The Rise of Early-Stage Financing in the US and Startup Performance

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This paper examines startup performance against the background of a significant shift in the US entrepreneurial financing landscape during the early 2010s. We study a large representative sample of nascent ventures that receive small-staked first-round investments from equity funds, whose appearance quadrupled between 2010 and 2013. Despite their inherent riskiness, these startups performed equally well compared to both other VC-backed US startups and a similar set of non-US startups from economies with comparable VC markets. We show that market-based and policy-related factors contributed to the shift towards smaller investments targeting increasingly young startups, highlighting their importance in shaping entrepreneurial financing.

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1 Introduction

New ventures play a central role in the development of new ideas and thus shape the path of economic evolution and growth (e.g., Haltiwanger *et al.* 2013). One common constraint often faced by these firms is limitations in their financial resources, which is a key determinant of startup success (Kerr and Nanda 2009; Lerner and Nanda 2020). Venture capitalists specialize in mitigating the financing issues of entrepreneurial startups through a combination of external capital, active involvement, and advice (Gompers and Lerner 1999; Hellmann and Puri 2002; Casamatta 2003; Chemmanur *et al.* 2011).

In the aftermath of the Global Financial Crisis, the entrepreneurial financing landscape in the US underwent significant changes. The emergence of new technologies accelerated the shift towards less capital intensive business activities, i.e., requiring less upfront investments to create a new venture (e.g., Ewens *et al.* 2018; Brynjolfsson and Collis 2019). Meanwhile, certain policy initiatives, such as the Small Business Creation Act, fostered investments in nascent, tech-oriented firms (Edwards and Todtenhaupt 2020). As a consequence of this combination of events, starting in 2010 first-round external equity investments shifted towards ever younger firms and became significantly smaller compared to any previous year. To illustrate, Figure 1 plots the annual number of first-round equity investments by private investment funds, distinguishing investments based on initial investment volume and target startup age. As of 2010, there was a surge of investments with a maximum volume of two million USD and a targeted startup age of no more than two years old relative to other first-round deals from the same investor types.[1]

- Insert Figure 1 here -

A priori, the implications of such a major shift for startup performance are not clear. Receiving equity financing at very early stages increases the probability of survival and implies more competition for subsequent VC deals, all of which is conducive for successful startup performance. However, very young targets feature few credible and visible signals, impairing investors' abil-

[1] The thresholds of two years and two million USD represent the median target age and volume of first-round equity investments by equity funds in the US prior to the Financial Crisis. We provide details on this classification approach in Section 2.1.

ities to select the best performing targets (e.g., Hsu and Ziedonis 2013; Bernstein *et al.* 2016). Further, facilitated entry may lead to more startup activity but also to higher failure rates (Kerr and Nanda 2009). It thus remains an empirical task to assess the implications of changes in the financing patterns on startup performance. To our knowledge, prior research has not yet addressed the shift in the US startup financing landscape during the early 2010s – a gap this study aims to fill.

In this paper our primary objective is to investigate startup performance against the background of the significant shift in the timing of early-stage equity investments. To this end, we explore a self-generated, representative sample of almost 8,000 US-based startups from Crunchbase including their investment history and performance as well as founder- and investor-level information for the years 2005-2015. We first document the general economic environment around 2010, the characteristics of the involved firms, the key adjustments in the investment patterns, and the underlying market developments that contributed to the boom in low volume investments targeted at increasingly younger ventures. Based on these observations, we then evaluate the performance outcomes of young, equity-backed startups that contributed to the shift in the financing landscape during the early 2010s.

Our analyses show that first-round equity deals from investment funds that target US-based startups that are less than two years old surged by about 430% between 2009 and 2013. This increase is disproportional to other early-stage equity investments and startup creation rates in the US over the same period. To better understand this phenomenon, we outline the general economic environment in the US during the late 2000s. Intuitively, repercussions of the Global Financial Crisis reshaped investment conditions along multiple dimensions. Indeed, we show that the change in the timing of first-round equity deals is likely an outcome of both demand- and supply-side developments. As such, we identify a shift in investment targets towards startups with less capital-intensive businesses activities. Startups from these fields require less investment upfront, and we find stratups to disproportionately contribute to the change in the financing landscape. At the same time, preferential legislative changes during this period, such as the introduction of the Small Business Jobs Act (SBJA) in 2010, made early-stage equity investments

more attractive. Indeed, we find that the disproportional increase in first-round early-stage financing deals was predominantly driven by startups for which capital gains tax exemptions under SBJA applied. In addition, we analyze the extent to which investors' financing patterns changed over the course of the early 2010s. We find no evidence of increased risk-taking other than the risk associated with younger investment targets. Instead, investors appear to mitigate this risk component by applying diversification strategies.

Focusing on market participants involved, we observe that startups that receive their initial financing within the first two years after incorporation by definition raise only low deal volumes. Moreover, we show that these young targets are more likely to signal their potential through the founding team. In contrast, startups that receive initial equity investments at a later stage and of higher volume are more likely to signal their abilities through their business activities, e.g., intellectual property. Otherwise, early-stage equity-backed startups are fairly comparable in terms of geographical distribution and investor characteristics irrespective of the timing of their first-round deal.

Next, we investigate the performance of young equity-backed startups in terms of their exit, financing, and intellectual property (IP) activity. We begin by comparing performance outcomes of US startups that obtained first-round equity deals from investment funds based on the timing of this initial financing round. Here, we find that targets with relatively early first-round deals on average raise comparable subsequent equity investments to the other group but underperform with regards to exit rates and IP creation. We then match startups with relatively early and late first rounds based on investor, location, and business activities to level some of the most fundamental differences. Probit estimations that further control for startup-, industry-, and time-specific characteristics confirm our descriptive findings. However, when we condition these young startups on reaching a subsequent funding stage, startups with earlier initial funding rounds outperform the comparison group. These findings advocate the need for a more nuanced view when evaluating startup performance.

To assess the performance implications in more detail, we compare early-stage equity-backed US startups to a set of natural control startups from outside the US. To this end, we first show

that the markable shift in the timing of first-round equity deals around 2010 was specific to the US. In fact, we do not find a comparable shift towards increasingly earlier first-round financing deals in the seven economies with the most similar VC-financing markets outside the US. We use startups from these economies as natural controls and investigate the firms' relative performance developments as of 2010. We find that early-stage financed US startups' relative performance did not decline compared to their international peers over the course of the early 2010s. This result holds when controlling for general country-specific differences and time trends and focusing on those startups that largely comprise the shift in early stage financing in the US, i.e., low capital intensive startups and those benefiting from the SBJA in 2010. Hence, the change in the timing of first-round investments was not accompanied by worse ex post startup performance. This means that despite the fact that nascent startups are more risky on average, the shift towards younger investment targets in the US is unlikely to imply slack investment behavior. Taken together, this study discloses insights on a significant yet previously understudied shift in the US startup financing landscape and highlights the importance of both market- and policy-based mechanisms to foster startup investments. Our findings add to the understanding of the outcomes associated with different startup investment patterns and thus the entrepreneurial process as a whole.

This study contributes to research on startup financing investigating the effect of VC financing on firm performance. Rin *et al.* (2013) and Lerner and Nanda (2020) provide comprehensive overviews on this literature. A large body of research shows superior firm outcomes of VC-backed firms in terms of higher probabilities of survival, going public, being acquired (e.g., Hellmann and Puri 2000; Cockburn and MacGarvie 2009; Chemmanur *et al.* 2011; Puri and Zarutskie 2012), engaging in strategic alliances and technology licensing (Hsu 2006; Ozmel *et al.* 2013), and a higher rate and quality of inventions (Kortum and Lerner 2000; Samila and Sorenson 2011; Howell *et al.* 2020). We offer new evidence of the effect of VC financing on startup performance, differentiating among US startups that receive their initial equity investments at different ages and comparing US startups with similar startups from similar markets that did not experience a comparable shift in the VC investment landscape.

Compared to the extensive literature on VC financing, literature on other modes of early-

stage financing is scarce (e.g., Tenca *et al.* 2018), particularly regarding the first-time equity investments of nascent startups. Some studies demonstrate the enhancing effect of accelerator groups and programs on startup performance (Gonzalez-Uribe and Leatherbee 2018; Cohen *et al.* 2019; Hallen *et al.* 2020). A few studies, such as Kerr *et al.* (2014), investigate angel financing, typically provided by wealthy individuals or specialized organizations, and conclude that it has a positive impact on startup performance. Hellmann *et al.* (2021) analyze the complementary role of investor-led angel- and company-led VC financing choices. Our work focuses on company-led financing choices and differentiates among investment types. A group of related studies compares VC-backed startups to those backed by other forms of early-stage funding: Goldfarb *et al.* (2013) find no difference in the performance of angel investment targets and VC targets, whereas Amore *et al.* (2022) find traditional VCs outperform micro VCs. These contrasting results illustrate the difficulty to evaluate the relative performance of startups and, thus, the implications of shifts in the startup financing landscape a priori. Unlike the aforementioned studies, we investigate the performance of early-stage equity-backed startups distinguishing the timing of the first financing round and assess startup performance against the background of overall developments in startup financing.

Closest to our work is Ewens *et al.* (2018), who study a different but related change in the US startup financing landscape. The authors document how the introduction of Amazon's Web Services (AWS) in 2006 significantly lowered initial fixed investments needed to create a business and thus raised the demand for small-staked early-stage investments. This shift promoted a rise in "cheap-to-establish" ventures in software and service oriented industries. The goal of our paper is not to isolate one specific channel that caused changes in the financing landscape, but rather to analyze whether these changes have implications on the performance of a startup and to outline likely causes that lead to these developments. In this context, our findings are consistent with Ewens *et al.* (2018) as we can attribute demand-side factors related to lower costs of creating new startups to the shift in early-stage startup financing about five years after the introduction of AWS and for a different subset of firms. Additionally, our findings illustrate that significant shifts in the entrepreneurial financing landscape are likely the result of several

different factors. Our paper therefore sheds light on a previously undisclosed market development in the US during the early 2010s and adds to our understanding of changes in the entrepreneurial financing landscape, their underlying causes, and their implications on startup performance.

2 Data, variable definition, and descriptive statistics

2.1 Defining seed financing

Our analysis focuses on equity investments by professional investment funds. This allows us to provide more generalizable results, since these investor types can be expected to follow a structured diligence when selecting targets to fulfill their prime objective of generating returns on behalf of their capital providers (Drover *et al.* 2017). As such, equity investors fulfill several roles by selecting and actively managing a portfolio of young, innovation-intensive companies (Hellmann and Puri 2002). We exclude public investors, individual entrepreneurs ("angels"), and other wealthy individuals with a specific interest in the target, all of which likely have distinct investment motives (Gompers *et al.* 2020).

Furthermore, we place an emphasis on the very first equity financing round of a startup. Here, the investor's roles of supporting initial product or concept developments and marketing are particularly important (see Figure IA1, Appendix). Investments into entirely new startups involve relatively small deal sizes, and target firms are likely not to have an existing track record. This differs from a more traditional view of VC investments, which usually select specific targets that can already provide first statistics on sales or other output. For relatively older targets, investors seek to support growth and expansion of existing operations and productions, which require relatively high investment volumes but comparably less involvement.

We specify two clear thresholds for defining particularly early investments which are used to enable a quantitative evaluation of startups' relative performance. We acknowledge that there are no generally applicable definitions for what is a particularly early investment and therefore base our definition on the general notion that these investments i) occur at very early stages

of the startup life and ii) involve comparably small volumes.[2] Specifically, we consider all first-round equity investments by private funds with a maximum deal volume of two million USD targeted at firms within the first two years after incorporation as early stage investments. These thresholds correspond to the median investment volume and age of first-round equity deals in the US during 2005 and 2006 (i.e., our first sample years) and allow for a clean delineation of relatively early and relatively late first-round equity investments. We collectively refer to early-stage equity investments as "Seed" investments.[3]

2.2 Data and descriptive statistics

Data sources: The information on startup and investor characteristics is obtained from Crunchbase.com listed as of 2022. Startup-level data comprises information on the firm itself, individual funding rounds, founder characteristics, and various performance indicators. Our initial sample comprises all startups targeted with first-round equity conducted by private investment funds with a registered address in the US. Specifically, this includes all Crunchbase investment types labeled as "pre-seed", "seed", "angel", "series A", or "series unknown" that are conducted by investors labeled as "organizations", i.e., excluding individual investors, government programs, or similar institutions that cannot be considered as investment funds. Moreover, we consider startups that obtained their first financing round between 2005 and 2015 excluding firms founded before January 1, 2000 as commonly applied in related literature (e.g., Edwards and Todtenhaupt 2020). In total, our sample contains information on 7,964 individual startups, of which we identify 5,062 as "Seed" targets.

We complement this data with information about intellectual property (IP) activities on the startup-level. Patent data is from the United States Patent and Trademark (USPTO) Patent Examination Research Dataset (PatEx) that we augment with patent-level quality measures such as number of forward citations at DOCDB family level (as in Harhoff *et al.* 2003) obtained from

[2] As such, available databases like Crunchbase do not clearly delineate deals. For example, Crunchbase distinguishes the following overlapping categories, all of which refer to early-stage equity investment: 1) Pre-seed and angel rounds involve relatively small financing volumes (i.e., below 150,000 USD) and typically do not involve investment funds. 2) Seed rounds are larger than the pre-seed or angel deals and range between 0.1 and 2 million USD. 3) Early-stage VC rounds range on average between 1 and 30 million USD (Series A and B) or include later stage investments in more established companies usually with a minimum investment of 10 million USD.

[3] This wording reflects that most of the respective deals are labeled as "seed" investment in the Crunchbase data (see Table IA1 in Appendix), easing the readability of our results.

the worldwide patent statistical database PATSTAT. In our sample, 34.4% of investment targets file at least one patent, comprising 83,776 individual applications. Further, we add startup-level trademark data obtained from USPTO Trademark Case Files Dataset, using the probabilistic record linkage method (Hall *et al.* 2001). The key variables used throughout all analyses are listed in Table IA2 (Appendix).

Descriptive statistics: By definition, the startups in our sample are small, very young, and tech-oriented enterprises. "Seed" targets are on average 0.77 years old at the time of the initial investment with about two-thirds of firms being younger than one year. Further, the median deal volume is a relatively small 0.75 million USD. By definition, other first-round equity targets not classified as "Seed" are much older and obtain initial investments of larger deal sizes, with a median age of 3.49 years and a median financing volume of 6.07 million USD.

Panel A of Table 1 documents how early first-round equity deals are targeted at entrepreneurial startups active in business fields with relatively low capital-intensity; for example, most "Seed"-backed startups operate in software, internet services, mobile and data analytics. We compare these business fields to those of startups that receive financing later. While the most common business fields are the same, the distribution within these sectors varies substantially. The share of startups with very early stage financing is much higher within those business fields. Table IA3 (Appendix) displays a complete list of business activities distinguishing startups with relatively early and late first investment rounds and shows that the latter operate in more capital intensive sectors, such as hardware, science and engineering, healthcare, biotechnology, or manufacturing. Further, startups are located predominantly in large states that are typically associated with innovation clusters such as California, New York, and Massachusetts (see Figure IA3, Appendix). For startups with earlier financing, however, we find a slightly stronger clustering in California and New York, which may be due to the aforementioned sectoral differences.

- Insert Table 1 here -

In Panel B of Table 1, we assess investor and founder characteristics, comparing startups backed by relatively early ("Seed") and relatively late ("Other") first-round equity investments.

About half of "Seed" deals (54%) are syndicated deals involving more than one investor, which is more than for non-"Seed" equity deals (44%). In both cases, investors are typically US-based (82% and 81% respectively), but the share of investors located in the same state is higher for startups with earlier first rounds (52%) compared to other startups (41%). Overall, the share of corporate VCs (CVC) among the first-round investors in our sample is fairly small. However, in relative terms, the CVC share is almost twice as high for firms with non-"Seed" first-round equity investments (7%) compared to "Seed"-backed firms (4%). Moreover, investment funds that back particularly young startups are themselves younger compared to non-"Seed" investment funds, with an average age of about 8 and 13 years, respectively. Despite these age differences, investment funds exhibit comparable levels of experience as measured in terms of the Crunchbase rank irrespective of the type of startup deals.[4]

Next, we find that relatively young first-round targets feature more visible signals regarding the founding team but fewer tangible signals regarding business activities compared to startups that receive their first round at a relatively older age. We first consider prior entrepreneurial experiences as credible signals regarding the founding team. The founding teams of relatively young first-round targets more frequently have prior experience launching a startup (28.2%) compared to relatively older equity-backed startups (15.6%). Similarly, 6.4% of founders of initially "Seed"-backed startups had a successful exit (IPO or acquisition) while this applies to only 4.1% of founders of startups with relatively later first rounds. The average founder age is relatively similar irrespective of the timing of the first-round deals. Second, we find that initially "Seed"-backed startups are less likely to feature tangible signals relating to their business activity at the time of the initial investment. As such, 9.1% of these startups hold a patent prior to the initial investment round, compared to 33.1% of other early-stage equity backed startups. These statistics likely reflect differences in both the age and business activities of respective startups.

[4]The rank variable is generated by Crunchbase using proprietary algorithms to rank firms according to their importance. Importance refers to the number of connections of a profile within the platform, which include but are not limited to news articles, funding events, and acquisitions. The algorithms allow each of these connections to decay over time, meaning ranks vary over time and are not solely a function of investor age.

3 Institutional environment

3.1 The shift in early-stage financing in the early 2010s

The startup investment environment underwent significant changes in the aftermath of the Financial Crisis of 2008 and 2009. Initial equity investments started to be mainly directed at younger startups with smaller deal volumes. While academic literature on this development is scarce, these trends are widely discussed in the startup finance community. For example, Peter Wagner, a top tech investor of Wing Venture Capital, reports on the surge in the number of early-stage equity-funded companies. An analysis of Wing Venture Capital (Wagner 2021) argues that seed deals gained a new role throughout the 2010s in serving as a prime mode of first-round equity investment in the US. According to Wing Venture Capital, early-stage financing has become even more important for building the foundation of a company, because traditional VC investments increasingly provide funding for more mature firms and based on startup's financial metrics, such as annual earning reports. Other insiders, such as Josh Kopelman (2015) – partner at First Round Capital and an early-stage venture capitalist, state that it has become much easier and takes much less time for an entrepreneur to raise a first round in the early 2010s.

Applying our definition on young first round "Seed" investments from Section 2.1 to Crunchbase data supports this anecdotal evidence on the shift in the timing of early-stage funding. Table 2 illustrates the rapid increase of smaller first-round investments targeted at younger startups with smaller deal volumes over the years 2005-2015. By definition, before the Financial Crisis first-round investments of institutional investors, with a maximum size of two million USD and targeted at nascent firms not older than two years were just as frequent as larger first-round equity investments targeted at more mature startups. This pattern persisted until 2010, when the number of first-stage equity rounds surged, predominantly driven by a disproportional rise in "Seed" investments. By 2012 first-time equity investments from private funds were directed 2.8 more often to targets less than two years old and with a funding volume of less than two million USD relative to larger deals targeted at older startups.[5] This gap persisted in the years

[5]Figure IA2 (Appendix) illustrates that this pattern is unlikely to be driven by the specific definition of investment types or compositional shifts. Using Crunchbase or Pitchbook classifications on seed investments

2013-2015, but at a slightly lower rate. This increase exceeds the rate of startup creation in the US over the same time frame (Column "*Startup creation*" in Table 2). While 1.7% of newly created firms in the US received "Seed" investments in 2009, the ratio increased to 4.9% in 2012. Panel B of Table 2 illustrates the shift in the timing and volumes of first-round investments in more detail. The graphs display the distributions of target age and investment volumes of first-round equity deals in the US. We observe a significant shift along both dimensions comparing deals before and after 2010.

- Insert Table 2 here -

The implications of this shift in early-stage financing are still not investigated. Practitioners state that easy-to-receive first-round funding may create a wrong perception to many entrepreneurs regarding the chances of obtaining subsequent funding (Kopelman 2015). With more startups receiving low stake first-round deals chances for the average startup to obtain follow-on investments is likely to decrease due to higher competition – a situation which Kopelman (2015) refers to as "Series A Crunch". Again, we confirm this notion using Crunchbase data. The last column in Table 2 Panel A reports the share of first-round "Seed"-backed startups that eventually obtained an equity deal of minimum two million USD. This share declined from about 50% in the years 2008-2010 to about 35% five years later.[6] Still, there is little empirical evidence on the implications of the boom in "Seed" financing on startup performance, i.e., the relationship we investigate in our main analysis.

3.2 Factors contributing to the shift in the timing of investments

This section outlines factors that contributed to the shift towards earlier, smaller-staked first-round deals during the early 2010s. We pertain that several complementary factors are important for explaining the shift in early-stage financing. This implies that a major development such as the surge in early-stage financing during the 2010s is unlikely to have a monocausal origin.[7]

(Panels A and B) yield very similar pictures. Further, the observed pattern is unlikely to be driven by a compositional shift related to changes in the prevalence of corporate VCs (Panel C).

[6] Since the time lag between initial and subsequent deals is typically less than two or three years, right censoring is unlikely to account for this observation by right censoring of the data.

[7] Answering the question on the relative importance of these factors or providing exhaustive evidence on each of these factors moves beyond the scope of this paper. Our goal is much more modest in that we outline important

3.2.1 Prevalence of low capital business activities

Changes in the type of startups that are created are an important factor shaping the entrepreneurial financing landscape (Ewens *et al.* 2018). As such, business activities correlate with the timing and amount of funding that is required. The US economy transformed towards a more digital market place at an accelerated pace since early 2000s (e.g., Brynjolfsson and Collis 2019; Tambe *et al.* 2020). Digital business strategies rely more on intangible assets that require fewer (and lower) fixed upfront investments. Hence, as a major implication of the digital transformation, this shift ultimately alters the amount (and timing) of funding required to start a business.

To analyze this, we examine the composition of early-stage equity deals according to the business activities of startups, focusing on fast-growing digital sectors. As a common denominator, firms in these business fields have relatively low capital expenditures compared to their operational expenditures. More specifically, we consider all business activities related to the so-called FAANG companies that dominated the US market starting in 2009.[8] The Financial Times (2020) coined the 2010s as "*The FAANG Decade*", referring to the disproportional growth of the tech sector in the 2010s. We gather the main business activities of these companies from Crunchbase, namely, software, data, internet, cloud, platforms, apps, security, and payment – all of which are low-capital intensive. We collect all business activity subfields related to the main activities listed in Table IA5 (Appendix).

Using this definition we show that the shift towards younger targets and lower investment volumes can be mostly attributed to an increase in "Seed" deals into firms operating in sectors with low capital-intensity. Panel A of Figure 2 displays the absolute number of first round investment deals similar to Figure 1, but distinguishes between firms from sectors with relatively low and high capital intensities. While the relative incidence of "Seed" deals across the different business fields prior to 2010 are comparable, low capital intensity sectors disproportionally attract more early and low-volume first-round deals beginning in 2010.

factors that likely contributed to the overall shift.

[8]The acronym stands for the five US tech companies: Facebook, Amazon, Apple, Netflix, and Google.

- Insert Figure 2 here -

To mitigate concerns that this reflects a general trend of increased investments into sectors with low capital intensity, we demonstrate that this pattern does not hold for first-round equity investments with more mature targets and higher investment volumes. Panel B of Figure 2 displays the absolute difference in first-round investments comparing low and high capital intensive sectors for both "Seed" deals and other non-"Seed" deals. Confirming insights from Panel A, the spread in "Seed" deals between low and high capital intensive sectors jumps as of 2010. Importantly, for non-"Seed" first-round equity investments the spread does not change comparing pre- and post-2010 levels.[9] These findings are consistent with the view that compositional changes in the business fields towards low capital intensive sectors contributed to the shift in first-round equity investments in the US.

3.2.2 Changes in the legal environment of taxing schemes

Next we assess a major legislative amendment that played an important role in stimulating the supply of early-stage equity financing activities. In particular, we investigate the *Small Business Jobs Act* (SBJA), a key policy change in the US that rendered investments into startups more attractive. The implementation of the SBJA allowed investors a full exemption from federal taxation of capital gains realized on the sale of the shares of certain qualified startups that were obtained after September 27, 2010. In order for an investment to qualify the targeted startup may not exceed a size of USD 50 million in gross assets and the overall value of its assets consisting of real property may not exceed 10%-cutoffs. Indeed, startups classified as "Seed" targets are unlikely to exceed these thresholds, as they are young and small by definition. Importantly, the law stipulates that tax exemptions only apply for investments into startups active in certain business fields.[10] According to Edwards and Todtenhaupt (2020), the SBJA caused a significant

[9] Note, that we find no drastic shift in the business activities of selected investment targets over time. For instance, the levels of business activities that are primarily targeted by "Seed" investments are very similar before and after 2010. Table IA4 in the Appendix illustrates this result, showing that 9 out of 10 most common business fields remain the same comparing the two time periods.

[10] Specifically, investments into firms from all sectors are eligible for the tax cut except those active in the following fields: Health, Law, Engineering, Architecture, Accounting, Actuarial science, Performing arts, Consulting, Athletics, Financial services, Brokerage, Banking, Insurance, Financing, Leasing, Investing, Farming, Hotels/Motels/Restaurants. For an excellent overview, see Edwards and Todtenhaupt (2020).

increase of equity investments into such qualified businesses.

We show that the SBJA can be associated with the shift towards younger and smaller-staked investments in the US during the 2010s as outlined in Section 3.1. To do so, we use the eligibility criteria to single out startups that are subject to the SBJA, providing potential investors with a tax exemption on realized profits. Panel A of Figure 3 is similar to Figure 2 but distinguishes startups in sectors that are eligible for tax exemption and those that are not. We find that startups, which provide tax exemption benefits to their investors, account for the majority of "Seed" deals after 2010. Confirming this, in Panel B we find that the spread in "Seed" deals between startups eligible and ineligible for SBJA tax exemption sharply widens as of 2010. Consistent with Edwards and Todtenhaupt (2020), the rate of relatively larger first-round equity investments is fairly stable irrespective of the business activities. These results demonstrate that changes in law are likely to have contributed to the shift in the timing of first-round equity investments during the early 2010s.

- Insert Figure 3 here -

In sum, our findings show that both market- and policy-based factors contributed to the rise of early-stage investments. For completeness, we acknowledge that there are likely further aspects that spurred this development. For example, the post-Crisis years mark an attractive financing environment due to the abundant, cheap money available for startup financing (see Lerner and Nanda 2020). As such, various financing platforms were launched, making it easier for professionals and individual angel investors to participate in early-stage financing activities both formally and informally (Cohen *et al.* 2019, Hallen *et al.* 2020). These factors are relevant for both new investors and incumbents, such as established VCs, which often chose to pursue strategic investments to fend off entry (Hochberg *et al.* 2010). Yet, providing an exhaustive list of factors goes beyond the scope of our analysis.

3.3 Changes in investment patterns of early-stage equity investors

The subsequent analysis carves out whether and how investors adjusted their investment behavior during the early 2010s. With increasing demand and a conducive investment environment as outlined in Section 3.2, early-stage investments likely became viable for an increasing number of investors. At the same time, young targets are fairly opaque and thus exert a relatively high degree of uncertainty. Against this background, we analyze if investors adjusted their financing patterns by focusing on two contrasting approaches both of which relate to the risk-taking behavior of investors.

In principle, it would be plausible that investors increase risk-taking not only with regard to the targets selected but also in the investment process as a whole. As such, literature documents increased risk-taking of market participants once they face financial slack (e.g., Nanda and Rhodes-Kropf 2017; Almeida *et al.* 2021). Financing of informationally opaque targets could thus be the expression of an overall "*spray and pray*" investment strategy, in which investors provide small funding amounts and limited governance to a larger number of startups (Ewens *et al.* 2018). Yet, at the same time, due to the increased inherent risk of "Seed" targets, it appears similarly plausible, if investors apply strategies to offset at least parts of the increased risk associated with these targets.

We follow the literature and use a set of different measures for increased and decreased risk-taking to operationalize these investment patterns (listed in Table IA2 in the Appendix as *Investor-level outcomes*). First, the average distance of investors to their targets is an indicator for risk-taking. Investors are aware that farther distances imply lower monitoring, thus more distant investment targets correspond with higher risk (see Bernstein *et al.* 2016). We measure distance by comparing whether investors and targets are headquartered in the same state. Second, ex ante differences across startup founders in terms of experience and age are found to relate to more risky targets (Ewens *et al.* 2018, Azoulay *et al.* 2020). Hence, we quantify the average founder experience regarding prior founding activities and age. Third, the share of targets that hold IP rights at the time of investment relates to its riskiness, because those

rights are tangible signals that are valued by investors (e.g., Hsu and Ziedonis 2013; Haeussler *et al.* 2014). Fourth, staging investments in a higher number of individual deals resembles a form of staging strategy described in the literature (Gompers 1995, Bergemann and Hege 1998). Hence, we measure changes in the diversification strategy of investors using the total number of investment deals per year. As an alternative measure of diversification, we use the average number of co-investors per deal. As such, syndication of investments is a fundamental strategy to lower exposure to risk.

To analyze whether these investment patterns have changed over the early 2010s, we construct an investor-level dataset sampling all US-based organizations that act as first-round equity investors during 2009-2015 in the Crunchbase data. We apply the same methodology as before to delineate investments into young and small-staked, and relatively more mature and larger deals. Formally, we estimate the following equation:

$$Y_{it} = \gamma_{st} + \gamma_i + \delta_1 \, Trend_t \times Seed_i^{Investor} + \gamma X_{it} + \epsilon_i, \tag{1}$$

where we use the above-described investment characteristics of investor i in period t, Y_{it}, as dependent variables. $Trend_t$ is a running count of the years (2009-2014), capturing the time trend in the outcome variable. $Seed_i^{Investor}$ is a dummy equal to one for investors that are observed to participate in any "Seed" deal as defined in Section 2.1 and zero otherwise. We include the interaction of the two variables ($Trend_t \times Seed_i^{Investor}$) such that δ_1 captures any differential change in trends after 2009, comparing "Seed" investors to other investor types. All specifications control for time varying investor characteristics (X_{it}), which are the six variables specified above excluding the one used as dependent variable in respective estimations and the base values of the interaction term. All regressions control for investor (γ_i) and state-year (γ_{st}) fixed-effects. We cluster standard errors at the investor-level.

Estimates in Table 3 support the notion that the patterns of early-stage equity investors did not change towards more risk-taking, but rather point towards risk-mitigation patterns. Panel A displays estimates for Equation 1. Columns I-IV display coefficients on estimations using the

four variables associate with increased risk-taking as dependent variables. Across specifications, the coefficient of interest is small and statistically not significant. In contrast, the two coefficients on the diversification measures are sizable and statistically significant at the one percent level. More specifically, the positive and highly significant coefficients in Columns V and VI indicate that investors engage in more deals while increasing the number of co-investors.

- Insert Table 3 here -

Panel B of Table 3 confirms this notion by analyzing the timing of the effects in more detail. The graph plots individual year coefficients obtained from event-study type regressions using 2009 as the reference year. For the risk-taking measures, coefficients are very similar in over the observed time period, indicating a sideways trend. In contrast to this, for the two diversification motive measures we find a trend towards an increased number of deals per year and more syndicated deals. Conditional on the fact that the shift towards earlier financing rounds in itself may resemble increased risk-taking, these results provide robust evidence that investors did not adjust investment towards riskier targets. Instead, investors intensified diversification strategies, potentially to moderate the risk associated with increasingly young targets.

4 Early-stage funding and startup performance

4.1 Hazard estimates: The probability of success over time

In this section, we examine the performance of initially "Seed"-backed startups over time. We measure performance along three distinct dimensions. First, we use information on the timing and accumulated amount of external equity financing collected by startups as indicator of a successful performance. Second, we assess whether startups eventually have a successful exit, i.e., either by having an initial public offering (IPO) or by being acquired. Third, we consider the creation of IP, such as patents or trademarks, as a performance dimension. Tables IA2 and IA6 (Appendix) provide variable descriptions and descriptive statistics on these performance dimensions of startups in our sample.

We start by providing descriptive evidence using hazard estimations on the probability of a successful startup performance outcome to arrive over time. To do so, we restructure our cross-sectional sample to a startup-month panel, measuring months relative to the incorporation date of the startup. We code the arrival of a successful performance event using dummy variables that are equal to one in the week the startup reaches any of the respective performance events. We assess the timing of startup performance over time using Kaplan-Meier failure estimates ("hazard rates") and distinguish startups that initially receive "Seed" financing and those receiving their first round at a more mature stage (denoted as "Others"), as defined before.

Subsequent funding as performance indicator: As a first set of performance outcomes, we assess the probability of securing additional funding subsequent to the initial deal over time. Panel A of Figure 4 shows that initially "Seed"-backed firms have a 58.4% chance of obtaining subsequent funding within the first five years after the first round. The vast majority of these startups receive the second round within the first two years after the initial round. For comparison, only 50.8% of other equity-backed startups receive a second financing round. The differences in the timing and the likelihood of receiving a subsequent deal likely reflect how funding volumes of initial "Seed" deals are relatively small and thus funds are depleted relatively fast. To show this, Panel B only considers subsequent funding rounds with a minimum deal volume of two million USD. In this case, 40.5% and 44.2% of initially "Seed"-backed and other startups receive subsequent equity deals, suggesting that the observed difference in funding rounds from Panel A is mainly due to small stake investment rounds.

- Insert Figure 4 here -

Furthermore, Panels C and D display hazard of obtaining at least 10 and 50 million USD in total funding and consider the first eight years after incorporation to account for duration of the time between their first round at very early stages and the obtaining of larger funding amounts. Overall, the probability of "Seed"-backed startups to obtain 10 million USD within this time window is significantly lower compared to other equity-backed startups. Yet this difference vanishes when considering the probability of collecting 50 million USD. Taken together,

these results suggest that "Seed"-backed startups are very frequently able to attract follow-on investments. Relative to other targets they obtain these investments earlier on, which may be by construction. Moreover, there is no robust evidence that initially "Seed"-backed startups collect less funds over their lifespan compared to other startups.

Exits and IP generation as performance indicator: Next we assess the rate of successful exits through IPOs or acquisitions. Figure 5 displays the hazard rates for the probability of an exit via an IPO (Panel A) or acquisition (Panel B) over time. The hazard rate is unconditional on having an exit. Overall, we observe 2,527 exits (2,359 acquisitions and 178 IPOs) for startups in our sample. Consistent with this, Panel A shows that the likelihood of any startup in our sample to exit via an IPO is rather low. Only about 1.1% of initially "Seed"-backed startups go public within the first eight years after incorporation. The graph suggest that they are significantly less likely to have an IPO within the first eight years after incorporation than startups that obtain the first round at a more mature age (1.9%).

- Insert Figure 5 here -

Panel B of Figure 5 shows that 25.8% of initially "Seed"-backed startups exit via an acquisition within the first eight years. Acquisitions involving "Seed"-backed startups occur significantly earlier than those of other equity-backed targets for which the probability of an acquisition is significantly lower (18.0%). However, conditional on a relatively high acquisition price, i.e., of at least 50 million USD, the difference in acquisition rates becomes much smaller (see Panel C). Hence, these statistics suggest that startups with initial funding rounds at younger ages are acquired more often and at earlier stages of their life cycle, but this difference is predominantly driven by low-stake acquisitions.

IP generation as performance indicator: Examining IP filings as a performance indicator for startups aligns with the observation that early-stage equity financing is particularly relevant for young innovative startups (e.g., Cockburn and MacGarvie 2009; Hsu and Ziedonis 2013; Howell *et al.* 2020). To account for the fact that distinct IP rights are not relevant for all firms,

we analyze both patents and trademarks. Specifically, we consider the timing of the first patent filing and trademark registration after the incorporation of startups.

Panel D of Figure 5 shows that 28.3% of initially "Seed"-backed startups and 39.1% of other equity-backed startups have filed or registered an IP right by the fifth year after incorporation. Yet, there is no statistically significant difference in IP generation across startups within the first two years after incorporation, i.e., coinciding with the threshold used for defining "Seed"-backed startups. These patterns are very similar when considering the two IP types separately. As such, Figure IA4 (Appendix) shows that the probability of "Seed"-backed startup to file a patent within the first five years after incorporation is significantly lower (21.5%) compared to the one of other equity-backed startups (28.2%). Further, we also apply several alternative quality-weighted measures in Figure IA4 to illustrate the robustness of the patent-related findings.

These results consistently document that initially "Seed"-backed startups generate significantly less IP than other startups. One possible reason for this observation could be differences in patenting strategies depending on the initial funding source. As presented in Section 3.1, traditional VC investments increasingly focus on tangible signals to evaluate startups. Hence, startups that receive first-round equity financing at a particularly young age may have a lower incentive to obtain a patent several years after incorporation as opposed to startups that might have not yet received funding.

4.2 Matched sample regressions

In this section, we analyze the performance of startups that obtain their first investment round at very early stages in more detail. To obtain a consistent picture of the performance of these initially "Seed"-backed startups, we proceed in two steps. First, we estimate performance differences on a matched sample, in which we pair these startups with those that received initial equity investments at later stages. Second, to account for these differences more closely, we focus on those initially "Seed"-backed startups that eventually reach a subsequent financing stage. In both cases, we estimate the following equation:

$$P_i = \beta_t + \beta_j + \beta(Seed_i) + u_{it} \ , \tag{2}$$

where P_i are different performance outcomes. To account for censoring of the data, we measured these performance outcomes within the first eight years after incorporation and only consider startups that are incorporated by 2014. To account for time-specific aspects that occurred throughout the sample period, we include investment-year fixed effects (β_t). Further, the regression controls for the fact that firm performance is likely to vary across sectors by including a set of industry fixed-effects (β_j). The dummy variable $Seed_i$ is equal to one if a startup is initially backed by "Seed" investments. Hence, the coefficient of interest is β which indicates the probability of reaching a given performance goal (P_i) for "Seed"-backed startups relative to initially other equity-backed startups. Standard errors are clustered at the startup level.

We estimate Equation 2 using a matched sample of initially "Seed"-backed and other equity-backed startups. Our matching approach imposes startups to share several characteristics that are already observable at the time the startup is founded, such as the same founding month, state, and industry. Moreover, we impose startup founders to have the same level of experience in terms of i) previously founded ventures and ii) age. We approximate founders' age by the time gap between their first university degree and the date of incorporation of the respective startup.[11] The matched sample excludes initially "Seed"-backed startups that does not have any comparable partner. However, we do not impose a perfect balance between the two groups, leading to a matched sample that contains 2,041 startups: 1,148 of them are initially "Seed"-backed, i.e., receive their initial equity deal before turning two years old, and 893 startups constitute the comparison group of startups that receive their initial equity financing at a later point in time.

Panel A of Table 4 displays regression results from estimating Equation 2. Columns I-III use as a dependent variable a set of indicators on successful exits. Column I estimates the probability

[11] This approach accounts for important features such that differences between the two groups are unlikely to arise due to time-, industry-, and founder-specific characteristics. Yet, we acknowledge that controlling for these characteristics does not provide us with two identical groups of firms.

of an IPO within the first eight years after incorporation. The coefficient on the "Seed"-dummy is large, negative but insignificant. The lack of precision of the estimate may reflect that IPOs are fairly rare events. Arguably, this can be interpreted that initially "Seed"-backed firms are less likely to exit via an IPO relative to a comparable group of other startups. Column II estimates the probability of being acquired within the first eight years after incorporation. The positive and highly significant coefficient on the "Seed"-dummy indicates that "Seed"-backed startups have a 42% higher probability to be acquired. This observation is not true though for high stake acquisitions as shown by the insignificant coefficient in Column III.

- Insert Table 4 here -

Like in the hazard analyses, we use an alternative way to assess startup performance by measuring the generated IP and collected funds over the course of the first eight years after incorporation. Column IV uses as a dependent variable an indicator equal to one to represent if a startup generated a patent or a trademark within that time window. The large negative and highly significant coefficient on the "Seed"-dummy confirms that "Seed"-backed startups have a significantly lower probability to generate IP relative to a comparable set of other startups. Similarly, in Columns V and VI, we show that "Seed"-backed startups are also less likely to gather 10 million USD in external equity funding relative to the comparison group. Again, when considering higher funding volumes (i.e., 50 million) the coefficient turns insignificant. The above findings confirm the descriptive evidence from Section 4.1, suggesting that "Seed"-backed startups are outperformed by the average startup that receives funding at a later stage, even after controlling for observable startup characteristics.

Next, we narrow the sample to those "Seed"-backed startups (and their matched counterparts) that are able to secure a subsequent funding round of at least two million USD. We thereby aim to screen out the early-failed startups, which should be less similar to the comparison group startups. In total this applies to about 43% of initially "Seed"-backed startups. Reestimating Equation 2 based on this sample significantly changes the previous results as displayed in Panel B of Table 4. Conditional on reaching the subsequent financing stage and controlling for observable

startup characteristics the coefficients on the "Seed"-dummy are positive across all performance indicators. For the IPO, high acquisition, and IP generation performance measures, the coefficients are, however, insignificant. Still, these estimates contrast those of Panel A, suggesting that "Seed"-backed startups are likely to outperform the matched comparison group conditional on reaching subsequent financing. Overall, the mixed results from the above multivariate analyses urge for a more detailed view when evaluating startup performance.

4.3 Non-US VC-backed startups as natural controls

Financing patterns outside the US: Previous results compare startups within the US that are different by definition. To gain a better understanding of the implications of startup financing on performance, we compare US-based startups to a more similar set of startups. Specifically, we explore how the shift towards very early-stage financing during the early 2010s is specific to the US. Our comparison group countries consist of seven OECD economies with the largest VC markets, i.e., Israel, Canada, Great Britain, Germany, France, Sweden, and the Netherlands.[12]

First, we demonstrate that these economies did not witness a comparable shift towards ever younger targets around 2010. This may be intuitive considering that changes legal framework,such as the passing of SBJA, are a domestic matter. However, the rise of low capital intensive startups may have been similar outside the US, too. To illustrate that the developments in the US were not paralleled in the largest non-US markets for startup financing, Figure 6 recasts previous statistics for startups headquartered in any of the comparison group countries. Panel A displays the total number of very early-stage startup financing deals and any other first-round equity investments equivalent to Figure 1.[13] We observe a very similar trend between initial startup investments at early or later stages for non-US startups. This pattern persists until 2012 with a slight divergence indicating a larger increase for early startup financ-

[12]We do not include China (non-OECD country) and Japan because of the structurally different VC-market at in the late 2000s and early 2010s. The seven selected countries' have plausibly the most comparable entrepreneurial financing landscapes relative to the US. For example, aggregate statistics support this notion, showing that the selected countries are most similar in terms of the size of the VC sector compared to the IS (using OECD Statistical Warehouse, 2010 figures of the tables: "*Venture capital investments*" in current USD prices, development stage "*Start-up and other early stage*").

[13]The classification of early- and late-initial stage financing are analogous to those used for the US market. In our main specification, however, we adjust the thresholds referring to the two million USD using the purchasing power adjustments to each country. In Figure IA5 (Appendix), we show that the patterns are very similar when not making these adjustments or when excluding specific countries such as Canada and the Great Britain.

ing beginning in 2013. Still, this increase is much smaller than the one observed in the US. For example, in 2012 the ratio of early deals to other initial VC deals was 2.8 in the US and 1.3 in the seven most comparable VC markets outside the US.

- Insert Figure 6 here -

In Panel B we confirm this notion recasting Figures 2 and 3. There was no disproportional shift in early startup financing rounds starting in 2010 for both targets eligible for the tax exemptions stipulated in the SBJA and those startups active in low capital intensive business fields. For the low-capital business fields, however, we again find a small but steady increase in early deals after 2010. In sum, robust descriptive evidence suggests that the sharp increase in very early startup equity deals was a phenomenon predominantly associated with the US. We observe a delayed and much smaller shift in the seven economies with the most comparable VC markets outside the US.

Relative performance of startups: Based on these observations, the use of non-US startups as a comparison group appears promising for analyzing changes in the performance of US-based startups after 2010. For example, an increased focus on young investment targets associated with poorer diligence in the selection and mentoring process of VCs should lead to a relative decrease in the performance of US-based startups relative to non-US startups after 2010. The absence of a shift in financing landscape outside the US introduces differential variation across time. These findings further support the notion that there was no compositional shift in the seven comparable VC markets outside the US. More specifically, we exploit this setting by using difference-in-difference estimations in which we compare the performance of US-based ("treated") startups that receive equity financing at very early stages to similar startups headquartered in large VC markets outside the US ("controls") both before and after 2010. We estimate this based on repeated cross-sectional data. The regression can be formally expressed as:

$$P_i = \delta(Seed_i^{US} \times Post_{it}^{2010}) + \delta_t + \delta_s + \delta_c + \epsilon_{ist} \ , \tag{3}$$

where P_{it} is the performance outcome of firm i that received the first equity financing round in year t. $Seed_i^{US}$ is an indicator equal to one for any startups headquartered in the US and zero otherwise. $Post_{it}^{2010}$ is an indicator equal to one if startup i received its initial VC financing round after 2010 and zero otherwise. The interaction of the two indicator variables is the DID estimator, and δ is the coefficient of interest, capturing the differential change in performance of early-stage equity-backed startups in the US after 2010 relative to the control group of non-US-based startups. Further, we control for general macroeconomic trends and country-specific differences by including home-country and investment-year fixed-effects. The inclusion of these two-way fixed-effects omits the estimates of the base variables $Seed_i^{US}$ and $Post_{it}^{2010}$.

For this analysis we use a sample of startups headquartered in any of the eight economies mentioned above. Just as before, we focus on startups that receive initial early-stage financing from an equity fund between 2005 and 2015. In our main analysis, however, we consider a symmetric time window of three years around 2010.[14] Further, we focus on startups that received their initial deal within the first two years after incorporation and with a financing volume of less than two million USD at purchasing power parity. Finally, we focus on startups active in business fields that are eligible fo the tax exemption stipulated by the SBJA. In an alternative specification, we focus on startups active in sector with low capital intensity. This leaves us with 3,219 startups that received initial financing in the years 2008-2013.

Table 5 displays the results from estimating Equation 3 on the described sample using a set of different performance indicators as dependent variables. In Column I-III we deploy probit estimations using different dummy variables indicating whether respective startups have successfully exited within the first eight years after incorporation. The negative but insignificant coefficient in Columns I and III suggest that there is no statistically significant change in the relative probability of a successful exit in general or exits via acquisitions when comparing US and non-US based startups both before and after 2010. The coefficient on IPOs is positive and significant at the ten percent level, indicating that the relative likelihood of an IPO has mildly

[14] This way, we focus on the years after 2010 for which we know that the shift towards earlier initial startup financing rounds has not yet started yet. For robustness, we relax this assumption yielding very similar results (untabulated).

increased for US-based startups with initial financing at very early stages. In Columns IV and V we find that the relative probability of raising 10 or 50 million USD has not changed either. We confirm this using an OLS regression in Column VI, which is specified just as the probit estimation but uses a continuous variable as dependent variable, measuring the funds raised within the first eight years after incorporation.

- Insert Table 5 here -

In Panel B of Table 5 we investigate the structure of these effects in more detail. The two graphs plot the dynamic treatment effects, i.e., regression coefficients of an event study type specification following Equation 3 and using 2010 as the reference year. For dependent variables the two specifications use an exit dummy variable and a continuous variable on total funds collected equivalent to Columns I and VI in Panel A. Both specifications confirm our previous results. In contrast to our prior methods, we include 2014 and 2015 to demonstrate that previous results did not mute long-run effects. Moreover, the insignificant coefficients on the pre-2010 coefficients show that the two groups moved in parallel trends prior to 2010. In Table IA7 (Appendix), we show that these results are not specific to startups that are eligible for tax exemptions under the SBJA, but also apply to startups active in low-capital intensive business fields. Further, our previous results hold when only considering Canada, Great Britain, and Israel, i.e., the economies with the most comparable VC markets among the comparison group (untabulated). Taken together, results in this section confirm that the shift towards earlier startup financing in the US and an overall increase in investments is not accompanied by a deterioration of investment quality. This is important since it emphasizes that market- and policy-based developments strengthened US-based startup financing in the aftermath of the Financial Crisis.

5 Conclusion

Accessing financial resources is a key determinant for startup success as structural changes may have important implications for shaping the evolution of nascent firms. In this paper we

investigate startup performance in the context of a significant but hitherto unexplored shift in the US startup financing landscape. In the aftermath of the 2009 Financial Crisis, first-round equity investments in the US started to target increasingly younger firms with smaller deal volumes. Using detailed investment and performance data on about 8,000 US-based startups, we provide evidence on the characteristics of targets and investors, the underlying mechanisms, and the performance implications of this markable shift.

We start by describing the evolution of early-stage startup financing by equity funds in the US throughout 2005-2015. We find that first-round financing more than quadrupled between 2009 and 2013 for equity deals from investment funds targeting US-based startups with less than two years of age, a rise unparalleled by other investment or startup creation developments. Against this backdrop we outline several potential drivers contributing to this "Seed" boom. Our findings suggest both market-based as well as policy-induced factors. In particular, we show that both a markable shift in the economy towards relatively less capital intensive business activities and significant changes in tax law (i.e., the 2010 SBJA) likely contributed to the growth in very early first-round equity investments. Importantly, we also conjecture that investors adjust their financing patterns by increasingly applying risk-mitigating strategies, suggesting that they are thereby attempting to dampen the increased risk associated with young targets.

Next, we evaluate the performance of startups that obtained first-round small-staked equity investments from professional funds within the first two years after incorporation. We find that more than half of these "Seed"-backed startups are able to secure follow-on investments within the first years after the initial deal. Compared to other non-"Seed"-backed startups, we find no difference in total funds raised or number of high-stake acquisitions but lower probabilities of IPOs and the generation of intellectual property over time. We confirm these findings in a multivariate setting, which allows us to control for startup-, industry-, and time-specific factors. Conditional on reaching a subsequent funding stage, we find that initially "Seed"-backed startups outperform a matched group of peers that obtain their initial financing at a more mature age. These findings underline the need for a more nuanced perspective when evaluating startup performance.

To address this, we analyze the performance of US-based startups relative to similar non-US startups that received their first equity round of comparable funding size at similar age. Indeed, we demonstrate that there are no comparable shifts towards early startup financing in the seven OECD economies with the most similarly developed VC markets outside the US. Hence, we compare startups with a similar funding history, only US startups are subject to changes in the investment environment. If the shift in the US-startup financing landscape was linked to specific investment patterns such as slack ("spray and pray") behavior, we would expect changes in relative performance of US- versus non-US-based startups. In a set of empirical analyses, however, we find robust evidence that the shift towards earlier financing was not accompanied by a decrease in startup performance. Taken together, our results disclose that the significant shift in the US startup financing landscape towards younger, riskier investment targets did not entail weaker startup performance. These insights are important as they highlight the potential of both market forces and policy efforts to steer the entrepreneurial financing landscape.

References

Almeida, H., Hsu, P.-H., Li, D. and Tseng, K. (2021). More cash, less innovation: The effect of the American Jobs Creation Act on patent value. *Journal of Financial and Quantitative Analysis*, **56** (1), 1–28.

Amore, M. D., Conti, A. and Pelucco, V. (2022). Micro VC. *Available at SSRN: https://ssrn.com/abstract=4094790 or http://dx.doi.org/10.2139/ssrn.4094790.*

Azoulay, P., Jones, B. F., Kim, J. D. and Miranda, J. (2020). Age and high-growth entrepreneurship. *American Economic Review: Insights*, **2** (1), 65–82.

Bergemann, D. and Hege, U. (1998). Venture capital financing, moral hazard, and learning. *Journal of Banking & Finance*, **22** (6-8), 703–735.

Bernstein, S., Giroud, X. and Townsend, R. R. (2016). The impact of venture capital monitoring. *The Journal of Finance*, **71** (4), 1591–1622.

Brynjolfsson, E. and Collis, A. (2019). How should we measure the digital economy. *Harvard Business Review*, **97** (6), 140–148.

Casamatta, C. (2003). Financing and advising: Optimal financial contracts with venture capitalists. *The Journal of Finance*, **58** (5), 2059–2085.

Chemmanur, T. J., Krishnan, K. and Nandy, D. K. (2011). How does venture capital financing improve efficiency in private firms? A look beneath the surface. *The Review of Financial Studies*, **24** (12), 4037–4090.

Cockburn, I. M. and MacGarvie, M. J. (2009). Patents, thickets and the financing of early-stage firms: evidence from the software industry. *Journal of Economics & Management Strategy*, **18** (3), 729–773.

Cohen, S., Fehder, D. C., Hochberg, Y. V. and Murray, F. (2019). The design of startup accelerators. *Research Policy*, **48** (7), 1781–1797.

Drover, W., Busenitz, L., Matusik, S., Townsend, D., Anglin, A. and Dushnitsky, G. (2017). A review and road map of entrepreneurial equity financing research: Venture capital, corporate venture capital, angel investment, crowdfunding, and accelerators. *Journal of Management*, **43** (6), 1820–1853.

Edwards, A. and Todtenhaupt, M. (2020). Capital gains taxation and funding for start-ups. *Journal of Financial Economics*, **138** (2), 549–571.

Ewens, M., Nanda, R. and Rhodes-Kropf, M. (2018). Cost of experimentation and the evolution of venture capital. *Journal of Financial Economics*, **128** (3), 422–442.

Financial Times (2020). FAANGs for the Memory; C. Nuttall. `https://www.ft.com/content/6934f384-3307-11ea-9703-eea0cae3f0de`, (accessed: 2022/11/08).

Goldfarb, B. D., Hoberg, G., Kirsch, D. A. and Triantis, A. J. (2013). Are angels different? An analysis of early venture financing. *Financial Accounting eJournal.*

Gompers, P. and Lerner, J. (1999). An analysis of compensation in the US venture capital partnership. *Journal of Financial Economics*, **51** (1), 3–44.

Gompers, P. A. (1995). Optimal investment, monitoring, and the staging of venture capital. *The Journal of Finance*, **50** (5), 1461–1489.

—, Gornall, W., Kaplan, S. N. and Strebulaev, I. A. (2020). How do venture capitalists make decisions? *Journal of Financial Economics*, **135** (1), 169–190.

Gonzalez-Uribe, J. and Leatherbee, M. (2018). The effects of business accelerators on venture performance: Evidence from start-up Chile. *The Review of Financial Studies*, **31** (4), 1566–1603.

Haeussler, C., Harhoff, D. and Mueller, E. (2014). How patenting informs VC investors–The case of biotechnology. *Research Policy*, **43** (8), 1286–1298.

Hall, B. H., Jaffe, A. B. and Trajtenberg, M. (2001). The NBER patent citation data file: Lessons, insights and methodological tools. *National Bureau of Economic Research Cambridge, Mass., USA*.

Hallen, B. L., Cohen, S. L. and Bingham, C. B. (2020). Do accelerators work? If so, how? *Organization Science*, **31** (2), 378–414.

Haltiwanger, J., Jarmin, R. S. and Miranda, J. (2013). Who creates jobs? Small versus large versus young. *Review of Economics and Statistics*, **95** (2), 347–361.

Harhoff, D., Scherer, F. M. and Vopel, K. (2003). Citations, family size, opposition and the value of patent rights. *Research Policy*, **32** (8), 1343–1363.

Hellmann, T. and Puri, M. (2000). The interaction between product market and financing strategy: The role of venture capital. *The Review of Financial Studies*, **13** (4), 959–984.

— and — (2002). Venture capital and the professionalization of start-up firms: Empirical evidence. *The Journal of Finance*, **57** (1), 169–197.

—, Schure, P. and Vo, D. H. (2021). Angels and venture capitalists: Substitutes or complements? *Journal of Financial Economics*, **141** (2), 454–478.

Hochberg, Y. V., Ljungqvist, A. and Lu, Y. (2010). Networking as a barrier to entry and the competitive supply of venture capital. *The Journal of Finance*, **65** (3), 829–859.

Howell, S. T., Lerner, J., Nanda, R. and Townsend, R. R. (2020). Financial distancing: How venture capital follows the economy down and curtails innovation.

Hsu, D. H. (2006). Venture capitalists and cooperative start-up commercialization strategy. *Management Science*, **52** (2), 204–219.

— and Ziedonis, R. H. (2013). Resources as dual sources of advantage: Implications for valuing entrepreneurial-firm patents. *Strategic Management Journal*, **34** (7), 761–781.

Kerr, W. R., Lerner, J. and Schoar, A. (2014). The consequences of entrepreneurial finance: Evidence from angel financings. *The Review of Financial Studies*, **27** (1), 20–55.

— and Nanda, R. (2009). Democratizing entry: Banking deregulations, financing constraints, and entrepreneurship. *Journal of Financial Economics*, **94** (1), 124–149.

Kopelman, J. (2015). Raising Seed Money Is Easy. Thas's What Makes Everything Elso So Hard. `https://www.inc.com/first-round-review/josh-kopelman/what-the-seed-funding-boom-means.html`, (accessed: 2022/27/04).

Kortum, S. and Lerner, J. (2000). Assessing the contribution of venture capital to innovation. *The RAND Journal of Economics*, **31** (4), 674–692.

Lerner, J. and Nanda, R. (2020). Venture capital's role in financing innovation: What we know and how much we still need to learn. *Journal of Economic Perspectives*, **34** (3), 237–61.

Marco, A. C., Sarnoff, J. D. and deGrazia, C. (2019). Patent claims and patent scope. *Research Policy*, **48** (9), 103790.

Nanda, R. and Rhodes-Kropf, M. (2017). Financing risk and innovation. *Management Science*, **63** (4), 901–918.

Ozmel, U., Robinson, D. T. and Stuart, T. E. (2013). Strategic alliances, venture capital, and exit decisions in early stage high-tech firms. *Journal of Financial Economics*, **107** (3), 655–670.

Puri, M. and Zarutskie, R. (2012). On the life cycle dynamics of venture-capital-and non-venture-capital-financed firms. *The Journal of Finance*, **67** (6), 2247–2293.

Rin, M. D., Hellmann, T. and Puri, M. (2013). Chapter 8 – A Survey of Venture Capital Research. *Handbook of the Economics of Finance*, vol. 2, Elsevier, pp. 573–648.

Samila, S. and Sorenson, O. (2011). Venture capital, entrepreneurship, and economic growth. *The Review of Economics and Statistics*, **93** (1), 338–349.

Tambe, P., Hitt, L., Rock, D. and Brynjolfsson, E. (2020). *Digital capital and superstar firms*. Tech. rep., National Bureau of Economic Research.

Tenca, F., Croce, A. and Ughetto, E. (2018). Business angels research in entrepreneurial finance: A literature review and a research agenda. *Journal of Economic Surveys*, **32** (5), 1384–1413.

Wagner, P. (2021). "The Sharpest of Recoveries": The 2021 V21 Analysis. `https://www.wing.vc/content/the-sharpest-of-recoveries-the-2021-v21-analysis`, (accessed: 2022/27/04).

Tables from the main part

Table 1: Summary statistics: First-round early-stage equity-backed startups

Panel A: Industry affiliations and geographical locations of first-round "Seed" targets

Share among total (in %)			
Business fields:		**Location (state):**	
Software	40.70	California	46.54
Internet Services	32.35	New York	17.86
Media & entertainment	29.02	Massachusetts	5.41
Mobile	20.53	Texas	2.84
Information technology	19.56	Washington	2.65
Data analytics	18.23	Illinois	2.73
Commerce & Shopping	16.78	Florida	1.62
Community & lifestyle	15.65	Others	20.35

Panel B: Investor and founder characteristics of first-round targets ("Seed" vs. "Other")

Mean values					
	Seed	**Other**		**Seed**	**Other**
Investor characteristics:			**Founder characteristics:**		
Sydicated investment	0.539	0.439	Serial entrepreneur	0.282	0.156
Total number of investors	2.787	1.950	Prior exit	0.064	0.041
US-based investors	0.805	0.817	Average age (since first degree)	13.438	16.095
Same state investors	0.517	0.412			
CVC participation	0.040	0.073	**Patent characteristics:**		
Investor Age (since incorporation)	7.873	13.142	Pre-investment filings (dummy)	0.091	0.331
Log(Rank)	12.145	12.165	Log(Patent filings pre-investment)	0.129	0.516

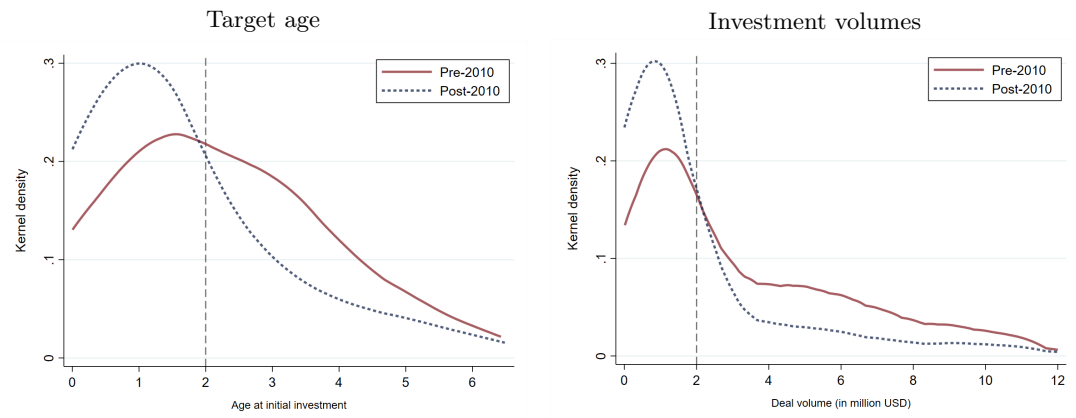
Notes: This Table displays summary statistics on sample startups, focusing on startups that obtained their initial equity investment at very early age and of small size ("Seed"). Panel A displays the share of "Seed"-backed startups according to their main business fields and locations. Startups may have multiple business fields (i.e., the shares do not sum up to 100%) but only one location. Location indicates the state of the registered address of respective firms. In Panel B investor- and founder-specific characteristics are displayed for both startups that receive first-time investments in form of "Seed" financing and those startups ("Other") that receive first-time investments of more than two million USD and at a minimum age of two years. The displayed variables refer to the first funding round: the share of investments conducted by a syndicate of investors, the total number of initial investors at initial financing round, the share of investors with a registered address in the US, the share of investors with a registered address in the home state of the target, the share of CVC investors, investor's age calculated based on the year of incorporation, and logarithm of Crunchbase rank as a measure of investor's prominence. Startup founder characteristics include founder entrepreneurship experience (serial entrepreneur), the success of prior founder startups (prior exit), and founders' average age since their first degree. Finally, Panel B also reports startup patent characteristics: the probability of filing a patent prior to first founding round, and logarithm of number of patents filed before the first investment.

Table 2: Initial startup deals and the shift in target age and investment size (2005-2015)

Panel A: Descriptive statistics: Startups with early- and late VC deals as initial investment

	First-round deal type					
	Seed	Other	Seed-ratio	Startup creation	Seed/Creation ratio	Seed with subs. deal
2005	96	105	0.914	7,550	0.013	0.667
2006	123	160	0.769	8,118	0.015	0.675
2007	190	211	0.900	9,201	0.021	0.552
2008	195	231	0.844	9,980	0.020	0.472
2009	194	165	1.176	11,754	0.017	0.500
2010	329	222	1.482	13,091	0.025	0.505
2011	562	252	2.230	14,046	0.040	0.420
2012	769	274	2.807	15,770	0.049	0.397
2013	841	356	2.362	16,106	0.052	0.347
2014	884	473	1.869	16,425	0.054	0.355
2015	879	453	1.940	15,025	0.059	0.380

Panel B: Shift in the age and investment size distributions, pre- vs. post-2010



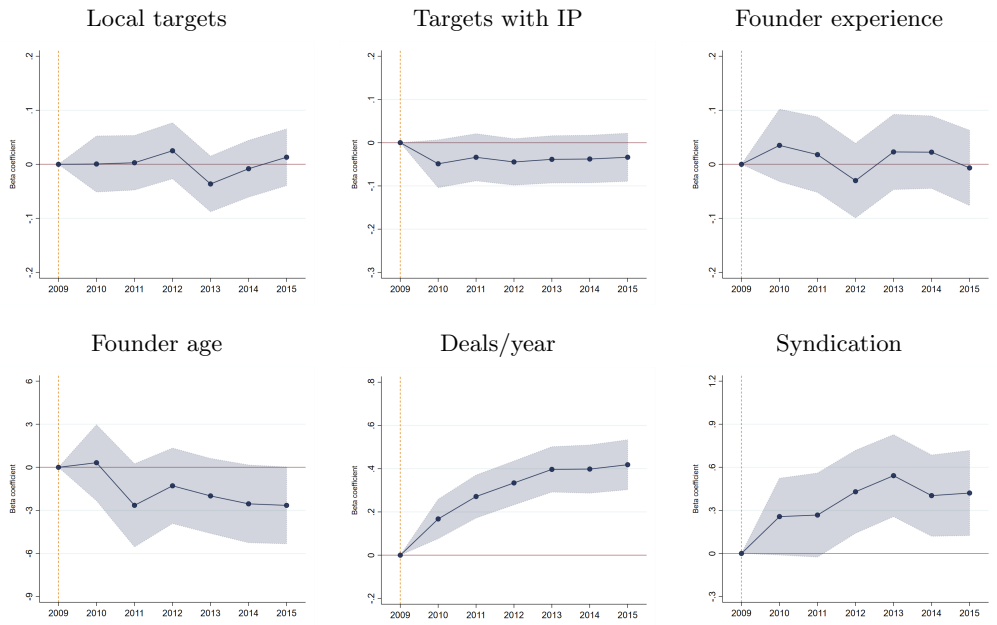
Notes: Panel A of this table displays the absolute numbers of first-round equity investments targets in the US from private investment funds. Corresponding to Figure 1 we distinguish targets younger (older) than two years and with a first round of less (more) than two million USD deal size, respectively. The third column is the ratio of "Seed" to "Other" first-round equity investments in respective years. The fourth column lists the total number of firms contained in the Crunchbase database that were founded in the US at any point during the respective calender years. The fifth column shows the ratio of initially "Seed"-backed startups as a fraction of the startups creation counts. The last column displays the share of initially "Seed"-backed startups that received subsequent equity funding. Panel B displays the kernel density distributions of target age and investment size on first-round early-stage VC investments. Target age is calculated as the days differences between the official incorporation of a startup and the initial funding date (divided by 365). Investment size is measured in million USD. The bandwidth in both graphs is 0.75. The dashed gray line resembles the classification thresholds as defined in Section 2.1.

Table 3: Changes of investment characteristics by US investors during the early 2010s

Panel A: Regression estimates explaining trends in investor motives relative to 2009

Strategies:	Risk-taking				Diversification	
Dep. variables:	Local targets	Targets with IP	Founder experience	Founder age	log(deals)	Nbr. coinvestors
	(I)	(II)	(III)	(IV)	(V)	(VI)
Trend × Seed$^{\text{inv.}}$	0.001	-0.003	-0.001	-0.342*	0.059***	0.045**
	(0.004)	(0.004)	(0.005)	(0.192)	(0.00910)	(0.023)
Additional controls:						
Investor-level	Yes	Yes	Yes	Yes	Yes	Yes
Investor FE	Yes	Yes	Yes	Yes	Yes	Yes
State-year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12,820	12,820	10,463	5,442	12,820	12,820
R^2	0.71	0.57	0.49	0.60	0.80	0.60

Panel B: Coefficient plot: Risk-taking and diversification strategy as investor motives



Notes: Panel A displays regression estimates as specified in Equation 1, explaining differential trends in investment characteristics of investors with and without "Seed" investments for the years 2009-2014. The six dependent variables in Columns I-VI are measures of risk-taking and diversification as introduced in Section 3.3. Standard errors (in parentheses below coefficients) are clustered on the investor-level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively. In Panel B the graphs plot coefficients of event-study type regressions. Specifically, we estimate the following regression using the six variables of investment characteristics (Y_{it}) used in Panel A as dependent variables: $Y_{it} = \alpha_{ct} + \alpha_i + \alpha X_{it} + \sum_{S=2014}^{2010} \beta_{it}^{S}(Seed_i^{\text{inv.}} \times Year_t^S) + u_{it}$, where α_{ct} and α_i are state-year- and investor-fixed effects. X_{it} is a vector of investor-specific, time varying control variables, as defined in Equation 1. The graphs plot the β coefficients, which capture the interaction effect of year dummies for each year between 2010 and 2014 interacted with the $Seed^{\text{inv.}}$ dummy as defined in Equation 1. The year 2009 serves as a reference year. Regressions are estimated deploying an investor-year level database obtained from Crunchbase data. The shaded areas denote the 95 percent confidence intervals.

Table 4: Probit regressions: The success probability of initially "Seed"-backed startups

Panel A: Performance outcomes of all "Seed"-backed startups

Dependent variable:	I(Performance indicators)					
	IPO	Acquisitions		Intellectual	Funds collected	
		All	>50 million	Property	10 million	50 million
	(I)	(II)	(III)	(IV)	(V)	(VI)
Seed	-0.698	0.422***	-0.288	-0.585***	-0.671***	-0.181
	(0.518)	(0.124)	(0.365)	(0.105)	(0.108)	(0.163)
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Deal-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1,700	2,021	1,895	2,021	2,021	2,021
Pseudo R^2	0.262	0.072	0.107	0.076	0.070	0.051

Panel B: Performance outcomes of "Seed"-backed startups with follow-on equity investments

Dependent variable:	I(Performance indicators)					
	IPO	Acquisitions		Intellectual	Funds collected	
		All	>50 million	Property	10 million	50 million
	(I)	(II)	(III)	(IV)	(V)	(VI)
Seed	0.089	0.425**	0.251	0.039	0.747***	0.862***
	(0.614)	(0.164)	(0.394)	(0.139)	(0.139)	(0.193)
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Deal-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	971	1,148	1,071	1,148	1,148	1,148
Pseudo R^2	0.309	0.074	0.136	0.054	0.067	0.064

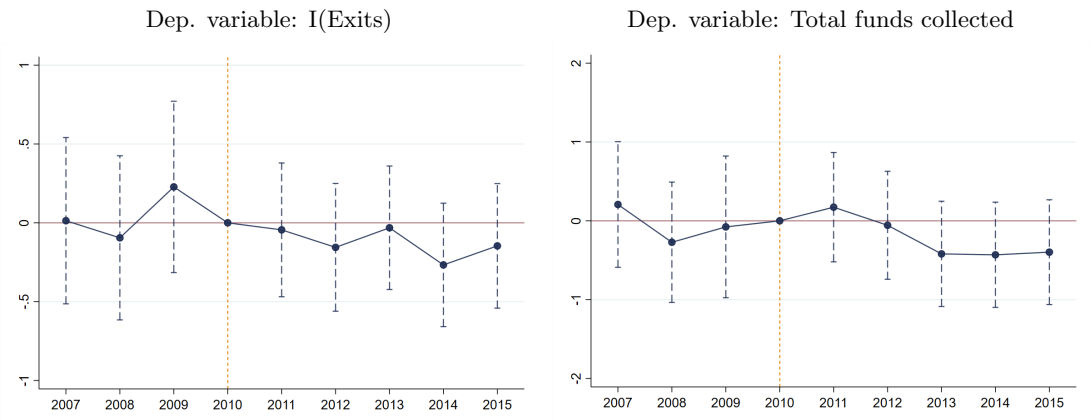
Notes: This Table shows results from probit regressions that use a set of performance indicators as dependent variables, estimating Equation 2. All performance indicators are coded as dummy variables equal to one for startups that successfully exit via IPO (Column I), exit via an acquisition (Column II), exit via an acquisition with minimum 50 million USD valuation (Column III), have generated at least one patent or trademark throughout (Column IV), have collected at least 10 or 50 million USD throughout (Columns V and VI, respectively). All performance outcomes are measured in the first eight years after incorporation to avoid issues arising from right censoring of the data. For the same reason, the sample includes firms that are incorporated by 2014. The data used is a matched sample as specified in Section 4.2. In Panel A we consider the full matched sample. Panel B repeats the analysis but includes only initially "Seed"-backed startups that eventually will reach a subsequent VC-investment stage (and their matched counterpart). Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 5: The performance of US- and non-US-based startups after 2010

Panel A: Performance outcomes of startups from SBJA-eligible sectors

Dependent variable:	Performance indicators					
	Exits			Funds collected		
	All	IPO	Acquisitions	10 million	50 million	Total funds
	(I)	(II)	(III)	(IV)	(V)	(VI)
$Seed^{US} \times Post^{2010}$	-0.102	0.455*	-0.131	-0.114	-0.073	-0.084
	(0.121)	(0.267)	(0.122)	(0.130)	(0.189)	(0.190)
Initial deal-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3,138	3,967	3,138	3,138	3,103	2,508
Pseudo R^2 (R^{2*})	0.026	0.028	0.027	0.043	0.031	0.077*

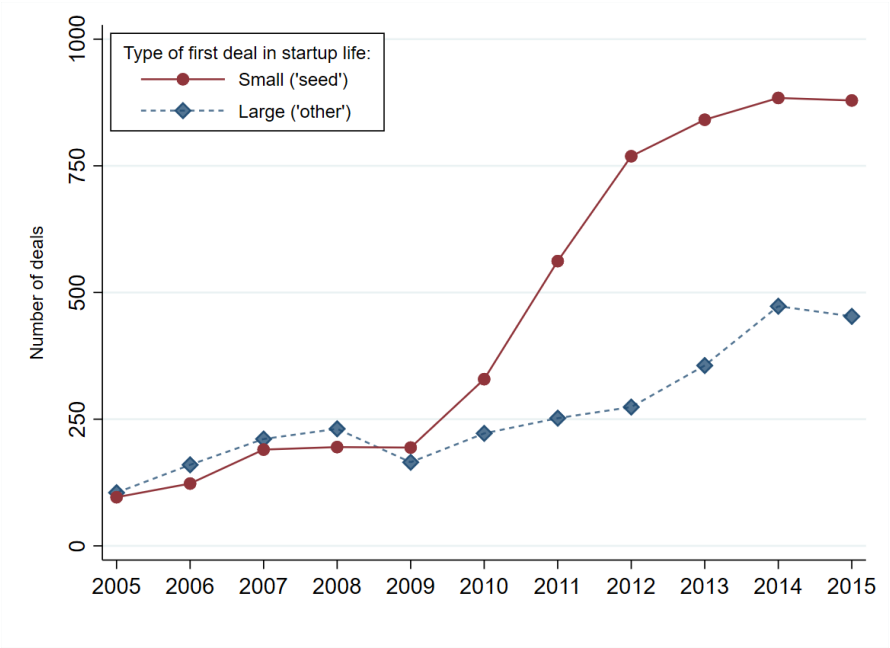
Panel B: Event-study type regression coefficient plots



Notes: This Table displays variants of different estimates of Equation 3. In Panel A Columns I-V show results from probit regressions that use a set of performance indicators as dependent variables coded as dummy variables equal to one for startups that successfully exit (Column I), exit via IPO (Column II), exit via an acquisition (Column III), have raised at least 10 or 50 million USD (Columns IV and V, respectively). All performance outcomes are measured in the first eight years after incorporation, to avoid issues arising from right censoring of the data. In Column VI, we estimate the same equation using OLS. Here the dependent variable is a continuous measure for the funds collected within the first eight years after incorporation. The data used is the full sample of startups that raised early-stage financing as specified in Section 2.1 with added respective firms from Israel, Canada, Great Britain, Germany, France, Sweden, and the Netherlands. Further, we exclude firms whose investors are not eligible for tax exemption under SBJA. Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively. In Panel B we estimate the following variation of Equation 3: $P_i = \sum_k \delta_k (Seed_i^{US} \times Year_{ik}) + \delta_t + \delta_s + \delta_c + \epsilon_{ist}$ for all $k \in [2007, 2015]$, excluding 2010 as a reference year. The figures plot the dynamic treatment effects (i.e., δ_k) of this event-study type specification, using an indicator of successful startup exit and the continuous measure on the total funds collected, equivalent to those in Columns I and VI from Panel A. The whiskers span the 95 confidence intervals.

Figures from the main part

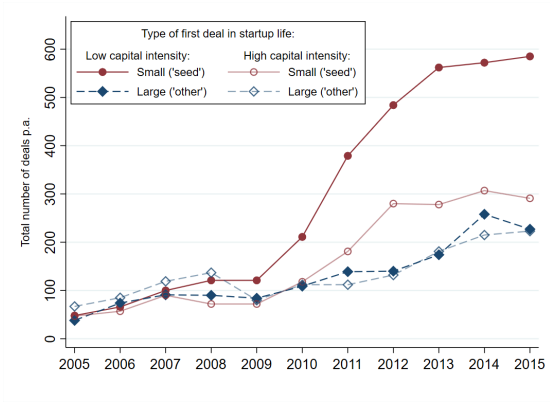
Figure 1: First time early-stage equity investments in the US by type



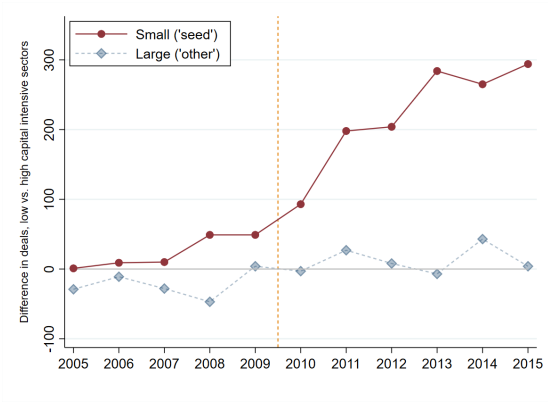
Notes: This figure illustrates the development of first-round equity investment deals for US-based investment targets in the years 2005-2015. The data is the universe of investment deals listed in the Crunchbase database for startups with US address, founded in 2002 or later, and with a first investment round between 2005 and 2015. The graph displays the absolute number of first-time financing events per year and per investment type. Specifically, it only considers the first ever entry in the Crunchbase data for any given startup. Here we refer to "Seed" or "Other" deals as any first time external equity investment that is conducted by an investment fund and has a maximum or minimum deal volume of 2 million US dollar provided for an investment target with a maximum or minimum age of 2 years at the time of the investment, respectively. Funds include all investors that are labeled as organizations (e.g., no individual investors) and exclude government or other public offices, incubators, accelerators, or angel groups.

Figure 2: The rise in early startup financing comparing targets from low and high capital intensive business fields

Panel A: Annual number of deals



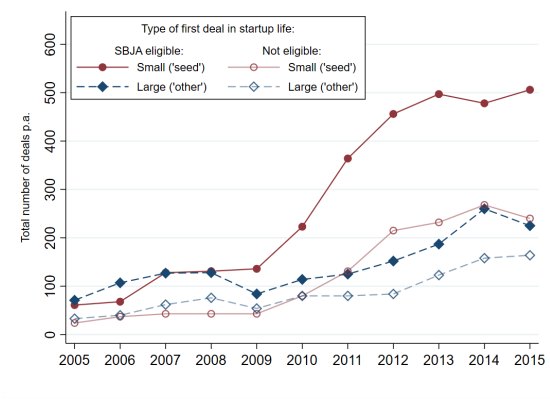
Panel B: Difference in deals across sectors



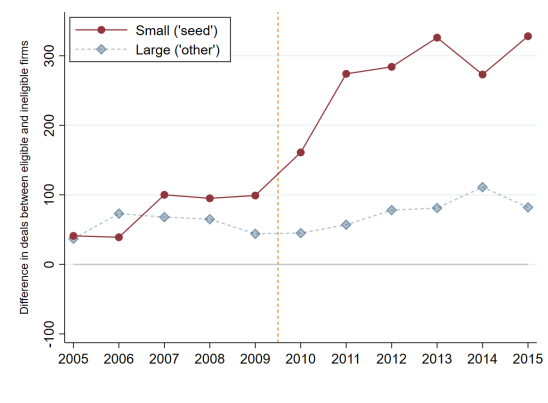
Notes: This graph displays the evolution of first-round "Seed"-backed US startups distinguishing among sectors with relatively low or high capital intensity as outlined in Section 3.2 and defined in Table IA5 (Appendix). For illustration, the graphs also display all other first-round equity-backed startups ("Other"). Panel A is similar to Figure 1 and plots the annual number of deals by respective cohorts. Panel B displays the difference in absolute number of rounds between startups in sectors with relatively low capital intensity and startups in relatively high capital-intensive sectors within respective cohorts, i.e., "Seed" and "Other". The dashed vertical line marks the onset of the accelerating shift towards younger and small targets as of 2010. All numbers are end-of-year total investment counts.

Figure 3: The rise in early startup financing comparing targets eligible and ineligible to tax exemption under 2010 SBJA

Panel A: Annual number of deals



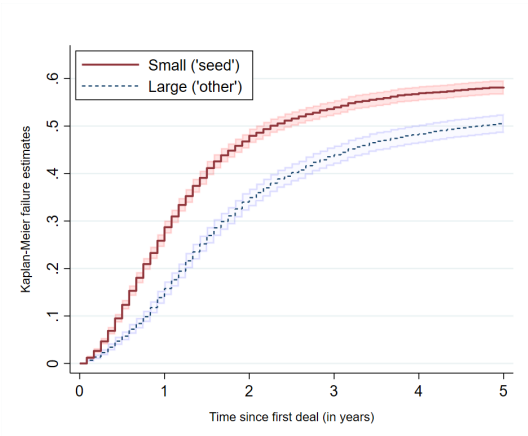
Panel B: Difference in deals across sectors



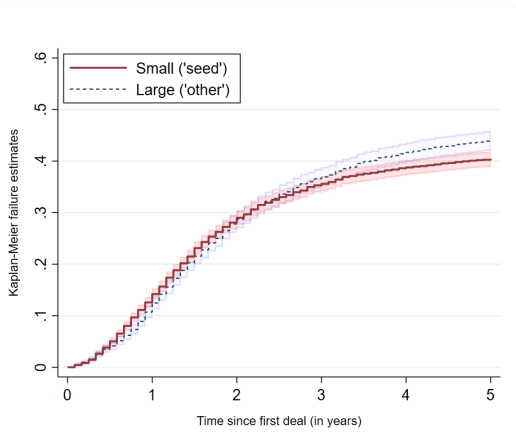
Notes: This graph displays the evolution of first-round "Seed"-backed US startups distinguishing firms that are active in sectors which are eligible to capital gains tax exemptions as stipulated in the SBJA as of September 2010 similar to Figure 2. Panel A plots the annual number of deals by respective cohorts. Panel B displays the difference in absolute number of rounds between startups in sectors that provide tax exemptions under SBJA and startups in other sectors. The dashed vertical line illustrates the onset of shift of first-round equity investments towards "Seed"-deals, which coincides with the adoption year of the SBJA. All numbers are end-of-year total investment counts.

Figure 4: The timing of subsequent financing of early-stage equity-backed startups

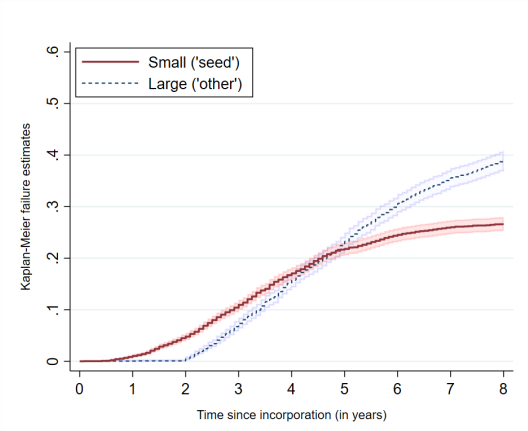
Panel A: Time until next deal



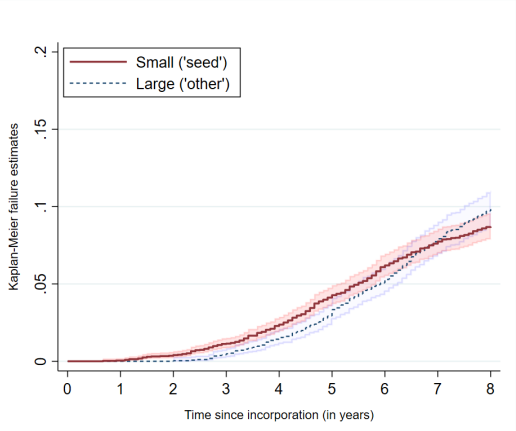
Panel B: Time until next deal (>2 mio. USD)



Panel C: Time until first 10 million USD

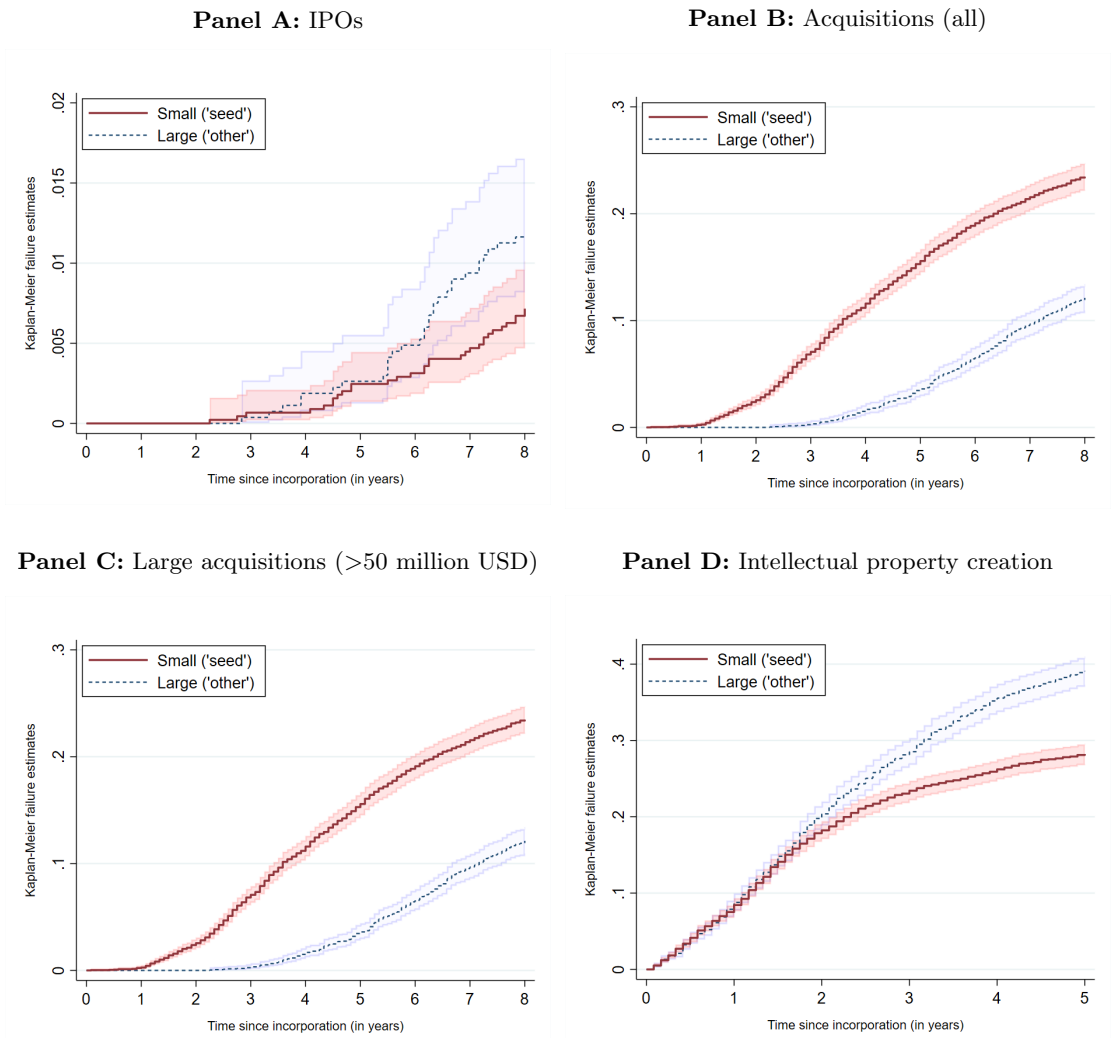


Panel D: Time until first 50 million USD



Notes: This graph displays the Kaplan-Meier failure estimates (hazard rates) of the timing of the subsequent financing events and the amounts of funds raised over time using a panel-structured dataset on the startup-month level. The hazard rate is unconditional on having an exit and is estimated for startups with a first-round equity investment of less than two million USD within the first two years after incorporation ("Seed"). For illustration, the graphs also display all other first-round equity-backed startups ("Other"). The data starts with the month in which the startup received the first financing round (Panels A and B) or the time the startup was founded (Panels C and D) and ends after five (eight) years or at the month the startups reach respective targets. To avoid right censoring issues, we measure all variables within these time frames and include startups founded by 2014. Panels A and B display the probability of receiving any subsequent funding and subsequent funding of at least two million USD per round. Panels C and D report until when the respective startups receive the first 10 and 50 million USD in funding. The shaded areas around the hazard rates mark the 95% confidence intervals.

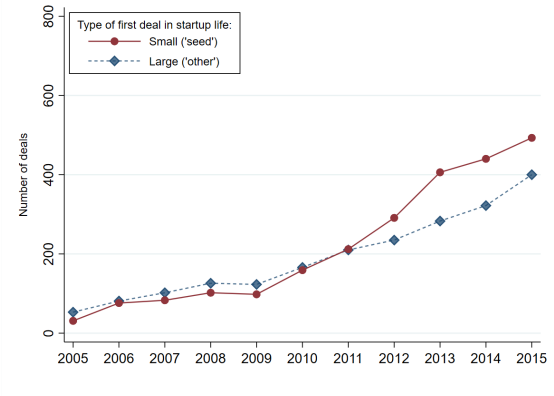
Figure 5: The timing of successful exits and IP generation of early-stage equity-backed startups



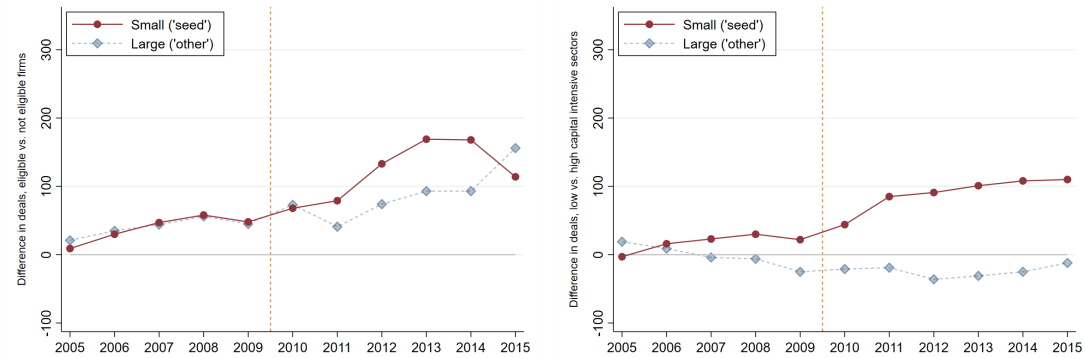
Notes: This graph investigates the timing of achieving a certain performance target, i.e., a successful exit via an IPO or acquisition or the creation of an intellectual property right (patent or trademark) distinguishing startups with initial "Seed" and "Other" first-round equity investments as defined before (Figure 4). The figure displays the probability of an IPO (Panel A), any acquisition (Panel B), acquisitions with a reported purchasing price of at least 50 million USD (Panel C), and the filing or registration of a patent or a trademark (Panel D), respectively. To avoid right censoring issues, we measure all variables within the first eight years after incorporation (five years for IP generation) and include startups founded by 2014. The shaded areas around the hazard rates mark the 95% confidence intervals.

Figure 6: The early-stage financing landscape outside the US

Panel A: First time early-stage equity investments in non-US startups



Panel B: Placebo test: Differences in early-stage financing – SBJA and low capital business fields



Notes: Panel A recasts Figure 1 using a sample of non-US based startups, headquartered in any of the seven economies with a most comparable VC-market relative to the US, i.e., Israel, Canada, Great Britain, Germany, France, Sweden, and the Netherlands. In Panel B we recast Panel B from the Figures 2 and 3 using the same sample.

FOR ONLINE PUBLICATION – Internet Appendix

Table IA1: Crunchbase investment type categories of sample startups by type

	Seed (first-round)		Other (first-round)	
CB investment type	Obs.	in %	Obs.	in %
Pre-seed	224	4.43	30	1.03
Angel	274	5.41	24	0.83
Seed	3,954	78.11	578	19.92
Series A	448	8.85	1,297	44.69
Series unkown	162	3.20	973	33.53
Total	5,062	100.00	2,902	100.00

Notes: This Table displays the Crunchbase investment type categories (variable *investment type*) assigned to first-round deals obtained from startups in our sample. Columns I and II distinguish startups that receive first-round investments at very early stages ("Seed") and at relatively later points in time ("Other").

Table IA2: List of variables

Main variables	Definitions
Main regressors	
Seed	Dummy variable taking a value of 1 for so-defined "Seed"-backed startups, i.e., that received first round equity investments by private funds with a maximum deal volume of two million USD targeted at firms within the first two years after incorporation; value 0 resembles startups that receive first round equity investments by private funds with a volume of more than two million USD and at a later age than two years.
$Seed^{US}$	Dummy variable taking a value of 1 for initially "Seed"-backed startups (as defined before) that are headquartered in the US and zero otherwise
$Post^{2010}$	Dummy variable taking a value of 1 for all years after 2010 and 0 for the years up until 2010
Startup and deal characteristics	
Target age	Differences in days (divided by 365) between the official incorporation of a startup and the date of the first equity investment deal that the focal startup received from an investment fund
Investment volumes	Size of the initial equity investment that the focal startup received from an investment fund in millions USD
Investor-level outcomes	
Local targets	Dummy variable taking a value of 1 if investors and targets are headquartered in the same state
Targets with IP	Share of targets that hold IP rights (patents and trademarks) at the time of investment
Founder experience	Number of startups created prior to the founding of the founders of the focal startup
Founder age	Difference in days between their first university degree and the date of incorporation of the respective startup (divided by 365)
log(deals)	Total number of investment deals per year per investor (logged)
Nbr. coinvestors	Average number of co-investors per deal in a given year, indicating the syndication of deals

(continued on next page)

Table IA2: List of variables (*continued*)

Main variables	**Definitions**
Startup Performance Indicators	
Exit	Dummy variable taking a value of 1 if the startup exited either via an IPO or via acquisition within in the first eight years after incorporation
IPO	Dummy variable taking a value of 1 if the startup went public, i.e., exited via initial public offering within in the first eight years after incorporation
Acquisition (all >50 mill USD)	Dummy variable taking a value of 1 if the startup exited via an acquisition of any deal volume (including unknown volumes) and acquisitions with minimum 50 million USD valuation, respectively, within in the first eight years after incorporation
Intellectual property	Dummy variable taking a value of 1 if the startup filed for a patent of had a trademark registration within in the first eight years after incorporation
Funds collected (10 / 50 mill USD)	Dummy varible taking a value of 1 if the startup has raised at least 10 or 50 million USD in funding in total within in the first eight years after incorporation
Total funds collected	Accumulated deal volumes collected (in USD) by a startup within in the first eight years after incorporation

Table IA3: Business activities of sample startups, as share of total (in %)

	First-round equity investment type		
	All startups	**Other**	**'Seed'-backed**
Software	36.44	28.99	40.70
Internet Services	28.15	20.82	32.35
Media & entertainment	25.02	18.05	29.02
Information technology	19.94	20.61	19.56
Mobile	17.62	12.54	20.53
Healthcare	17.30	22.90	14.10
Data analytics	16.02	12.16	18.23
Hardware	15.61	19.36	13.47
Commerce & shopping	14.11	9.45	16.78
Sales & marketing	13.95	11.64	15.27
Science & engineering	13.57	18.60	10.69
Community & lifestyle	12.94	8.21	15.65
Financial services	9.65	8.59	10.25
Apps	8.95	5.61	10.87
Advertising	7.45	6.75	7.85
Content & publishing	7.37	5.58	8.39
Biotechnology	7.11	11.78	4.44
Professional services	6.58	6.96	6.37
Consumer electronics	6.37	7.38	5.79
Design	6.10	4.64	6.94
Video	5.75	4.57	6.42
Artificial intelligence	5.51	3.74	6.53
Payments	5.06	3.95	5.69
Manufacturing	4.94	8.52	2.90
Security	4.73	5.51	4.28
Education	4.68	3.95	5.10
Cloud	4.58	4.75	4.48
Administrative services	3.93	3.60	4.13
Messaging & telecommunication	3.76	2.46	4.50
Food & beverages	3.57	4.26	3.17
Sustainability	3.57	6.10	2.12
Transportation	3.54	3.57	3.53
Energy	3.51	6.27	1.92
Real estate	3.23	2.91	3.41
Sports	3.06	2.60	3.33
Platforms	3.01	1.70	3.77
Travel & tourism	2.89	2.60	3.05
Clothing & apparel	2.74	1.70	3.33
Gaming	2.57	2.25	2.76

Notes: This table displays all self-reported business fields in the sample for which the aggregate share ("*All startups*") is at least 2.5%. The table further distinguishes among startups that receive financing within the first two years of incorporation and afterwards. The main categories are not mutually exclusive. "Other" refers to startups with a first round equity investment of at least two million USD and a minimum age of two years. "Seed" refers to startups with first round equity investments of less than two million USD and that are younger than two years at the respective first round.

Table IA4: Business activities of "Seed"-backed targets before and after 2010

Pre 2010			Post 2010		
Rank	Business field	Share	Rank	Business field	Share
1.	Internet services	38.9	1.	Software	42.4
2.	Media and entertainment	34.3	2.	Internet services	30.9
3.	Software	33.3	3.	Media and entertainment	27.8
4.	Information technology	20.0	4.	Mobile	21.4
5.	Sales and marketing	19.6	5.	Data analytics	19.4
6.	Community and lifestyle	17.3	6.	Information technology	19.4
7.	Mobile	16.6	7.	Commerce & shopping	17.9
8.	Advertising	14.2	8.	Community and lifestyle	15.3
9.	Health care	13.2	9.	Health care	14.3
10.	Data analytics	12.9	10.	Sales and marketing	14.3

Notes: This table compares the composition of seed investment targets in our sample. It compares the composition of business activities in all years before 2010 and all subsequent years. Business activities are subcategories of the main industry field obtained from Crunchbase. Business activities are not mutually exclusive, but firms are often in more than one business field. The table compares the relative frequency of these activities (denoted as *Shares*) between the two periods focusing on the top 10 activities in the pre-2010 period. The only field present the pre-2010 (post-2010) period but not afterwards (before) is advertising (commerce and shopping).

Table IA5: List of low capital intensive sectors with subcategories

Main activity	Subfields
Software	3d technology; application performance management; augmented reality; billing; bitcoin; browser extensions; cad; cms; computer vision; consumer software; contract management; crm; cryptocurrency; data center automation; data storage; developer apis; developer platforms; developer tools; document management; drone management; electronic design automation (eda); embedded software; embedded systems; enterprise resources planning (erp); enterprise software; ethereum; file sharing; iaas; image recognition; machine learning; marketing automation; meeting software; mooc; open source; paas; presentation software; presentations; productivity tools; qr codes; retail technology; robotics; saas; sales automation; scheduling; sex tech; simulation; sns; social crm; software engineering; task management; transaction processing; virtual assistant; virtual currency; virtual desktop; virtual goods; virtual reality; virtual world; virtualization
Data analytics	Artificial intelligence; big data; bioinformatics; biometrics; business intelligence; consumer research; data integration; data mining; data visualization; database; intelligent systems; location based services; machine learning; market research; natural language processing; predictive analytics; product research; quantified self; speech recognition; test and measurement; text analytics; usability testing
Internet	Darknet; domain registrar; e-commerce platforms; e-learning; ediscovery; edtech; email; internet of things; isp; location based services; music streaming; online forums; product search; online portals; social media; social media management; social network; web development
Cloud	Cloud computing; cloud data services; cloud infrastructure; cloud management; cloud storage; private cloud
Platforms	Android; Facebook; Google; Google glass; iOs; Linux; MacOs; Nintendo; operating systems; Playstation; Roku; Tizen; Twitter; webOs; Windows; Windows phone; xBox
Apps	App discovery; apps; consumer applications; enterprise applications; mobile apps; reading apps; web apps
Online security	Cloud security; cyber security; drm; e-signature; facial recognition; fraud detecion; identity management; intrusion detection; network security; penetration testing; privacy
Payments	Billing; mobile payments; payments; transaction processing; virtual currency; fintech

Notes: This table lists all main business fields and the corresponding subfields, which we consider as low capital intensive sectors. Specifically, we obtain the main fields from the industries listed for Facebook, Amazon, Apple, Netflix, and Google in Crunchbase. We then retrieve all corresponding subfields listed for these main fields in Crunchbase. We exclude fields that cannot be associated with high tech, digital sectors. The classification is based on Crunchbase's business fields as of November 2022. The main categories are not mutually exclusive, thus we omit multiple entries.

Table IA6: Descriptive statistics on successful startup exits and performance

Panel A: Number of exits via acquisitions and IPOs

	Total	**Acquisition**	**IPO**
Incidence	2,537	2,359	178
Incidence - seed only (in %)	1,541 (60.7)	1,541 (65.3)	80 (44.9)
Timelag until exit (seed only):			
- mean	7.21 (5.62)	7.03 (5.47)	9.59 (8.43)
- median	6.58 (5.05)	6.37 (4.93)	9.18 (8.49)

Panel B: Performance of startups within first eight years after incorporation

		First round 'seed'-backed startups		
	Full sample	**All**	**Until 2010**	**After 2010**
Exit, dummy	0.331	0.339	0.462	0.294
Acquisition, dummy	0.308	0.321	0.436	0.278
IPO, dummy	0.023	0.018	0.027	0.015
Nbr. funding rounds	3.111	3.272	3.642	3.134
Sum of funds collected (in mio. USD)	18.646	19.199	20.322	18.781
5 mio. collected, dummy	0.383	0.351	0.443	0.318
10 mio. collected, dummy	0.279	0.257	0.335	0.229
20 mio. collected, dummy	0.179	0.173	0.221	0.155
50 mio. collected, dummy	0.076	0.077	0.091	0.072
Obs.	7,964	4,183	1,127	3,056

Notes: These tables display the incidences of successful firm exits via acquisitions and IPOs and their funding history for the full Crunchbase sample on US-based startups that received first-round equity investments by equity funds between 2005 and 2015. Panel A shows the number of exits both for the full sample and for startups that received their first funding round of less than two million USD within the first two years after incorporation ("Seed"). The table also displays the average and median duration in years (i.e., days/365) between the incorporation date and the exits of respective startups. Panel B displays further statistics on startup exit and funding rates. To avoid right censoring issues we measure all variables within the first eight years after incorporation and include startups founded by 2014. Most variables are coded as indicator variables equal to one if any of the respective outcomes is achieved within the first eight years of startup life. Only for the number of funding rounds and the sum of funds collected we use continuous variables. The table reports respective numbers for the full sample and for all startups with early first-round deals, further distinguishing whether first rounds are collected until 2010 or after.

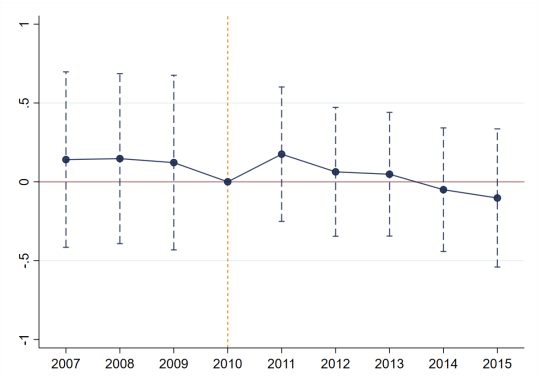
Table IA7: Robustness test: The performance of US- and non-US-based startups after 2010

Panel A: Performance outcomes of startups in low capital intensive sectors

Dependent variable:	Performance indicators					
	Exits			Funds collected		
	All	IPO	Acquisitions	10 million	50 million	Total funds
	(I)	(II)	(III)	(IV)	(V)	(VI)
$Seed^{US} \times Post^{2010}$	-0.005	0.288	-0.025	-0.208	-0.179	-0.194
	(0.127)	(0.273)	(0.128)	(0.131)	(0.177)	(0.199)
Initial deal-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3,027	2,781	3,027	3,027	2,983	2,536
Pseudo R^2 (R^{2*})	0.029	0.040	0.030	0.032	0.020	0.067*

Panel B: Event-study type regression coefficient plots

Dep. variable: I(Exits)



Dep. variable: Total funds collected

Notes: This Table displays variants of different estimates of Equation 3 as robustness tests for the main analyses. Specifically, all variables, model specifications, and the sample are equivalent to those displayed in Table 5 Panels A and B, but here we include only those startups operating in sectors with low capital intensity as defined in Section 3.2.1.

Figure IA1: Stylized startup lifecycle – a traditional perspective

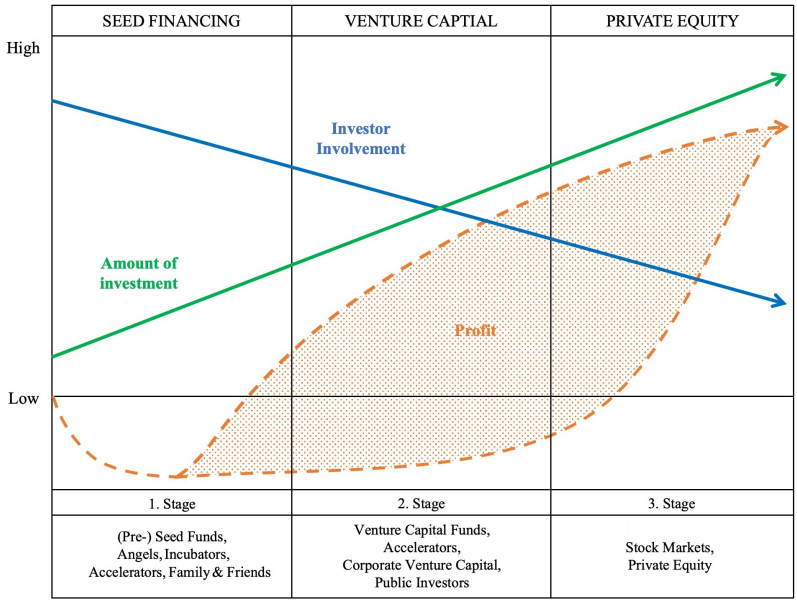
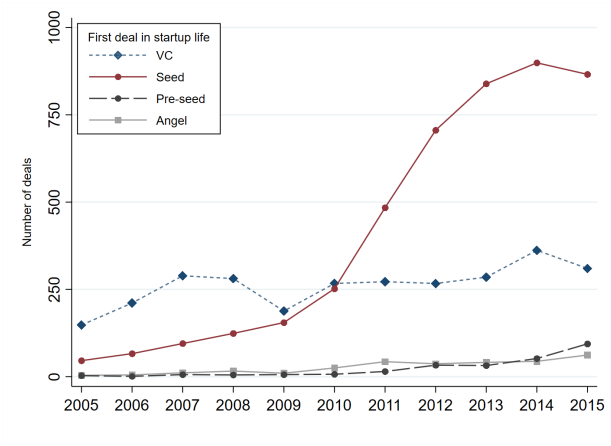
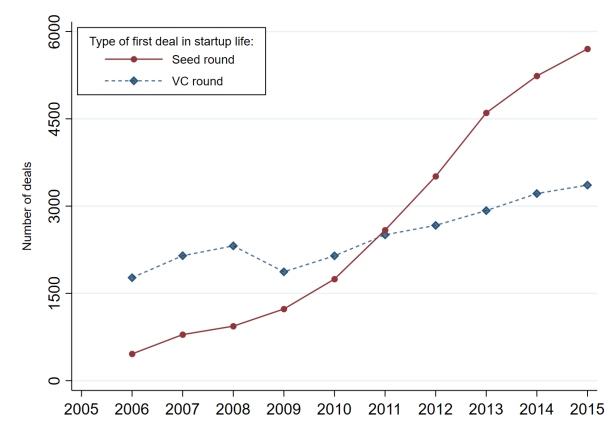


Figure IA2: Different perspectives on the early-stage startup financing in the US (2005-2015)

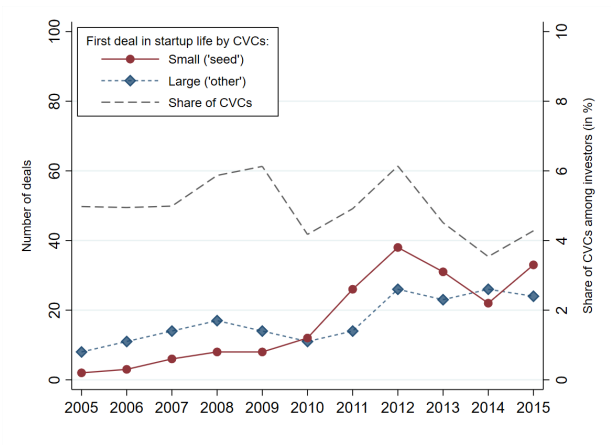
Panel A: Crunchbase investment classifications



Panel B: Pitchbook data



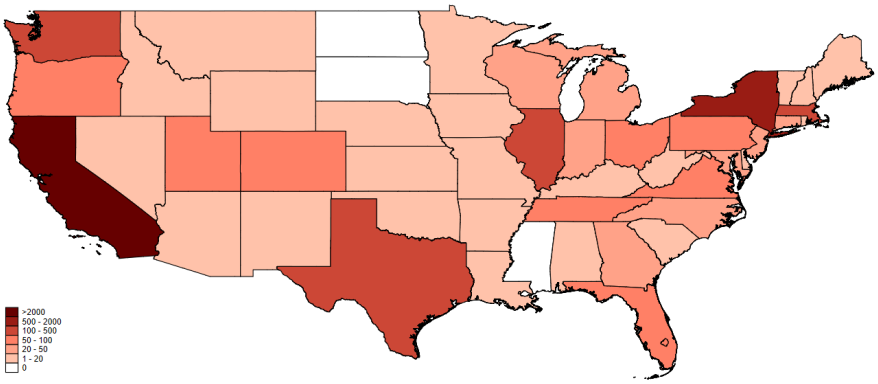
Panel C: Share of CVC investments



Notes: This figure illustrates the development of early-stage equity financing activities for US-based investment targets in the years 2005-2015. The data is the universe of investment deals listed in the Crunchbase database for startups with a US address, founded in 2002 or later, and with a first investment round between 2005 and 2015. The graph displays the absolute number of first-time financing events per year across different investment type definitions. Panel A classifies first-round equity investments according to Crunchbase labels, distinguishing seed, pre-seed, angel, and VC rounds. Panel B uses out-of-sample data from Pitchbook (only available as of 2006) and distinguishes the investment type classes seed and VC. Note that these values do not specifically refer to the first deal but more generally refer to any early-stage rounds. By definition we thus expect slightly higher values in the absolute number of deals relative to the Crunchbase data. Panel C displays the shares of CVC investments within these rounds.

Figure IA3: Geographic locations of first-round equity investment targets, by type

'Seed'-backed targets:



'Other' first round targets:

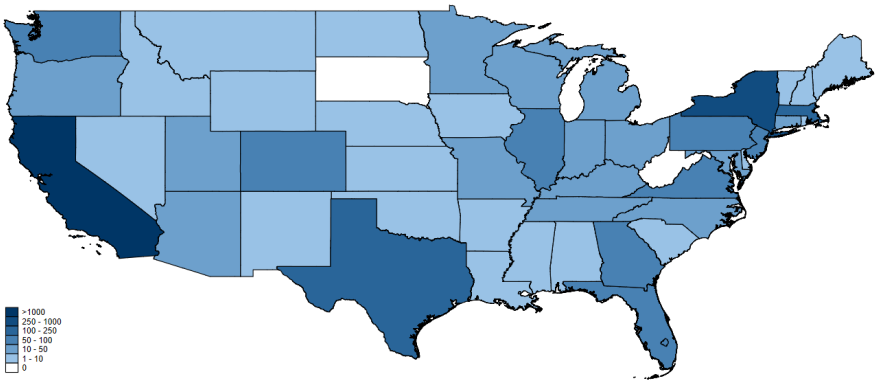
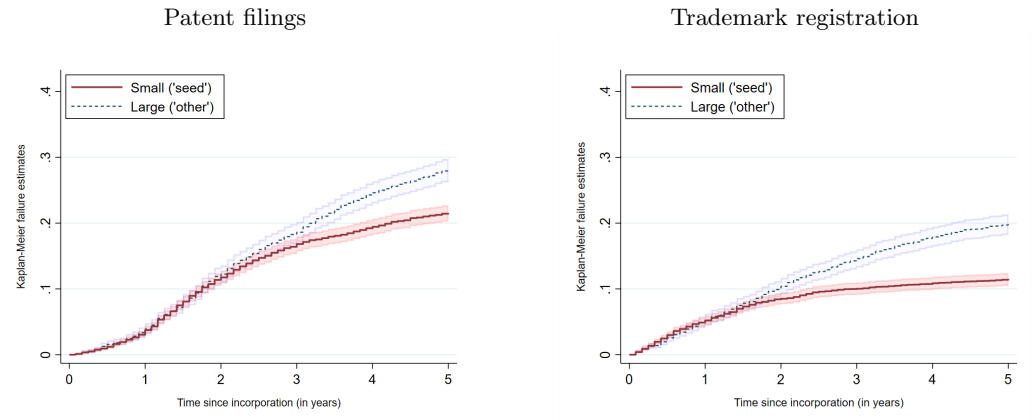
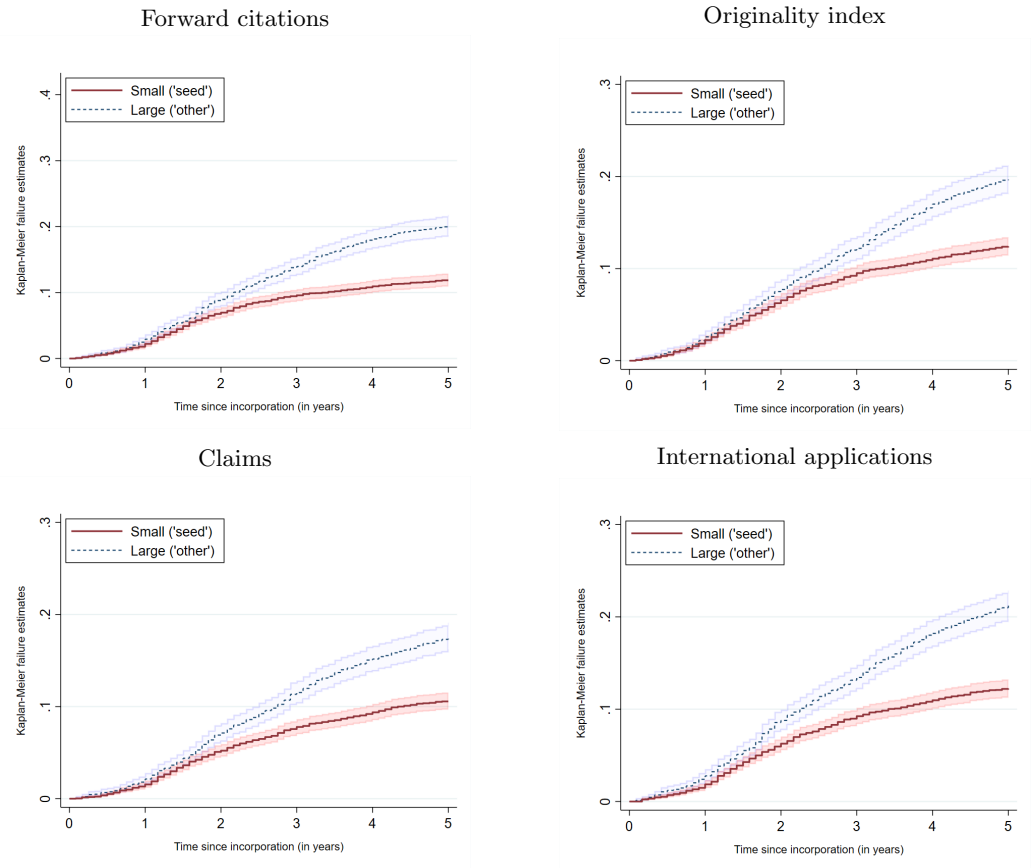


Figure IA4: Robustness tests on the timing of generating intellectual property rights

Panel A: Separating patent and trademark generation

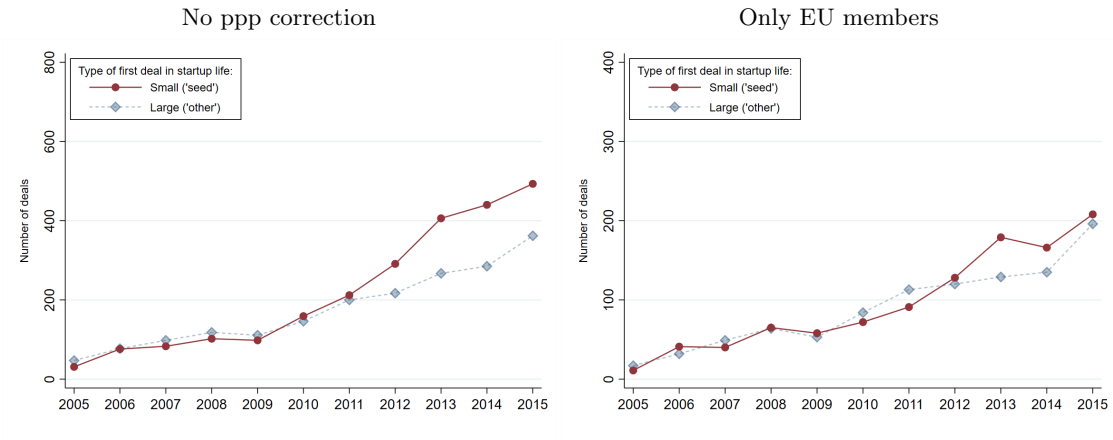


Panel B: Testing patent-quality adjustments



Notes: This graph is similar to Figure 5 and documents the timing of IP generation within the first five years after incorporation, distinguishing startups with initial "Seed" and "Other" first-round equity investments. Panel A displays the hazard rate for patents and trademarks separately. The graphs in Panel B are similar to the hazard rate on patents in Panel A but consider patents of high quality only. We use four measures of patent quality to determine high quality patents: patents with an above median i) forward citations (Harhoff *et al.* 2003), ii) originality index score (Hall *et al.* 2001), iii) number of claims (Marco *et al.* 2019), and iv) international patents, i.e., those that either have a triad or transnational patent application (Harhoff *et al.* 2003). To avoid truncation issues common to related literature, in Panel A we consider only citations within first five years after patent filing. The shaded areas around the hazard rates mark the 95% confidence intervals.

Figure IA5: Robustness test: Startup funding rates outside the US and alternative definitions



Notes: These figures recast Panel A of Figure 6. Only here we define the cutoff for early- and small VC deals without adjusting for the purchasing power parity (left panel). Alternatively, we exclude non-EU member states from the comparison group – Israel, Great Britain and Canada – because of the proximity in terms of entrepreneurial cultural to the US (right panel).