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

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This paper examines startup performance in the context of a previously unexplored but significant transformation in the US entrepreneurial financing landscape, the shift of first-round VC investments towards increasingly younger startups. Unparalleled by other developments, the frequency of such deals quadrupled during the early 2010s, facilitating the survival of promising but high-risk startups. We find that both market- and policy-based factors account for this shift and that targets backed by early-stage investments outperform other VC-backed startups. These results highlight the benefits of continued regulatory improvements that match the evolutions in business activities and thereby stimulate the growth of nascent ventures.

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1 Introduction

Nascent firms play a central role in developing new business ideas and thus shape economic development and growth (e.g., Haltiwanger *et al.* 2013). For these firms, adequate funding is one common constraint that crucially determines their success (Kerr and Nanda 2009; Lerner and Nanda 2020). Specialized intermediaries, such as venture capitalists, play an essential role in mitigating the financing issues of entrepreneurial startups (Gompers and Lerner 1999; Hellmann and Puri 2002; Chemmanur *et al.* 2011; Bernstein *et al.* 2016). However, changes in the economic environment and public policies may significantly affect the activities of these intermediaries (Cumming and Li 2013; Ewens *et al.* 2018).

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, in response to the Crisis, the US government initiated policies fostering investments in young, tech-oriented firms (e.g., Edwards and Todtenhaupt 2020). This combination of events unleashed a substantial change: As of 2010, early-stage startup investments shifted towards ever younger targets and became significantly smaller than in 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 low volume investments targeted at particularly young startups relative to other first-round deals from the same investor types.[1]

- Insert Figure 1 here -

To our knowledge, prior research has not covered this transition in the US startup financing landscape – a gap we aim to fill. Studying this shift is important because, a priori, its implications for startup performance are unclear. On the one hand, the surge in early-stage funding may

[1]The thresholds of a maximum volumne of two million USD and a maximum age of two years represent the median volume and median target age of first-round equity investments by equity funds in the US before the Financial Crisis. Further, they correspond closely to the investment type classes "Seed" or "Pre-Seed" versus "Series A" used in standard startup data providers, such as Crunchbase. Section 2.1 details on this approach.

have dampened startup performance: the enhanced availability of funding leads to more startup activity but also to more startup failures (Kerr and Nanda 2009). In particular, the shift in the 2010s disproportionally raised investments into very young targets, which are associated with high information opacity and uncertainty, thus increasing the risk of investment misallocation. On the other hand, the shift in financing patterns could have enhanced startup performance. For example, favorable market- and policy-based changes potentially mitigate resource constraints, allowing investors to satisfy the financial needs of specific high-potential startups. In light of these aspects, assessing the implications of changes in financing patterns on startup performance remains an empirical task.

This paper investigates startup performance in the context of the evolution of the US startup financing landscape during the 2010s. To this end, we study startups' exit, financing, and IP activities, exploring a representative sample of almost 8,000 US-based ventures active between 2005 and 2015. The data covers information from Crunchbase on investment histories, firm performance as well as founder- and investor-level characteristics and allows us to draw a comprehensive picture of the entrepreneurial financing landscape at the time. We find that those young, equity-backed startups that constituted the rise of early-stage funding (henceforth, "Seed"-backed startups) outperform firms that receive VC financing at later stages, controlling for several confounding factors. This finding emphasizes the overall positive implications of the changes in the early 2010s, as investors increasingly shifted their investments towards more risky but also more successful startups.

We start our analysis by showing that first-round equity deals from investment funds with a maximum volume of two million USD targeted at US-based startups with less than two years of age increased by about 430% between 2009 and 2013. This increase is disproportional relative to other early-stage equity investment and also to startup creation rates. Summary statistics of "Seed"-backed startups show that most key differences between "Seed"-backed startups and other startups with VC funding likely reflect differences in the age and business activities of respective startups. For example, startups that receive initial equity investments at an earlier stage are more likely to signal their potential through the founding team. In contrast, startups

with first-round deals at a later stage and of higher volume are more likely to signal their abilities through their business activities, such as intellectual property.

We then document the general economic environment around 2010 and the underlying developments that contributed to the boom in early-stage investments. Intuitively, repercussions of the Global Financial Crisis reshaped investment conditions along multiple dimensions, such that changes in investment patterns are likely an outcome of demand- and supply-side developments. On the demand side (market-based factor), we find a shift towards investment targets with less capital-intensive business fields. Startups in these fields require relatively little investments to launch their business model. On the supply side (policy-based factor), preferential legislative changes, such as the introduction of the Small Business Jobs Act (SBJA) in 2010, made early-stage equity investments more attractive. While these factors have been previously identified to support startup financing, we find that the boom in early-stage investments can only be attributed to startups subject to both market- *and* policy-based factors. Given the positive effect of the "Seed"-boom on startup performance, our results thus advocate for continued improvements in regulation that support funding of young startups to match evolutions in business activities.

Additionally, we analyze the extent to which investors' financing patterns changed throughout 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.

We proceed to investigate the performance of young equity-backed startups in terms of their exit, financing, and IP activity. We find that "Seed"-backed targets, on average, raise similar subsequent investment amounts relative to firms that receive VC financing at later stages and they underperform regarding exit rates and IP creation. These findings are robust to using a matched sample and controlling for startup-, industry-, and time-specific characteristics. However, conditional on reaching a subsequent funding stage, "Seed"-backed startups outperform the comparison group along several dimensions. These effects apply before and after the surge in early-stage startup financing in 2010, suggesting that the market- and policy-based changes

related to early-stage financing made high-risk, high-return startups more appealing investment targets.

Finally, we compare our previous findings on early-stage equity-backed US startups to a set of startups from outside the US, i.e., startups that were not subject to changes in their economic environment. We show that the markable shift in the timing of first-round equity deals around 2010 was specific to the US: There is no comparable shift towards increasingly earlier first-round financing deals in the seven economies with the most similar VC financing markets outside the US. Moreover, our analyses show that early-stage financed US startups' relative performance did not decline compared to their international peers throughout the early 2010s, corroborating our results on startup performance.[2]

This study discloses insights on a significant yet understudied shift in the US startup financing landscape. It highlights the importance of market- and policy-based mechanisms for fostering startup investments. Despite the higher associated risk of nascent firms, the shift towards "Seed" investments facilitated the survival of more profitable startups. Our findings add to the understanding of different startup investment patterns and, thus, the entrepreneurial process as a whole.

Our findings contribute to the rich literature on startup financing that investigates 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 ascertains superior firm outcomes of VC-backed firms in terms of higher probabilities of survival, going public, and 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 generating innovation (Kortum and Lerner 2000; Samila and Sorenson 2011; Howell *et al.* 2020). We offer new evidence in this domain by distinguishing the timing of initial VC investments and, in particular, by examining changes in startup performance over time as the underlying financing environment evolves.

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

[2]US and non-US startups will likely differ along unobservable and institutional characteristics. To partially account for this, we demonstrate that US and non-US startups evolved along parallel paths before 2010.

stage financing is scarce (e.g., Tenca *et al.* 2018), especially 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; Yu 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 positively impacts startup performance. Hellmann *et al.* (2021) discover that investor-led angel- and company-led VC financing are dynamic substitutes while formerly considered sequentially operating (i.e., complementary) intermediaries. Our work focuses on company-led external equity financing and differentiates among investment types. A group of related studies compares VC-backed startups to those backed by other forms of early-stage funding and documents mixed results: Goldfarb *et al.* (2013) find no difference in the performance of angel investment targets and VC targets, while Amore *et al.* (2022) find traditional VCs outperform micro VCs. These contrasting results illustrate the difficulty of predicting the relative performance of startups and, thus, the implications of shifts in the startup financing landscape. Unlike the studies mentioned above, we examine the performance of initially "Seed"-backed startups. In particular, we compare these firms to startups that receive VC funding at later stages or that receive similar investments but in comparable jurisdictions outside the US. This approach facilitates evaluating the implications of the significant change in the entrepreneurial financing landscape in the US.

Our work builds on Ewens *et al.* (2018), who study a different but related change in the US startup landscape. The authors document how the introduction of Amazon's Web Services (AWS) in 2006 significantly lowered initial fixed investments required for business creation, raising the demand for small-staked early-stage investments. This change mainly benefitted "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. Instead, we outline likely causes that led to changes in the financing landscape about five years after the introduction of AWS and for a different subset of firms. 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. Importantly, however, our findings illustrate that significant shifts in the entrepreneurial financing landscape are likely the joint result of different factors, meaning that the major shifts in market dynamics are unlikely to have a singular cause. Therefore, our paper sheds light on a previously undisclosed market development in the US during the early 2010s. Furthermore, it adds to our understanding of changes in the entrepreneurial financing landscape, their underlying causes, and their implications for startup performance.

2 Data, variable definition, and descriptive statistics

2.1 Defining the classification of startup financing

Our analysis covers equity investments by professional VC investment funds. This way, we aim to provide generalizable results. For example, VC funds have the prime objective of generating returns on behalf of their capital providers, inducing them to follow structured diligence when selecting targets (Drover *et al.* 2017); they fulfill several roles by selecting and actively managing a portfolio of young, innovation-intensive companies (Hellmann and Puri 2002; Bottazzi *et al.* 2008). Moreover, by focusing on VC funds, we consider the most common investor type in entrepreneurial finance and control for confounding factors arising from differences in investment strategies associated with other early-stage equity investor types (e.g., Block *et al.* 2019; Gompers *et al.* 2020). More specifically, our analysis does not include public investors, individual entrepreneurs ("angels"), and other wealthy individuals with a specific interest in the target.

Furthermore, we mostly focus on a startup's first equity financing round. Here, the investor's role in supporting concept developments, the initial product, and marketing is particularly important (see Figure IA1, Appendix). Investments into entirely new startups involve relatively small deal sizes, and target firms typically do not have an existing track record. This is different from more traditional VC targets that typically already have a proven record of sales or other output. In such cases, investors seek to support the growth and expansion of existing operations and productions for relatively older targets, which require relatively high investment volumes

but comparably less involvement.

In order to evaluate startup performance, we define two unambiguous thresholds for particularly early investments and, thus, "Seed"-backed startups. Defining a clear threshold is essential since there are no generally applicable definitions for what is a particularly early investment. Such clear definitions typically do not exist in databases that are commonly used in the entrepreneurial finance literature.[3] We 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. For defining thresholds, we consider the median investment volume and target age of first-round equity deals in the US during 2005 and 2006 (i.e., our first sample years). This definition corresponds to 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. We collectively refer to early-stage equity investments as "Seed" investments, reflecting that the vast majority of the respective deals are labeled as "Seed" investments in the Crunchbase data (see Table IA1 in Appendix). However, unlike these labels, our definition allows for a clean delineation of relatively early and relatively late first-round equity investments.

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, individual funding rounds, founder characteristics, and various performance indicators. Our initial sample comprises all startups with a registered address in the US, and that received a first-round equity investment by a private investment fund. This sample includes all Crunchbase investment types referring to external equity investments conducted by investors labeled as "organizations", i.e., excluding individual investors, government programs, or similar institutions that cannot

[3]For example, Crunchbase distinguishes the following overlapping categories, all of which refer to an 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.

be considered as investment funds. Moreover, we follow related literature (e.g., Edwards and Todtenhaupt 2020) and cover startups that obtained their first financing round between 2005 and 2015, excluding firms founded before January 1, 2000. 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 the number of forward citations at DOCDB family level (as in Harhoff *et al.* 2003) obtained from 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: The startups in our sample are small, very young, and tech-oriented ventures. "Seed"-backed 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, with 0.75 million USD the median deal volume is fairly small. By definition, other first-round equity targets not classified as "Seed-backed" 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 displays the most common business fields and headquarter locations in the sample. Most "Seed"-backed startups operate in software, internet services, mobile, and data analytics. Compared to the business fields of startups that receive financing later, the most common fields are very similar. However, the distribution within these sectors varies substantially (see Table IA3 in the Appendix). Startups with relatively late first investment rounds operate more often in capital-intensive sectors, such as hardware, science and engineering, healthcare, biotechnology, or manufacturing. Further, Panel A of Table 1 also shows that startups are located predominantly in large states that are typically associated with innovation clusters, such as

California, New York, and Massachusetts. Again, this is very similar to other non-"Seed"-backed targets (see Figure IA2, Appendix).

- Insert Table 1 here -

In Panel B of Table 1, we assess investor and founder characteristics, comparing "Seed"-backed startups to relatively late ("Other") first-round equity investments. About half of "Seed" deals (54%) are syndicated deals involving more than one investor, which is higher 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 venture capitalists (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 "Other" 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' experience as measured in terms of the Crunchbase rank is very similar, comparing the "Seed"-backed startups to others.[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 than 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 ini-

[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, including 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.

tially "Seed"-backed startups are less likely to feature tangible signals relating to their business activity at 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 the age and business activities of respective startups.

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. One particular development was that initial equity investments shifted towards targeting ever 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 startups in the US throughout the 2010s. According to Wing Venture Capital (2021), seed deals gained a new role in serving as a prime mode of first-round equity investment, building the foundation of a company. In contrast, traditional VCs increasingly fund more mature firms based on financial metrics, such as annual earning reports. Other insiders, such as Josh Kopelman (2015), a 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 the definition of "Seed" investments from Section 2.1 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. 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 equally frequent as larger first-round equity investments targeted at more mature startups. This pattern arises by definition but persisted until 2010. Then, the number of first round equity investments surged, a change predominantly driven by a disproportional rise in "Seed" rounds.

This gap widened until 2012 and plateaued in 2013-2015 but at a slightly lower rate. In 2012, "Seed" deals were 2.8 times more frequent relative to larger deals targeted at older startups.[5]

Further, we find that this development is unrelated to underlying business formation changes. As such, the increase in "Seed" investments 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 are likely to decrease due to higher competition – a situation which Kopelman (2015) refers to as "Series A Crunch". Again, we provide support for this notion using descriptive statistics. The last column in Table 2 Panel A reports the share of first-round "Seed"-backed startups that eventually obtained an equity deal of at least two million USD. The share of initially "Seed"-backed startups with such subsequent deals declined from about 50% in 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 in Section .

[5]To mitigate concerns that this pattern arises from selection criteria of Crunchbase, the definition of specific classification thresholds, or compositional shifts, Figure IA3 (Appendix) displays different variants of the same timeline. Panels A and B show that using Crunchbase or Pitchbook classifications on seed investments leads to similar evolutions. Panel C shows that the observed pattern is not driven by a compositional shift related to changes in the prevalence of corporate venture capitalists.

[6]Since the time lag between initial and subsequent deals is typically less than two or three years, right censoring is unlikely to cause this result.

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 likely to have triggered the rise of "Seed" financing, implying that such large transformations are unlikely to have a singular cause. Specifically, we will show that market and policy-based factors were the underlying mechanisms.

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 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 choose to pursue strategic investments to fend off entry (Hochberg *et al.* 2010). Yet, providing an exhaustive list of factors or detailing the question about the relative importance of the described factors goes beyond the scope of our analysis. Instead, our goal is much more modest in that we compare the effects of essential factors that likely contributed to the overall shift in the entrepreneurial finance landscape.

3.2.1 Prevalence of low capital business activities

Changes in the type of firms that are created are an important factor shaping the entrepreneurial financing landscape (Ewens *et al.* 2018). Since the early 2000s, the US economy evolved towards a more digital marketplace at an accelerated pace (e.g., Brynjolfsson and Collis 2019; Tambe *et al.* 2020). Digital business strategies rely more on intangible assets that require less upfront capital investments. Hence, it seems reasonable that the digital transformation ultimately altered the amount (and timing) of funding required to start a business throughout the 2000s.

To analyze this, we examine the composition of business fields of "Seed"-backed startups, focusing on fast-growing digital sectors. As a common denominator, firms in these sectors 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 in the aftermath of the financial crisis.[7] The Financial Times (2020) coined the 2010s as "*The FAANG Decade*", referring to the disproportional growth of the tech sector in the 2010s. First, we gather the main business fields of these companies from Crunchbase, namely, software, data, internet, cloud, platforms, apps, security, and payment – all of which are low capital intensive. We then collect all subfields related to these main business activities, as listed in Table IA5 (Appendix).

Using this definition, we show that the pattern observed in Figure 1 can be mostly attributed to an inflow of firms operating in sectors with low capital intensity. Panel A of Figure 2 displays the absolute number of first-round investment deals, similar to before, but distinguishes 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 is comparable, low capital intensity sectors disproportionally attract more early and low-volume first-round deals beginning in 2010.

- Insert Figure 2 here -

To mitigate concerns that the observed pattern reflects a general trend of increased investments into sectors with low capital intensity, we demonstrate that this pattern only holds for first-round "Seed" investments with younger but not for older targets and higher investment volumes. Therefore, Panel A of Figure 2 also displays the absolute difference in first-round investments comparing low and high capital-intensive sectors for both "Seed" deals and other first-round equity 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.[8] These patterns suggest that compositional changes in the business fields towards low capital-intensive sectors are one factor contributing to the shift in first-round equity investments in the US.

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

[8] Note, that we find no drastic shift in the business activities of selected investment targets over time. For instance, the levels of business activities 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.

3.2.2 Changes in the legal environment of taxing schemes

Next, we focus on policy-based factors as a complementary stimulus to market-based transformations. Specifically, we assess a major legislative amendment that was important 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. 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, per se. Notably, the law stipulated that tax exemptions only apply to investments in startups active in specific business fields.[9] According to Edwards and Todtenhaupt (2020), the SBJA caused a significant increase in equity investments into such qualified businesses.

We show that the SBJA can be associated with the shift towards increased "Seed" 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 subject to the SBJA and, thus, provide potential investors with a tax exemption on realized profits. Panel B of Figure 2 is similar to Panel A 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, we also 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 the law are also likely to have contributed to the shift in the timing of first-round equity investments during the early 2010s.

[9]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).

3.2.3 The relative importance of market- and policy-based factors

Next, we compare the effects of market- and policy-based factors. To do so, we distinguish four categories of startups: those that are subject to both market- and policy-based factors, those that are subject to either one of the two, and those that are not subject to any. In our sample, 18% of firms are unaffected by the two factors, while 43% are affected by both. Further, 15% of firms are active in low capital-intensive sectors but not subject to the SBJA, while 24% are subject to the SBJA but are not active in low capital-intensive business fields.

Figure 3 recasts the graphs from Figure 2 but distinguishes startups from the four distinct categories. The results show that the above-observed patterns are predominantly driven by startups subject to both market- and policy-based factors. This pattern consistently applies regarding the trends in the absolute number of "Seed" deals (Panel A) and regarding the relative increase in the number of deals comparing early- and later-stage deals (Panel B).

- Insert Figure 3 here -

In sum, our findings show that both market- and policy-based factors contributed to the rise of early-stage investments. Moreover, we find that the overall shift in the entrepreneurial financing landscape is predominantly driven by startups that are subject to both factors simultaneously. This insight highlights the complementary importance of market forces and policy initiatives to foster dynamics in the marketplace.

3.3 Changes in investment patterns of early-stage equity investors

The subsequent analysis points 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, as underlined by the decrease in startups with follow-on investments. 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 concerning the targets selected (i.e., increasing "Seed" funding) but also regarding the investment process as a whole. Consistent with this, 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). At the same time, it would be equally plausible that investors apply strategies to offset at least parts of the increased risk associated with young targets.

We follow the literature and use a set of different measures for increased and decreased risk-taking to operationalize such 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 of risk-taking. Investors are aware that farther distances imply lower monitoring; thus, more distant investment targets correspond with higher risk (see Tian 2011; 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 experience of the founder regarding prior founding activities and age. Third, the share of targets holding IP rights at the time of investment relates to its riskiness as these rights are tangible signals 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; Tian 2011). Therefore, we measure changes in investors' diversification strategy 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, the syndication of investments is a fundamental strategy to lower their risk exposure.

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 "Seed" investments and other, larger early-stage equity 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 a dependent variable in the 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. Instead, the results point towards risk-mitigation patterns. Panel A displays the estimates for Equation 1. Columns I-IV display coefficients on estimations using the four variables associated 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. 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 similar over the observed time period, indicating a sideways trend. In contrast, we

find a trend toward an increased number of deals per year and more syndicated deals for the two diversification motive measures. While the mere 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 altogether. Indeed, 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 unconditional success probability over time

This section examines the performance of initially "Seed"-backed startups over time. We measure performance along three distinct dimensions. First, we use data on the timing and accumulated amount of external equity financing collected by startups as indicators 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. 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). Moreover, using the raised funding volumes and generated IP as performance measures is helpful as these activities are found to serve well as substitute measures for exits once a sample contains young startups that are too young for an exit (Yimfor and Garfinkel 2023). Table IA6 (Appendix) provides 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, the data is restructured to a startup-month panel, measuring months relative to the incorporation date of the startup. The arrival of a successful performance event is indicated using dummy variables that are equal to one in the week the startup reaches any of the respective performance events. Based on this setting, 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 after the initial deal over time. Initially "Seed"-backed firms have about a 60% 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 51% of other equity-backed startups receive a second financing round. The differences in the timing and the probability of receiving a subsequent deal most likely reflect that funding volumes of initial "Seed" deals are relatively small, and thus funds are depleted relatively fast. Consistently, this changes when we condition on receiving subsequent funding rounds with a minimum deal volume of two million USD. Panel A of Figure 4 shows that in this case, 41% and 44% of initially "Seed"-backed and other startups receive subsequent equity deals within five years after the initial funding round. This difference is only weakly significant at the ten percent level.

- Insert Figure 4 here -

Furthermore, Panel B of Figure 4 displays hazards of obtaining at least 10 and 50 million USD in total funding, respectively. Here, the first eight years after incorporation are considered to avoid truncation issues arising from the time it takes to raise large funding amounts. Overall, the probability of "Seed"-backed startups gathering 10 million USD within this time window is significantly lower than other equity-backed startups. However, this difference vanishes when we consider the probability of collecting 50 million USD. Taken together, these results suggest that "Seed"-backed startups can frequently attract follow-on investments. Despite the descriptive evidence on the lower share of startups with follow-on investments from Section 3.1, there is no robust evidence that initially "Seed"-backed startups collect fewer 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. Overall, sampled startups account for 2,527 exits (2,359 acquisitions and 178 IPOs) for startups in our sample. Figure 5 displays the unconditional probability (hazard rate) of an exit via an IPO (Panel A) or acquisition (Panel B) over time. Panel A shows that the likelihood of any startup in our sample exiting via an IPO is relatively low. Only about 1.1% of initially "Seed"-backed startups go public within the first eight years after incorporation. The graph suggests 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%) – an arguably low difference in economic terms.

- Insert Figure 5 here -

Panel B of Figure 5 shows that 26% 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 being acquired is significantly lower (18%). 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 low-stake acquisitions predominantly drive this difference.

IP generation as performance indicator: As a last performance indicator, we asses startups' IP filings over time. 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% of initially "Seed"-backed startups and 39% 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 a "Seed"-backed startup to file a patent within the first five years after incorporation is significantly lower (22%) compared to the one of other equity-backed startups (28%). 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.

Multivariate analysis on matched sample: We validate the above descriptive findings in regression analyses that control for confounding factors in multiple ways. Specifically, we estimate performance differences on a matched sample, in which we pair these startups with those that received initial equity investments at later stages. The matching approach imposes startups to share several characteristics that are already observable at the time the startup is created, i.e., the same founding month, state, and industry as well as characteristics of startups' founders. Respective characteristics are founders' experience in terms of i) previously founded ventures and ii) age, which we approximate by the time gap between their first university degree and the date of incorporation of the respective startup.[10] 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 and 893 startups are in the comparison group of startups that receive their initial equity financing at a later point in time.

Panel E of Figure 5 displays results from estimating a conditional logit regression, which uses any of the above-described performance measures as dependent variables and controls for

[10]This approach accounts for important features such that the 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.

the funding year, startup location, and business fields (see also Section 4.2). Overall the results closely mirror the findings from the hazard estimates, suggesting that the average startup that receives funding at a later stage outperforms the average "Seed"-backed startups even after controlling for observable startup characteristics.

4.2 Regression analyses

In this section, we analyze the performance of startups that obtain their first investment round at very early stages in more detail. To do so, we focus on those initially "Seed"-backed startups that eventually reach a subsequent financing stage. This way, we account for the fact that non-"Seed"-backed startups entail a survivorship bias, since we only observe them conditional on receiving external equity financing at a later stage. In total this applies to about 43% of initially "Seed"-backed startups. Hence, this approach screens out the early-failed startups, which should be less similar to the comparison group startups. Analyzing performance differences between "Seed"-backed startups with subsequent financing and the control groups, as defined before, should thus yields important additional insights on early-stage equity-backed startups' performance. We estimate different variants of the following specification:

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

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.

First, we repeat the analyses from Section 4.1 excluding "Seed"-backed startups that never obtained any follow-on financing. Reestimating Equation 2 using these firms significantly changes the previous results as displayed in Panel A 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 the average "Seed"-backed startup (Figure 5), suggesting that "Seed"-backed startups are likely to outperform the comparison group conditional on reaching subsequent financing. To test the robustness of these estimates, Panel A of Table IA7 (Appendix) shows that the estimates are similar though less precisely estimated, when we repeat these estimations for a matched sample similar to Panel E of Figure 5.

- Insert Table 4 here -

Second, we analyze whether the patterns described in Panel A changed throughout the booming phase of early-stage startup financing. To this end, we repeat the analysis and split the sample distinguishing startups with initial external financing rounds before and after 2010. The signs and level of significance are equal across both subsamples. This finding is robust to using the full sample and including an interaction term of *Seed* and an indicator $Post^{2010}$, which is equal to one for all startups with an initial financing round in 2010 or later (see Panel B of Table IA7, Appendix). Hence, these estimates imply that the superior performance of initially "Seed"-backed startups over other startups applies before and after the surge in early-stage financing. As such, investors are likely to have known about both the associated riskiness of these startups, represented by the high failure rates, and their beneficial performance outcomes. Yet, only the emergence of low capital-intensive startups and preferential legal changes during the early 2010s, as shown in Section 3.2, might have induced investors to fund these startups early on increasingly.

Hazard rate analyses on the timing of failure of "Seed"-backed startups corroborate these results. Specifically, we consider the likelihood of startup liquidation. Startup liquidation is one

of the indicators of failure, which is particularly severe since investors have to write off their entire investment. Overall, 27% of startups in the sample are liquidated by early 2023, i.e., the latest available update of the Crunchbase data used in this study.[11] Figure IA5 (Appendix) shows that failure rates of "Seed"-backed startups within the first years after incorporation do not significantly differ comparing pre- and post-2010 levels.

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 better understand the implications of startup financing on performance, we compare US-based startups to a similar set of startups. Specifically, we explore how the shift towards very early-stage financing during the early 2010s is specific to the US. The comparison group comprises seven OECD economies with the largest VC markets: 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. The absence of a "Seed" boom outside the US may be intuitive, considering that changes in the legal framework, such as the passing of SBJA, are a domestic policy. However, the rise of low capital-intensive startups may have been similar outside the US. To illustrate that the developments in the US were unparalleled 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 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.

[11] Although failure rates are likely to be underreported, this value is in line with other reports on respective liquidation rates. For example, Gage (2012) reported that 30-40% for US venture-backed startups failed between 2000 and 2010. Our sample comprises startups backed by professional funds, likely implying lower liquidation rates. Moreover, in our case failure rates are in part lower by construction as we impose on firms to survive until the first funding round. We acknowledge that failure can be measured differently, e.g., using negative return on investment (see, e.g., Arora *et al.* 2021). Unfortunately, we cannot identify this with our observational data.

[12] Aggregate statistics show that these economies have the most similar (albeit not equivalent) VC markets compared to the US, e.g., with respect to the size of the VC sector (see OECD Statistical Warehouse, 2010 figures of the tables: "*Venture capital investments*" in current USD prices, development stage "*Startup and other early stage*"). Despite their size, we do not consider China and Japan as they have structurally distinct VC-markets (see, e.g., Chen 2022).

[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 IA6 (Appendix), we show that the patterns are very similar when not making these adjustments or excluding specific non-EU countries, i.e., Canada and Great Britain.

This pattern persisted until 2012, with a slight divergence indicating a larger increase in early startup financing beginning in 2013. Still, this increase is much smaller than in the US. For example, in 2012, the ratio of initial deals with a target age of fewer than two years relative to initial deals with older targets was 2.8 in the US and 1.3 in the seven most comparable VC markets outside the US. This absence of a comparable shift in the entrepreneurial financing landscape outside the US is consistent with the observation that, for example, European countries suffered from VC investment shortfalls during the 2010s caused by supply and demand factors (Cumming and Groh 2018).

- Insert Figure 6 here -

In Panel B we confirm this notion. Recasting the graphs in Figure 2, we find 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 modest but steady increase in early deals after 2010. In sum, descriptive evidence strongly suggests that the sharp increase in very early startup equity deals was a phenomenon associated with the US. If anything, there is a delayed and much smaller shift in the seven economies with the most comparable VC markets outside the US.

Relative performance of startups: Given the descriptive findings, using non-US startups as a comparison group seems promising for analyzing the changes in the performance of US-based startups after 2010. For example, suppose an increased focus on young investment targets is associated with poorer diligence in the selection and mentoring process of VCs. In that case, we should observe a disproportional decrease in the performance of US-based startups *relative* to non-US startups after 2010.

More specifically, we exploit this setting by using difference-in-difference estimations in which we compare the performance of US-based startups that receive equity financing at very early stages to similar startups headquartered in large VC markets outside the US ("comparison group") both before and after 2010. Importantly, this strategy does not suggest that US and

non-US startups are similar, which they are likely not. Instead, the strategy merely requires that US and non-US startups would have evolved along parallel paths both before 2010 and in the absence of market- and policy-based changes in the US financing landscape. 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 estimates δ, i.e., the coefficient of interest, which captures the differential change in performance of early-stage equity-backed startups in the US after 2010 relative to the comparison group. 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 $Post_{it}^{2010}$.

Equation 3 is estimated using repeated cross-sectional data on the sample of startups headquartered in the US or any of the seven economies specified above. Just as before, this includes startups that receive initial early-stage financing from an equity fund between 2005 and 2015. Further, sampled non-US startups also received their initial deal within the first two years after incorporation and obtained a total financing volume of less than two million USD at purchasing power parity. Finally, the main analyses in this section focus on startups that comprised the "Seed"-boom, i.e., startups active in business fields subject to market- and policy-based factors. This approach results in a sample of 3,389 initially "Seed"-backed startups from the US (2,359) and abroad (1,030).

Table 5 displays the results from estimating Equation 3 using different performance indicators as dependent variables. In Columns I-III, probit estimations use a set of dummy variables indicating whether respective startups have successfully exited within the first eight years after

incorporation. The insignificant coefficients in Columns I and III suggest no statistically disproportional change in the probability of successful exits when comparing US and non-US-based startups 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 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 equivalent to the probit estimation but uses a continuous variable as the dependent variable that measures 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 graphs plot the dynamic treatment effects, i.e., regression coefficients of an event study type specification similar to Equation 3. As the dependent variable, we use an indicator of exit, an indicator of high-value exit (i.e., IPOs or acquisitions worth more than 50 million USD), or a continuous variable on the funds collected within the first five years after incorporation. The graphs deliver two key takeaways. First, the coefficients in the years before 2010 are insignificant across specifications. This finding suggests that US and non-US-based startups evolved in parallel trends before 2010 and supports the applicability of our approach. Second, the insignificant coefficients after 2010 confirm estimates from Panel A. In Table IA8 (Appendix), we show that these results are robust to analyzing startups affected by market- or policy-related factors separately. Similarly, our previous results hold when using a triple-DID design or considering Canada, Great Britain, and Israel, i.e., the economies with the most comparable VC markets among the comparison group (untabulated). Overall, using non-US startups as a comparison group provides additional evidence that supports our main results, mitigating concerns that the specific selection of the empirical design determines previous results. Again, these results emphasize that the surge in "Seed"-backed startups in the US is not accompanied by a reduction in startup performance, despite the strong rise of high-risk startups being financed.

5 Conclusion

Access to funding is a key determinant for startup success, such that structural changes in their financing environment may have important implications for shaping the trajectories of nascent firms. In this paper, we investigate startup performance in the context of a significant but hitherto unexplored shift in the US startup investment landscape. In the aftermath of the 2009 Financial Crisis, increasingly younger firms became targets of relatively small first-round equity investments. Using detailed investment and performance data on about 8,000 US-based startups, we provide a detailed portrayal of this markable shift and particularly its performance implications for startups.

Early-stage first-round equity investments more than quadrupled between 2009 and 2013, a rise unparalleled by developments of other investment types or startup creation rates. A large share of these "Seed"-backed startups is able to secure follow-on investments within the first years after the initial deal. We find that conditional on reaching this subsequent funding stage, "Seed"-backed startups outperform other VC-backed startups that obtain their initial financing at later stages. Moreover, our findings suggest that a combination of market-based and policy-induced factors is pivotal to the rise in early-stage financing. We also conjecture that investors adjust their financing patterns by increasingly applying risk-mitigating strategies, suggesting an attempt to dampen the increased risk associated with young targets.

These results are important, as they shed light on a previously unexamined development in the financing landscape, the implications of which are a priori unclear. Indeed, we disclose that the significant shift in the US towards younger, riskier investment targets benefited well-performing startups. These insights highlight the potential of market forces and policy efforts to shape entrepreneurial financing and startup growth. Our results call for continued improvement of regulation to allow startups to get funded early on in order to adapt to ongoing transformations in the marketplace.

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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

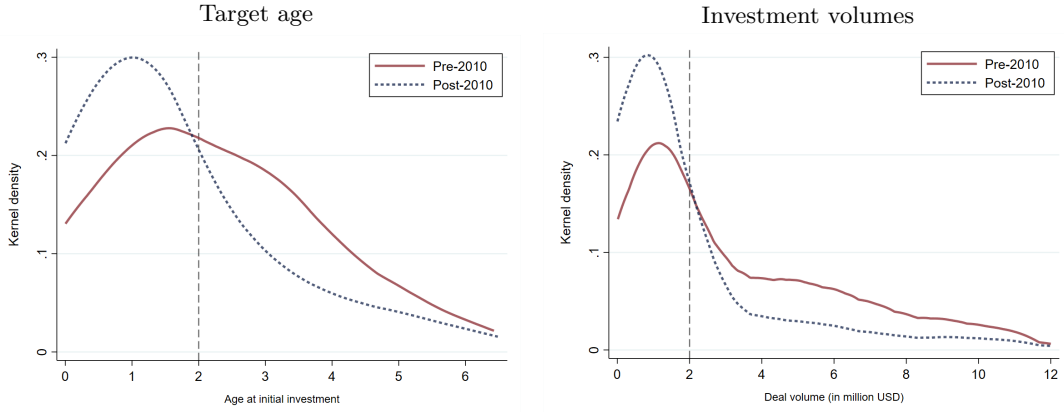
Notes: This Table displays summary statistics on sample startups, focusing on startups that obtained their initial equity investment at very early age and of small size ("Seed"). Panel A displays the share of "Seed"-backed startups according to their main business fields and locations. Startups may have 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



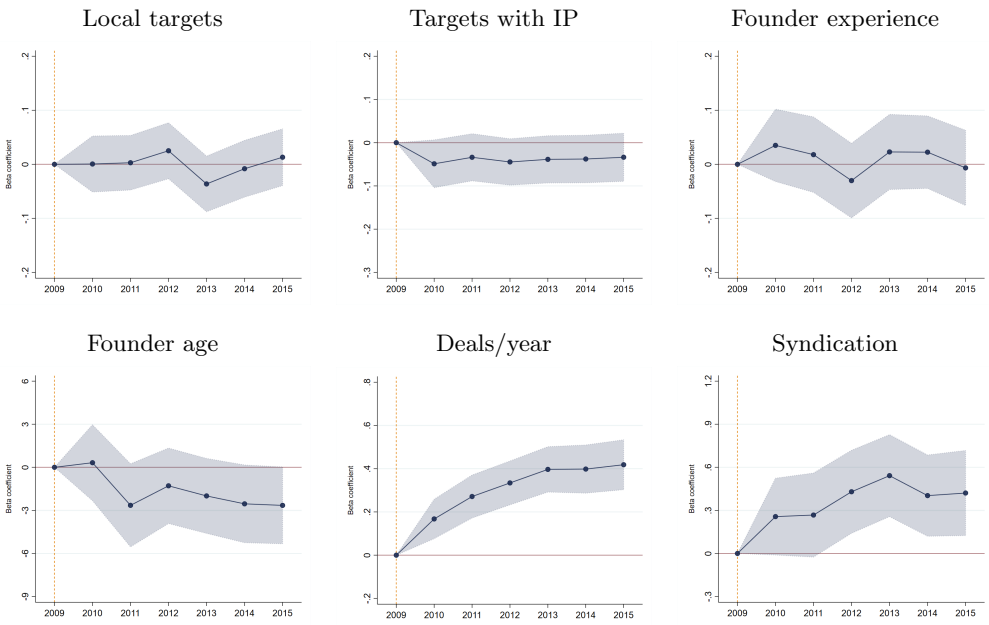
Notes: Panel A of this table displays the absolute numbers of first-round equity investments targets in the US from private investment funds. Corresponding to Figure 1 we distinguish targets younger (older) than two years and with a first round of less (more) than two million USD deal size, respectively. 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: Logistic regressions explaining performance outcomes of "Seed"-backed startups

Panel A: The success probability 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	0.360***	0.402***	0.496***	0.040	0.573***	0.386***
	(0.106)	(0.048)	(0.087)	(0.042)	(0.042)	(0.051)
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	4,560	4,560	4,560	4,560	4,560	4,560
Pseudo R^2	0.153	0.076	0.070	0.056	0.086	0.071

Panel B: Comparing pre and post 2010 success probability rates

Dependent variable:	I(Performance indicators)					
	IPO	Acquisitions		Intellectual	Funds collected	
		All	>50 million	Property	10 million	50 million
	(I)	(II)	(III)	(IV)	(V)	(VI)
	Investment years before 2010:					
Seed	0.617***	0.386***	0.731***	-0.037	0.299***	0.400***
	(0.164)	(0.088)	(0.150)	(0.082)	(0.083)	(0.098)
N	1,248	1,248	1,248	1,248	1,248	1,248
Pseudo R^2	0.152	0.077	0.134	0.052	0.052	0.091
	Investment years as of 2010:					
Seed	0.228	0.405***	0.398***	0.070	0.662***	0.382***
	(0.140)	(0.057)	(0.107)	(0.049)	(0.049)	(0.060)
N	3,312	3,312	3,312	3,312	3,312	3,312
Pseudo R^2	0.185	0.074	0.058	0.048	0.096	0.073
Controls in top and bottom panel:						
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

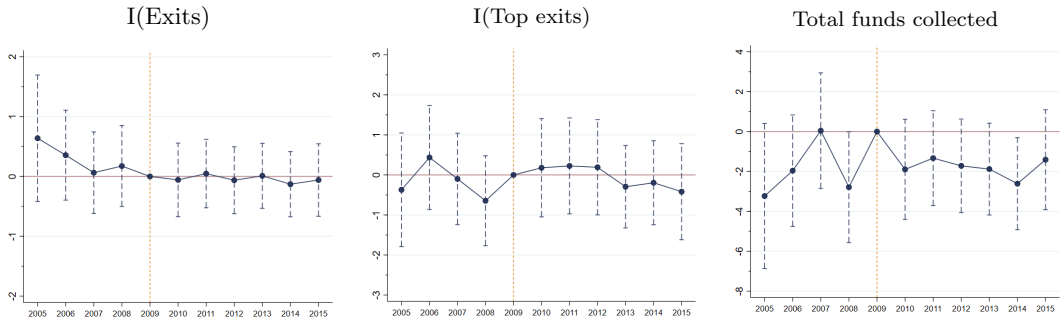
Notes: This Table shows results from logit regressions that use a set of performance indicators as dependent variables, estimating Equation 2. All performance indicators are coded as dummy variables equal to one for startups that successfully exit via IPO (Column I), exit via an acquisition (Column II), exit via an acquisition with minimum 50 million USD valuation (Column III), have generated at least one patent or trademark throughout (Column IV), or have collected at least 10 or 50 million USD throughout (Columns V and VI, respectively). The sample excludes initially "Seed"-backed startups that do not reach a subsequent VC-investment stage. To avoid right censoring issues, all performance outcomes are measured in the first eight years after incorporation and the sample includes only firms that are incorporated by 2014. In Panel A considers the full sample. Panel B repeats the analysis but estimates it separately on a sample of startups with the initial financing round before (top panel) and after 2010 (bottom). Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 5: Performance of US- and non-US startups subject to market- and policy-based changes

Panel A: Probit estimates on the likelihood of a successful startup performance

Dependent variable:	Performance indicators					
	Exits			Funds collected		
	All	IPO	Acquisitions	10 million	50 million	Total funds
	(I)	(II)	(III)	(IV)	(V)	(VI)
$Seed^{US} \times Post^{2010}$	-0.152	0.177	-0.179	-0.265*	0.026	-0.554
	(0.123)	(0.281)	(0.124)	(0.147)	(0.279)	(0.482)
Initial deal-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3,389	3,213	3,389	3,389	3,296	3,389
Pseudo R^2 (R^{2*})	0.031	0.051	0.031	0.061	0.041	0.091*

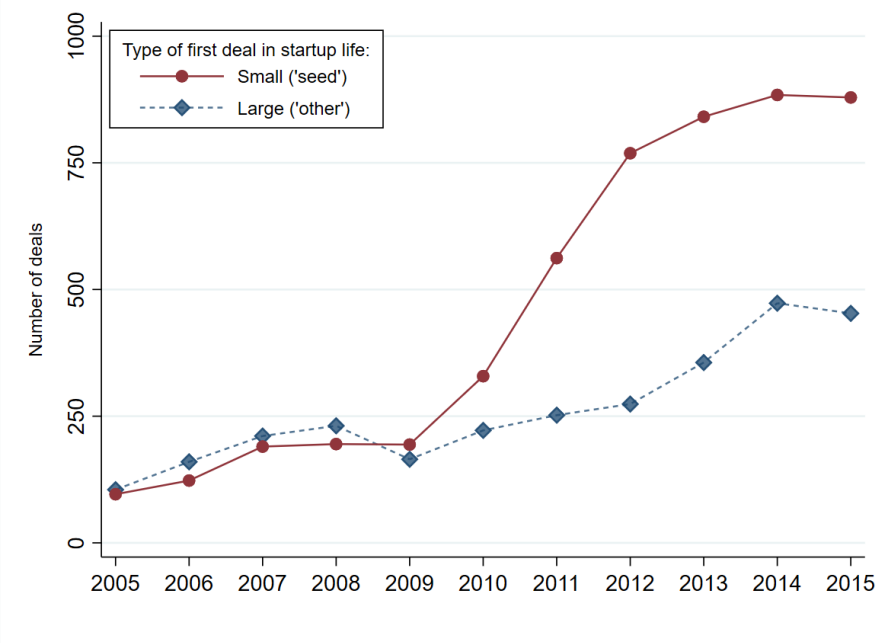
Panel B: Event-study type regression coefficient plots using different dependent variables



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). Performance outcomes are measured in the first eight years after incorporation and funding outcomes within the first five years, 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 five years after incorporation. The data used is all firms that fulfill the "Seed"-backed venture category from both the main sample and respective firms from Israel, Canada, Great Britain, Germany, France, Sweden, and the Netherlands. Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively. Panel B displays the dynamic treatment effects (i.e., δ_k) estimated from the following equation: $P_i = \sum_k \delta_k (Seed_i^{US} \times Year_{ik}) + \delta_t + \delta_s + \delta_c + \epsilon_{ist}$ for all $k \in [2007, 2015]$, excluding 2009 as a reference year. The dependent variables are an indicator of startup exit equivalent to Column I in Panel A, an indicator only of those exits that are acquisitions of at least 50 million USD or an IPO, and the continuous measure on total funds collected equivalent Columns 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

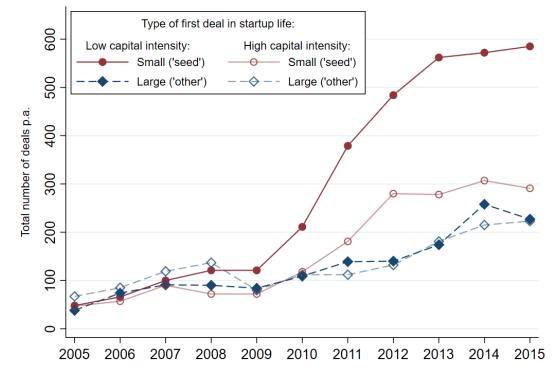


Notes: This figure illustrates the development of first-round equity investment deals for US-based investment targets in the years 2005-2015. The data is the universe of investment deals listed in the Crunchbase database for startups with US address, founded in 2002 or later, and with a first investment 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.

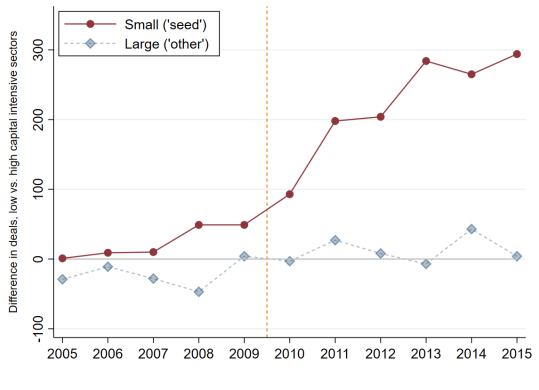
Figure 2: Factors driving the rise in early startup financing

Panel A: Comparing targets from low and high capital intensive business fields

Annual number of deals

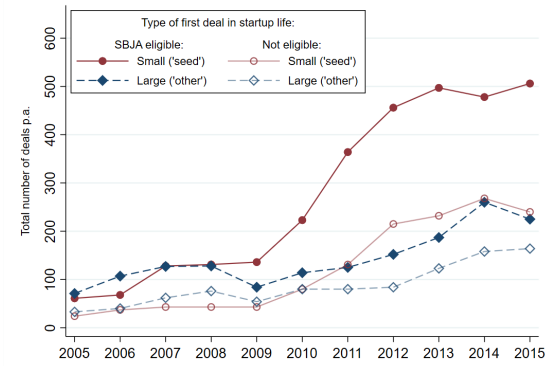


Difference in deals across sectors

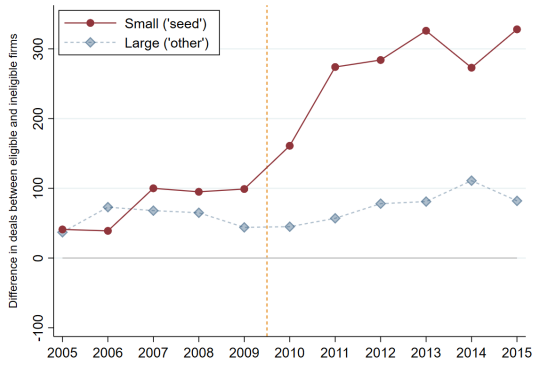


Panel B: Comparing targets eligible and ineligible to tax exemption under 2010 SBJA

Annual number of deals



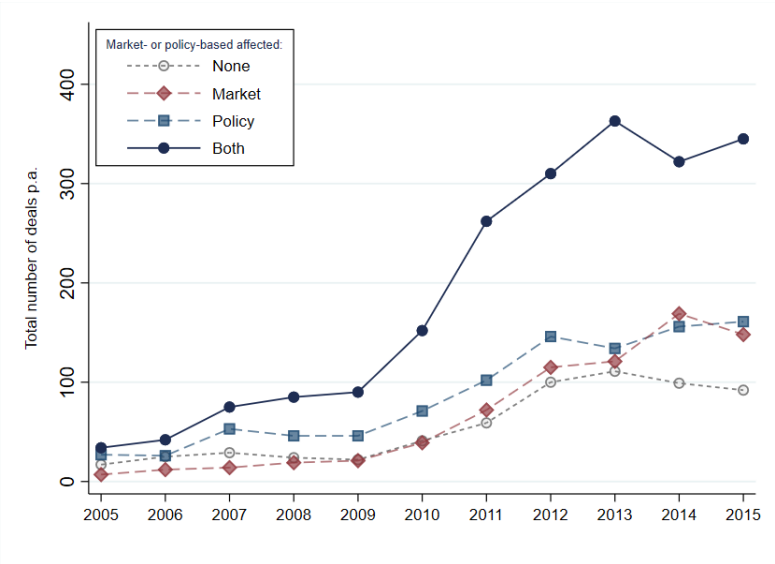
Difference in deals across sectors



Notes: Panel A 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"). The left graph ("Annual number of deals") is similar to Figure 1 and plots the annual number of deals by respective cohorts. The right graph ("Difference in deals across sectors") 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. Panel B repeats these graphs, however, this panel distinguishes firms that are active in sectors which are eligible to capital gains tax exemptions as stipulated in the SBJA as of September 2010.

Figure 3: Disentangling the effect of market- and policy-based factors

Panel A: Annual number of deals

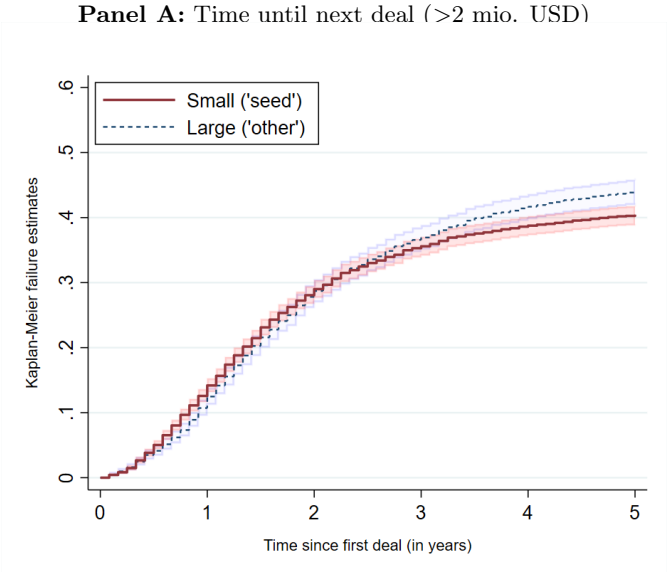


Panel B: Difference in deals across sectors

Notes: This graph displays the evolution of first-round "Seed"-backed US startups distinguishing firms that are either subject to both market- and policy-based factors, to none, or to only either one of them. The graphs are structured equivalent to those of Figure 2. Panel A plots the annual number of deals by respective cohorts. Only here, Panel B displays the difference in absolute number of rounds between startups startups that are initially "Seed"-backed to those that receive financing at later stages but share the same business field categories. All numbers are end-of-year total investment counts.

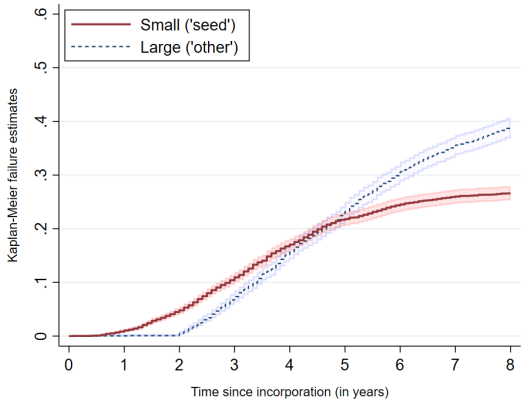
Figure 4: The timing of subsequent financing of early-stage equity-backed startups

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

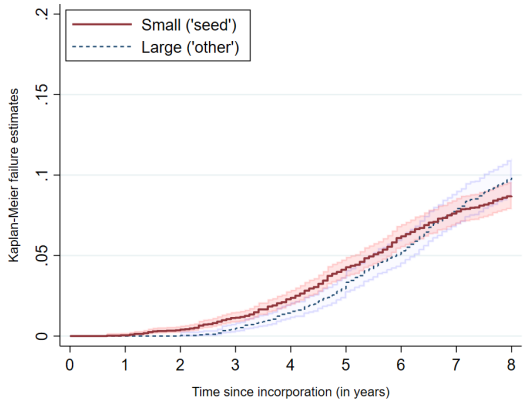


Panel B: Time until reaching large funding targets

10 million USD



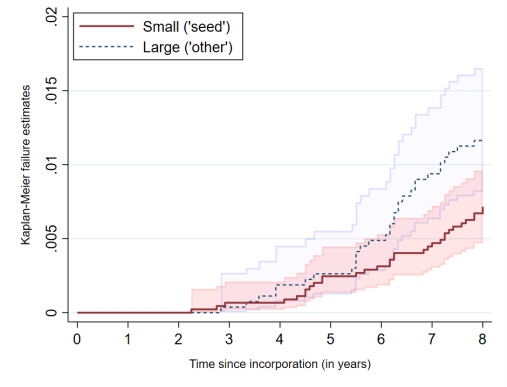
50 million USD



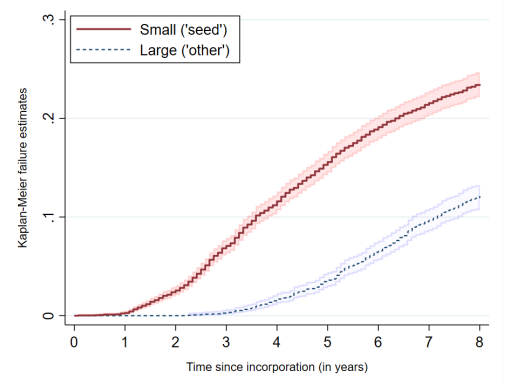
Notes: The graphs display the Kaplan-Meier failure estimates (hazard rates) of the timing of the subsequent financing events and the amounts of funds raised over time using a panel-structured dataset on the startup-month level. The hazard rate is unconditional on having an exit and is estimated for startups 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 (Panel A) or the time the startup was founded (Panel B) and ends after five and eight years if a funding event is not reached or at the month the startups reach respective targets, respectively. To avoid right censoring issues, we measure all variables within these time frames and include startups founded by 2014. Panel A displays the probability of receiving any subsequent funding and subsequent funding of at least two million USD per round. Panels B and C 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

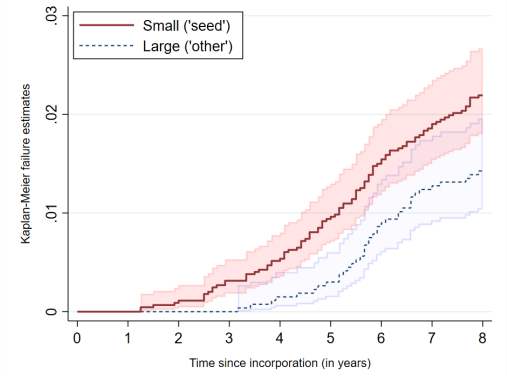
Panel A: IPOs



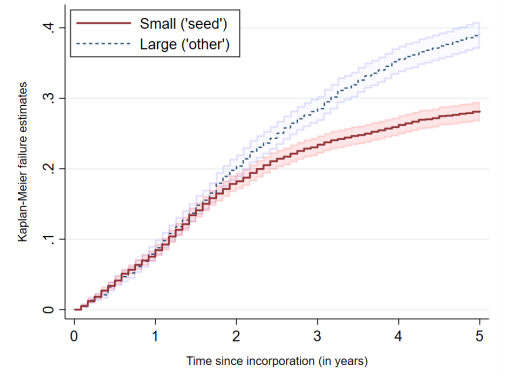
Panel B: Acquisitions (all)



Panel C: Large acquisitions (>50 million USD)



Panel D: Intellectual property creation



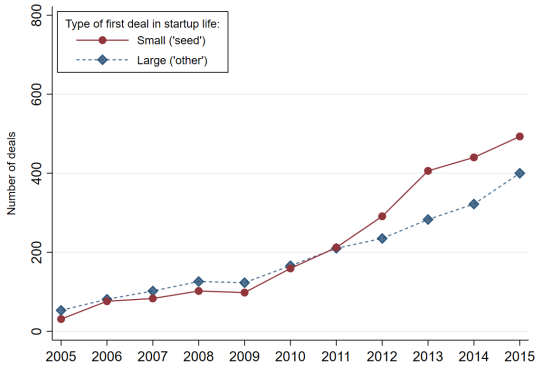
Panel E: Logistic regressions explaining performance outcomes of all "Seed"-backed startups

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

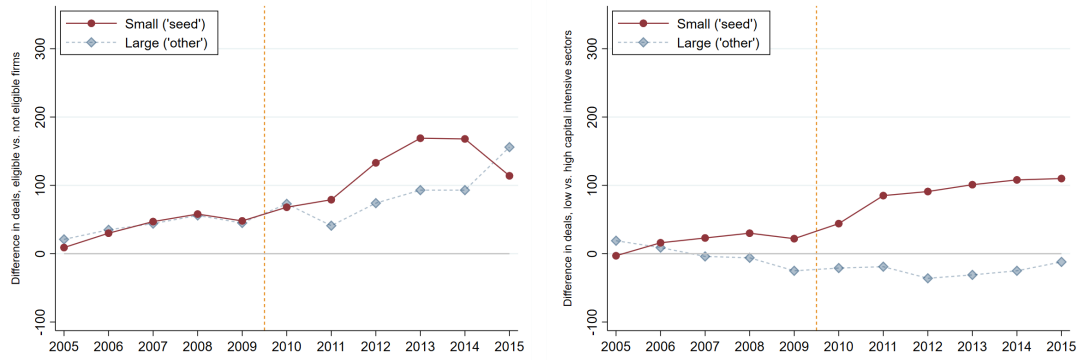
Notes: This graph investigates the timing of achieving a certain performance target, i.e., a successful exit via an IPO or acquisition or the creation of an intellectual property right (patent or trademark) distinguishing startups with initial "Seed" and "Other" first-round equity investments as defined 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. Panel E estimates the differences in performance outcomes over time using logistic regression on a matched sample (as described in Section 4.1). The regression specification is: $P_i = \beta_t + \beta_j + \beta(Seed_i) + u_{it}$, where P_i are different performance outcomes, β_t and β_j are industry- and investment-year fixed effects, and $Seed_i$ is a dummy equal to one if a startup is initially backed by "Seed" investments. Hence β is the coefficient of interest, displayed in the table. Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

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 the right graphs ("Differences in deals across sectors") from the Figure 2 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)	
Crunchbase label	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 outcomes of "Seed"-backed startups

Panel A: Estimating the success probabilities using matched sample regressions

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	0.063	0.223*	0.166	0.010	0.433***	0.446***
	(0.279)	(0.094)	(0.167)	(0.086)	(0.086)	(0.103)
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	978	1,155	1,078	1,155	1,155	1,155
Pseudo R^2	0.153	0.076	0.070	0.056	0.086	0.071

Panel B: Comparing pre and post 2010 success probability rates using interaction terms

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 × $Post^{2010}$	-0.412	0.015	-0.377*	0.081	0.372***	0.110
	(0.213)	(0.093)	(0.164)	(0.081)	(0.083)	(0.100)
$Post^{2010}$	-0.078	-0.269***	-0.070	-0.363***	-0.554***	-0.149*
	(0.146)	(0.065)	(0.129)	(0.051)	(0.052)	(0.069)
Seed	0.571***	0.416***	0.715***	0.018	0.335***	0.335***
	(0.157)	(0.074)	(0.126)	(0.067)	(0.069)	(0.081)
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Deal-year FE	No	No	No	No	No	No
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	4,560	4,560	4,560	4,560	4,560	4,560
Pseudo R^2	0.148	0.071	0.070	0.048	0.085	0.069

Notes: This Table shows results from logit regressions that use a set of performance indicators as dependent variables, estimating Equation 2, similar to Panel A of Table 4. Only here, Panel A uses startups from the matched sample as described in Section 4.1. Panel B includes $Post^{2010}$, which is an indicator equal to one for all startups with the first financing round in 2010 or later, and the interaction term of $Post^{2010}$ and the Seed-dummy. To avoid perfect multicollinearity, Panel B does include deal-year fixed effects. Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table IA8: 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)
$Seed^{US} \times Post^{2010}$	-0.118	0.095	-0.139	-0.355**	0.072	-0.520
	(0.109)	(0.227)	(0.111)	(0.126)	(0.216)	(0.428)
Initial deal-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	4,546	4,314	4,546	4,546	4,486	4,546
Pseudo R^2 (R^2*)	0.029	0.051	0.029	0.042	0.031	0.075*

Panel B: Performance outcomes of startups in sectors subject to SBJA

Dependent variable:	Performance indicators					
	Exits			Funds collected		
	All	IPO	Acquisitions	10 million	50 million	Total funds
	(I)	(II)	(III)	(IV)	(V)	(VI)
$Seed^{US} \times Post^{2010}$	-0.196*	0.308	-0.218**	-0.274**	-0.219	-0.620
	(0.105)	(0.233)	(0.106)	(0.126)	(0.250)	(0.428)
Initial deal-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	4,684	4,438	4,684	4,684	4,547	4,684
Pseudo R^2 (R^2*)	0.029	0.033	0.029	0.063	0.042	0.100*

(continued on next page)

Table IA8: *continued*

Panel C: Triple-Differences estimations using the full sample

Dependent variable:	Performance indicators					
	Exits			Funds collected		
	All	IPO	Acqui.	10 mio.	50 mio.	Total funds
	(I)	(II)	(III)	(IV)	(V)	(VI)
$Sector^{\text{affected}} \times Seed^{\text{US}} \times Post^{2010}$	0.041	-0.149	0.039	0.090	-0.104	-0.551
	(0.180)	(0.371)	(0.183)	(0.195)	(0.300)	(0.722)
$Sector^{\text{affected}} \times Seed^{\text{US}}$	0.018	0.027	0.014	0.068	0.161	0.322
	(0.155)	(0.267)	(0.158)	(0.170)	(0.258)	(0.613)
$Seed^{\text{US}} \times Post^{2010}$	-0.191	0.359	-0.218	-0.486***	-0.083	0.023
	(0.134)	(0.237)	(0.137)	(0.139)	(0.204)	(0.540)
$Sector^{\text{affected}} \times Post^{2010}$	-0.078	0.106	-0.085	-0.102	-0.031	0.338
	(0.154)	(0.315)	(0.157)	(0.172)	(0.275)	(0.613)
$Sector^{\text{affected}}$	0.240*	-0.264	0.275*	-0.057	-0.136	0.373
	(0.132)	(0.215)	(0.135)	(0.150)	(0.237)	(0.521)
Initial deal-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
N	6,644	6,644	6,644	6,644	6,644	6,644
Pseudo R^2 (R^{2*})	0.029	0.048	0.033	0.051	0.045	0.095*

Notes: This Table displays robustness tests on Section 4.3. Panels A and B are equivalent to Panel A of Table 5, only here the sample is either all US and non-US "Seed"-backed startups from sectors with low capital intensities (Panel A) or sectors subject to the SBJA (Panel B). In Panel C displays estimates on regressions using the full sample of "Seed"-backed firms, irrespective of the business field. The regression specification is similar to Equation 3 but adds an indicator $Sector^{\text{affected}}$, equal to one for all startups active in sectors that are subject to both market- and policy-related changes in the US and non-US startups active in the equivalent business sectors. Standard errors are clustered at the firm level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Figure IA1: Stylized startup lifecycle – a traditional perspective

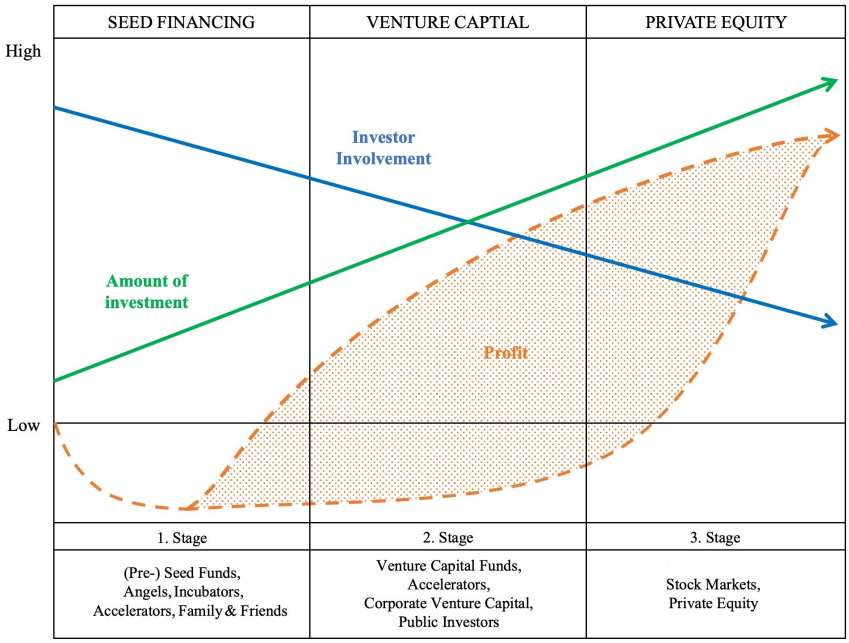
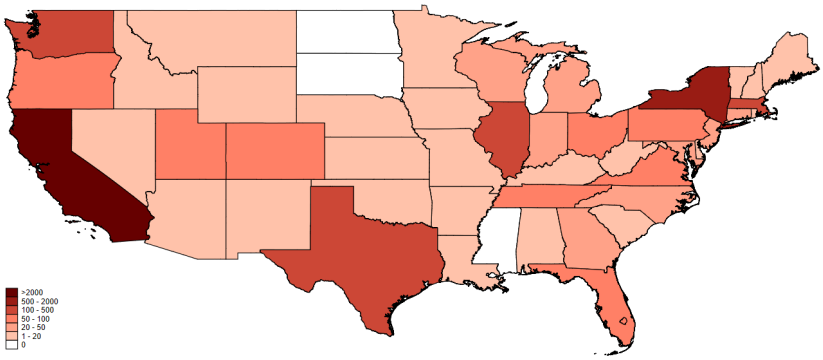


Figure IA2: Geographic locations of first-round equity investment targets, by type

'Seed'-backed targets:



'Other' first round targets:

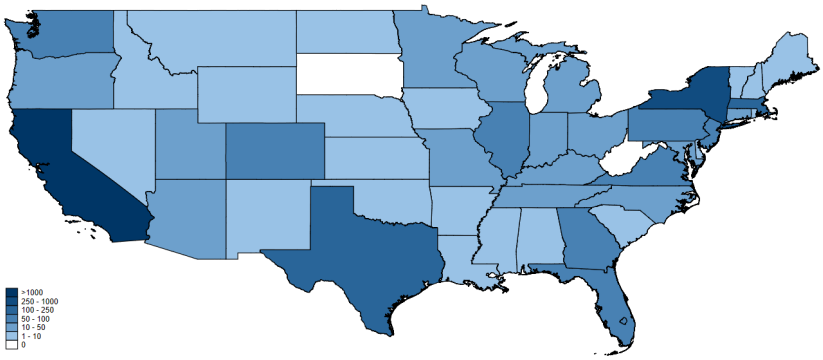
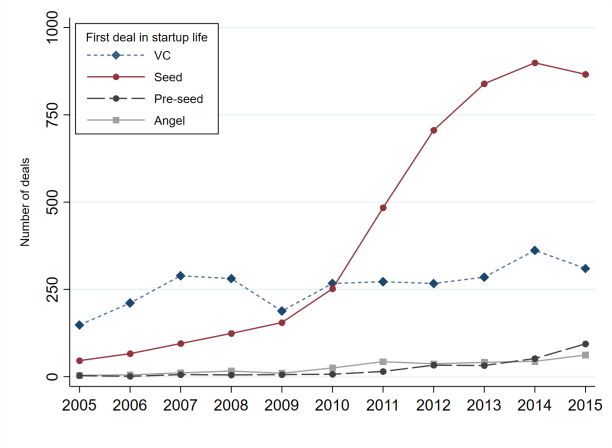
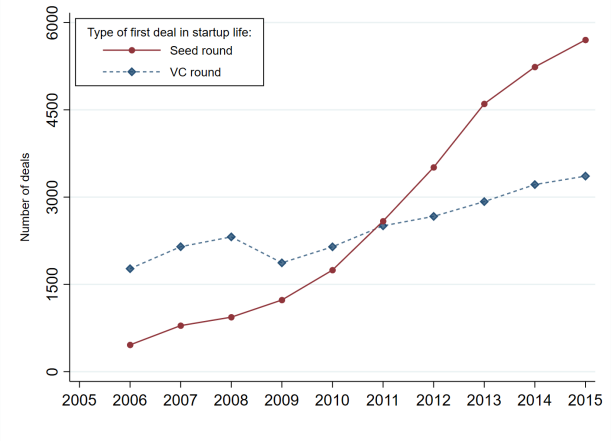


Figure IA3: Different perspectives on the early-stage startup financing in the US (2005-2015)

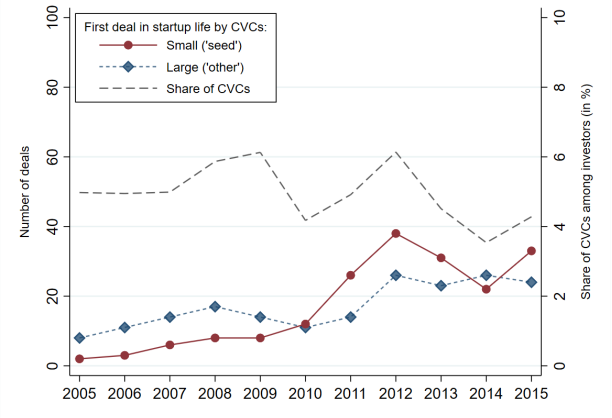
Panel A: Crunchbase investment classifications



Panel B: Pitchbook data



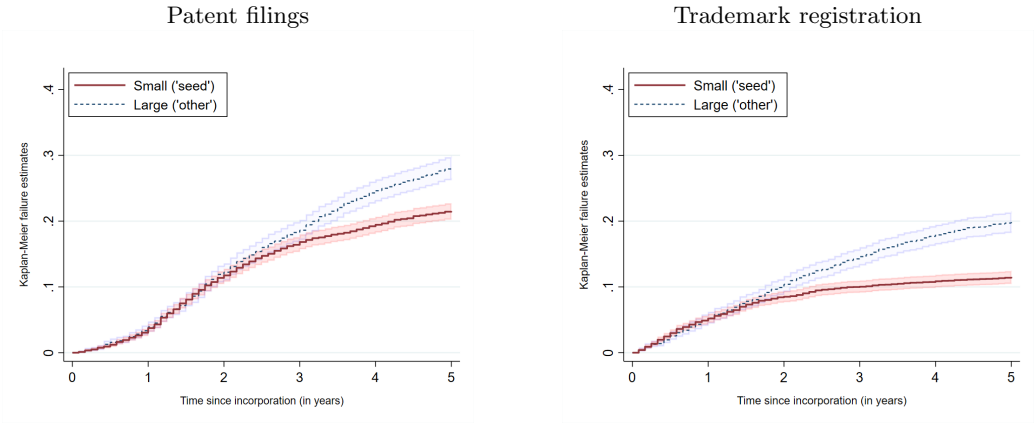
Panel C: Share of CVC investments



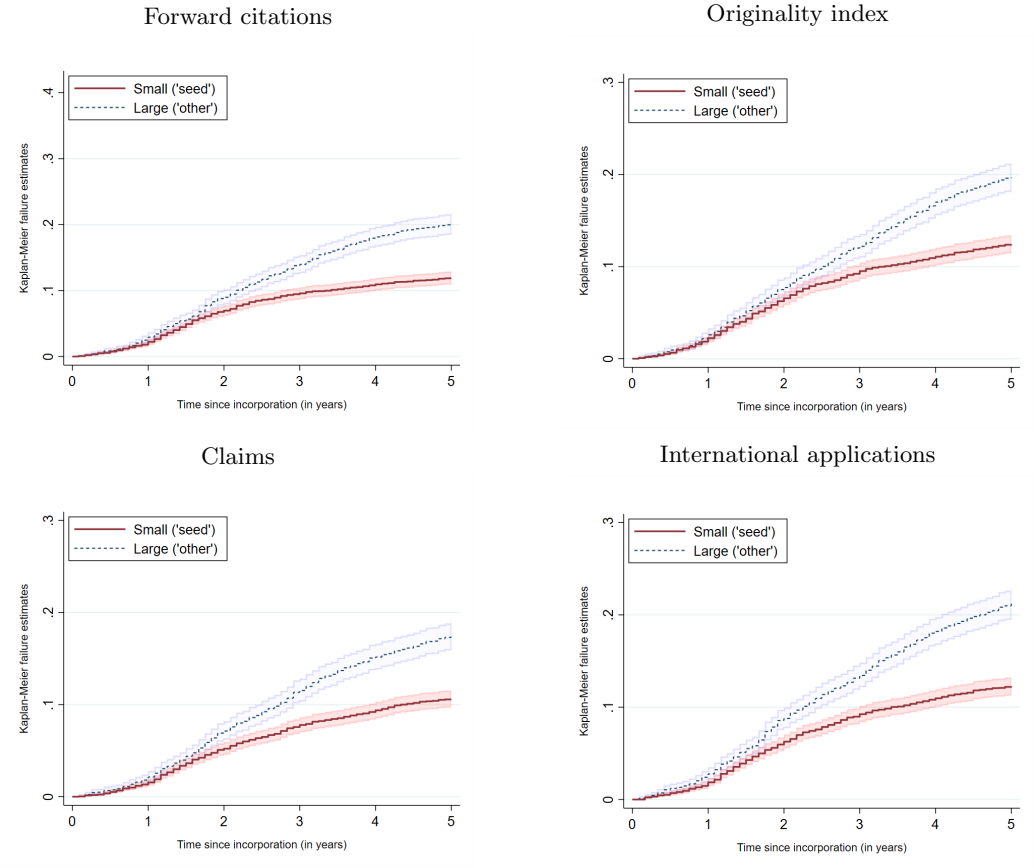
Notes: This figure illustrates the development of early-stage equity financing activities for US-based investment targets in the years 2005-2015. The data is the universe of investment deals listed in the Crunchbase database for startups with a US address, founded in 2002 or later, and with a first investment 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 IA4: Robustness tests on the timing of generating intellectual property rights

Panel A: Separating patent and trademark generation

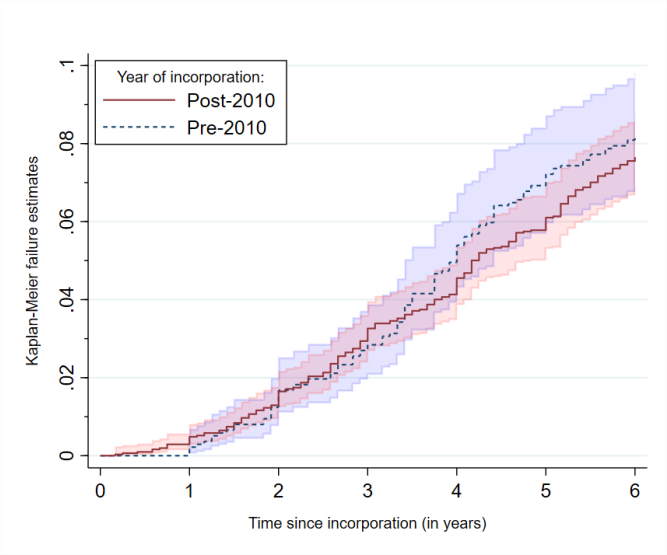


Panel B: Testing patent-quality adjustments



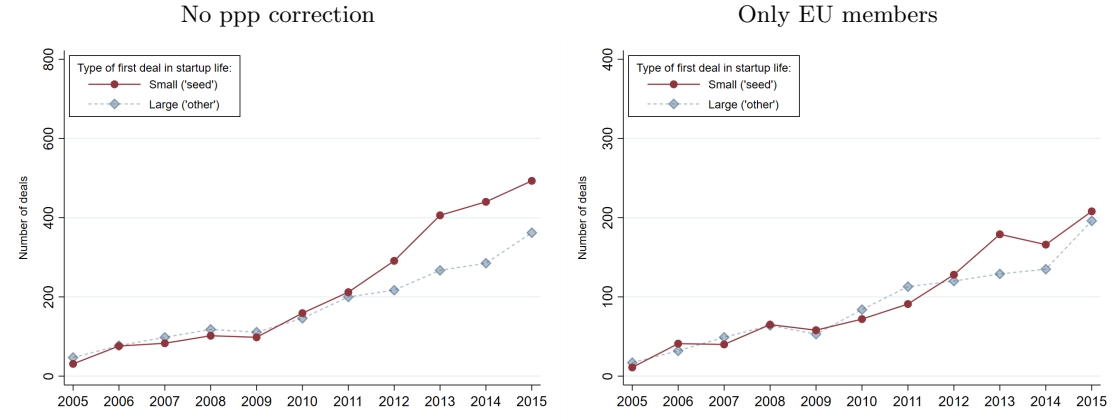
Notes: This graph is similar to Figure 5 and documents the timing of IP generation within the first five years after incorporation, distinguishing startups with initial "Seed" and "Other" first-round equity investments. Panel A displays the hazard rate for patents and trademarks separately. The graphs 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: Liquidation rates of 'Seed'-backed targets: before and after 2010s



Notes: These figure displays the probability of firm closure within the first six years after incorporation, comparing "Seed"-backed startups that were incorporated before and after 2010, respectively. Closure refers to all startups that are assigned a definite closure date in the Crunchbase data. This does not include all firms that are assigned as closed. For consistency, only closures that are not associated with acquisitions.

Figure IA6: 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).