients. While β always increases in the accrual tax level α when $\sigma > 0$, consistent with the insurance effect, the slope becomes small for very risk-averse founders. In other words, accrual-based taxation does compress the distribution faced by founders, but it ultimately remains extremely skewed. As a result, a highly risk-averse individual still greatly discounts its value.

Taking stock, these results reveal that, when analyzing the effect of taxing unrealized capital gains on entrepreneurship, it is not enough to just observe that it hurts successful founders. Instead, the more nuanced effects on risk-sharing need to also be accounted for. Perhaps surprisingly, at least in the case of full tax credits, these insurance effects can be

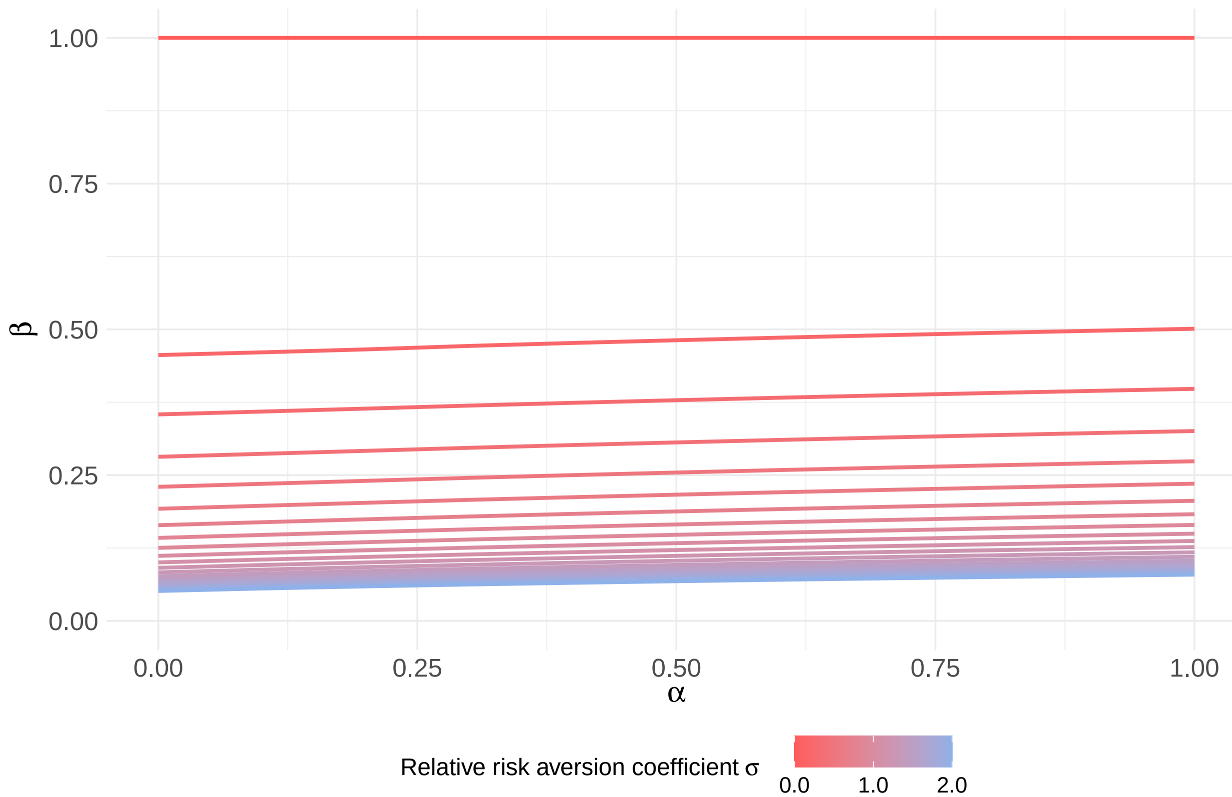


Figure 7: Dynamic risk discount β as a function of the accrual level α and risk aversion σ

Notes: The figure shows the risk discount β as a function of the accrual level α and risk aversion σ. Worker wage $w^* = \$194,126$, initial wealth $a_0 = \$1,000,000$.

quantitatively important, potentially even offsetting the additional dilution effects. While this insurance is of course not valued by risk-neutral founders, it can make founders with intermediate risk aversion close to indifferent across tax regimes or even make them prefer accrual-based taxes.

In Appendix D, we show the corresponding results for the case of loss carry-forward. Since this greatly limits the tax credits for unsuccessful founders, it also diminishes the insurance effect, while exacerbating the additional ownership dilution. As a result, accrual-based taxation is generally bad even for more risk-averse founders. This emphasizes the importance of loss provisions when designing accrual-based capital gains taxes. In particular, to reduce the negative impact on entrepreneurship, our analysis shows that tax credits that are actually refunded and not limited to loss carry-forward would be crucial.

7 Conclusion and Extensions

This paper examines how taxing unrealized capital gains affects entrepreneurship, combining a dynamic career-choice model with new evidence on all U.S. venture capital-backed startups. A stylized model highlights a key trade-off: accrual-based capital gains taxes dilute successful founders by forcing additional share sales before exit, a well-known concern, yet they also provide insurance through tax credits to founders whose ventures fail, an aspect often overlooked.

Quantitatively, advance taxation substantially reduces founder' ownership at exit: average founder shares fall about 25% under accrual-based taxation relative to realization-based taxation. At the same time, accrual taxation increases the fraction of entrepreneurs with positive payoffs from around 16% to nearly 47%. Embedding these outcomes in a career-choice framework shows that the insurance value of accrual taxation partly offsets dilution costs: less risk-averse founders favor realization-based taxes, while more risk-averse ones prefer accrual-based taxes. The strength of this insurance channel depends on the highly skewed distribution of entrepreneurial payoffs and the design of loss provisions under accrual-based taxation.

We conclude by outlining natural extensions and directions for future research.

Risk vs. ex-ante heterogeneity. Our simulations interpret the observed payoff distribution of founders as arising from ex-post risk, consistent with Hall and Woodward (2010). An alternative interpretation is that it reflects ex-ante heterogeneity in founder quality, which founders may privately observe.

Although ex-ante heterogeneity is undoubtedly important, two observations suggest that substantial ex-post risk remains. First, the payoff distribution is highly risky even when conditioning on intermediate milestones, such as successful funding rounds or pre-exit valuation thresholds. Thus, even founders who can anticipate these events still face considerable residual uncertainty. Second, if founders possessed extensive private information about their future success, high-quality founders would be more inclined to preserve ownership stakes, implying a positive correlation between exit values and founder shares. In contrast, Appendix D shows that this correlation is negative in our data.

Wealth taxes and tax progressivity. Although our analysis focuses on an accrual-based capital gains tax, similar implications arise under a wealth tax. Both regimes impose tax liabilities before exit, forcing illiquid founders to sell additional shares and thereby diluting ownership. The key distinction is that a wealth tax applies annually—independent of new funding rounds or valuation changes—potentially amplifying its dilution effects. Appendix D illustrates this for a 2% annual wealth tax, which produces dilution comparable to fully shifting from realization- to accrual-based capital gains taxation.

Recent policy proposals often incorporate progressive features, such as triggering taxation of unrealized gains or wealth only above specified thresholds.[33] Such design elements would not alter the qualitative mechanisms identified here but would attenuate their quantitative magnitude. In particular, if accrued gains are taxed only once firms have attained high valuations, the resulting ownership dilution is smaller than when taxation occurs throughout earlier funding stages.

VC contracting. The insurance properties associated with accrual-based taxation raise the question why standard venture capital contracts do not already provide similar risk-sharing for founders. Appendix D develops a model of optimal contracting, allowing the division of compensation between equity and wages to be endogenous. The lack of contractual insurance may reflect low founder risk aversion, moral hazard, or adverse selection. Our main result is that accrual taxation is neutral up to a point: as accrual taxation rises, VC contracts adjust by reducing wages so the fixed component of pay remains unchanged. This neutrality, however, is limited: if wages cannot be lowered sufficiently, the contracts shift in response to the mechanical dilution effect described previously. Such shifts may benefit founders under adverse selection when current contracts are inefficiently high-powered, but may be harmful to less risk-averse founders under moral hazard, or when adverse selection leads lower-powered contracts to cause a market breakdown.

Paying for advance taxes. Our baseline calculations assume that founders finance tax prepayments by selling additional shares to their VC investors. Alternative arrangements might be feasible. For example, the government could lend founders the required funds, effectively becoming a co-owner until repayment. This approach would leave founders incentives unchanged and our ealier results would still apply. Founders might also attempt to meet tax obligations through outside borrowing, if accessible, or by reducing personal consumption. These mechanisms—subject to borrowing constraints—impose costs on founders that differ in form but not in substance from equity dilution. These alternative arrangements also raise price discovery and future governance issues for a private firm that the existing VC investors would have already solved. Still, comparing

[33] For instance, the Harris tax plan for 2025 proposed a 25% minimum income tax (including unrealized capital gains) for taxpayers with wealth exceeding $100 million (U.S. Department of the Treasury, 2024).

these channels within our dynamic consumption-saving framework represents an interesting direction for future research.

Tax rate. To transparently isolate the effects of the tax *regime*, parameterized by the accrual factor α, we have held the tax *rate* τ fixed at its status quo value. A fruitful direction for future research is to examine the interaction between tax rates and tax regimes. For example, the behavioral response to marginal tax rate changes, reflected in the elasticity of taxable entrepreneurial income, may vary systematically with the degree of accrual taxation, with important implications for revenue-maximizing policy. More broadly, our analysis provides a foundation for normative studies of optimal tax design, spanning both the choice of tax regime and rate for startup entrepreneurs.[34]

Valuations and investments. Our quantitative analysis assumes that the empirical distribution of company valuations and investments remains fixed when evaluating the effects of capital gains taxation on founders. Proposition 1 establishes that, under a perfectly elastic supply of VC funding, valuations should indeed be expected to remain unchanged. Consequently, our estimates capture the mechanical effects of accrual-based taxation, which is an important statistic that can be computed without further structural assumptions. Incorporating elastic responses of valuations and investment flows is straightforward, using recent empirical evidence (see, e.g., Edwards and Todtenhaupt (2020)). We leave this promising direction for future research.

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Appendix

A Proofs

A.1 Proof of Proposition 1

VC investors invest $d + T$ at $t = 1$ and receive a pre-tax payoff $(1 - s)y$ at time $t = 2$. For their after-tax payoffs, we distinguish between the two possible outcomes for the company exit value. In case of success, they receive $(1 - s)Y$ and need to pay taxes $\tau[(1 - s)Y - d - T]$ on their capital gains. In case of failure, they obtain zero, so their capital losses are $d + T$ on which they receive a partial tax credit of $\phi\tau(d + T)$. In sum, their expected after-tax payoff is

$$\begin{aligned} &(1-s)\mathbb{E}[y] - p\tau[(1-s)Y - d - T] + (1-p)\phi\tau(d+T) \\ =&(1-\tau)(1-s)\mathbb{E}[y] + \tau(d+T)(1-(1-p)(1-\phi)) \end{aligned}$$

For investors to be indifferent, this needs to be equal to their required rate of return Ψ on their investment, so

$$(1-\tau)(1-s)\mathbb{E}[y] + \tau(d+T)(1-(1-p)(1-\phi)) = \Psi(d+T),$$

which we can write as

$$\tilde{\Psi}(d+T) = (1-s)\mathbb{E}[y], \tag{A.1}$$

where the required pre-tax return is

$$\tilde{\Psi} \equiv 1 + \frac{\psi}{1-\tau} + \frac{\tau}{1-\tau}(1-p)(1-\phi). \tag{A.2}$$

By definition, the VCs' investment $d + T$ equals their share $1 - s$ of the company's post-money valuation: $d + T = (1 - s)u$, which implies by equation (A.1)

$$u = \frac{d+T}{1-s} = \frac{\mathbb{E}[y]}{\tilde{\Psi}}. \tag{A.3}$$

The pre-money valuation is

$$v = u - d = \frac{\mathbb{E}[y]}{\tilde{\Psi}} - d. \tag{A.4}$$

By equation (A.2), $\tilde{\Psi}$ is independent of α, increasing in τ and decreasing in ϕ. Hence, by (A.3) and (A.4), both pre- and post-money valuations are independent of α, decreasing in τ and increasing in ϕ. This establishes the first part of the proposition. The second part follows from the assumption that VC investors are perfectly competitive and elastic. Finally, the third part follows from equations (2) and (A.3). Since T is increasing in α, so is $1 - s$.

A.2 Proof of Proposition 2

At the end of period 1, the founder owns a share s of the company with value $v - T$. She has paid an amount $(1 - \tau)T$ of accrual-based taxes at this point, financed by selling shares to VC investors, plus τT of realization-based taxes from this sale (amounting to a total of T in taxes).

If the company is successful, founders receive a pre-tax payoff of sY at $t = 2$. Using equation (A.3), this becomes

$$Y - (d + T)\frac{\tilde{\Psi}}{p}. \tag{A.5}$$

Their tax liability consists of two components: First, they pay taxes on their capital gains from $t = 1$ to $t = 2$ of

$$\tau \left[sY - (v - T) \right]. \tag{A.6}$$

Second, they pay the remaining taxes on their gains from $t = 0$ to $t = 1$, which have not been pre-paid yet. This amounts to

$$(1 - \alpha)\tau(v - T). \tag{A.7}$$

Combining equations (A.5) to (A.7), successful founders receive after taxes

$$\begin{aligned}
&(1-\tau)\left(Y - (d+T)\frac{\tilde{\Psi}}{p}\right) + \tau(v - T) - (1-\alpha)\tau(v-T) \\
=&(1-\tau)\left(Y - d\frac{\tilde{\Psi}}{p}\right) - (1-\tau)T\frac{\tilde{\Psi}}{p} + \alpha\tau(v-T) \\
=&(1-\tau)\left(Y - d\frac{\tilde{\Psi}}{p}\right) - (1-\tau)\frac{\tilde{\Psi}}{p}T + (1-\tau)T \\
=&(1-\tau)\left(Y - d\frac{\tilde{\Psi}}{p}\right) - (1-\tau)\left(\frac{\tilde{\Psi}}{p} - 1\right)T
\end{aligned} \tag{A.8}$$

where the third step used equation (1). Since, by (2), T is increasing in α, this establishes part 1 of the proposition.

If the company fails, the founder loses her entire investment worth $v - T$. She receives a tax credit for the accrual taxes worth

$$\phi\alpha\tau(v - T) = \phi(1 - \tau)T \tag{A.9}$$

where we used equation (2). This is increasing in α, which establishes part 2 of the proposition.

Finally, we obtain the mean payoff to founders by taking the average of (A.8) and (A.9):

$$(1-\tau)(\mathbb{E}[y] - \tilde{\Psi}d) - (1-\tau)T\left(\tilde{\Psi} - [p + \phi(1-p)]\right).$$

Rearranging the second term yields the expression in part 3 of the proposition. It is decreasing in T and hence, by (2), in α, which completes the proof.

A.3 Proof of Proposition 3

Tax revenue from founders consists of T in pre-paid taxes in $t = 1$. At the time of exit in $t = 2$, founders pay taxes given by equations (A.6) and (A.7) in case of success and get a tax credit given by (A.9) in case of failure. Combining all of these yields the expected tax revenue from founders:

$$\begin{aligned} & T + p[\tau(sY - (v - T)) + (1 - \alpha)\tau(v - T)] - (1 - p)\phi(1 - \tau)T \\ =& \tau s\mathbb{E}[y] + T(\tau + (1 - p)(1 - \tau)(1 - \phi)) \end{aligned}$$

VC investors pay taxes $\tau[(1 - s)Y - d - T]$ on their capital gains in case of success and get a tax credit of $\phi\tau(d + T)$ on their losses in case of failure. Taken together, this yields expected tax revenues from VCs equal to

$$\begin{aligned} & p\tau[(1 - s)Y - d - T] - (1 - p)\phi\tau(d + T) \\ =& \tau((1 - s)\mathbb{E}[y] - d - T) + (1 - p)(1 - \phi)\tau(d + T). \end{aligned}$$

Adding the revenue from founders and VCs, we obtain

$$\begin{aligned} & \tau[\mathbb{E}[y] - d - T] + T(\tau + (1 - p)(1 - \tau)(1 - \phi)) + (1 - p)(1 - \phi)\tau(d + T) \\ =& \tau(\mathbb{E}[y] - d) + (1 - p)(1 - \phi)[(1 - \tau)T + \tau(d + T)], \end{aligned}$$

which is the expression in the proposition.

A.4 Proof of Proposition 4

We prove the proposition by first establishing the following lemma detailing the closed-form solution to the Bellman equation (7). Let $C(a)$ be the founder's consumption policy function.

Lemma A.1. *With CARA preferences and no borrowing constraint, the policy and value functions are*

$$\begin{aligned} C(a) &= ra + w + k \\ V(a) &= \frac{R}{r} u\left(C(a)\right) \end{aligned} \tag{A.10}$$

where the constant k solves

$$u(rk) = \pi\mathbb{E}u(rx + w^* - w - k) + (1 - \pi)u(0). \tag{A.11}$$

Proof. We guess and verify that the value function takes the form

$$V(a) = \frac{R}{r} u\left(ra + w + k\right) \tag{A.12}$$

where k is a constant. Differentiating, we have

$$V'(a) = Ru'(ra + w + k).$$

By the envelope theorem, the marginal utility of wealth $V'(a)$ equals the utility of consuming wealth immediately, $Ru'(C(a))$. Therefore, the consumption policy function must be

$$C(a) = ra + w + k.$$

Next, we substitute the policy function $c = C(a)$ and the guessed value function (A.12) into the Bellman equation (7). This yields

$$\frac{R}{r} u(C(a)) = u(C(a)) + \frac{\pi \frac{R}{r} \mathbb{E} u(ra' + rx + w^*) + (1-\pi) \frac{R}{r} u(ra' + w + k)}{R},$$

where

$$a' = Ra + w - C(a) = a - k.$$

Cancelling terms, this simplifies to

$$u(ra + w + k) = \pi \mathbb{E} u(ra' + rx + w^*) + (1-\pi) u(ra' + w + k).$$

If we subtract $ra' + w + k$ units of consumption from all terms and use the CARA property $u(a-b) = -u(a)/u(b)$ to cancel terms, we obtain equation (A.11). Note that the left-hand side of equation (A.11) is strictly increasing in k and the right-hand side is strictly decreasing in k. Moreover, when evaluated at $k = 0$, we have

$$u(0) < \pi \mathbb{E} u(rx + w^* - w) + (1-\pi) u(0)$$

since $x \geq 0$ and $w^* > w$. Hence, at $k = 0$, the right-hand side exceeds the left-hand side whereas the opposite is true for sufficiently large k. This means that equation (A.11) has a unique solution $k \in (0, \infty)$, which verifies the guessed value function. □

Based on this lemma and comparing the value functions for the worker (6) and for the founder (A.10), the critical paycut is given by $\Delta = k$. Substituting this into equation (A.11) and using $u(0) = -1$ delivers formula (9) in Proposition 4.

A.5 Proof of Proposition 5

Write equation (9) as

$$u(r\Delta) = \pi \mathbb{E} u(rx) + (1-\pi)u(0)$$

and use the definition of the static risk discount $\overline{\beta}$ to re-write it as

$$u(r\Delta) = \pi u(\overline{\beta} r \mathbb{E} x) + (1-\pi)u(0).$$

Risk aversion implies that

$$\pi u(\overline{\beta} r \mathbb{E} x) + (1-\pi)u(0) < u(\pi \overline{\beta} r \mathbb{E} x + (1-\pi) \cdot 0) = u(\pi \overline{\beta} r \mathbb{E} x)$$

and therefore

$$u(r\Delta) < u(\pi \overline{\beta} r \mathbb{E} x).$$

This in turn implies $\Delta < \pi \overline{\beta} \mathbb{E} x$ as claimed.

B Data Construction

B.1 Data Sources

Our analysis combines five data sources: PitchBook, CRSP/Compustat, Capital IQ, PrivCo and CB Insights. PitchBook, Capital IQ, PrivCo and CB Insights are industry datasets that track venture capital deals and VC-funded startups. Using these sources, we construct a dataset of VC-funded companies, the VC-funded deals financing them, and their exits.

To construct the company dataset, we start with the universe of all venture capital funded companies on PitchBook, founded between 1987 and 2021. From this universe of companies, we collect all deals available from PitchBook to create our baseline deals dataset. We then extract the following variables from the different sources:

- PitchBook: Company name, Central Index Key (CIK) code, year founded, deal date, deal type, deal class, deal size, pre-money valuation, post-money valuation, employee name, employee title.
- CRSP/Compustat: Company name, CIK code, daily close price, outstanding shares.
- Capital IQ: Company name, employee name, employee title.
- PrivCo: Company name, deal size, deal date, post-money valuation, founder names.
- CB Insights: Company name, deal size, deal date, deal type, post-money valuation.

B.2 Merging Different Data Sources

We use the PitchBook universe of companies as our benchmark and then merge the other data sources at the company level as follows. For CRSP/Compustat, we initially use CIK codes to match companies with PitchBook. If this is not available, we compare the strings of company names. To implement string matching, company names from PitchBook serve as the standard. We then bring the company names reported in CRSP/Compustat in the same form as in PitchBook and employ fuzzy matching. We measure the success of a match between two strings S_1 and S_2 with the score

$$\Sigma = 100 \cdot \left(1 - \frac{D(S_1, S_2)}{\max\{L(S_1), L(S_2)\}}\right)$$

where D denotes the Levenshtein distance between two strings and L the length of a string. We consider a match with a score higher than 90 as successful. In case of multiple matches, only the one with the highest score is considered. Similarly, for the other alternative datasets (Capital IQ, PrivCo and CB Insights), we match companies based on names and website URLs.

Of the 2,046 IPO companies in our sample, we match 1,557 with CRSP/Compustat (1,391 by CIK, the others by fuzzy matching). Of the 19,582 companies with an IPO or M&A exit, we match 11,489 with PrivCo, 7,821 with Capital IQ, and 9,531 with CB Insights.

B.3 Company Exit Classifications

For each company in the PitchBook universe, we classify it in one of five possible company statuses: IPO, M&A (merger and acquisition), confirmed shutdown, inferred shutdown and ongoing. The status of each company is determined as follows:

- IPO: The first exit deal round type is an IPO.
- M&A: The first exit deal round is a Buyout/LBO, Merger of Equals or Merger/Acquisition.
- Confirmed shutdown: The first exit deal round type is Out of Business, Bankruptcy: Admin/Reorg, Bankruptcy: Liquidation, or Restart.
- Inferred shutdown: The firm does not have any exit rounds and there have been 5 or more years since the last funding deal round.
- Ongoing: All other companies.

In our sample, there are 2,046 IPO exits, 17,536 M&A exits, 18,424 confirmed shutdowns, 9,952 inferred shutdowns, and 48,010 ongoing companies. For our analysis in the main text, we combine confirmed and inferred shutdowns into a single category.

B.4 Company Exit Values

We calculate the exit value for IPO and M&A companies as follows.

1. For IPO companies, we first use CRSP/Compustat to obtain the market capitalization as the company exit value. To account for the lock-in period during which founders cannot sell their shares after the IPO, we calculate the market capitalization m_{it} of company i at $t = 180$ days after the IPO date with the definition: $m_{it} = p_{it} S_{it}$, where p_{it} is the daily close price and S_{it} is the number of outstanding shares. If p_{it} or S_{it} are not available in the CRSP/Compustat data at $t = 180$, we search the date backwards, in the order of $t = 90$ days, 60 days, 30 days and 1 day after IPO exit, and we use the market capitalization from the latest date available. If we are unable to construct the market capitalization in this way from CRSP/Compustat, we use the pre-money valuation at the IPO round as the exit value.

2. For M&A companies, we use the post-money valuation at the exit round as the exit value. If valuation information is missing in the exit round and cannot be imputed (as explained in the next subsection), we use the last available post-money valuation from the VC-rounds before the exit round.

B.5 Dealing with Missing Values

As mentioned in the main text, the PitchBook data is not complete. We recover missing valuation and deal size data with three approaches. First, if only one of the deal size d, pre-money valuation v or post-money valuation u is missing, we use the relationship $u = v + d$ to obtain the missing one. Second, we use our alternative data sources (namely, PrivCo and CB Insights) to fill in gaps in the PitchBook data whenever possible. Third, we use imputation techniques to estimate missing valuations for deals that contain information on deal sizes. We explain the latter two approaches in more detail next. Finally, deals that lack both deal size and valuation information, even when using the alternative data sources, are ignored for the purpose of our dilution calculations.

Filling in deal information from PrivCo and CB Insights. If two deals with available deal dates and deal sizes—one sourced from PitchBook and the other from one of the two alternative sources (PrivCo or CB Insights)—exhibit deal dates differing by no more than 4 months and deal sizes differing by no more than $2 million, we classify them as the same deal round and fill in the missing valuation. When valuations are present in both deals, we consider data from PitchBook as the standard. If the difference between two deal dates is within a 4-month range and the Pitch-Book deal misses deal size information, we fill in the deal size from the alternative data source. Otherwise, we include additional deals from alternative data sources if they are not identified as belonging to any of the deal rounds reported in the PitchBook data.

In total, for the companies in our sample excluding the ongoing ones, PitchBook provides information on 153,205 funding deals. Among those, our alternative data sources allow us to fill in data on deal size or valuation for 10,940 deals where it is missing in PitchBook. Moreover, the alternative data sources provide information about 14,258 additional deals, resulting in a total of 167,463 deals.

Imputation. We impute valuations for deals whenever we observe the deal size but not the valuation. We use different imputation techniques depending on whether or not any valuation from a previous deal is observed.

1. *Imputing valuations for deals without valuation data from previous deals.*

   In this case, we predict the dilution ratio v_i/u_i, where v_i denotes the pre- and u_i the post-money valuation in deal round i, using data on the deal size d_i and the number of the deal round. Following Hall and Woodward (2010), we use the logit specification

   $$\frac{v_i}{u_i} = \frac{1}{1 + \exp(-X_i\eta)}$$

   where

   $$X_i\eta = \eta_0 + \sum_{s=1}^{5} \eta_s D_i^s + \mu_0 d_i + \sum_{s=1}^{5} \mu_s D_i^s d_i + \rho_0 M_i + \sum_{s=1}^{5} \rho_s D_i^s M_i \tag{B.1}$$

   where D_i^s is a dummy variable for the deal round number, i.e., $D_i^s = 1$ if the deal round number is s and $D_i^s = 0$ otherwise ($D_i^5 = 1$ means round 5 or higher), and M_i is the percentage increase in the Wilshire index since the last deal round (if $D_i^1 = 1$, we use the increase in the previous two years).

   We estimate the parameters in regression (B.1) using all deals with reported valuation data, which means that valuations and deal sizes from PitchBook, PrivCo and CB Insights are included. We obtain the valuations from the predicted ratio v_i/u_i and the relationship $u_i = v_i + d_i$.

2. *Imputing valuations for deals with valuation data from the preceding deal.*

   For deal rounds where we observe, in addition, the valuation from the preceding round for that company, we predict the (relative) change in valuation using the regression specification

   $$v_i = \delta_i u_{i-1}$$

   where $\delta_i = \exp(X_i\eta)$ and:

   $$X_i\eta = \eta_0 + \sum_{s=1}^{5} \eta_s D_i^s + \mu_0 d_i + \sum_{s=1}^{5} \mu_s D_i^s d_i + \rho_0 M_i + \sum_{s=1}^{5} \rho_s D_i^s M_i + \xi_0 u_{i-1} + \sum_{s=1}^{5} \xi_s D_i^s u_{i-1} \tag{B.2}$$

where u_{i-1} is the post-money valuation from the preceding deal round. We estimate this equation using all deals where the current as well as the preceding valuation are known.

3. *Imputing valuations for deals with valuation data from earlier deals.*

   For deals where some previous valuation is available, but not the one from the immediately preceding deal, we iterate on step 2. In other words, we use the predicted $\hat{u}_{i-1}$ in (B.2) and sequentially construct $\hat{v}_i = \hat{\delta}_i \hat{u}_{i-1}$, starting from the deal following the last known valuation.

Of the total of 167,463 deals we have collected from PitchBook, PrivCo and CB Insights, 71,324 have complete information about both deal size and valuation. For 53,421 deals, we observe the deal size but not the valuation, which we therefore impute as described above. For the remaining 42,718 deals, we lack data on both deal size and valuation.

B.6 Ownership Split Among Founders

B.6.1 Constructing the Set of Founders

We combine information from PitchBook, Capital IQ and PrivCo to compile the set of founders for each company.

PitchBook provides employee names and positions without indicating exact founder names. To address this, we introduce two different rules to define a founder, one more and the other less restrictive. The first rule, a narrow definition, identifies individuals as founders if their position label contains the terms founder, co-founder or the like. The less restrictive definition expands this to include individuals whose positions contain terms such as chairman/-woman, chief executive officer, chief operating officer (or the respective abbreviations) in addition to the narrow rule.

PrivCo and Capital IQ each provide the founder names for each company. Therefore, together with the two sets of founder names from PitchBook, we obtain a total of four sets of founder names. Based on these sets, we construct 22 groups of founder name information by applying possible combinations of unions and intersections between any of these four sets. We compare these 22 combinations with founder information we collected by hand for a subset of 445 companies in Wikipedia (which is a subset of the companies with an IPO exit in our sample). We consider the information in Wikipedia as the accurate benchmark and choose the founder set specification, among the 22 combinations, that achieves the best predictive power.[35] This results in the combination that first intersects the list of founders reported in PrivCo with the one reported in Capital IQ and then applies the union with the narrow definition of founders in PitchBook. We use this set of founders in our main analysis.

[35] We measure the predictive power using a score that divides the number of founders in the intersection between Wikipedia and the respective combination by the number of founders in the union and taking the mean of this score across all companies. Thus, this measure accounts for both false positives and false negatives.

B.6.2 Constructing the S-1 Sample

S-1 filings provide details on the total outstanding shares, the founder-specific shares allocation (capitalization table) before the IPO, and the excluded shares of a publicly traded company. From the S-1 filings, we extract two pieces of information:

1. Individual founder shares and the corresponding percentages in the capitalization table.

2. Outstanding shares excluded from the capitalization table.

We collect this information by web-scraping S-1 filings or S-1/A filings (which are amendments of S-1 filings) from the U.S. Securities and Exchange Commission (SEC) website. We take into account S-1 filing amendments because they often provide the complete capitalization table when it is missing from the initial S-1 filings. For each company, we deduce the URLs of its S-1 or S-1/A filings using its CIK code. If multiple filings exist for one company, we identify the latest filing and then backtrack until a non-empty capitalization table is successfully scraped.

Founder shares are scraped from the capitalization table based on founder names. For beneficial ownership of less than 1%, the percentage value is not further specified in the capitalization table. In this case, we first calculate the total founder share based on the available individual shares and the percentage in the capitalization table (where the total shares are given by individual shares divided by the percentage). Subsequently, the ownership split among founders is determined by dividing the individual founder share by the total founder share.[36] If shares are classified into different share classes, we aggregate them. This allows us to construct the empirical distribution of relative founder ownership, within the group of all founders, as described in the main text.

C Dilution Calculations

Based on our deals data, we iteratively compute the percentage of the company collectively owned by the founders at exit. In this dilution calculation, we consider different capital gains tax regimes as captured by the accrual level α, as well as anti-dilution provisions and preferences protecting the VC investors. When $\alpha > 0$, we distinguish between full tax credits (refunds) and incomplete tax credits (loss carry-forward).

[36] Alternatively, we may compute founder shares assuming that all excluded shares go to founders, with a distribution among founders that is the same as for the shares included in the capitalization table. Thus, including the excluded shares in this way would not affect the within-founder ownership split, which is all we use the S-1 sample for. It would only increase the collective founder ownership share if we were to compute it based on the S-1 filings. However, we construct the collective founder ownership share based on our dilution calculations even for IPO exits.

C.1 Anti-Dilution Provisions

We first explain how we incorporate the anti-dilution provisions protecting the VC investors in case of down rounds. The most common provisions are referred to as weighted average or full ratchet, with the former much being much more frequent according to the PitchBook deals data. Accordingly, instead of the standard recursion (11), we use the following weighted average formula for down rounds ($v_i < u_{i-1}$):

$$s_i = \left(1 - \frac{1 - s_{i-1}}{P_i}\right) \frac{v_i}{u_i} \tag{C.1}$$

where

$$P_i = \frac{1 + d_i/u_{i-1}}{1 + d_i/v_i} \tag{C.2}$$

is the adjusted conversion price in round i.

To understand this, normalize the share price in round $i-1$ to \$1, so the number of shares right after round $i-1$ is just given by u_{i-1}. In the down round i, the new VC investors agree to purchase d_i/u_i percent of the company for d_i dollars, which means they buy $u_{i-1}d_i/v_i$ shares at a price of v_i/u_{i-1} dollars each. In other words, the share price has dropped from \$1 to \$$v_i/u_{i-1}$. To compensate the old VC investors, their conversion price gets adjusted according to the formula

$$P_i = P_{i-1} \cdot \frac{a_{i-1} + d_i}{a_{i-1} + b_i}$$

where P_i is the new conversion price, P_{i-1} is the previous share price, a_{i-1} denotes the number of shares outstanding prior to round i, d_i is the VC-investment in round i and b_i is the number of shares issued in round i. Given our normalization, we have $P_{i-1} = 1$, $a_{i-1} = u_{i-1}$ and $b_i = u_{i-1}d_i/v_i$. Hence,

$$P_i = \frac{u_{i-1} + d_i}{u_{i-1}\left(1 + \frac{d_i}{v_i}\right)} = \frac{1 + d_i/u_{i-1}}{1 + d_i/v_i}.$$

Right after round $i-1$, the old VC investors had $(1 - s_{i-1})u_{i-1}$ shares. With the adjusted conversion price, they now get

$$\frac{(1 - s_{i-1})u_{i-1}}{P_i}$$

shares. Note that $P_i < 1$ in a down round, so they get issued additional shares. The value of these shares at the new share price in round i, namely v_i/u_{i-1}, is

$$\frac{(1 - s_{i-1})v_i}{P_i}.$$

This means that we can set

$$\frac{(1 - s_{i-1})v_i}{P_i} = v_i - s_i u_i.$$

The left-hand side is the value held by the old VC investors as calculated above. The right-hand side is the value they hold after round i, which must be the same. Solving for s_i yields formula (C.1).[37]

C.2 Capital Gains Taxation

We distinguish between full tax credits that are refunded to founders ($\phi = 1$) and incomplete tax credits in the form of loss carry-forward ($\phi < 1$).

Full tax credits. In an up round, the founders' ownership share is diluted according to

$$s_i = \frac{v_i s_{i-1} - T_i}{u_i}$$

where

$$T_i = \frac{\alpha \tau g_i}{1 - (1 - \alpha)\tau}$$

as discussed in the main text.

In a down round, the formula is

$$s_i = \tilde{s}_i - \frac{\alpha \tau g_i}{u_i} \tag{C.3}$$

where

$$\tilde{s}_i = \left(1 - \frac{1 - s_{i-1}}{P_i}\right) \frac{v_i}{u_i}$$

to account for the anti-dilution provisions as described in the preceding subsection and the conversion price P_i is given by (C.2).

In the exit round $i = I$, founders pay taxes $\tau g_I + (1 - \alpha)\tau s_{I-1} u_{I-1}$.

Loss carry-foward. Suppose accrued capital losses can be carried forward against future gains. Then we need to keep track of a new state variable L_i defined as the tax shield accumulated by the founders up until round i. We initialize it with $L_0 = 0$ and update it each funding round according

[37] Alternatively, we also calculated founders' ownership shares using full-ratchet anti-dilution provisions. In this case, the formula in down rounds is

$$s_i = \left(1 - (1 - s_{i-1}) \frac{u_{i-1}}{v_i}\right) \frac{v_i}{u_i}$$

instead of (C.1). Note that it implies $(1 - s_{i-1}) p_{i-1} = v_i - s_i u_i$. The left-hand side is the total value held by the VCs after round $i - 1$. The right-hand side is the value they hold after the down round i. The two being the same means that the VCs who were invested in the company up to round $i - 1$ remain whole despite the down round. As a result, full-ratchet provisions are harsher to founders than weighted-average provisions, leading to lower ownership shares at exit. However, we find the effects of accrual-based capital gains taxation to be similar.

to the recursion

$$L_i = \max\{0, L_{i-1} - g_i\}. \tag{C.4}$$

In an up round, the taxable gains are now given by $\max\{0, g_i - L_{i-1}\}$, so the advance taxes are given by

$$T_i = \frac{\alpha\tau \max\{0, g_i - L_{i-1}\}}{1-(1-\alpha)\tau}$$

and dilution evolves according to

$$s_i = \frac{v_i s_{i-1} - \alpha T_i}{u_i}.$$

In a down round, there is no refund nor tax liability, so dilution evolves according to (C.1) and the tax shield gets updated according to (C.4). Finally, in the exit round, the founders pay taxes

$$\tau \max\{0, g_I - L_{I-1}\} + (1-\alpha)\tau s_{I-1} u_{I-1},$$

which is always non-negative.

C.3 Preferences

In line with common practice in VC contracting, we assume that, if the company exit value allows it, the VC investors are guaranteed a multiple ω of their investments. Hence, the VCs obtain at exit

$$\max\left\{(1-s_I)v_I, \min\left\{\omega \sum_{i=1}^{I} d_i, v_I\right\}\right\}.$$

Following Hall and Woodward (2010), we set $\omega = 1.25$. Note that such preferences have no impact on how we calculate the founders' ownership dilution except in the exit round. Effectively, they impact the founders' capital gains g_I. Rather than being given by $g_I = s_{I-1}(v_I - u_{I-1})$ as in the pre-exit rounds, they are modified to

$$g_I = s_{I-1}(\tilde{v}_I - u_{I-1})$$

with

$$\tilde{v}_I = \begin{cases} v_I & \text{if } s_{I-1}v_I < v_I - \omega \sum_i d_i \\ \frac{\max\{0, v_I - \omega \sum_i d_i\}}{s_{I-1}} & \text{otherwise.} \end{cases}$$

This then determines the gains and hence the taxes paid in the exit round, both in the full tax credit and the loss carry-forward cases described in the previous subsection.

Table 5: Individual Founder Payoff Distribution Statistics by Accrual Level α

	All Exit Values		**Positive Exit Values**			
Accrual Level α	Probability Positive	Mean	Mean	Median	99th Percentile	Pareto Tail Coefficient
0%	16%	7.2	45.6	5.558	621	1.03
10%	16%	6.9	44.0	5.489	597	1.03
20%	16%	6.7	42.6	5.427	583	1.04
30%	16%	6.4	41.3	5.375	571	1.05
40%	16%	6.2	40.1	5.333	557	1.06
50%	15%	6.0	39.0	5.292	540	1.07
60%	15%	5.8	37.9	5.224	520	1.08
70%	15%	5.7	37.0	5.167	507	1.08
80%	15%	5.5	36.1	5.118	490	1.08
90%	15%	5.4	35.3	5.077	480	1.09
100%	15%	5.2	34.6	5.031	473	1.10

Notes: Dollar values are in millions. Pareto tail coefficient is the maximum likelihood fit over values above $100m. The table uses the loss carry-forward tax scenario.

D Extensions

D.1 Loss Carry-Forward

Table 5 collects descriptive statistics of the distribution of individual founder exit payoffs under loss carry-forward for increasing accrual levels α (analogous to Table 4). The main difference to the tax refund scenario is that, in the absence of refunds, there is no composition effect, which means that, even as we increase the accrual-level, the sample of founders with a strictly positive payoff does not expand. This implies that the mean and median conditional on a positive payoff, as well as the top one percentile, remain higher, even though the ownership dilution is slightly worse. Still, increasing the accrual tax level unambiguously shifts the payoff distribution down. Indeed, the (unconditional) mean decreases from \$7.2m under $\alpha = 0$ to \$5.2m under $\alpha = 1$ (compared to \$6.1m with full tax credits), confirming that loss carry-forward is worse for a risk-neutral founder.

Figure 8 displays the critical paycuts Δ for different accrual levels α and risk aversion coefficients σ between 0 and 2. Because of the reduced insurance effect, accrual-based taxation is now always bad for founders, even with higher risk-aversion.

Evoking Proposition 3, however, it should be noted that the government collects more revenue under accrual-based compared to realization-based taxation when tax credits are incomplete, as is the case in the loss carry-forward scenario. Hence, in this case we are faced with a tradeoff between the additional tax revenue and the reduced founder welfare.

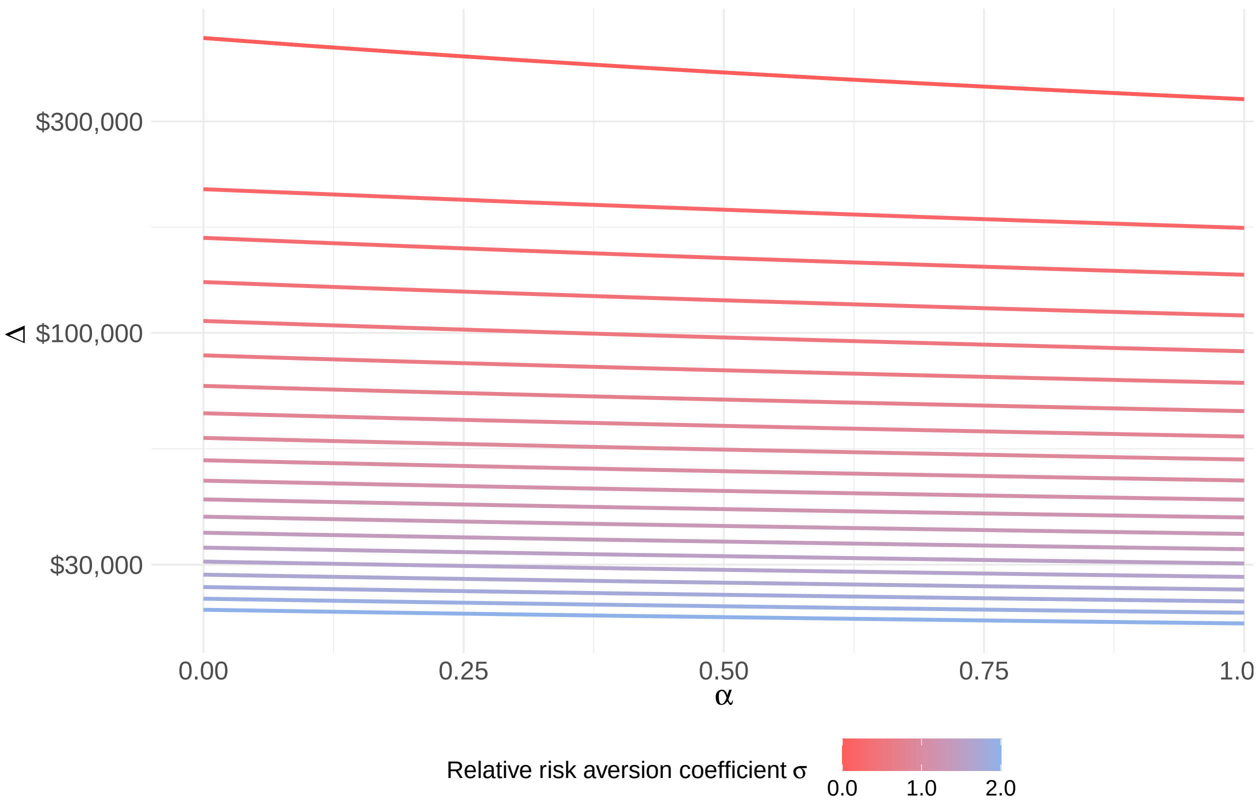

Figure 8: Critical paycut Δ as a function of the accrual level α and risk aversion σ

Notes: The figure shows the critical paycut Δ that makes an agent indifferent between entrepreneurship and wage work. Parameters: worker wage $w^* = \$194,126$, initial wealth $a_0 = \$1,000,000$.

D.2 Ex-ante Heterogeneity versus Ex-post Risk

In our baseline model, we assume that the observed distribution of exit values is due to ex-post risk rather than ex-ante heterogeneity. Here we report two pieces of evidence supporting the view that there is indeed considerable residual uncertainty in exit values.

The first fact is that, even conditional on companies reaching key milestones, there is still vast heterogeneity in outcomes. This is illustrated in Table 6, which displays basic statistics on exit values conditional on companies achieving a certain number of VC rounds. Companies that reach later rounds have considerably higher values on average, but there is still a large amount of remaining uncertainty in outcomes.

Similarly, when conditioning on companies achieving specific valuations thresholds, substantial heterogeneity in exit outcomes remains. Table 7 presents summary statistics of the exit value distribution conditional on reaching a given valuation milestone in a pre-exit round. Companies that reach higher pre-exit valuations naturally face a better exit value distribution on average, but there remains considerable risk. For instance, even when having reached a valuation of at least \$100 million in a pre-exit VC round, there is still a 18% probability of a zero exit value, and a 26%

Table 6: Exit Statistics Conditional on Reaching VC Round Targets

Round	N	Prob. Positive Value	Mean	P25	P50	P75	IQR
1st	46,472	37%	259	13	44	139	126
2nd	30,778	43%	293	19	57	164	145
3rd	17,263	57%	358	28	76	210	183
4th	10,453	68%	434	38	97	272	234
5th	6,572	76%	507	47	123	343	296
6th	4,212	82%	630	59	148	419	359
7th	2,731	87%	759	68	177	511	442

Notes: The table shows exit statistics conditional on reaching a certain VC round. N is the number of companies reaching each round with exit value data. Prob. Positive Value is the probability of a positive exit value. The mean and percentiles P25, P50, P75, and interquartile range (IQR) are reported conditional on positive exit value. All monetary values are in millions of dollars.

Table 7: Exit Statistics Conditional on Reaching Valuation Targets

Pre-exit Valuation	N	Prob. Positive Exit Value	Prob. Exit Below Threshold	Mean	P25	P50	P75	IQR
1	27,978	53%	47%	266	16	48	145	129
10	17,303	68%	33%	335	33	74	194	161
50	8,088	79%	26%	570	96	165	382	286
100	4,716	82%	26%	793	169	275	592	422
500	764	85%	33%	2367	647	1094	2013	1366
1000	322	87%	33%	3946	1123	1844	3262	2139

Notes: The table shows exit statistics conditional on reaching a certain valuation in the pre-exit VC rounds. N is the number of companies reaching each valuation threshold. "Prob. Positive Exit Value" is the conditional probability of a positive exit value. "Prob. Exit Below Threshold" is the conditional probability of an exit value lower than the pre-exit valuation threshold. The mean and percentiles P25, P50, P75, and interquartile range (IQR) are reported conditional on a positive exit value and conditional on the company having exceeded the pre-exit valuation threshold. All monetary values are in millions of dollars.

probability of a subsequent down round such that the exit value is below $100 million.

The second fact is that exit values are negatively correlated with collective founder share. This contradicts a situation where higher-ability founders (with private information about the potential of their company) retain a larger equity share, e.g. as a costly signal to investors. Instead, we find that the correlation between founder exit value and collective founder share is -0.21. Figure 9 displays a scatterplot between these two variables and shows that the average collective founder share decreases with log exit value.[38]

[38]While this relationship is suggestive, it needs to be interpreted with caution since there are also differences in capital intensity across startup companies, which may be correlated with founder success.

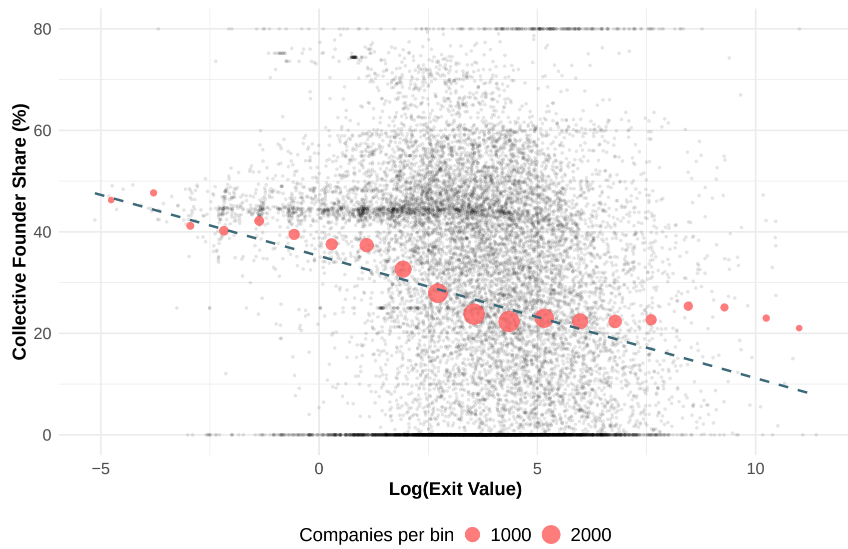

Figure 9: Scatterplot of collective founder share vs. log exit value

Notes: The figure plots collective founder share vs. log exit value. The dots are individual companies. The larger dots are binned averages. The dashed line is a linear fit.

D.3 Wealth Tax

We compare our results on accrual-based capital gains taxation to a 2% wealth tax, which is levied on top of the existing realization-based 20% capital gains tax. Figure 10 displays the distribution of collective founder shares with and without the wealth tax. The wealth tax reduces the average collective founder share at exit, among all IPOs and M&As, from 36% to 28%. Thus, such a wealth tax, despite the relatively modest tax rate, is comparable to shifting the capital gains tax regime from $\alpha = 0$ to $\alpha = 1$ in terms of its effects on founders ownership shares. Similar to the loss carry-forward scenario, a wealth tax does not provide insurance to unsuccessful founders, which is why we find that it has small but negative effects on entrepreneurship even for more risk-averse founders.

D.4 Endogenous VC Contracts

Founder contracts are typically extremely high-powered, with average wages between $50,000 to $150,000 and average equity payments of around $450,000. Consequently, roughly 85% of total compensation is received in equity. This pronounced lack of risk sharing likely reflects agency problems such as moral hazard and adverse selection; absent these frictions, most founders would prefer a higher proportion of fixed pay. We now extend our model from Section 2 to incorporate these agency problems and endogenize contractual arrangements.

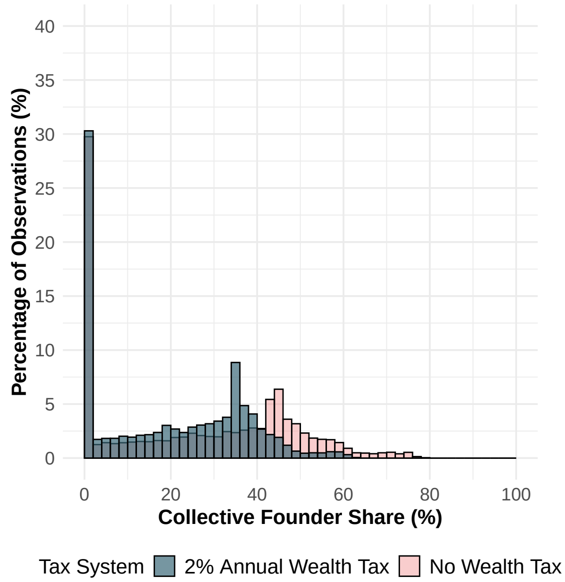

Figure 10: Distribution of collective founder shares at exit under a wealth tax

Notes: Collective founder share at exit with (teal bars) and without (red bars) a 2% annual wealth tax.

D.4.1 Endogenous contracts

Return to the baseline model of Section 2. For simplicity, consider the case of $\phi = 1$, and assume founders are risk averse. We now consider a set of contracts indexed the share s of the company held by the founders. In addition, founders receive a fixed wage w at $t = 2$. The fixed wage is financed by investors exactly as by selling T dollars of shares. The premoney valuation v and total $t = 1$ dollar value of shares sold T then satisfy

$$\begin{aligned} s &= (v - T)/(v + d + w) \\ T &= \alpha\tau v + (1 - \alpha)\tau T. \end{aligned}$$

Solving for v and T gives:

$$\begin{aligned} \bar{v}(s, w) &= \frac{s}{1 - s}\left(1 - \frac{L}{1 - s}\right)^{-1}(d + w), \\ \bar{T}(s, w) &= L\,\bar{v}(s, w), \text{ where} \\ L &= \frac{\alpha\tau}{1 - \tau + \alpha\tau}. \end{aligned}$$

We use the notation $\bar{v}$ and $\bar{T}$ to emphasize that they depend on the contract s and w. The advance tax payment that may be refunded is $(1 - \tau)\bar{T}(s, w)$ as before.

We can now calculate the after-tax cash flows to founders at $t = 2$ for each realization of the exit value y: The after-tax cash flows to founders are the wage, tax advance that is returned as refund or tax credit, plus possible equity value:

$$x^{\text{fail}}(s,w) := (1-\tau)\left[w + \bar{T}(s,w)\right]$$
$$x^{\text{success}}(s,w) := (1-\tau)\left[w + \bar{T}(s,w) + sY\right]$$

The condition for investors to break even, assuming a success probability of p is the same as in Proposition 1, but replacing d with $d + w$. So the break-even condition is

$$w + \bar{T}(s,w) + \frac{1}{\tilde{\Psi}} spY = \frac{1}{\tilde{\Psi}} pY - d. \tag{D.1}$$

For contracts where investors break even, we can substitute $w + \bar{T}(s,w)$ in the founder payoff equations to get:

$$\bar{x}^{\text{fail}}(s) \equiv (1-\tau)\left[\frac{1}{\tilde{\Psi}} pY - d - \frac{1}{\tilde{\Psi}} spY\right]$$
$$\bar{x}^{\text{success}}(s) \equiv (1-\tau)\left[\frac{1}{\tilde{\Psi}} pY - d - \frac{1}{\tilde{\Psi}} spY + sY\right].$$

Thus, if investors break even, founder payoffs in each state do not depend on the accrual tax level α. This happens because the total fixed part of pay, due to tax refunds plus wages, adjusts to make investors break even, and is thus fully determined by the equity share s. From these formulas, the expected value of founder payoffs when investors break even is

$$pY - d - (1-s)\frac{\tilde{\Psi} - 1}{\tilde{\Psi}} pY. \tag{D.2}$$

That is, founders receive the expected value generated by the company, but have to pay for actuarially unfair insurance if they want a safer contract.

We will often consider the wage $\bar{w}(s)$ where investors break even for a given share s of the company. We can solve for this substituting $\bar{T}$ in the break-even condition:

$$\bar{w}(s) = \frac{pY}{\tilde{\Psi}}\Big[1 - (1+L)s\Big] - d. \tag{D.3}$$

D.4.2 No Agency Problems

Consider first the case of no agency problems. The contract s is chosen optimally to maximize expected utility subject to the break even condition

$$pu(\bar{x}^{\text{success}}(s)) + (1-p)u(\bar{x}^{\text{fail}}(s)).$$

Figure 11 displays the optimal contract in a numerical example with a successful company exit value $Y = \$10$ million, probability of success $p = 10\%$, required return $\tilde{\Psi} = 125\%$, investment cost

$d = \$500,000$ and tax rate $\tau = 20\%$. Founders are risk averse with log utility and initial wealth of \$100,000.

The optimal contract gives considerable insurance to founders, who receive much of their pay as fixed wages. The optimal solution effectively does not depend on the level of accrual taxation α because $\bar{x}$ does not depend on α. The optimal share s is the same in both regimes. The optimal wage is lower with accrual taxation, but the fixed portion of pay remains the same. The wage simply goes down to compensate for the tax advance and make the overall pay the same.

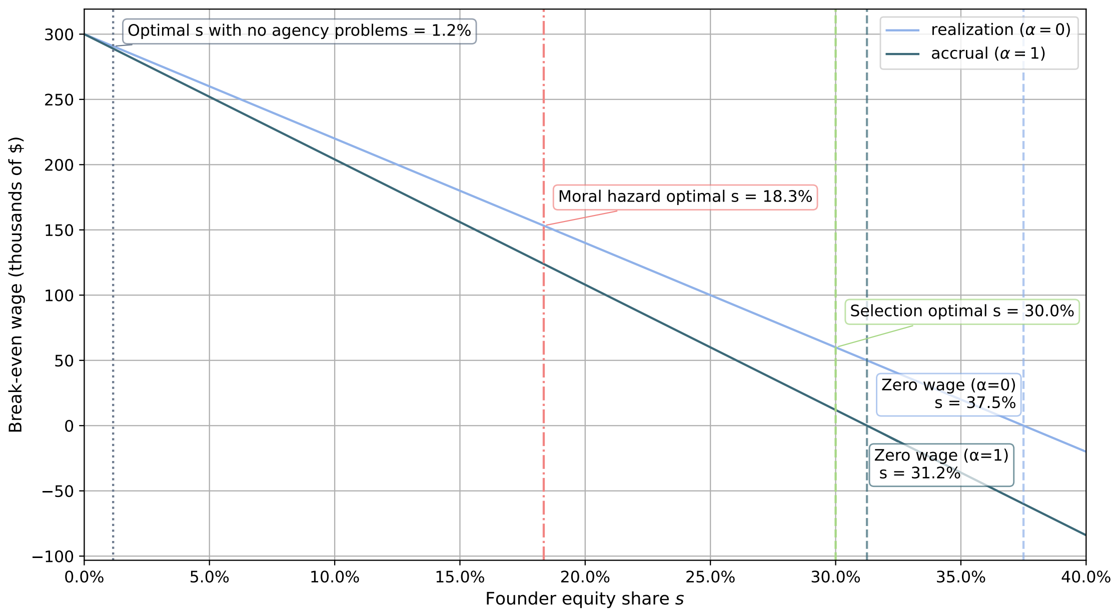

Figure 11: Optimal founder-investor contracts in the numerical example. The plot shows the break-even wage (in thousands of dollars) required for investors as a function of the founder equity share s, under both realization-based ($\alpha = 0$) and accrual-based ($\alpha = 1$) taxation regimes. Vertical lines and annotations indicate the optimal contract founder share s without agency problems, with moral hazard, and with adverse selection. Parameter values used: $Y = \$10$ million, $p = 10\%$, $\tilde{\Psi} = 125\%$, $d = \$500{,}000$, $\tau = 20\%$, founder log utility with initial wealth \$100,000, shirking benefit $B = \$50{,}000$, adverse selection outside wage $w_{\emptyset} = \$60{,}000$.

However, the neutrality result breaks under the natural assumption that $w \geq 0$. In that case, the set of contracts s where investors can break even is smaller with accrual taxation than with realization-based, because accrual taxation provides some fixed pay even when the wage is zero. Thus, for founders with small risk aversion, accrual can make them worse off by forcing them to choose a contract with too much insurance.

D.4.3 Moral hazard

In the moral hazard case, assume that founders may shirk. Shirking produces a private benefit of B dollars, but reduces the probability of success to 0. The optimal contract is the break-even contract that maximizes expected utility subject to the shirking constraint:

$$pu(\bar{x}^{\text{success}}(s)) + (1-p)u(\bar{x}^{\text{fail}}(s)) \geq u(\bar{x}^{\text{fail}}(s) + B). \tag{D.4}$$

When this constraint is binding, the optimal contract gives up some insurance to lower the value of shirking. As before, the solution is independent of α because $\bar{x}$ does not depend on α if wages can be negative. Otherwise, accrual taxation may force founders to buy more insurance than desired. This has either no effect, or it rules out all contracts that induce effort. In this case, accrual taxation makes founders worse off as the startup is no longer viable due to moral hazard.

Figure 11 plots the optimal contract in our numerical example with $B = \$50,000$. We see that there is considerably less insurance than in the no-agency case. Founders receive a large fraction of their compensation in equity. Overall, the tax regime is neutral, since the optimal contract undoes the accrual by making a corresponding decrease in wages.

D.4.4 Adverse selection

Assume that there is a bad founder type whose project always fails. There is a mass M of bad founders and a mass 1 of good founders. We also assume that there is a null contract $\emptyset$ that pays wages $w_\emptyset > 0$. The null contract is created to model a founder not participating in the project. We consider a set of regular contracts $[0, s^{\max}]$ with $s^{\max} < 1 - \tau$. This avoids a practical issue with accrual taxation, where the formula for $\bar{v}$ implies that there are no contracts with positive finite valuations when s is too high. To make adverse selection interesting, assume that $\bar{x}^{\text{fail}}(0) > w_\emptyset$, so that bad founders would want to buy a fixed pay contract that pays fair wages to the regular founders.

We define an equilibrium as in Azevedo and Gottlieb (2017) (henceforth AG). The equilibrium is similar to Rothschild and Stiglitz (1976), but with the advantage that an equilibrium always exists. Moreover, the equilibrium is tailored towards competitive markets with many small investors, which is arguably more reasonable in our setting. Our model is a particular case of the model in AG, modulo some notation differences. In AG, firms have a positive cost of selling products to consumers, whereas in our model investors can receive either positive of negative profits. So, to cast our model in AG's notation, we would have to define costs as a constant minus profits, and likewise make price a constant minus w.

An equilibrium determines an equilibrium function $w^*(s)$ and an allocation. Roughly speaking, the equilibrium conditions are that founders optimize, all contracts break even on average, and compensation $w^*(s)$ for non-offered contracts is as high as possible (which AG use to avoid self-fufilling equilibria with low wages and no trade). An equilibrium can be determined similarly to AG's example 1 (we refer readers to their corollary 1).

The following proposition characterizes the equilibrium.

Proposition D.1. *Equilibrium with adverse selection is as follows:*

- **Separating case.** *If* $\bar{x}^{fail}(s^{max}) < (1-\tau)w_{\emptyset}$*, let* s^* *be the solution to* $\bar{x}^{fail}(s) = (1-\tau)w_{\emptyset}$*. Then, all bad founders purchase the null contract, and all regular founders purchase their favorite contract in* $[s^*, s^{max}] \cup \{\emptyset\}$ *at an actuarially fair price.*

- **Pooling case.** *If* $\bar{x}^{fail}(s^{max}) \geq (1-\tau)w_{\emptyset}$*, then the only contracts transacted are the null contract and possibly* s^{max}*.*

The proposition shows that equilibrium with adverse selection makes contracts higher powered than in the no-agency case. Contracts need to give founders a high enough share to dissuade bad founders from taking them. In the separating case, bad founders do not purchase non-null contracts. Regular founders get to choose their favorite contract as long as it would not attract bad founders if wages are actuarially fair. In the pooling case, the only non-null contract that is possibly transacted is $s^{\max}$, and some bad founders may purchase it, lowering wages.

The proposition clarifies two points on the effects of accrual taxation. Without constraints on wages, we have the same neutrality result as in the moral hazard case: accrual taxation has no effect, because equilibria only depend on $\bar{x}$, which does not depend on α. That is, optimal contracting completely undoes accrual taxation. However, if wages must be non-negative, then accrual taxation has a lower $s^{\max}$ than realization-based taxation, which may lead to different equilibria.

Second, non-neutral accrual taxation may either increase or decrease founder welfare. Consider an example where accrual taxation makes separating equilibria impossible, so that at a certain low value of $s^{\max}$, only pooling equilibria are possible. If the mass of bad founders is large, regular founders would receive lower wages and be worse off. But, if the mass of bad founders is not that large, the pooling equilibria have a nearly actuarially fair wage, and offer more insurance, making regular founders better off. Thus, unlike the moral hazard case, accrual taxation can make regular founders *better off*. The reason is that the separating equilibrium under realization-based taxes can be constrained inefficient, exposing founders to too much risk, and accrual-based taxation can induce a Pareto improvement in this situation.[39]

We conclude by proving the proposition. The proof is similar to AG's proof of Corollary 1. The idea is that the equilibrium properties in AG's Proposition 1 are enough to pin down the equilibrium by simple arguments.

Proof of Proposition D.1. We first prove that, if a contract $s < s^{\max}$ is in the support of transacted contracts, then it is priced at $\bar{w}(s)$. s has to be purchased by at least some regular founders, as otherwise zero profits would imply that $w(s)$ is so low that no founders would choose it. The indifference curve of regular founders is strictly steeper than that of bad founders. So any contract

[39]This is akin to the constrained inefficiency of the original Rothschild and Stiglitz (1976) equilibrium, which is due to a lack of cross-subsidization across founder qualities. See, for instance, Miyazaki (1977) and, more recently, Netzer and Scheuer (2014), for conditions under which the market may or may not be able to sustain such cross-subsidization.

$s' > s$ is only in the indifference curve of regular founders. AG's Proposition 1 then implies that $w^*(s') \geq \bar{w}(s')$. Continuity of the equilibrium wage then implies $w^*(s) \geq \bar{w}(s)$. Zero profits implies that transacted contract prices are lower than $\bar{w}(s)$, and so $w^*(s) = \bar{w}(s)$ as desired. Note that zero profits implies that bad types purchase no contracts with $s < s^{\max}$.

Separating case: Bad founders would never purchase $s^{\max}$ because, even at a wage $\bar{w}(s^{\max})$, they would strictly prefer the null contract. And bad founders purchase no contracts with $s < s^{\max}$ as noted above. Thus, bad founders only purchase the null contract, and get equilibrium utility $u((1-\tau)w_{\emptyset})$. Thus, contracts $s < s^*$ are not transacted in equilibrium, as otherwise bad founders would prefer them to the null contract.

If all regular founders purchase the null contract, we are done. So consider the case where some regular founders purchase a contract $s > 0$. By the argument above, the transacted contracts are in $[s^*, s^{\max}]$. To reach a contradiction, assume that a transacted contract $(s, \bar{w}(s))$ does not maximize the regular type utility over actuarially fair priced contracts in this interval. Then there exists another contract $s' \in [s^*, s^{\max}]$ such that $(s', \bar{w}(s'))$ gives strictly higher utility to regular founders. AG's Proposition 1 implies that $w^*(s')$ is either in the indifference curve of regular founders or in the indifference curve of bad founders. If it is in the indifference curve of regular founders, AG's Proposition 1 implies $w^*(s') \geq \bar{w}(s')$. It it is in the indifference curve of bad founders, then $w^*(s') \geq \bar{w}(s')$ by the definition of s^*. In either case, $w(s') \geq \bar{w}(s')$. But this contradicts s having been chosen instead of s' by some regular founders.

Pooling case: If all regular founders purchase the null contract, we are done. So consider the case where some regular founders purchase a contract $s > 0$. If bad founders only purchase the null contract, then zero profits implies $w(s^{\max}) = \bar{w}(s^{\max})$. But this would make $s^{\max}$ strictly preferred by bad founders to the null contract, a contradiction. Thus, some bad founders purchase a non-null contract, and by the argument above, this must be $s^{\max}$. Regular founders have strictly steeper indifference curves, and thus they only purchase the $s^{\max}$ contract. □