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Tolerating Losses for Growth: J-Curves in Venture Capital Investing

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ABSTRACT

Startups face a trade-off between short-term profitability versus long-term growth where investors tolerate prolonged financial losses. We present a new theory and empirical evidence about the existence and shape of so-called J-curves. The theory predicts that investors facing better exit opportunities have a higher loss tolerance, encouraging startups to pursue more ambitious growth strategies. Empirically, we examine a large Swedish dataset with detailed cash flow information. Swedish startups backed by US venture capitalists experience deeper J-curves than those backed by non-US venture capitalists. They have more successful exits, higher exit values, faster sales growth, and more follow-on funding.

JEL classification: F39, G24, L26, O16.

Keywords: Venture Capital, Loss tolerance, J-curves, Entrepreneurship, Exits.

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1 Introduction

A large prior literature establishes the importance of venture capital for innovation and economic growth.[1] However, a fundamental challenge for startups seeking to develop new technologies and business models is that this require substantial investments, and takes considerable time. There is a fundamental trade-off between short-term profitability and longer-term growth. This is reflected in the shape of so-called "J-curves" that describe how start-ups initially incur short-term losses, but over time (hopefully) recoup those losses and eventually generate large positive cash flows. Financing deep J-curves requires investors who are willing to tolerate financial losses over prolonged periods of time.

In this paper, we present a theory and new empirical evidence about J-curves in venture capital (VC henceforth). The theory develops a model that specifically focuses on the investor's loss tolerance and the determinants of short-term cash flows. The purpose of the model is to introduce the key tension between short- vs. long-term investments, and to derive theoretical conditions under which one should expect higher or lower investor loss tolerance. The model builds on the seminal work of Stein (1989) who uses a signal-jamming model to examine how managers manage short-term earnings and manipulate the beliefs of rational but imperfectly informed shareholders. We adapt the model to the context of staged venture financing (Sahlman 1990) where the investor's reinvestment decision depends on short-term cash flows as a signal of venture quality.[2] Entrepreneurs can 'jam' this signal by bolstering short-term cash flows. This increases the probability of obtaining refinancing, but undermines long-term cash flow prospects. Our theory endogenously derives the entrepreneur's choice between short- vs. long-term cash flows, as well

[1] See Gompers and Lerner (2001) and Da Rin, Hellmann, and Puri (2013).

[2] The work of Manso (2011) and Ferreira, Manso, and Silva (2014) further examines the incentives for short- vs. long-term investing in a variety of related financing contexts.

as the investor's optimal loss tolerance. The key prediction from the model is that investors that have better access to exit markets develop higher loss tolerance. This encourages their companies to invest more in the long-term which generates deeper J-curves: more financial losses in the short-term, but also more growth and successful exits in the long-term.

We take the predictions to a large dataset that allows us to examine detailed cash flow and financial data from Swedish VC-backed startups. Unlike in most countries, including the US, detailed financial data is available in Sweden because every private company, regardless of size, must submit detailed annual financial statements to government authorities. This mandate ensures comprehensive and reliable data, crucial for accurately analyzing loss tolerance among VCs. Sweden's well-developed VC market, ranking 12th worldwide relative to GDP and 7th for early-stage financing, provides a mature and diverse ecosystem for our study. Moreover, Sweden's stable economy, transparent legal system, and supportive business policies create an ideal environment for VC activities, making our research both precise and globally relevant (Lerner and Tåg 2013).

The objective of the empirical exercise is to provide novel large sample evidence of J-curves in VC investing, and to document heterogeneity in the depth of J-curves and loss tolerance across investors with different exit opportunities. For this, we focus on comparing US venture capitalists (USVCs henceforth) against a benchmark of Swedish domestic and non-US foreign venture capitalists (non-USVCs henceforth). We focus on the USVC vs. non-USVC distinction based on a large prior literature which shows that USVCs have better exit opportunities, either through IPOs or acquisitions (see Conti and Guzman (2021) and Bertoni and Groh (2014)). Additionally, USVCs assist companies in achieving better sales growth by providing market access and facilitating internationalization and technology transfer (Mäkelä and Maula 2005; Mäkelä and Maula 2006; Akcigit et al. 2024; Fernhaber, Mcdougall-Covin, and Shepherd 2009; Carneiro, Moreira, and Sheng 2022). Their extensive networks and experience also enhance funding access, as shown by Humphery-Jenner and Suchard (2013). Moreover, the US venture market is the largest globally and has a comparative advantage especially for scale-up financing (Hellmann, Frydrych, et al. 2016; Devigne et al. 2018).

We examine the changes in various dependent variables before and after the first USVC investment, comparing them against a benchmark group of companies receiving non-USVC investments. Within this setting we first examine whether companies backed by USVCs have deeper J-curves. Before receiving funding, cash from operations and EBITDA evolve similarly for both groups. However, post-funding, companies with USVC backing experience significantly higher losses. Specifically, in the first three years following investment, cash from operations decreases by USD 1.1 million, representing a 107% increase in the so-called burn rate (i.e., the annual losses), relative to the pre-period mean. Moreover, EBITDA decreases by USD 1.2 million, representing an 127% increase relative to the pre-period mean. These losses are statistically significant in the short-term. However, as suggested by the shape of a J-curve, they start to recover in the long-term, becoming statistically non-significant after three years. This pattern supports the theoretical prediction that investors with higher exit potential (i.e., USVCs) tolerate greater short-term losses, but eventually generate higher growth paths.

This is a new and significant empirical finding that matches the predictions of our theory. The next step of the analysis is to unpack this result by exploring the underlying mechanisms. We first validate the differences between USVC and non-USVC in terms of their exit potential. We show that in case of exit, the average exit value for USVC-funded startups is USD 135 million, whereas it is only USD 46 million for benchmark startups. We also verify that USVCs are associated with more successful exits. Our analysis shows that three years post-investment, the exit rate begins to increase. Over the full post-period, USVC-funded startups have a 5.1 percentage point (pp) higher exit rate relative to benchmarks. Six years after the investment, the exit rate for USVC-funded startups is approximately 15 pp higher, a difference that is both statistically and economically significant.

To further understand the mechanisms that supports USVC-backed companies along this path, consider the model once more. It suggests that greater investor loss tolerance encourages entrepreneurs to invest more aggressively for the long-term. As discussed in the seminal work of Porter (1980), product market strategies often focus of increasing market share with aggressive sales targets. We therefore examine how top-line sales evolve after USVC vs. non-USVC investment. Initially, companies with USVC have somewhat higher sales in the first two years, and significantly higher sales thereafter. We also find that USVC funding leads to the establishment of more foreign subsidiaries, with a significant jump at the time of investment and continued growth thereafter. Regression results indicate a 9% increase in the likelihood to have foreign subsidiaries compared to benchmarks.

In order to fund more aggressive long-term strategies, we finally ask if USVC-backed companies have better access to investor networks and follow-on funding. We find that USVC-backed companies receive higher initial investment amounts, with a 35% increase in VC fundraising in the short-term and a 29% overall increase relative to benchmarks. They also have a significantly higher likelihood of raising follow-on funding, an increase of 44% relative to the pre-period mean. Additionally, USVC investments result in larger investor networks, with the number of new investors at USVC-backed companies increasing by 154% relative to the pre-period mean. This highlights the superior network access and follow-on funding associated with USVC investments.

A large corporate finance literature examines the relationship between cash flows, investments, and financial structures (Myers 2001; Almeida et al. 2014; Brealey et al. 2022). Much of this literature focuses on publicly listed companies, but a smaller literature also examines these topics for private companies (Gao, Harford, and Li 2013). The major limitation of studying this in private companies is that systematic cash flow data is rarely available, especially so for startups. Moreover, there is considerable heterogeneity among private companies and the ambitious growth-oriented startups that we are interested in behave very differently from the vast majority of small enterprises (see Haltiwanger, Jarmin, and Miranda (2013).

VCs specialize in financing such ambitious growth-oriented companies. Our analysis builds on a prior literature that establishes the importance of VC for innovation and economic growth. The work of Kortum and Lerner (2000) and Hellmann and Puri (2000) shows that VC-backed companies are more innovative. Moreover, Chemmanur, Krishnan, and Nandy (2011), Chemmanur, He, et al. (2018), Puri and Zarutskie (2012), and Croce, Martí, and Murtinu (2013) show how VC-backed companies are more productive and grow faster than other startups. Another important insight from the VC literature is that there is considerable heterogeneity in the investment practices of different VC investors, as shown in the work of Bottazzi, Da Rin, and Hellmann (2008), Bottazzi, DaRin, and Hellmann (2016), Gompers, Kovner, et al. (2008), Hochberg, Ljungqvist, and Lu (2007), and Sorensen (2007), as well as the literature on international VCs discussed above. Our analysis therefore focuses on VC-backed companies and leverages this heterogeneity among VC investors.

The most notable aspect of cash flows in VC-backed companies is that most companies make losses most of the time. In our sample, 72% and 76% of company-year observations have negative operating cash flows and EBITDA, respectively. This is not entirely surprising, after all VCs specialize in funding J-curves, i.e., startups that incur short-term losses to pursue large positive cash flows in the future. Still, the question arises how much losses VC investors are willing to accept. This is why we propose a new concept in the literature, namely investor loss tolerance. Let us distinguish this concept from two similar sounding but fundamentally different concepts, namely risk tolerance and failure tolerance.

There is a very large finance literature on risk and risk tolerance. In the VC area, the main research focus has been the measurement of risk. Important contributions include Cochrane (2005), Korteweg and Sorensen (2010), Korteweg and Nagel (2016), and Ang et al. (2018). However, this literature focuses on the variability of investor returns at exit, measured either at the company or VC fund level. This is fundamentally different from loss tolerance which concerns short-term negative cash flows that occur before exit.

The literature on the role of failure tolerance includes the works of Landier (2005), Burchell and Hughes (2006), Tian and Wang (2014), and especially Cahn, Girotti, and Landier (2021). This literature examines how investors perceive entrepreneurs who failed in a prior venture and subsequently seek funding for a new venture. This is different from our notion of loss tolerance, which concerns the willingness to continue supporting an on-going (so not yet failed or successfully exited) venture with negative cash flows.

Our central trade-off builds on a prior literature about investor short-termism. This goes back to the seminal work of Stein (1989), which sets out the fundamental trade-off between short-term profits and long-term growth. Important follow-on papers include Bebchuk and Stole (1993) and Aghion and Stein (2008). A central tenant is that companies actually have a chance of achieving significant growth and positive cash flows in the future. This applies well to our context of ambitious growth-oriented startups, as documented in the literature on firm dynamics, especially the influential work of (Decker et al. 2014; Haltiwanger, Jarmin, and Miranda 2013).[3]

With this understanding of the potential long-term upside, the key trade-off driving our analysis is the willingness to tolerate negative cash flows in the short run. These losses are the result of

[3] Related to this, a more recent literature focuses on scale-up decisions (DeSantola and Gulati 2017; Shepherd and Patzelt 2020). Norbäck, Persson, and Tåg (2024) provide a model where scaling involves substantial risk-taking, and VC helps by facilitating strategic pivoting. Hellmann and Thiele (2023) shows how the presence of foreign acquirers may affect scaling decisions. Giustiziero et al. (2021) empirically shows how digital companies become narrow in vertical scope but large in size. Finally, also in a related vein, Belenzon, Chatterji, and Daley (2020) identifies a trade-off between growth and glory in his examination of eponymous startup names.

investments made in the early venturing stages. A recent literature on entrepreneurial experimentation explains the nature of these risky investments. Manso (2011), Kerr, Nanda, and Rhodes-Kropf (2014), Nanda and Rhodes-Kropf (2016), and Ewens, Nanda, and Rhodes-Kropf (2018) all explain the central role that experimentation plays in the entrepreneurial process.

Our central trade-off arises in the context of staged financing where investors use the signal of short-term cash flows to decide on whether to grant another financing round. A prior literature explains the necessity of staged financing, such as in the work of Sahlman (1990), Gompers (1995), Neher (1999), and Kerr, Nanda, and Rhodes-Kropf (2014). However, this staged financing process also poses challenges to entrepreneurs who worry about the availability of follow-on funding. The work of Nanda and Rhodes-Kropf (2013) and Nanda and Rhodes-Kropf (2017) develops the concept of "financing risk", i.e., the risk of not finding follow-on financing even if the underlying venture remains promising. They show how changing market conditions for later stage financing affect the level of risk taken by early-stage investors. Our paper looks at a similar set of choices but differs in two important respects. First, their analysis leverages changing market conditions over time, whereas our empirical design focuses on cross-sectional variation. Second, we have cash flow data and can therefore directly analyze the signalling role of short-term losses. This is what allows us to empirically explore J-curves and the notion of loss tolerance.

Overall, our contribution is to present both a theory and empirical evidence about J-curves and optimal loss tolerance in VC investing. We examine the behaviour of cash burn rates, and the depth of J-curves. Moreover, while a large VC literature has studied fundraising, our paper makes a novel contribution in terms of empirically analysing the dynamics of the actual cash flows, and how they vary across different investors.

The paper is structured as follows. Section 2 provides a theory of J-curves in VC investing, and derives the core model predictions. Section 3 introduces our data and estimation methods, and discusses the main empirical findings. Section 4 gathers all the robustness analyses and further discussion. Section 5 provides a concluding summary.

2 A theory of J-curves in VC investing

The objective of this section is to develop a theory model that specifically focuses on the investor's loss tolerance and the determinants of short-term cash flows. The purpose of the model is to introduce the key tension between short- vs. long-term investments, and to derive theoretical conditions under which one should expect higher or lower investor loss tolerance. This will allow us to obtain predictions on heterogeneity in J-curves across different investors that we can then take to the data.

2.1 Model set-up

Our starting point is Figure 1 which depicts several so-called J-curves, aka "hockey sticks," which represent typical cash flow projections for startups. In the short-term, cash flows are negative reflecting initial investments in building the company; in the long-term they become positive reflecting the company's cash flow potential. In Figure 1 the upper two J-curves belong to a high-quality venture and represent a short-term and a long-term investment strategy. The third belongs to a low-quality venture with a short-term strategy. This is a highly simplified representation of our model which has continuous quality and strategy parameters. Figure 1 conveys the following signal-jamming problem. The high-quality venture would ideally like to invest in the long-term strategy. However, doing so makes it indistinguishable from a short-term oriented low-quality venture. The problem is thus how much short-term losses a company can afford to have before being considered of too low quality to be worthy of the next investment round.

In our model there is one entrepreneur and one focal investor. Both parties are risk-neutral, so that any results about loss tolerance are not merely driven by risk-averse preferences, but by the economic circumstances themselves. The model has three periods and no discounting. Date 0 represents an initial investment at the very beginning. Date 1 represents the realization of short-term cash flows and the investor's choice to either refinance the venture or liquidate it (in which case we assume zero value). Date 2 represents the long-term potential of the venture. This is a reduced from model of a J-curve with short-term losses at date 1 representing the lowest point on the J-curve, and date 2 representing the long-term upside of the J-curve.

To describe investments and cash flows, let K_0 be the initial investment and K the required additional investment at date 1. Let R be the short-term cash flows at 1. We can think of it as early revenues, and/or any short-term cost savings. We define short-term losses (aka the burn rate) by $L = K_0 - R$. If the company receives an additional investment at date 1, the expected long-term cash flows at date 2 are denoted by π. We assume that $\pi = \alpha(1-\beta)x$, where each of these three components (discussed below) can be interpreted as a probability of success and/or a value in case of success.

$R(\sigma)$is an increasing concave function of a signal σ that consists of two components: $\sigma = \theta + \beta$. θ is a quality parameter, and β is the entrepreneur's unobservable strategy choice. We assume that $\alpha(\theta)$ is an increasing and concave function of a quality parameter θ, which is ex-ante unknown to all parties. Higher values of θ increase both short-term cash flows (via $R(\theta+\beta)$) and expected long-term cash flows π (via $\alpha(\theta)$). Increasing θ corresponds to an upward shift of the J-curves described in Figure 1.

The parameter β measures the degree to which the entrepreneur strategically chooses between short-term vs. long-term investments. Higher β increases the short-term signal σ, and thus short-term revenues $R(\theta+\beta)$. However, there is a long-term cost to increasing β, as reflected in the $(1-\beta)$ component of π. Higher β corresponds to compressing the J-curve by giving it higher lows and lower highs, as described by the short-term strategy in Figure 1. If β was symmetrically observable, there would be no signal jamming and $\beta = 0$ would be optimal. However, following Stein (1989), we assume that only the entrepreneur but not the investor can observe β. We derive the optimal choice of β as part of the rational expectations equilibrium.

The third component of π is x, which represents the exit opportunity; in VC this means IPOs or acquisitions. Technically, x is the "expected" exit value which includes both the probability of exit and the exit value in case of exit. In this model we think of x as an investor-specific variable, in the sense that different investors can offer their entrepreneurs different exit prospects. This builds on a large prior literature (see Da Rin, Hellmann, and Puri (2013) for an overview) which shows how different VCs provide different value-adding support to their portfolio companies, including network access to investment bankers, acquirers, key customers, strategic partners, and follow-on-investors. In Section 4.3 we discuss how to also include company-specific information in the interpretation of x.

To keep the model tractable, we assume a simple division of surplus where the entrepreneur captures a constant fraction γ of future expected cash flows π, leaving the investor with the remaining fraction $1-\gamma$. This approach is consistent with standard models of entrepreneurial moral hazard and hold-up (Aghion and Tirole 1994). At date 1, short-term cash flows R are retained by the company to reduce the required investment to $K-R$. In case of liquidation, the investor simply recovers R, consistent with the use of preferred securities (Hellmann 2006). For tractability we leverage the constant hazard rate property of exponential distributions, and use the following functional forms: $\alpha(\theta) = 1 - exp(-\varphi\theta)$, and $R(\sigma) = r(1 - exp(-\rho\sigma))$. Moreover, we assume that θ has a negative exponential distribution with a density $\omega(\theta) = \lambda exp(-\lambda\theta)$.

2.2 Model derivation

At the core of the model are three equilibrium conditions. The first condition concerns the investor's reinvestment decision, based on the short-term cash flow signal R. There is a one-to-one mapping between every realization of R and σ, so an investor observing R always knows σ. Given some belief $\tilde{\beta}$ about the entrepreneur's unobservable choice β, the investor infers a quality $\tilde{\theta} = \sigma - \tilde{\beta}$. The investor only wants to refinance if the company can at least return investment costs K, formally if

$$\Gamma(\sigma, \widetilde{\beta}) = \overline{\gamma}\alpha(\sigma - \tilde{\beta})(1 - \widetilde{\beta})x - K \geq 0.$$

Thus there exists $\widehat{\sigma}$ so that $\Gamma(\widehat{\sigma}, \widetilde{\beta}) = 0$. Refinancing occurs whenever $\Gamma(\sigma, \widetilde{\beta}) \geq 0 \Leftrightarrow \sigma \geq \widehat{\sigma}$. Since $R(\sigma)$ is increasing in σ, this condition can also be re-expressed as $R(\sigma) \geq R(\widehat{\sigma})$. Moreover, the short-term loss function $L(\sigma) = K_0 - R(\sigma)$ is decreasing in σ. Thus the condition $\sigma \geq \widehat{\sigma}$ is equivalent the condition $L(\sigma) \leq L(\widehat{\sigma})$, where $L(\widehat{\sigma})$ defines the upper bound on the short-term losses the investor is willing to tolerate. Thus our model derives an endogenous level of investor loss tolerance. Note that the optimal $\widehat{\sigma}$ depends on $\tilde{\beta}$ and x. We discuss the comparative statics in Section 2.3.

The second condition concerns the endogenous choice of short- vs. long-term investments, i.e., the optimal β^*. This is derived from the first-order condition of the entrepreneur's objective function, which is given by

$$U_E = \int_{\widehat{\sigma}(\tilde{\beta})-\beta}^{\infty} \gamma\pi(\theta, \beta)\omega d\Omega(\theta)$$

The benefit of increasing β is to increase the probability of receiving refinancing at date 1, given by $1 - \Omega(\widehat{\sigma}(\tilde{\beta}) - \beta)$. The entrepreneur can always increase β beyond the expected level of $\tilde{\beta}$. This is the signal jamming effect, similar to Stein (1989). In equilibrium the temptation to increase β has to be counteracted by a marginal cost of doing so. This comes from the fact that $\pi(\theta, \beta)$

is decreasing in β. In the Internet Appendix we derive the optimal β^*, which in equilibrium is a function of $\hat{\theta}$.

The third condition is that, in equilibrium, there are rational expectations. Formally, $\beta^* = \tilde{\beta}$.[4]

2.3 Model predictions

The most interesting results of the model concern the comparative statics with respect to x, which measures expected exit values. We immediately state the main model prediction.

Model Prediction: Higher expected exit values generate deeper J-curves where companies optimally produce more losses in the short-term, but generate more profits in the long-term. Formally, the equilibrium cut-off $\widehat{\sigma}$ is a decreasing function of x, so that the maximum short-term losses $L(\widehat{\sigma})$ are an increasing function of x. Moreover,the equilibrium choice β^* is a decreasing function of x.

The key insight here is that when the exit potential is high, the investor is less concerned about short-term losses. The fact that $\widehat{\sigma}$ is a decreasing function of x shows that better exit opportunities makes investors more loss-tolerant. This empowers entrepreneurs to make decisions that improve the long-term prospects, even if they result in more short-term losses. The fact that β^* is a decreasing function of x shows that better exit opportunities encourages entrepreneurs to focus more on long-term investments. Overall, this suggests that in situation with better exit potential we can expect a deeper J-curve, with lower short-term cash flows, but better long-term prospects.

[4]Note that if there is symmetric information, there is no possibility of signal jamming, and the optimal choice is always $\beta^* = 0$. In the Internet Appendix we further note that even with asymmetric information, $\beta^* = 0$ remains optimal for sufficiently low values of λ, simply because the marginal benefit of signal jamming is too low. The model with $\beta^* = 0$ remains largely the same but captures fewer effect. This is because there is no tension around the management of short-term vs. long-term profits, and the entrepreneur does not respond to different investors with different values of x.

3 Empirical evidence of J-curves in VC investing

The objective of this section is to provide novel, large sample evidence of J-curves in VC investing, and identify some key variation in J-curve depth. We document heterogeneity in the depth of J-curves and loss tolerance across different investors, focusing specifically on the difference between US and non-US VCs, in the context of Swedish companies. Our first step in Section 3.1 is to motivate the choice of USVCs as the key source of variation. In Section 3.2 we discuss our data and empirical approach. In Section 3.3 we describe the main results and explore the underlying mechanisms.

3.1 The distinct status of USVCs

We here discuss the link between our theory, which is generic, and our empirical context, which focuses specifically on comparing US vs. non-US VCs. We first hypothesize, and then empirically verify, that USVCs are associated with higher x (in the form of better access to exit markets, better access to global product markets, and better access to networks that lead to more funding, follow-on funding and the involvement of new investors). Formally, this means that we can test our theory by looking at the comparative statics of the model with respect to x. For this we associate USVCs with higher average values of x, relative to those of non-USVCs. The rationale for this is as follows.

First, USVCs have better exit opportunities, which means either going public or getting acquired. The work of Conti and Guzman (2021) suggests that one of the key advantages of the US entrepreneurship ecosystem is more liquid acquisition markets and Bertoni and Groh (2014) finds that foreign VCs can help firms find exit opportunities in their home markets. The US also has one of the most active IPO markets globally. Again, we argue that better access to exit markets makes USVCs have higher x.

Second, USVCs might help companies obtain better prospects of sales growth. Prior work suggests that USVCs provide market access to their foreign portfolio companies (Mäkelä and Maula 2005). Foreign VC more generally can also help bring the portfolio companies' products to the VC home market by legitimizing them there (Mäkelä and Maula 2005; Mäkelä and Maula 2006) or facilitate technology transfer to the home country (Akcigit et al. 2024). There is also evidence that they tend to internationalize companies/invest in companies that are internationalizing (Fernhaber, Mcdougall-Covin, and Shepherd 2009; Carneiro, Moreira, and Sheng 2022). If USVCs can help their portfolio companies to better access US markets, then they should be associated with higher x in the model.

Third, we argue that USVCs face higher x because they have better access to funding through their extensive networks and experience abroad (Humphery-Jenner and Suchard 2013). USVCs typically have a longer track record and may be more experienced investors.[5] It is well documented that the US has the largest VC market.[6] Moreover, the comparative advantage of USVC is relatively bigger for later stage than for early-stage financing (Hellmann, Frydrych, et al. 2016; Devigne et al. 2018). Thus, if USVCs face less later-stage financing risks, we argue that they should be associated with higher x.

3.2 Data

3.2.1 Institutional details

Our empirical analysis draws on data from Sweden. The Swedish data offers a distinctive advantage. Unlike many other countries, including the United States, Sweden mandates that every private company, regardless of size, submits detailed annual financial statements to government authori-

[5]For further studies of the differences between the US and European VC ecosystems see Hege, Palomino, and Schwienbacher (2009), Lerner and Tåg (2013), and Weik (2023).

[6]USVC funds received 61% of global capital raised in 2021 (National Venture Capital Association 2022).

ties.[7] Companies have strong incentives to submit accurate information because non-compliance or submitting incorrect information can result in liquidation and unlimited liability for board members. This policy creates a comprehensive and reliable database, accessible for research purposes from the Swedish Companies Registration Office. Such a rich data environment is rare and provides a unique opportunity to analyse financial gains and losses in private companies with a high degree of precision and credibility. This robust data infrastructure is crucial for our study as it allows for a more accurate and granular analysis of loss tolerance among VCs.

Furthermore, Sweden's VC market itself presents an intriguing case for study. Ranking 12th worldwide in terms of the size of its VC market relative to GDP, and 7th for early-stage financing, Sweden stands out not just for its market size but also for its maturity and diversity. The presence of a well-developed VC ecosystem indicates a range of investment activities and strategies, making Sweden a microcosm of global VC dynamics. The significance of Sweden's VC market is further underscored by the substantial presence of foreign investors, including those from the US, which introduces a variety of investment philosophies and practices. This diversity is essential for our study, as it allows for a comparative analysis of different investor behaviors within a single, coherent institutional framework.

Additionally, Sweden's economic and regulatory environment is conducive to VC investment. Known for its stable economy, transparent legal system, and supportive policies for business and innovation, Sweden provides a nurturing environment for VC activities (Lerner and Tåg 2013). This stability is crucial for attracting a mix of domestic and international investors. The Swedish setting, therefore, not only facilitates a detailed analysis of loss tolerance due to its comprehensive data availability but also situates our research in a dynamic and internationally relevant VC market.

[7] Årsredovisningslag [1995:1554] 8 sec. 3 and Bokföringslag [1999:1078] 6 sec. 2.

3.2.2 Data sources

We use data from the Swedish Companies Registration Office (SCRO) that covers the population of limited liability companies between 1998 and 2020.[8] The limited liability company is the most prevalent type of business enterprise in Sweden, principally because formation requires relatively little effort and because it is the only type of business enterprise that offers limited liability to all shareholders.

We merge data on VC investments and exits from Crunchbase, Pitchbook, ThomsonOne, and Preqin. We use deals classified as VC equity financing rounds (e.g., "Early stage VC" or "Series C"). For investment or exit events that occur in more than one of these databases, we use Crunchbase as a base and then fill in missing information first from Pitchbook, then from ThomsonOne and last from Preqin.[9] We then match this combined VC dataset to the SCRO data by company name and city. For each company in the combined VC dataset with a single exact match (by company name) in the SCRO data, we keep that match. For each company with multiple matches by name and only one exact match by city, we keep that match. We focus on how VCs from different countries obtain different future company outcomes. We therefore manually collect the location of the headquarters for those VC investors for whom this information is missing.

[8]Our analysis is based on company-level financial statement data. A prior entrepreneurship literature also uses similar data, but does not focus on financial losses and the trade-off between growth and profitability. Several papers investigate how productivity, costs, sales, employment, and payroll evolve under VC ownership (Chemmanur, Krishnan, and Nandy 2011; Puri and Zarutskie 2012; Croce, Martí, and Murtinu 2013; Chemmanur, He, et al. 2018). Other work examines how investor types (government versus private or corporate versus independent) affect efficiency and profitability (Alperovych, Hübner, and Lobet 2015; Colombo and Murtinu 2017), how financing type affects performance (Giraudo, Giudici, and Grilli 2019), and how non-executive directors affect company performance (Montag 2024). Using an accounting approach, Hand (2005) examines the value relevance of financial statements in VC. Barrot and Nanda (2020) examine how faster payments affect startup cash flows and how this can impact employment. Finally, Belenzon, Chatterji, and Daley (2020) show that eponymous European private companies have lower sales growth than similarly profitable companies, and how the prevalence of eponymous names is related to a company's financing environment.

[9]We choose this order of third-party provider databases as it reflects their relative coverage of VC events.

3.2.3 Sample construction

We construct our sample, a company-fiscal year panel for companies that receive VC funding, in the following way. First, we restrict observations to companies that ever receive VC investment. Second, for observations with both unconsolidated and consolidated financial statements, we use the consolidated version because it reflects the company's overall economic activity. Third, we annualise flow as well as growth stock variables to account for differences in fiscal period lengths. Section B in the Internet Appendix contains further details on the construction of cash flow statements.

We then, for each cohort of VC investments separately, retain the company-year panel of only those companies that receive a VC investment in that year. Furthermore, to be able to investigate pre-trends, we only keep companies with at least two years of accounting data prior to obtaining the investment. Finally, we also drop all companies that do not receive a USVC investment, but that had previously received a USVC investment. This ensures that the benchmark companies are companies without USVCs at event time zero. Finally, we stack all cohorts and run the regression models specified in Equation 1. We cluster the standard errors at the company times cohort level to account for the fact that a benchmark company can be a benchmark in multiple cohorts. We also include cohort fixed effects in all regressions to control for time-invariant differences across cohorts.[10]

Table 1 presents descriptive statistics at event time minus one (i.e., one year before receiving the VC investment). It shows average values for observable characteristics measured one year before the first USVC investment for the full sample (Column 1), the firms receiving USVC investments (Column 2), and the benchmark group of firms receiving non-USVC investments (Column 3).

[10]Results are almost identical when including calendar year fixed effects in addition to or instead of cohort fixed effects (omitted for brevity).

Both groups consists of firms that have been in operation for at least two years. Table 1 also reports the difference in means (Column 4) as well as their statistical significance from t-tests (Column 5). Although there are some differences in means, the table shows that firms that receive USVC investments do not differ on these observables from the firms that receive non-USVC investments in the same year in a statistical sense.

3.2.4 Empirical specification

To compare the depth of J-curves across USVCs vs. non-USVCs we, for each year of USVC investments, create event-specific datasets with information on companies that receive USVC and non-USVC investments in a given year. With VC investments in Sweden covering the years 2000 to 2014, we obtain 15 event-specific datasets that we stack and align using normalized time relative to the time of the first USVC investment. We then estimate the following model:

$$Y_{f,k,t} = \alpha + \pi \text{Post}_k + \gamma \text{USVC}_f + \beta \text{Post}_k \times \text{USVC}_f + \varepsilon_{f,k,t}, \quad (1)$$

for the outcome Y of company f in event year k at calendar year t.[11] Post_k takes the value one in the event year receiving a VC investment and all years after. USVC_f takes the value one for companies that receive their first USVC investment and zero for companies that, in the same year, receive a non-USVC investment. Consequently, the interaction term $\text{Post}_k \times \text{USVC}_f$ takes a value of one for companies in the event year of the first USVC investment and all years after, and zero otherwise. The coefficient β captures the mean difference between receiving USVC investments on our outcomes relative to receiving non-USVC investments. We present these estimates for our

[11] This empirical specification corresponds to the staggered difference-in-differences design (Baker, Larcker, and Wang 2022; Roth et al. 2023), a common approach in the literature on ownership changes such as private equity buyouts (Agrawal and Tambe 2016; Olsson and Tåg 2017; Antoni, Maug, and Obernberger 2019; Agrawal and Tambe 2016) and privatizations (Arnold 2022; Olsson and Tåg 2024).

outcomes in Panel A of Table 2.

To estimate the dynamic effects around USVC investments, we replace Post_k with event time-specific dummies τ_k ranging from $k-4$ to $k+6$, setting $k-4$ as the baseline year. We present these results in the form of figures.

To analyze the overall statistical significance of short- and long-term effects (i.e., different parts of the J-curve), we split Post_k into PostST_k and PostLT_k, which cover event years 0-3 and 4-6, respectively. Panel B in Table 2 presents these results. To examine event and follow-on fundraising events, we run difference regressions using only post-period observations. Panel C in Table 2 shows these results.

3.3 Results

3.3.1 Do USVCs have deeper J-curves?

We first investigate if USVCs have deeper J-curves relative to non-USVCs. Figure 2A presents means for cash from operations and Figure 3A for EBITDA. This is shown in event time for companies that receive USVC funding and those that receive non-USVC funding. Prior to the funding event, both cash from operations and EBITDA evolve in parallel, but afterward we see clear evidence of higher losses for companies receiving USVC funding.

Figures 2B and 3B display the coefficients of the event time dummies interacted with receiving USVC funding or not. These panels thus display the difference between the two lines in Figures 2A and 3A, also adding 95% confidence intervals. We find statistically significantly lower cash from operations and EBITDA for USVC-backed startups for the first three years following the investment, and then cash and EBITDA start trending upwards.

In addition to reporting the figures in event times, Panel B of Table 2 reports the DiD estimates breaking up the POST dummy into a short-term (0-3 years) and long-term (4-6 years) period. Both measures of burn are statistically significantly lower in the short-term. For cash from operations, we estimate a short-term (0-3 year) decrease of USD 1.4 million, representing a 107% increase in the burn rate relative to the pre-period mean. For EBITDA, we estimate a short-term (0-3 year) decrease of USD 1.2 million, representing an 127% increase relative to the pre-period mean. Moreover, in the long-term the coefficients are statistically insignificant, suggesting that burn rates recover to prior levels, which is consistent with the shape of a J-curve.

Note that both in Figures 2 and 3 as well as Table 2 the upper part of the J-curve is not always fully developed. This can be because more time is needed to reach the upper parts of the J-curve, and/or because start-ups do not necessarily have to reach this part by themselves, they can get acquired beforehand. We examine both of these possibilities further in Section 3.3.2.

Overall, these results are supportive of the central finding from our theory, namely that companies funded by investors with higher x (USVCs) have deeper J-curves. The empirical results clearly show that companies funded by USVCs (read higher x) incur more losses in the short-term, but this reverses in the long-term.

3.3.2 What mechanisms explain deeper J-curves of USVCs?

To fully understand this central finding, we now examine the mechanisms that lead to deeper J-curves for USVCs. We begin by documenting differences between USVCs and non-USVCs in terms of outcomes. Recall from Section 3.1 that we hypothesized that USVCs are associated with higher x due to better access to exit markets, to global product markets, and to investor networks that lead to larger funding rounds, more follow-on rounds, and more new investors. We now test this assumption with our sample data, asking if USVCs are actually associated with more successful exits (read higher x). We begin by comparing exit values, conditional on observing exit. We find that the average exit value for USVC-backed startups is approximately three times as large as for non-USVC-backed startups. Specifically, the average exit value is USD 135 million for USVCs compared to USD 46 million for non-USVCs.

In addition to looking at average exit values, we consider the likelihood of having a successful exit. Figure 4 displays the means (Panel A) and regression coefficients (Panel B) for the cumulative successful exit rate after the investment. We see that starting from three years after the investment, the exit rate starts increasing. Table 2 displays the regression coefficients for the full post-period. Averaged over the entire post-period, the point estimate is a 5.1 pp higher exit rate relative to benchmarks. Six years after the investment, USVC funded startups have about a 15% higher exit rate (Panel B in Figure 4). This difference is both statistically and economically significant.

These findings clearly support the arguments from Section 3.1 about USVCs being associated higher exit potential x, so that we can now turn to better understanding the underlying mechanisms. One of the core insights from our theory is that VCs with higher values of x are more loss tolerant, which in turn encourages their entrepreneurs to invest more aggressively into the long-term. A large prior strategy literature explores what product market strategies build larger market shares, and how aggressive sales strategies may lower short-term profits.[12] A natural conjecture for the mechanism underlying the J-curve result is thus that USVC-backed companies are more aggressive in terms of growing their top-line sales.

Figure 5 reveals that, upon receiving USVC, companies experience higher sale growth for the initial three years. They also experience eventually higher sales, especially from year 3 onwards. Consistent with USVCs helping domestic firms reach global markets, Figures 6A and 6B find that funding from USVC leads to the opening of more foreign subsidiaries. At the time of the investment, there is a clear jump in foreign subsidiaries for USVC investments, and this continues

[12]See Porter (1980), Ordover and Saloner (1989), Fudenberg and Tirole (1984), Bolton and Scharfstein (1990), and Katz and Shapiro (1994).

in the following years. The regression results from Table 2 further show a positive effect of USVC on sales and foreign subsidiaries at the 5% significance level. We estimate an overall increase in sales and the likelihood to have foreign subsidiaries by 44% and 9% relative to the benchmarks, respectively. These are economically meaningful increases.[13]

If companies backed by USVCs are more successful in growing their top line sales, they presumably also need more funding to support their aggressive growth strategies. We therefore examine if USVCs have better access to investor networks that lead to better funding outcomes. For this we focus on three main measures: the log amount of money raised per year, the cumulative number of follow-on funding rounds, and the cumulative number of new investors. Panel A in Table 2 shows that USVC-backed startups have, on average, 29% larger fundraising rounds over the full post-period relative to benchmarks, which represents an increase of 168% compared to the pre-period mean. Figure 7 shows that, while most of the effect comes from the initial round, fundraising is statistically significantly higher for at least four years after a USVC investment relative to benchmarks. This shows that USVC investments lead to more follow-on capital raised. Whereas Figure 7 focuses on investment amounts, Figures 8 and Figure 9 consider investment rounds and investor networks created, respectively. They look at the cumulative number of follow-on fundraising rounds (Figure 8) and of new investors (Figure 9), and therefore only include the post-period. Clearly, companies with USVC backing have more follow-on funding rounds and build larger investor networks. In both figures, the effect of USVC is positive and all coefficients are statistically significant at the 5% level, except for the event year 1 coefficient in Figure 8 which is significant at the 10% level. Panel C in Table 2 shows that effect sizes over the full post-period represent 44%

[13]Is it worth mentioning, insofar as accurate, that our sales and subsidiaries results are, if anything, a lower bound because getting acquired will likely shift the reporting of sales/subsidiaries from the Swedish startup to the acquirer and USVC-backed startups are more likely to get acquired. Also note, however, that our accounting data related to sales growth and subsidiaries does not accurately capture sales and subsidiaries abroad if the firm gets acquired and absorbed by the acquirer.

and 154% relative to pre-period means for follow-on rounds and new investors, respectively.

Overall, we find strong evidence for the hypothesis that USVCs are associated with higher x. We show that USVCs achieve much higher exit values and that they have significantly higher exit rates. We then trace the underlying mechanism back to USVC-backed companies achieving higher sales growth, suggesting a willingness to give up bottom-line profitability (as shown in the J-curve) for more aggressive top-line sales growth. Finally, these aggressive strategies are supported by better access to investor networks and more funding. Specifically, we find that USVC-backed companies receive larger funding rounds, have more follow-on funding rounds, and attract more new investors.

4 Discussion and robustness

4.1 Are USVC investments associated with higher failure rates?

One natural conjecture, related to the work of Nanda and Rhodes-Kropf (2013), is that ambitious long-term strategies are also riskier. This suggests a prediction that USVC funding is associated with more company failures. However, our theoretical framework from Section 2 does not rely on the underlying company strategies being riskier. The results in Figure 10 find no statistically significant relationship between USVC backing and the probability of failure in the post-period.

4.2 Do non-US foreign VCs have the same effect as USVCs?

A natural question to ask is in how far our baseline empirical results capture a "true" positive association between USVCs and higher x, or whether USVC is a proxy for foreign VCs more generally. To test this, we re-run the baseline regressions comparing initial foreign non-USVC funding rounds with Swedish VC-only rounds. Table 3 presents these results, which show that startups receiving foreign non-USVC funding follow a different development path compared to those receiving USVC funding. Specifically, initial foreign non-USVC funding is associated with a lower probability of having an exit or follow-on funding round, and lower subsequent sales. Similar to initial USVC funding, receiving first foreign non-USVC funding is positively correlated with more follow-on capital raised as well as lower operating cash and EBITDA, however, the economic magnitudes are about half as large. Overall, the results in Table 3 validate our empirical choice of associating USVCs, as opposed to foreign VCs, with higher x.

4.3 Do USVC investments generate deeper J-curves?

So far, our analysis shows how USVCs are associated with deeper J-curves. To what extent can our estimates be interpreted as causal? In empirical finance, claims of causality must be made with reference to some established estimation framework, in our case this would be the differences-in-differences (DiD) framework. Its key assumption for the estimates to be interpreted as causal is that the trend in outcomes for the benchmark set of companies serves as a good counterfactual for the outcome the companies that receive USVC investments had they not obtained them. One central hesitation with concluding that there is a causal relationship is the possibility of unobserved heterogeneity. Specifically, our analysis cannot exclude the possibility that, at the time of investment, the sample of companies that receive USVC investments differs from the benchmark set of companies that do not receive USVC investments with respect to some unobservable characteristics that are uncorrelated to all observable characteristics, and uncorrelated to any trends over time. Let us refine our understanding by linking this question back to our theory.

Consider first how the DiD framework relates our theory. The USVC investment shock is comparable to the comparative statics of x, with variations in x capturing investor-specific differences.

Thus, the unobserved company heterogeneity is comparable to allowing variations in x that are company-specific, i.e., that are generated by heterogeneity among companies. While these variations are unobservable to the econometrician, to matter they must be observable to market participants. To better interpret our empirical results, we now examine the role of 'unobservable' company heterogeneity within our theory. We will consider four theoretical scenarios with different constellations of heterogeneity and derive their respective equilibria. We then ask what an econometrician using the DiD framework would find.

Suppose that, at the time of an investment, all market participants (but not the econometrician) can observe heterogeneity in companies' exit potential. Specifically, assume companies can have two expected exit values: Low potential means an expected exit value x_L, and high potential means x_H (where $x_H > x_L$). Based on this, investors and entrepreneurs all make their optimal choices $\widehat{\sigma}$ and β. Assume for now that there is a unit interval of companies and a unit interval of investors, so that all eligible companies get funded. Investments occur at the terms described in the base model. Suppose that USVCs provide some fraction ϕ_{US} (with $0 < \phi_{US} < 1$) of the available funding. In equilibrium, every company is funded by some investor, the question is what type of investor funds what type of company.

Our first scenario only has investor heterogeneity and thus corresponds to the base model where all companies are homogeneous. They have high exit potential (x_H) when funded by USVC, but low exit potential (x_L) with non-USVCs. In equilibrium, all companies prefer USVCs. A fraction ϕ_{US} of companies receive USVC and enjoy the x_H equilibrium. All remaining companies are funded by non-USVCs and get x_L equilibrium outcomes.

The second scenario only has company heterogeneity. Specifically, in this scenario there is heterogeneity in the exit potential of different companies, but investors are homogeneous. That is, USVCs and non-USVCs are distinguishable but are identical in terms of the value they bring to companies. This implies that a company's exit potential no longer depends on investor characteristics. Specifically, a fraction ϕ_H (with $0 < \phi_H < 1$) of all companies have high exit potential (x_H), irrespective of the type of their investor. These high potential entrepreneurs are indifferent between USVCs and non-USVCs, because picking USVC no longer conveys advantages. The same is also true for low potential entrepreneurs. In equilibrium, USVCs and non-USVCs all expect to receive a random draw of high (with probability ϕ_H) or low (with probability $(1 - \phi_H)$) company types.

In the third and fourth scenario both companies and investors are heterogeneous. For the third, suppose that a fraction ϕ_H of all companies have a latent potential for achieving high exit values (x_H), but only if they receive the support of USVCs. The remaining fraction $(1 - \phi_H)$ always has low exit potential (x_L), irrespective which type of VC funds them. The high exit outcome (x_H) therefore requires a combination of company characteristics (those with latent potential) and investor characteristics (funding from USVC). This corresponds to a idea from the prior VC literature (Da Rin, Hellmann, and Puri (2013)) that certain high-quality VCs are better at supporting and adding value to high-potential startups. In equilibrium, all companies with latent potential seek out USVCs, who themselves also prefer to fund such high potential companies. We distinguish two parameter ranges. First, if $\phi_H > \phi_{US}$, then USVCs can choose ϕ_{US} companies with latent potential who gladly accept. The remaining $(1 - \phi_{US})$ companies receive non-USVC funding. Of those, $(1 - \phi_H)$ have no latent high potential anyway, but $(\phi_H - \phi_{US})$ companies have latent potential they cannot unlock. Second, if $\phi_H < \phi_{US}$, then all companies with latent potential seek USVCs, who gladly fund them all. The remaining $(\phi_{US} - \phi_H)$ investments made by USVC go to companies without latent potential. Non-USVCs only fund companies without latent potential.

There are numerous additional model permutations one could consider, let us focus on one more case. The VC literature (Da Rin, Hellmann, and Puri (2013)) argues that VCs play two important roles: support (a.k.a. value adding) and screening. Our third scenario already described the former, so our fourth scenario will focus on the latter, assuming that investors are heterogeneous in their ability to screen out high potential companies. To model this, we use the simplest possible specification where USVCs have the ability to identify high-quality (x_H) companies, and non-USVCs do not. A company's potential to achieve the high exit outcome does not depend on the choice of investor. The key difference with scenario 3 is that USVCs are not needed to unleash the high exit potential, instead USVCs are simply better at spotting those companies. To generate a meaningful difference with scenario 2, we need one more assumption. For investor screening to matter, companies must have a reason to accept an offer from a better screener. This is true as soon as there is some scarcity of capital, so that a company always accepts its first investor offer, fearing it might otherwise be left out of the funding market. With this assumption, all USVCs offer their funding to x_H companies. If $\phi_H > \phi_{US}$, then USVCs choose ϕ_{US} companies with x_H. The remaining $(1-\phi_{US})$ companies receive non-USVC funding. Of those, $(1-\phi_H)$ have x_L and $(\phi_H - \phi_{US})$ have x_H. Second, if $\phi_H < \phi_{US}$, then all companies with x_H accept USVC funding. The remaining $(\phi_{US} - \phi_H)$ investments made by USVCs go to companies with x_L. Non-USVCs only fund companies with x_L.[14]

The key question is what an econometrician, using the DiD framework, would find across these four scenarios? In the first scenario, the econometrician finds that companies funded by USVC have, on average, lower short-term profits (R), but a higher probability of successful long-term outcomes (Π). This scenario conforms to the identification conditions required by the DiD framework, i.e., scenario 1 describes a pure treatment effect.

In scenario 2 there is unobserved company heterogeneity, but no investor heterogeneity. To be precise, there are observable differences between investors (USVC vs. non-USVC), but they have

[14] It is worth noting that the presence of USVCs clearly benefits the economy in scenarios 1 and 3 and does not make any difference in scenario 2. In scenario 4, the ability to screen out high potential companies also benefits the economy, because more x_H companies get funded in equilibrium. This follows from the fact that there is scarcity of capital, and that USVCs are better at avoiding x_L companies.

no economic consequences. Interestingly, unlike all other scenarios, the econometrician will find no significant differences between companies funded by USVC vs. non-USVC. This is simply because both investor types are drawing from the same underlying distribution of company types. Our theory thus suggests that, without any investor heterogeneity, company heterogeneity on its own should not generate statistically significant coefficients.

The remaining scenarios 3 and 4 rely on investor heterogeneity but also allow for heterogeneous companies. The DiD framework finds similar patterns as in scenario 1, namely that companies with USVC funding have lower short-term profits (R), but better long-term outcomes (Π).[15] Scenarios 1, 3, and 4 all generate significant DiD coefficients. Unlike scenario 1, scenarios 3 and 4 allow for some unobservable company heterogeneity. The DiD method cannot distinguish between these scenarios. We therefore cannot exclude the possibility of unobserved company heterogeneity. However, the DiD framework can distinguish scenarios 1, 3 and 4 against scenario 2, which has homogeneous investors. The DiD framework can thus distinguish between homogeneous and heterogeneous investors.

Based on these theoretical insights, we submit the following simple interpretation of the empirical associations we find. A significant effect does not exclude the possibility of company heterogeneity, but it does exclude the possibility of investor homogeneity. Consequently, we can interpret our J-curve effects as being influenced by differences between USVCs and non-USVCs. The differences may stem from better investor support (such as better access to exit markets), and/or better screening and selection abilities. These alternative mechanisms follow a similar economic logic, they are all simple variations of our core theory. However, we do not claim to be able to distinguish

[15] Specifically, for $\phi_H > \phi_{US}$, the DiD coefficients under scenario 1 and scenario 3 would be identical, since the two equilibria are identical. Under scenario 4, the DiD coefficient for USVC would again be positive, but the difference would be smaller since non-USVCs also invest in some x_H companies. For $\phi_H < \phi_{US}$, the DiD coefficients from scenarios 3 and 4 would be positive but smaller than under scenario 1. This is because USVCs now fund a mixture of x_H and x_L companies, whereas non-USVCs only fund x_L companies.

among them.

4.4 Does attrition from the sample affect the results?

Are the results affected by differential attrition from the sample that can create a bias? In order to investigate this we run dynamic regressions with pre-investment observables on the left-hand side. If there is differential attrition out of the sample that is correlated with observables, we would expect to find statistically significant coefficients on the interactions between the event time dummies and the USVC investment dummy. Figure 11 displays these results and shows no statistically significant differences. There is also little evidence of trends in the coefficients over event time.

5 Concluding summary

Startups often grapple with a trade-off between short-term profitability and long-term growth. Ambitious growth strategies require investors who can tolerate prolonged financial losses, generating what is known as a J-curve. In this paper, we present both theory and novel empirical evidence of J-curves and optimal loss tolerance in VC investing. The theory predicts that investors facing better exit opportunities have a higher optimal loss tolerance, which in turn encourages startups to pursue more ambitious growth strategies. Empirically, we examine detailed cash flow and financial data from Swedish VC-backed startups and compare USVC-backed companies with a benchmark of non-USVC-backed companies. Consistent with our theory, we find that USVC-backed companies are associated with better exit opportunities and deeper J-curves.

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Tables

Table 1

Descriptive statistics

This table describes the differences between companies receiving their first US VC investment and those receiving funding from non-US VC investors a year before the funding round. We require companies to have been in operation for at least two years prior to the funding round.

	(1) Full	(2) US VC	(3) Non-US VC	(4) Difference	(5) *t*-statistic
Operating cash (mil SEK)	-9.923	-13.111	-9.628	-3.482	(-1.033)
EBITDA (mil SEK)	-8.787	-10.806	-8.601	-2.205	(-0.854)
Sales (mil SEK)	69.514	42.354	72.024	-29.670	(-1.502)
Foreign subsidiary dummy	0.200	0.189	0.201	-0.012	(-0.315)
Employees	44.883	40.523	45.286	-4.764	(-0.311)
Assets (mil SEK)	65.004	86.931	62.978	23.953	(0.830)
VC backed	0.389	0.342	0.394	-0.051	(-1.087)
Observations	1,312	111	1,201	1,312	

Table 2

Overview of regression results

This table presents results for all regressions. Panel A shows coefficients from DiD regressions and Panel B shows these with short-term (event year 0 to 3) and long-term (event year 4 to 6) post values. Panel C shows coefficients from difference regressions using only post-period observations. The unit of analysis is a company-year. We calculate effect sizes in Panels A and B as the US VC#Post coefficient divided by the pre-period average of the dependent variable for the companies receiving US VC funding. In Panel C, we calculate the effect size as the US VC coefficient divided by average of the dependent variable in the post period for all companies. Table 1 describes the sample. Standard errors are clustered at the company-cohort level. *t*-statistics are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: DiD regressions

	(1) Operating cash	(2) EBITDA	(3) Sales (log)	(4) For subsidiary	(5) VC rnd amnt (log)
US VC	-1.6934	-1.6845	-0.4860**	-0.0366	0.0476
	(-0.483)	(-0.637)	(-2.162)	(-1.017)	(1.237)
Post	-2.1351***	-2.1274***	0.4801***	0.1131***	0.1079***
	(-3.036)	(-3.314)	(9.034)	(11.142)	(9.361)
US VC#Post	-7.4907*	-9.3079**	0.4413**	0.0913**	0.2852***
	(-1.876)	(-2.548)	(2.058)	(2.044)	(4.579)
Cohort FEs	Yes	Yes	Yes	Yes	Yes
Observations	11,310	11,310	11,310	11,310	11,310
Adj. R^2	0.011	0.015	0.846	0.033	0.025
Effect size (%)	71	101	4	62	168

Panel B: Short- vs long-term effects					
	(1)	(2)	(3)	(4)	(5)
	Operating cash	EBITDA	Sales (log)	For subsidiary	VC rnd amnt (log)
US VC	-1.6815	-1.6728	-0.4837**	-0.0364	0.0469
	(-0.479)	(-0.633)	(-2.152)	(-1.014)	(1.220)
PostST	-3.1875***	-3.3120***	0.3096***	0.0988***	0.1813***
	(-4.707)	(-5.560)	(6.294)	(10.442)	(14.463)
PostLT	-0.2412	0.0013	0.7843***	0.1387***	-0.0237*
	(-0.216)	(0.001)	(10.581)	(9.635)	(-1.719)
US VC#PostST	-11.3642***	-11.7539***	0.3699*	0.0810*	0.3527***
	(-2.718)	(-3.786)	(1.854)	(1.952)	(5.534)
US VC#PostLT	0.4233	-4.2042	0.6179**	0.1145*	0.1360
	(0.074)	(-0.724)	(2.096)	(1.846)	(1.599)
Cohort FEs	Yes	Yes	Yes	Yes	Yes
Observations	11,310	11,310	11,310	11,310	11,310
Adj. R^2	0.014	0.018	0.847	0.034	0.045
ST effect size (%)	107	127	3	55	208
LT effect size (%)	-4	45	5	78	80

Panel C: Post-period only regressions			
	(1)	(2)	(3)
	Exited	Follow-on rounds	New VC investors
US VC	0.0510**	0.2043**	0.6079***
	(2.132)	(2.357)	(3.211)
Cohort FEs	Yes	Yes	Yes
Observations	8,460	8,460	8,460
Adj. R^2	0.010	0.052	0.026
Effect size (%)	52	44	154

Table 3

Comparing initial foreign non-US VC with domestic VC only

This table presents results for regressions comparing companies receiving their first non-US VC investment with those receiving funding from domestic VC investors only. Panel A shows coefficients from DiD regressions and Panel B shows these with short-term (event year 0 to 3) and long-term (event year 4 to 6) post values. Panel C shows coefficients from difference regressions using only post-period observations. The unit of analysis is a company-year. Standard errors are clustered at the company-cohort level. t-statistics are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: DiD regressions

	(1) Operating cash	(2) EBITDA	(3) Sales (log)	(4) For subsidiary	(5) VC rnd amnt (log)
Non-US VC	6.4651***	7.9219***	0.5226***	-0.0480*	-0.2221***
	(5.244)	(6.374)	(3.399)	(-1.724)	(-10.221)
Post	-0.4991	-0.1363	0.6420***	0.1159***	-0.0140
	(-0.402)	(-0.117)	(5.882)	(5.316)	(-0.579)
Non-US VC#Post	-3.0883**	-3.2923**	-0.2423*	0.0022	0.1834***
	(-2.128)	(-2.407)	(-1.883)	(0.088)	(6.737)
Cohort FEs	Yes	Yes	Yes	Yes	Yes
Observations	8,876	8,876	8,876	8,876	8,876
Adj. R^2	0.014	0.019	0.844	0.043	0.028

Panel B: Short- vs long-term effects

	(1) Operating cash	(2) EBITDA	(3) Sales (log)	(4) For subsidiary	(5) VC rnd amnt (log)
Non-US VC	6.4670***	7.9254***	0.5231***	-0.0480*	-0.2224***
	(5.246)	(6.378)	(3.402)	(-1.722)	(-10.234)
PostST	-1.4987	-1.3101	0.4206***	0.1000***	0.0359
	(-1.293)	(-1.266)	(4.129)	(4.816)	(1.382)
PostLT	1.4524	2.1558	1.0742***	0.1468***	-0.1115***
	(0.719)	(1.107)	(6.913)	(4.774)	(-3.945)
Non-US VC#PostST	-2.7068**	-3.1498**	-0.1603	0.0021	0.1972***
	(-1.967)	(-2.541)	(-1.334)	(0.088)	(6.664)
Non-US VC#PostLT	-3.9781*	-3.8139*	-0.4351**	-0.0013	0.1716***
	(-1.720)	(-1.706)	(-2.410)	(-0.038)	(5.466)
Cohort FEs	Yes	Yes	Yes	Yes	Yes
Observations	8,876	8,876	8,876	8,876	8,876
Adj. R^2	0.015	0.021	0.845	0.045	0.044

Panel C: Post-period only regressions			
	(1) Exited	(2) Follow-on rounds	(3) New VC investors
Non-US VC	-0.0477***	-0.1138**	0.0111
	(-2.713)	(-2.522)	(0.231)
Cohort FEs	Yes	Yes	Yes
Observations	6,589	6,589	6,589
Adj. R^2	0.016	0.050	0.013

Figures

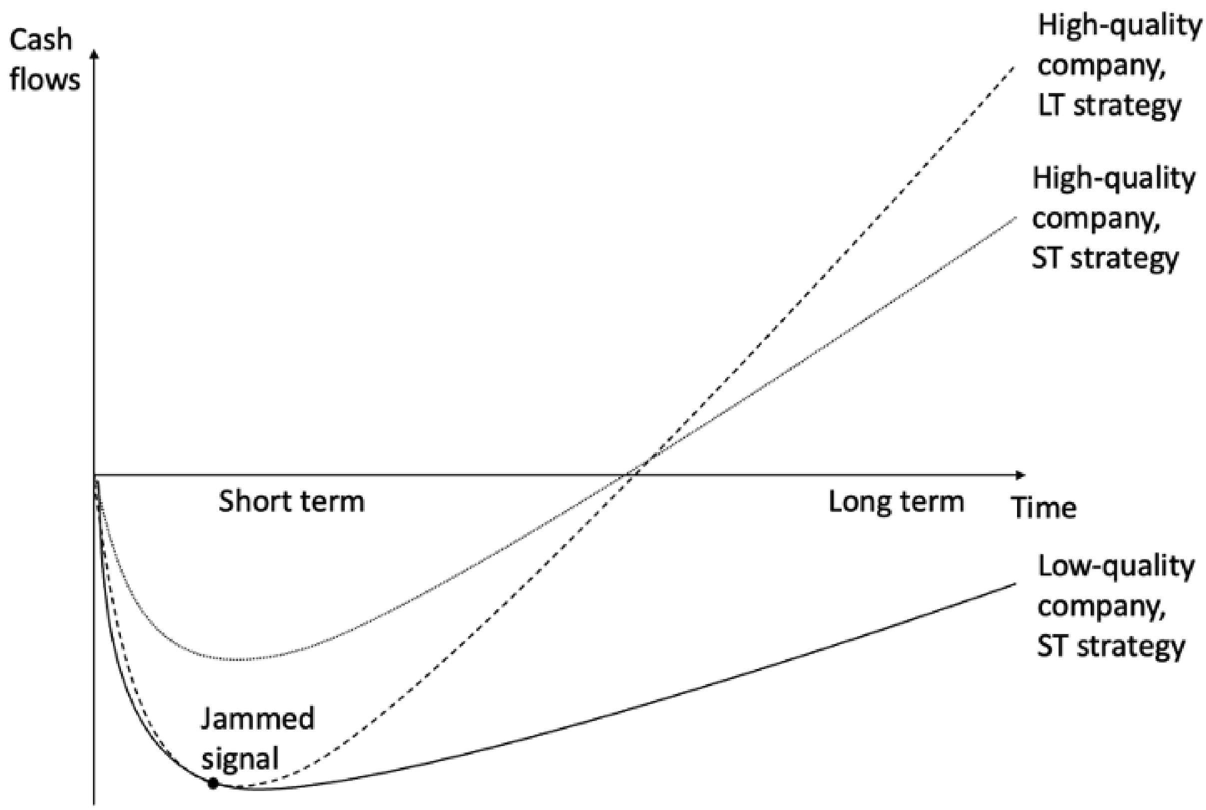
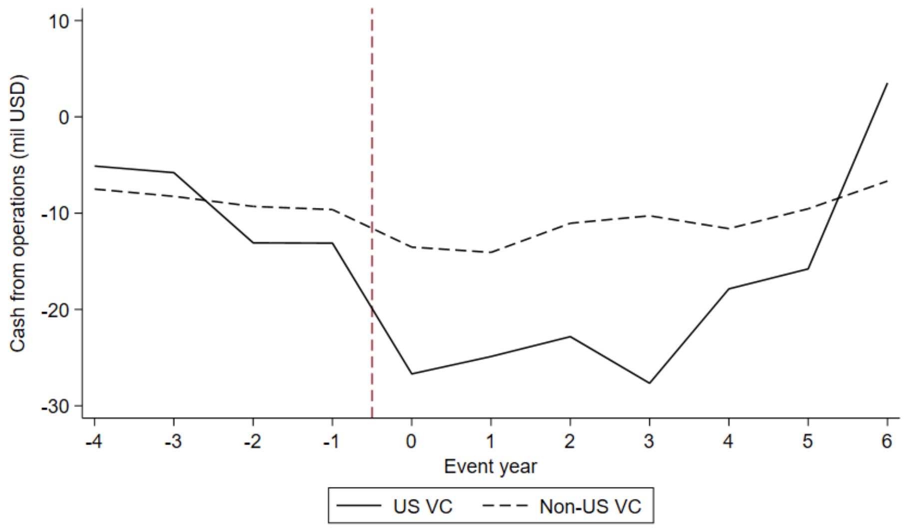
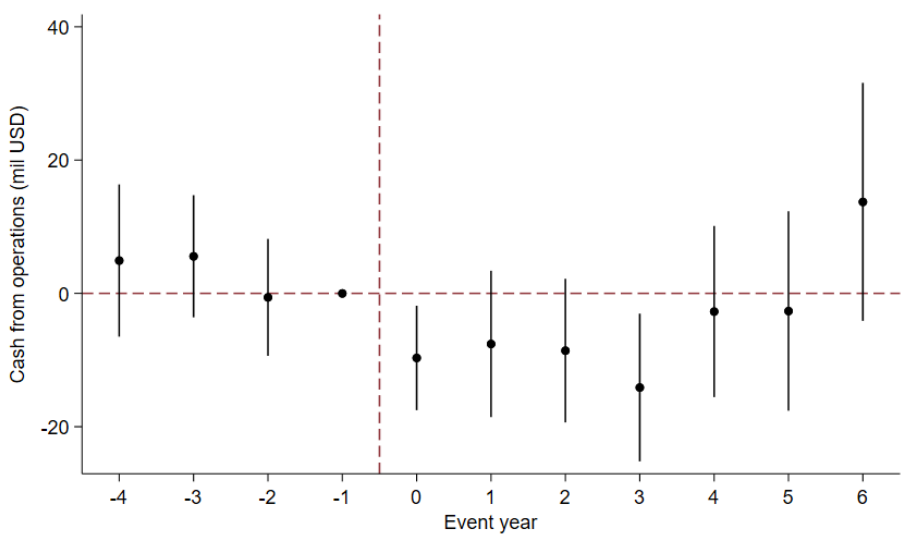


Figure 1. Model intuition. This figure illustrates the intuition for our theoretical model. It shows cash flows over time for different types of start-ups (low/high quality with short-/long-term strategy).

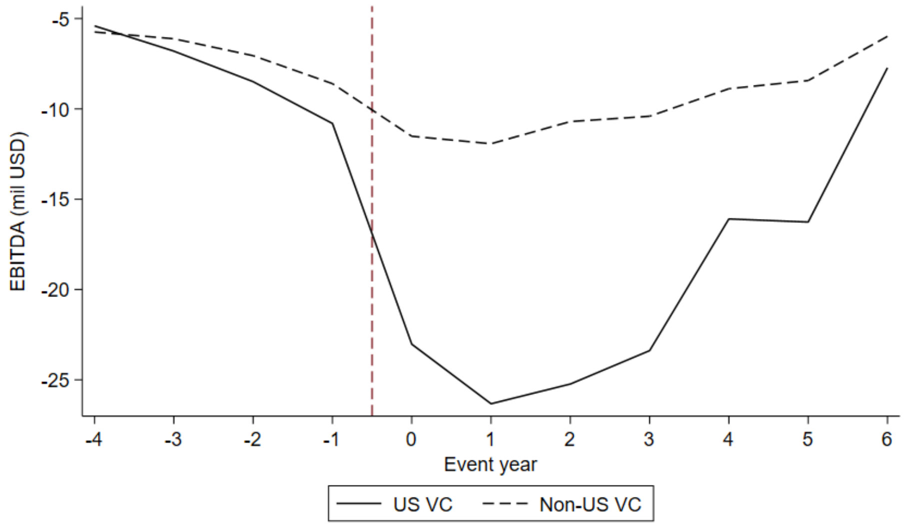


A: Raw means.

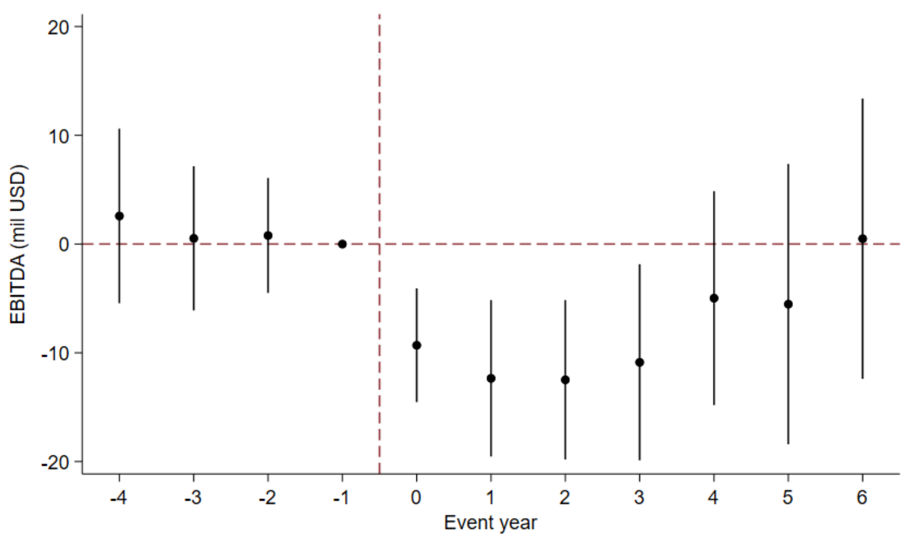


B: DiD coefficients.

Figure 2. Cash from operations around first USVC investment. This figure shows the effects of receiving initial US VC funding on cash from operations. It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as DiD coefficients estimated by event time with 95% confidence intervals (Panel B). Table 1 describes the sample.

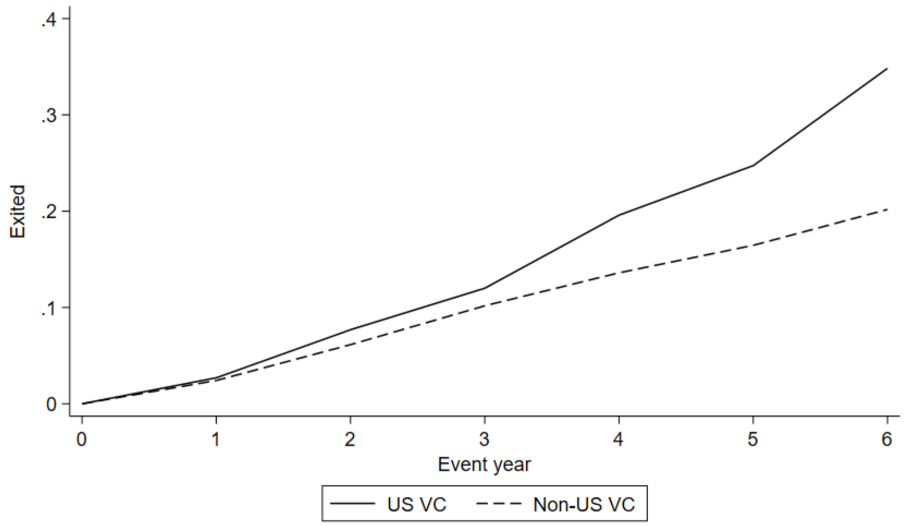


A: Raw means.

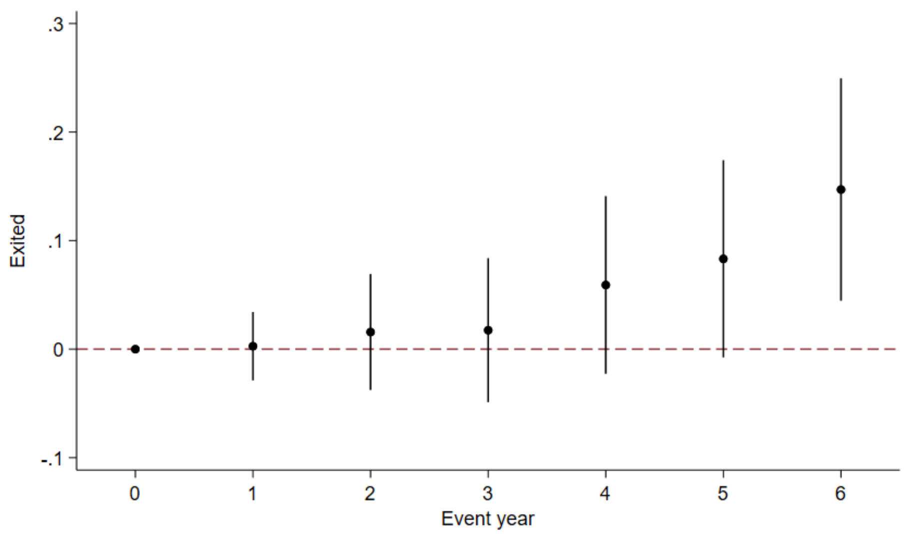


B: DiD coefficients.

Figure 3. EBITDA around first USVC investment. This figure shows the effects of receiving initial US VC funding on EBITDA. It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as DiD coefficients estimated by event time with 95% confidence intervals (Panel B). Table 1 describes the sample.

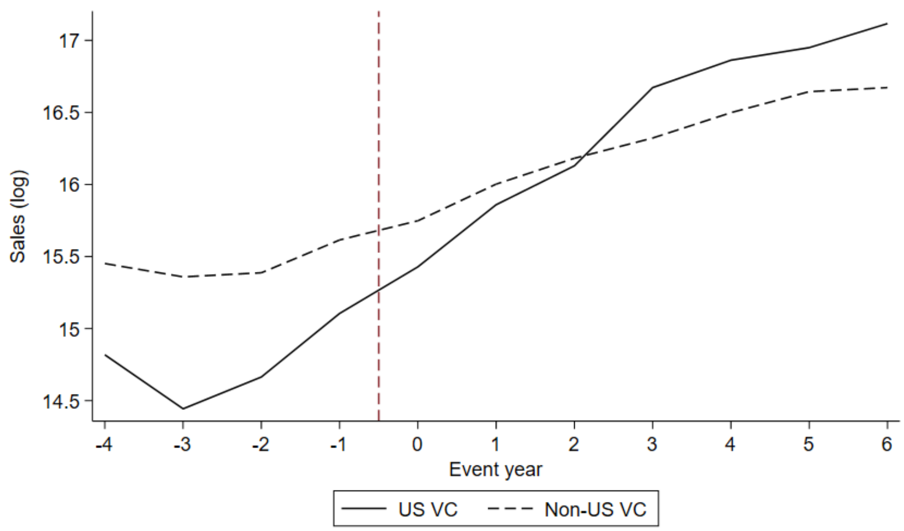


A: Raw means.

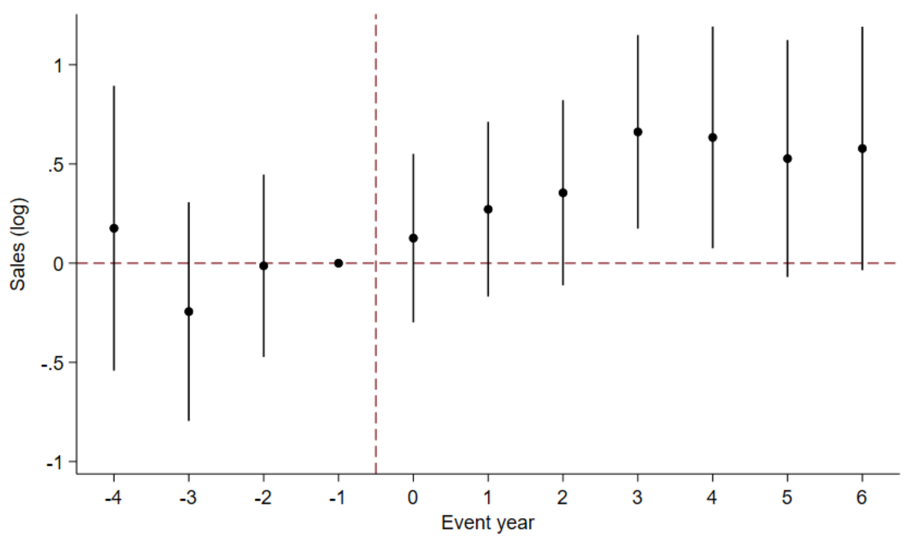


B: DiD coefficients.

Figure 4. Exit trajectories after first USVC investment. This figure shows the effects of receiving initial US VC funding on exit. It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as event time regression coefficients from a regression run only in the post period with event year zero omitted and with 95% confidence intervals (Panel B). Table 1 describes the sample.

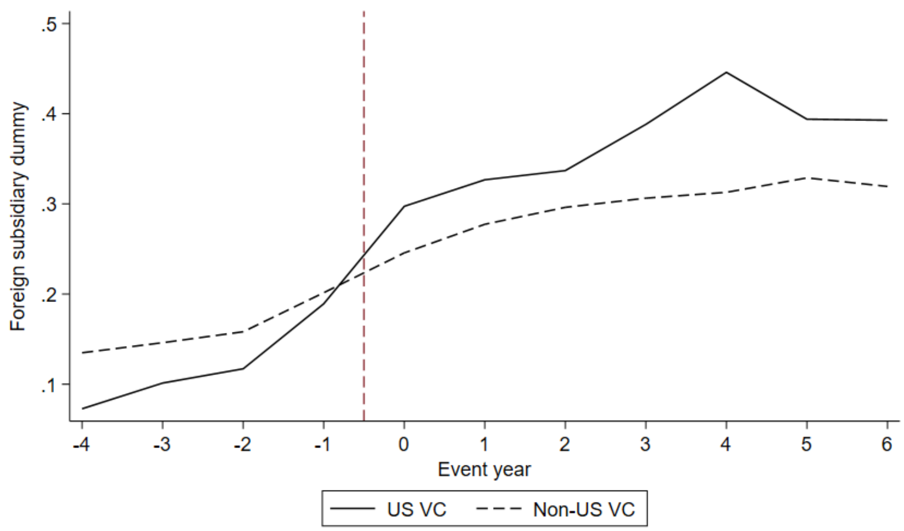


A: Raw means.

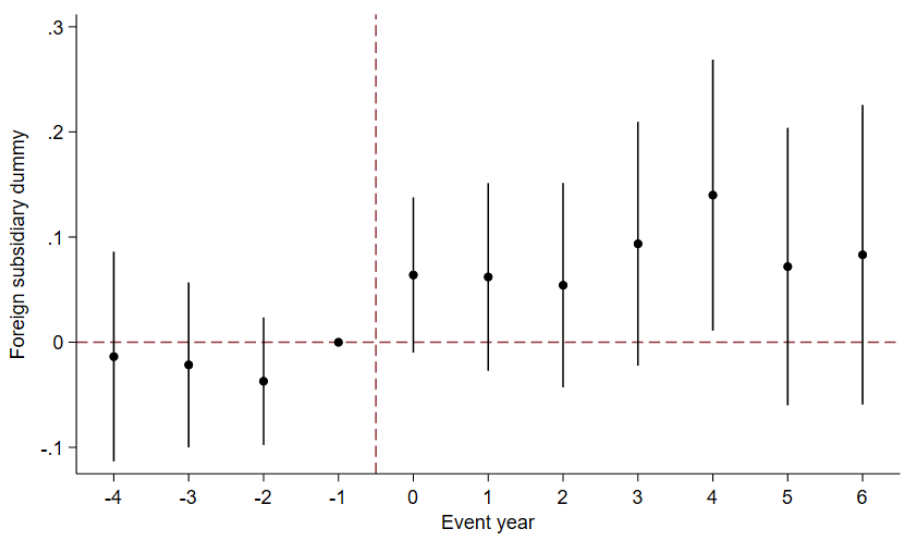


B: DiD coefficients.

Figure 5. Sales around first USVC investment. This figure shows the effects of receiving initial US VC funding on sales (log). It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as DiD coefficients estimated by event time with 95% confidence intervals (Panel B). Table 1 describes the sample.

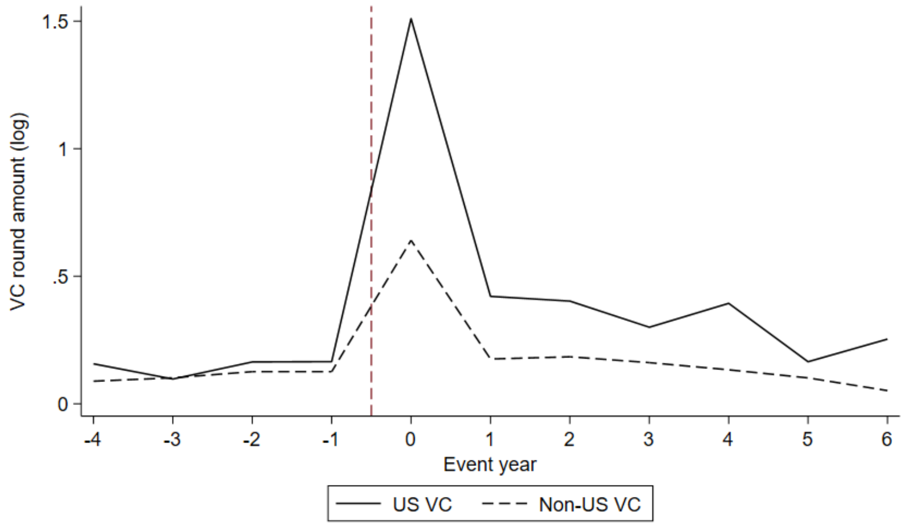


A: Raw means.

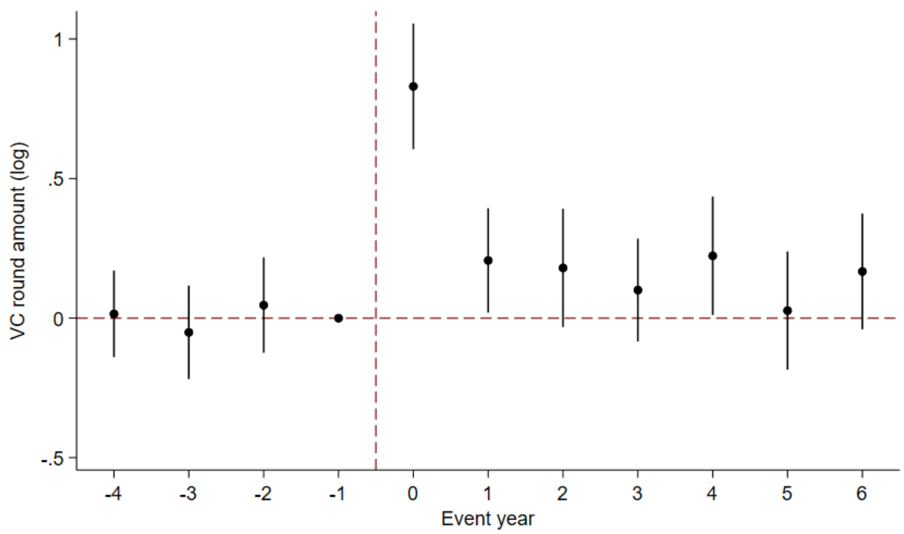


B: DiD coefficients.

Figure 6. Foreign presence around first USVC investment. This figure shows the effects of receiving initial US VC funding on a foreign subsidiary dummy. It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as DiD coefficients estimated by event time with 95% confidence intervals (Panel B). Table 1 describes the sample.

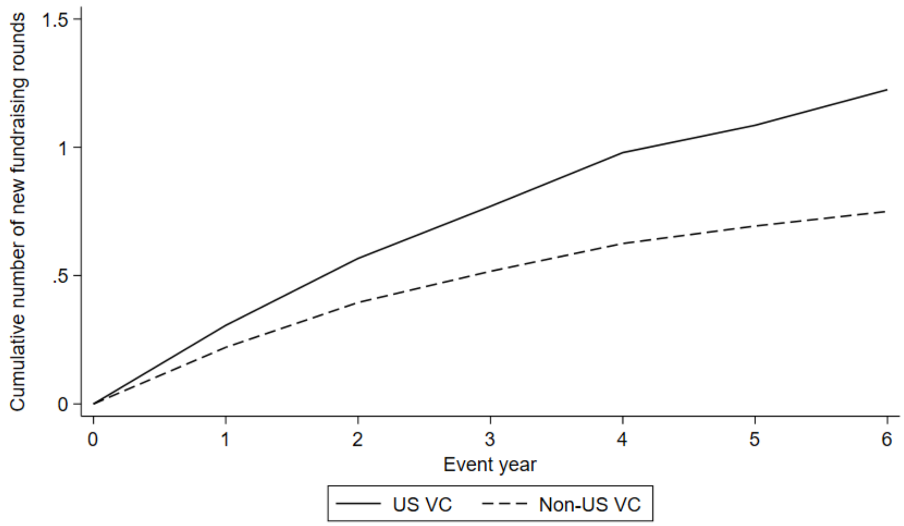


A: Raw means.

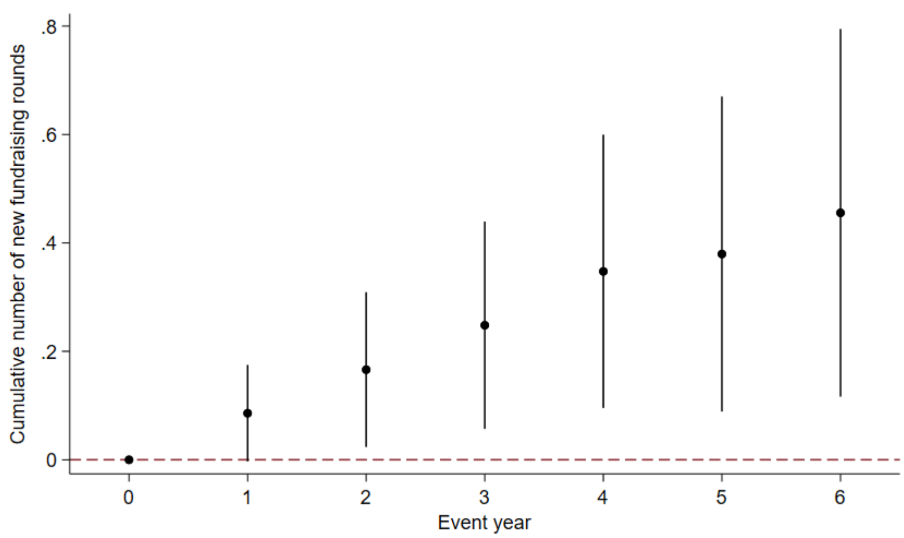


B: DiD coefficients.

Figure 7. Fundraising around first USVC investment. This figure shows the effects of receiving initial US VC funding on VC round amount (log). It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as DiD coefficients estimated by event time with 95% confidence intervals (Panel B). Table 1 describes the sample.

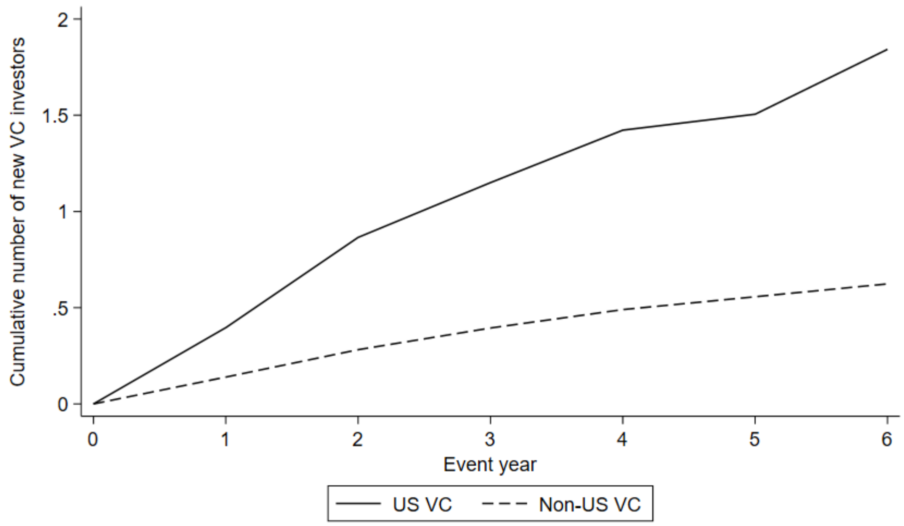


A: Raw means.

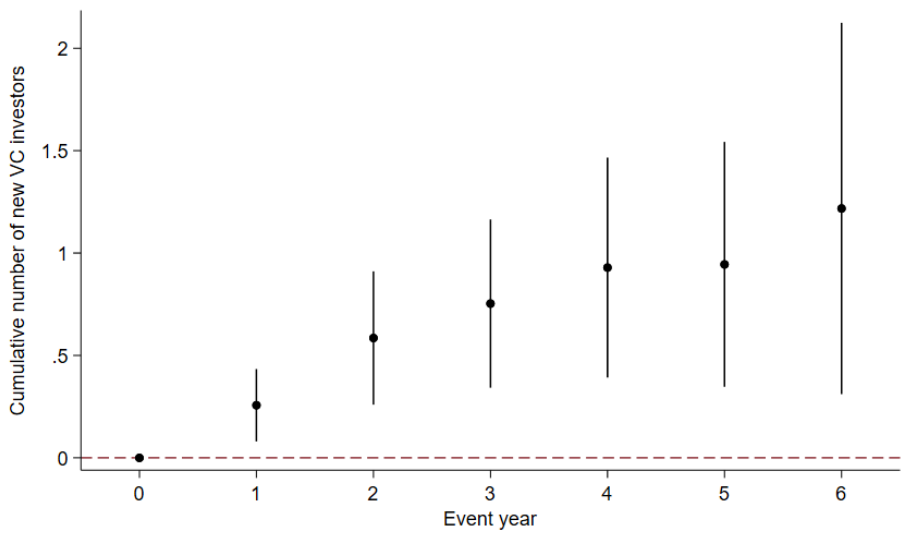


B: DiD coefficients.

Figure 8. Follow-on funding after first USVC investment. This figure shows the effects of receiving initial US VC funding on follow-on funding (cumulative number of new fundraising rounds). It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as event time regression coefficients from a regression run only in the post period with event year zero omitted and with 95% confidence intervals (Panel B). Table 1 describes the sample.

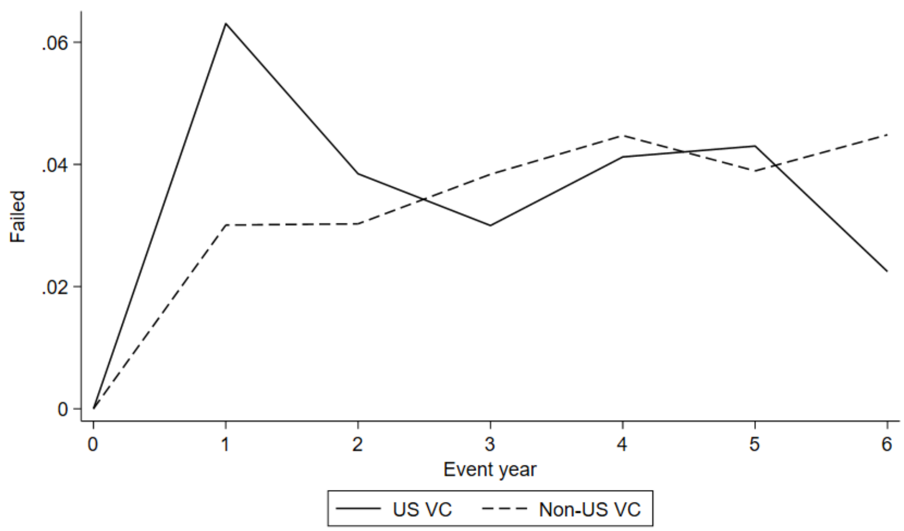


A: Raw means.

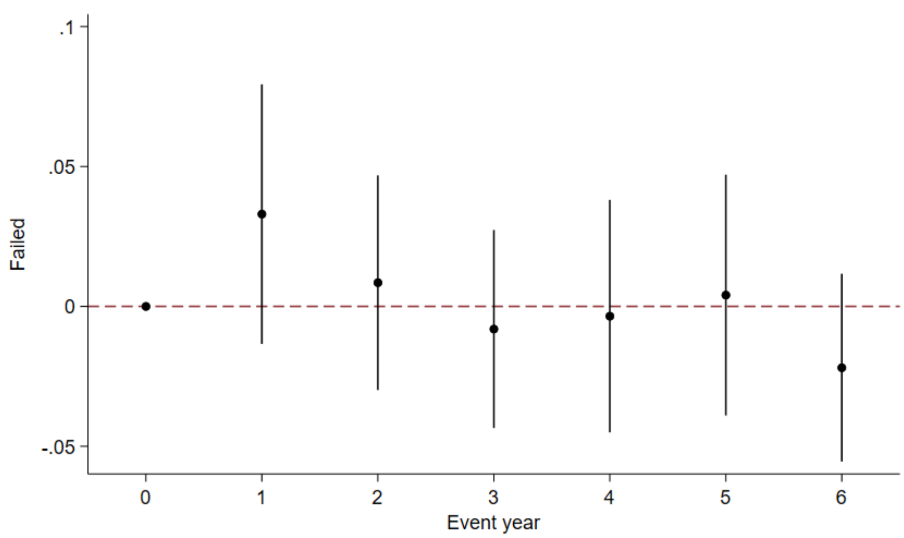


B: DiD coefficients.

Figure 9. New investors after first USVC investment. This figure shows the effects of receiving initial US VC funding on networks (cumulative number of new investors). It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as event time regression coefficients from a regression run only in the post period with event year zero omitted and with 95% confidence intervals (Panel B). Table 1 describes the sample.



A: Raw means.



B: DiD coefficients.

Figure 10. Failure trajectories after first USVC investment. This figure shows the effects of receiving initial US VC funding on failure. It displays the raw means for companies receiving their first US VC investment and those receiving funding from non-US VC investors (Panel A) as well as event time regression coefficients from a regression run only in the post period with event year zero omitted and with 95% confidence intervals (Panel B). Table 1 describes the sample.

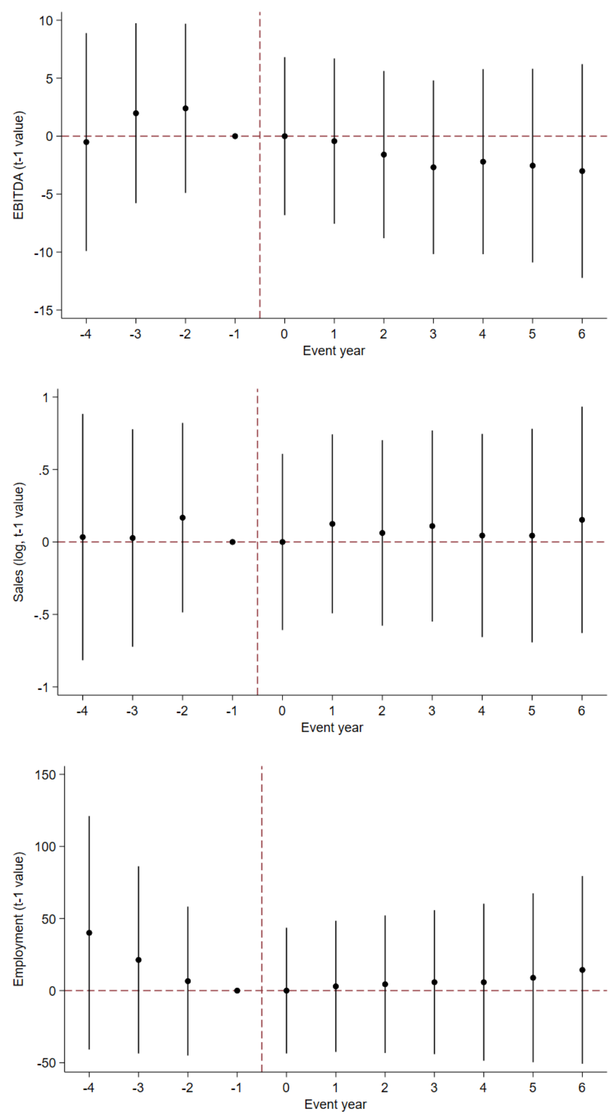


Figure 11. Attrition. The figures reports coefficients from a dynamic stacked difference-in-differences model with values of EBITDA, sales and employment measured at $t-1$ on the LHS. The figures indicate that there is no statistically significant selection effects out of the sample on the basis of pre-investment EBITDA, sales or employment.

Internet Appendix for

Tolerating Losses for Growth: J-Curves in Venture Capital Investing

Thomas Hellmann, Alexander Montag, Joacim Tåg

A Details of the model

A.1 Assumptions

Consider a model with three dates. There is one entrepreneur and one investor. Both parties are risk-neutral and there is no discounting. Date 0 represents an initial investment, given by K_0, at the very beginning. At Date 1 short-term cash flows R are realized. The investor has a choice to either refinancing the venture which requires capital K, or liquidate it. Date 2 represents the long-term potential of the venture, with expected cash flows denoted by π. We assume that $\pi = \alpha(1-\beta)x$ and will explain the three components shortly. Each component can be though of as a probability of a monetary value component.

At date 1 all parties observe short-term cash flows $R \in [0, K_0)$. We can interpret these as early revenues and/or as cost savings. The cumulative losses at date 1 are given by $L = K_0 - R$. If the company is liquidated we assume that the investor recovers the remaining cash reserves R. This can be achieved with standard contractual terms, such as preferred securities (Hellmann 2006). If the company continues at date 1, it needs total capital investment K. The existing cash reserves R can be reinvested, so that company only needs to raise an additional amount of $I = K - R$.

We assume that in case the company is successful, the entrepreneur can always extract a fraction γ of the returns, leaving the investor with the remaining fraction $(1-\gamma)$. This assumption is necessary to keep the model tractable and can be justified on the basis of standard entrepreneurial moral hazard and hold-up problems (Aghion and Tirole 1994).

At date 1, there is an underlying signal σ that generates the short-term cash flows R, so that there is a one-to-one correspondence between σ and R. We assume that $R(\sigma)$ is a concave increasing function of the signal σ, so $R(\sigma) \geq 0$, $R'(\sigma) > 0$, and $R''(\sigma) < 0$. For tractability it is useful to assume that $R(\sigma) = r(1 - \exp[-\rho\sigma])$, so that for $\sigma = 0$ we get $R(0) = r(1 - \exp[0]) = 0$; and for $\sigma \to \infty$ we get $R(\sigma) = r(1 - \exp[-\infty]) = r$.

The signal σ consists of two components: $\sigma = \theta + \beta$. $\theta \in [0, \infty)$ is an (ex-ante unknown) quality index with higher values representing better quality ventures. Specifically, let α be a concave increasing function $\alpha(\theta)$ with $\alpha'(\theta) > 0$ and $\alpha''(\theta) < 0$. For tractability it is useful to assume that $\alpha(\theta) = 1 - \exp[-\varphi\theta]$; at $\theta = 0$ we get $\alpha(0) = 1 - \exp[0] = 0$; and for $\theta \to \infty$ we get $\alpha(\theta) = 1 - \exp[-\infty] = 1$.

Let $\Omega(\theta)$ be the cumulative probability distribution of θ and $\omega(\theta)$ the corresponding density. For tractability we assume an exponential distribution with parameter λ (implying a mean λ^{-1}), i.e., $\omega(\theta) = \lambda \exp(-\lambda\theta)$ and $\Omega(\theta) = 1 - \exp(-\lambda\theta)$.

The parameter β measures short-term orientation. The entrepreneur privately chooses $\beta \in [0, \infty)$ sometime after date 0 and before date 1. β is thus privately known to the entrepreneur but not the investor, giving rise to the signal jamming problem (Stein 1989). Note that R depends on σ, not θ so that higher β increases short-term cash flows. However, higher β reduces the long-term expected cash flows π via the $(1 - \beta)$ term. Throughout we assume that r is not too large (relative to x). This means that short-term cash flows are relatively unimportant relative to long-term cash flows, and ensures that the socially optimal choice is always $\beta = 0$. However, in equilibrium the entrepreneur may have incentives to increase β, for reasons explained below. The investor cannot observe β, and we denote his belief by $\widetilde{\beta}$. In a rational expectations equilibrium this will equal the entrepreneur's privately optimal choice, denoted by β^*, i.e., in equilibrium we will have $\widetilde{\beta} = \beta^*$.

A.2 Investor cutoff preferences

Consider the investor's choice of refinancing or liquidating the venture at date 1. The investor holds a belief $\widetilde{\beta}$ about the entrepreneur's choice. Upon observing R, he infers σ, and thus forms a belief about the quality of the venture given by $\widetilde{\theta} = \sigma - \widetilde{\beta}$. This also generates a belief about future cash flows denoted by $\widetilde{\pi} = \alpha(\widetilde{\theta})(1-\widetilde{\beta})x$.

If the investor does not reinvest, he takes the remaining cash reserves R. If he reinvests, he tops up the cash reserves R with an investment I. The investor's incremental gain from investing is thus given by $\Gamma = \overline{\gamma}\widetilde{\pi}x - I - R = \overline{\gamma}\widetilde{\pi}x - K$. The investor wants to reinvest whenever $\Gamma = \overline{\gamma}\alpha(\widetilde{\theta})(1-\widetilde{\beta})x - K \geq 0$. We define $\widehat{\sigma}$ so that $\Gamma(\widehat{\sigma},\widetilde{\beta}) = \overline{\gamma}\alpha(\widehat{\sigma}-\widetilde{\beta})(1-\widetilde{\beta})x - K = 0$. Refinancing occurs whenever $\Gamma(\sigma,\widetilde{\beta}) \geq 0 \Leftrightarrow \sigma \geq \widehat{\sigma}$. The condition $\sigma \geq \widehat{\sigma}$ can also be re-expressed as $R(\sigma) \geq R(\widehat{\sigma})$ or $L(\sigma) \leq L(\widehat{\sigma})$, where $L(\widehat{\sigma})$ measures the highest losses the investor is willing to tolerate. It is easy to verify that the threshold $\widehat{\sigma}$ is increasing in $\widetilde{\beta}$ and decreasing in x. This says that a higher expectation about signal jamming (higher $\widetilde{\beta}$) results in a higher threshold $\widehat{\sigma}$, and thus higher revenue expectations or lower loss tolerance. However, a higher return expectation x results in a lower thresholds $\widehat{\sigma}$, thus lower revenue expectations and great loss tolerance.

A.3 Entrepreneurial strategy choice

We denote the entrepreneur with E. After date 0, but before date 1, E makes her strategy choice β. If no reinvestment occurs at date 1 (i.e., if $\sigma < \widehat{\sigma}$), then the investor gets the remaining $R(\widetilde{\sigma})$, and E receives a utility normalized at zero. Conditional on reinvestment ($\sigma \geq \widehat{\sigma}$), E's utility is given by $u_E = \gamma\pi = \gamma\alpha(\theta)(1-\beta)x$. Using $\sigma = \theta + \beta$ we can also rewrite this as $u_E = \gamma\alpha(\sigma-\beta)(1-\beta)x$. E's ex-ante utility at the time of choosing β is found by integrating over the distribution of θ. We define the critical value $\widehat{\theta} = \widehat{\sigma} - \beta$ from

$$\Gamma(\widehat{\theta},\widetilde{\beta},\beta) = \overline{\gamma}\alpha(\widehat{\theta}+\beta-\widetilde{\beta})(1-\widetilde{\beta})x - K = 0.$$

For $\theta < \widehat{\theta}$ the investor sees a signal $\sigma = \theta + \beta < \widehat{\sigma}$ and does not reinvest. For $\theta \geq \widehat{\theta}$ the investor sees a signal $\sigma = \theta + \beta \geq \widehat{\sigma}$ and reinvests. Thus, E's ex-ante utility is given by

$$U_E(\beta, \widehat{\theta}) = \int_{\widehat{\theta}}^{\infty} u_E d\Omega(\theta) = \int_{\widehat{\sigma}-\beta}^{\infty} \gamma\alpha(\theta)(1-\beta)x d\Omega(\theta).$$

E's optimal choice of β is found by the first-order condition. E takes $\widehat{\sigma}$ as given which is based on belief $\widetilde{\beta}$ but not the actual choice of β. The first-order condition is

$$\begin{aligned} \frac{dU_E(\beta, \widehat{\theta})}{d\beta} &= \omega(\widehat{\theta})\gamma\alpha(\widehat{\theta})(1-\beta)x - \textstyle\int_{\widehat{\theta}}^{\infty} \gamma\alpha(\theta)x d\Omega(\theta) = 0 \\ \Leftrightarrow \frac{\omega(\widehat{\theta})}{1-d\Omega(\widehat{\theta})}\alpha(\widehat{\theta})(1-\beta) &- \frac{\int_{\widehat{\theta}}^{\infty} \alpha(\theta)d\Omega(\theta)}{1-d\Omega(\widehat{\theta})} = 0 \end{aligned}$$

The exponential distribution has a constant hazard rate λ, so that $\dfrac{\omega(\widehat{\theta})}{1-d\Omega(\widehat{\theta})} = \lambda$. Moreover, we define $q(\widehat{\theta}) = \dfrac{\int_{\widehat{\theta}}^{\infty} \alpha(\theta)d\Omega(\theta)}{1-d\Omega(\widehat{\theta})}$ where $q(\widehat{\theta})$ measures the average value of α over the range where refinancing happens. The derivative of $q(\widehat{\theta})$ given by

$$\frac{dq(\widehat{\theta})}{d\widehat{\theta}} = -\frac{\omega(\widehat{\theta})}{(1-d\Omega(\widehat{\theta}))}\alpha(\widehat{\theta}) + \frac{\omega(\widehat{\theta})}{(1-d\Omega(\widehat{\theta}))}\frac{\int_{\widehat{\theta}}^{\infty} \alpha(\theta)d\Omega(\theta)}{1-d\Omega(\widehat{\theta})} = \lambda(q(\widehat{\theta}) - \alpha(\widehat{\theta})) > 0$$

(because α is an increasing function of θ). We can thus rewrite the first-order condition as $\lambda\alpha(\widehat{\theta})(1-\beta) - q(\widehat{\theta}) = 0$. We solve this for the optimal β^*, obtaining $\beta^* = 1 - \dfrac{1}{\lambda}\dfrac{q(\widehat{\theta})}{\alpha(\widehat{\theta})}$. We note that $\beta^* > 0$ if only if

$$\lambda\alpha(\widehat{\theta}) > q(\widehat{\theta}) \Leftrightarrow \lambda > \frac{q(\widehat{\theta})}{\alpha(\widehat{\theta})}(> 1).$$

This says that for lower values of λ, the incremental benefit of increasing the signal σ is not worth it. That is, the hazard rate is too low, so that the effect on the marginal probability of getting refinancing is too low. The interesting case is clearly when $\beta^* > 0$, so we assume throughout that λ sufficiently large to ensure the above condition.

A.4 Equilibrium cut-off point

We now use the optimal β^* to examine the equilibrium properties of the cut-off point $\widehat{\theta}$. Recall $\Gamma(\widehat{\theta},\widetilde{\beta},\beta) = \overline{\gamma}\alpha(\widehat{\theta}+\beta-\widetilde{\beta})(1-\widetilde{\beta})x - K = 0$. In equilibrium we have $\widetilde{\beta} = \beta^*$ so that $\Gamma(\widehat{\theta},\beta^*) = \overline{\gamma}\alpha(\widehat{\theta})(1-\beta^*)x - K = 0$. Using $\beta^* = 1 - \frac{1}{\lambda}\frac{q(\widehat{\theta})}{\alpha(\widehat{\theta})}$ we obtain after simple transformations $\Gamma = \frac{\overline{\gamma}x}{\lambda}q(\widehat{\theta}) - K = 0$. This equation determines the equilibrium cut-off point. We totally differentiate this equation to obtain

$$\Gamma_{\widehat{\theta}} = \frac{d\Gamma}{d\widehat{\theta}} = \frac{\overline{\gamma}x}{\lambda}\frac{dq(\widehat{\theta})}{d\widehat{\theta}} = \overline{\gamma}x(q(\widehat{\theta}) - \alpha(\widehat{\theta})) > 0, \quad \text{and } \Gamma_x = \frac{d\Gamma}{dx} = \frac{\overline{\gamma}}{\lambda}q(\widehat{\theta}) > 0.$$

Thus

$$\Gamma_{\widehat{\theta}}d\widehat{\theta} + \Gamma_x dx = 0 \Leftrightarrow \frac{d\widehat{\theta}}{dx} = -\frac{\Gamma_x}{\Gamma_{\widehat{\theta}}} = -\frac{1}{\lambda x}\frac{q(\widehat{\theta})}{q(\widehat{\theta}) - \alpha(\widehat{\theta})} < 0.$$

This shows that the critical cut-off $\widehat{\theta}$ is a decreasing function of x.

A.5 Equilibrium short-term investments

We are now in a position to examine the equilibrium behaviour of β^*. We are particularly interested in

$$\frac{d\beta^*}{dx} = \frac{d}{dx}[1 - \frac{1}{\lambda}\frac{q(\widehat{\theta})}{\alpha(\widehat{\theta})}] = -\frac{1}{\lambda}\frac{d}{dx}\frac{q(\widehat{\theta})}{\alpha(\widehat{\theta})}.$$

We now use our convenient functional form of $\alpha(\theta) = 1 - \exp[-\varphi\theta]$, which gives us

$$\int_{\widehat{\theta}}^{\infty} \alpha(\theta) d\Omega(\theta) = \int_{\widehat{\theta}}^{\infty} [1 - \exp(-\varphi\theta)] \lambda \exp(-\lambda\theta) d\theta.$$

After standard transformations this becomes

$$\int_{\widehat{\theta}}^{\infty} \alpha(\theta) d\Omega(\theta) = \exp(-\lambda\widehat{\theta})[1 - \frac{\lambda}{\varphi+\lambda} \exp(-\varphi\widehat{\theta})].$$

We use this in

$$q(\widehat{\theta}) = \frac{\int_{\widehat{\theta}}^{\infty} \alpha(\theta) d\Omega(\theta)}{1 - d\Omega(\widehat{\theta})} = 1 - \frac{\lambda}{\varphi+\lambda} \exp(-\varphi\widehat{\theta}).$$

We also have

$$\int_{\widehat{\theta}}^{\infty} \alpha(\widehat{\theta}) d\Omega(\theta) = \alpha(\widehat{\theta}) \int_{\widehat{\theta}}^{\infty} \lambda \exp(-\lambda\theta) d\theta,$$

which after transformations yields

$$\int_{\widehat{\theta}}^{\infty} \alpha(\widehat{\theta}) d\Omega(\theta) = \exp(-\lambda\widehat{\theta})[1 - \exp(-\varphi\widehat{\theta})].$$

Combining these expressions we obtain

$$\frac{q(\widehat{\theta})}{\alpha(\widehat{\theta})} = \frac{1 - \frac{\lambda}{\varphi+\lambda} \exp(-\varphi\widehat{\theta})}{1 - \exp(-\varphi\widehat{\theta})}.$$

We can now consider the derivative w.r.t. x. We have

$$\frac{d}{d\widehat{\theta}}\frac{q(\widehat{\theta})}{\alpha(\widehat{\theta})} = \frac{Q(\widehat{\theta})}{[1-\exp(-\varphi\widehat{\theta})]^2} \text{ where}$$
$$Q(\widehat{\theta}) = [1-\exp(-\varphi\widehat{\theta})]\frac{\varphi\lambda}{\varphi+\lambda}\exp(-\varphi\widehat{\theta}) - [1-\frac{\lambda}{\varphi+\lambda}\exp(-\varphi\widehat{\theta})]\varphi\exp(-\varphi\widehat{\theta}).$$

This yields after transformations $Q(\widehat{\theta}) = -\frac{\varphi^2}{\varphi+\lambda}\exp(-\varphi\widehat{\theta}) < 0$. It follows that

$$\frac{d}{d\widehat{\theta}}\frac{q(\widehat{\theta})}{\alpha(\widehat{\theta})} = -\frac{\varphi^2}{\varphi+\lambda}\frac{\exp(-\varphi\widehat{\theta})}{[1-\exp(-\varphi\widehat{\theta})]^2} < 0.$$

With this, we finally obtain

$$\frac{d\beta^*}{d\widehat{\theta}} = \frac{1}{\lambda}\frac{\varphi^2}{\varphi+\lambda}\frac{\exp(-\varphi\widehat{\theta})}{[1-\exp(-\varphi\widehat{\theta})]^2} > 0.$$

This shows that the optimal β^* is an increasing function of the cutoff level $\widehat{\theta}$.

Next, recall that $\frac{d\widehat{\theta}}{dx} = -\frac{1}{\lambda x}\frac{q(\widehat{\theta})}{q(\widehat{\theta})-\alpha(\widehat{\theta})} < 0$. Using our functional form assumptions, and after some transformations, we obtain

$$\frac{q(\widehat{\theta})}{q(\widehat{\theta})-\alpha(\widehat{\theta})} = \frac{\varphi+\lambda-\lambda\exp(-\varphi\widehat{\theta})}{\varphi\exp(-\varphi\widehat{\theta})}, \text{ so that}$$
$$\frac{d\widehat{\theta}}{dx} = -\frac{1}{\lambda x}\frac{\varphi+\lambda-\lambda\exp(-\varphi\widehat{\theta})}{\varphi\exp(-\varphi\widehat{\theta})}$$

Recalling $\beta^* = 1-\frac{1}{\lambda}\frac{q(\widehat{\theta})}{\alpha(\widehat{\theta})}$, we obtain

$$\frac{d\beta^*}{dx} = \frac{d\beta^*}{d\widehat{\theta}}\frac{d\widehat{\theta}}{dx} = \frac{1}{\lambda}\frac{\varphi^2}{\varphi+\lambda}\frac{\exp(-\varphi\widehat{\theta})}{[1-\exp(-\varphi\widehat{\theta})]^2} * \frac{-1}{\lambda x}\frac{\varphi+\lambda-\lambda\exp(-\varphi\widehat{\theta})}{\varphi\exp(-\varphi\widehat{\theta})}.$$

After transformations we obtain

$$\frac{d\beta^*}{dx} = -\frac{\varphi}{\lambda^2 x}\frac{1-\dfrac{\lambda}{\varphi+\lambda}\exp(-\varphi\widehat{\theta})}{[1-\exp(-\varphi\widehat{\theta})]^2} < 0.$$

This shows that β^* decreasing in x.

Since $\widehat{\theta}$ is also decreasing in x, it follows that $\widehat{\sigma} = \widehat{\theta} + \beta^*$ is also decreasing in x, i.e., $\frac{d\widehat{\sigma}}{dx} = \frac{d\widehat{\theta}}{dx} + \frac{d\beta^*}{dx} < 0$.

Overall, we have thus shown that higher values of x generate a lower signal threshold $\widehat{\sigma}$, and lower revenue threshold $R(\widehat{\sigma})$, and thus also a higher loss tolerance $L(\widehat{\sigma})$.

B Financial statements

This section outlines the income statement and balance sheet items from the annual reports submitted to the Swedish Companies Registration Office and shows how we use these to construct cash flow statements.

We are interested in studying how companies use cash flows. The annual reports submitted to the Companies Registration Office include an income statement and a balance sheet, neither of which directly shows how cash is spent or generated. The balance sheet shows the aggregate net change in cash from the previous to the current fiscal year. The income statement lists income and expense items that reflect economic activity regardless of when cash is exchanged.[16] It recognizes economic activity by matching revenue and expenses when a transaction occurs, and not when a payment is made.[17] We therefore use the income statement and balance sheet information to construct cash flow statements. Section B.1 uses a stylized example to illustrate how the income statement and balance sheet record transactions, and how the timing of these can be different from when cash is exchanged.

To give some intuition for how we construct the cash flow statements, we use the property of the balance sheet that the total of the left-hand side (assets) is equal to the total of the right-hand side (liabilities and equity).

$$Assets = Liabilities + Equity \tag{2}$$

This implies that the changes from one fiscal year to the next must also be equal on both sides of the balance sheet.

$$\Delta Assets = \Delta Liabilities + \Delta Equity \tag{3}$$

[16]This is known as accrual accounting.
[17]This is known as matching principle.

We can decompose the change in assets into the change in cash and the change in all other items, and then solve for the change in cash.

$$\Delta Cash = -\Delta \textit{Non-cash assets} + \Delta Liabilities + \Delta Equity \tag{4}$$

The cash flow statement breaks down the net change in cash on the balance sheet into cash provided by or used for operating, investing, and financing activities during a fiscal year. To compute the net cash from operating activities, we take the net profit/loss from the income statement and adjust it by using non-cash items from the income statement as well as changes in current asset and current liability accounts from the balance sheet. For example, we add back depreciation expenses which decrease net profit but do not involve a cash outflow. Most adjustments to compute the net cash from financing activities involve summing up changes in non-current liability and equity accounts. We calculate the net cash from investing activities as a balancing amount by taking the net change in cash on the balance sheet and subtracting the sum of net cash from operating and financing activities. Figure IA.1 illustrates how we use items from the income statement and balance sheet account categories to construct the cash flow statement activities. Section B.4 outlines all adjustments we make to construct cash flow statements.

A limitation of the data is that we can only observe net changes in balance sheet items and not all underlying transactions. Ideally, we would break down net changes in balance sheet items into transactions that involve cash and those that do not. We would then only use transactions that involve cash and assign each to either operating, investing, or financing activities. For example, the net change in the balance sheet item machinery can combine the purchase of a new machine for cash (involves cash) and depreciation (does not involve cash). The purchase decreases *Cash* and increases *Non-cash assets* in Equation 4 by the same amount. Depreciation, on the other hand, decreases both *Non-cash assets* and *Equity* on the right-hand side of Equation 4, leaving cash unchanged. Using the net change in machinery when constructing the cash flow statement would understate the cash outflow from investing activities.

Using net changes in balance sheet items introduces the largest measurement error in the calculation of net cash from investing activities because non-cash transactions account for a relatively large part of non-current assets. Net cash from operating and financing activities should be mostly unaffected. The biggest source of measurement error in net cash from operating activities is most likely the difference between observable tax expenses on the income statement and unobservable actual taxes paid (the effective tax rate). We do not expect this to have a significant effect because our sample consists of young companies for whom tax optimization is probably not that important. Using net changes in balance sheet items for constructing the cash flow statement should not affect the calculation of net cash from financing activities.

We compute net cash from investing activities by taking the net change in cash on the balance sheet and subtracting the sum of net cash from operating and financing activities. This minimizes the measurement error in breaking down the net change in cash into net cash from each of the three activity categories (operating, investing, financing) by trading off granularity in investing activities. We calculate net cash from investing activities as a balancing amount as opposed to the sum of cash from different investing activities.

Companies can choose between the nature of expense and cost of sales accounting types when preparing the income statement. The nature of expense method is easier to follow because it assigns expenses to categories (e.g., raw materials or depreciation), whereas the cost of sales method breaks down expenses according to their function (e.g., cost of goods sold or administrative expenses). The main drawback of the nature of expense method is that the income statement does not show a gross profit. Almost all income statements in our dataset follow the nature of expense method, and companies rarely switch accounting types. Sections B.2.1 and B.2.2 outline income statement items for the nature of expense and cost of sales accounting types, respectively. Similarly, Sections B.4.1 and B.4.2 show how we construct cash flow statements for either accounting type.

Smaller companies have the option to submit abridged annual reports. We find that these companies often leave the most granular balance sheet items blank and only provide the total for that account category. For example, total inventories is much less likely to be missing than its two components work in progress and other inventories. We therefore use the total amounts of account categories instead of the respective component accounts to construct cash flow statements for smaller companies. Abridged annual reports: Cash flow statement outlines all adjustments that we make when constructing cash flow statements for smaller companies.

B.1 Stylized example

This section uses a stylized example to illustrate how transactions are recorded on the balance sheet and income statement, and that the timing of these can be different from when cash is exchanged.

A company produces a good in period 1, sales the good on account in period 2, and receives payment for the sold good in period 3. In period 1, the asset side of the balance sheet shows a decrease in raw materials and a complementary increase in finished goods reflecting the production costs of the good. This is known as an asset swap because total assets remain unchanged. The income statement does not record anything. In period 2, the asset side of the balance sheet shows a decrease in finished goods by the production costs and an increase in accounts receivable by the sales price. This usually results in an increase of total assets because the sales price of a good is typically higher than its production costs. The income statement reports the sales price of the good as revenue and its production costs as expense. The sales profit appears as net income on the income statement and increases retained earnings (part of equity) on the balance sheet. Both sides of the balance sheet increase by the same amount, the sales profit. In period 3, the balance sheet shows another asset swap with an increase in cash and a decrease in accounts receivable by the sales price. Again, the income statement does not record anything.

This stylized example shows that the company records a profit on the income statement and balance sheet at the time of the sale (period 2), and not when it receives the cash payment (period 3). We therefore create cash flow statements, which reflect when cash is exchanged, to study how companies manage cash flows.

B.2 Income statement

B.2.1 Nature of expense method

Item

Net sales
± Inventory change
± Capitalized work
+ Other operating income
− Raw materials and consumables
− Goods for resale
− Other external expenses
− Salaries and benefits
− Depreciation
± Financial items affecting comparability
− Other operating expenses
Operating profit/loss
± Profit/loss from group companies
+ Interest income from group companies
+ External interest income
+ Other financial income
− Interest expenses to group companies

− External interest expenses
− Other financial expenses
Profit/loss after net financial income
+ Extraordinary income
− Extraordinary expenses
± Group contributions
± Shareholders' contributions
± Appropriations
− Taxes
± Minority shareholdings
Net profit/loss

B.2.2 Cost of sales method

Item

Net sales
− Cost of goods sold
Gross profit/loss
− Selling expenses
− Administrative expenses
− R&D expenses
± Financial items affecting comparability
+ Other operating income
− Other operating expenses
Operating profit/loss
± Profit/loss from group companies
+ Interest income from group companies
+ External interest income
+ Other financial income
− Interest expenses to group companies

− External interest expenses
− Other financial expenses
Profit/loss after net financial income
+ Extraordinary income
− Extraordinary expenses
± Group contributions
± Shareholders' contributions
± Appropriations
− Taxes
± Minority shareholdings
Net profit/loss

B.3 Balance sheet

Item

Assets
Cash
Short-term investments
Accounts receivable
Current receivables from group/associated companies
Other current receivables
Total current receivables
Work in progress
Other inventories
Total inventories
Total current assets
Participation in group/associated companies
Long-term receivables from group/associated companies
Loans to partners and related parties
Other financial assets
Total financial assets

Buildings and land
Machinery
Equipment
Machinery and equipment
Other tangible fixed assets
Total tangible fixed assets

Subscribed capital unpaid
Capitalized R&D expenses
Patents, licenses, concessions etc.
Goodwill
Other intangible fixed assets
Total intangible fixed assets

Total fixed assets

Total assets

Liabilities and equity
Current liabilities to credit institutions
Accounts payable
Current liabilities to group/associated companies
Other current liabilities

Total current liabilities

Untaxed reserves
Minority shareholding
Provisions
Bonds

Non-current liabilities to credit institutions
Non-current liabilities to group/associated companies
Other non-current liabilities

Total non-current liabilities

Nominal share capital
Share premium reserve

Revaluation reserve
Other restricted equity
Profit/loss brought forward
Group contributions
Shareholders' contributions
Profit/loss for the year

Total equity

Total liabilities and equity

B.4 Cash flow statement

B.4.1 Nature of expense method

Item

OPERATING ACTIVITIES

Net profit/loss
+ Depreciation
− Group contributions
− Shareholders' contributions
− Appropriations
− Δ Accounts receivable
− Δ Current receivables from group/associated companies
− Δ Other current receivables
− Δ Work in progress
− Δ Other inventories
+ Δ Current liabilities to credit institutions
+ Δ Accounts payable
+ Δ Current liabilities to group/associated companies
+ Δ Other current liabilities
+ Δ Deferred taxes

Net cash provided by/used in operating activities

FINANCING ACTIVITIES

Group contributions

+ Shareholders' contributions

+ Appropriations

− Dividends

+ Δ Bonds

+ Δ Non-current liabilities to credit institutions

+ Δ Non-current liabilities to group/associated companies

+ Δ Other non-current liabilities

+ Δ Nominal share capital

+ Δ Share premium reserve

+ Δ Revaluation reserve

+ Δ Other restricted equity

Net cash provided by/used in financing activities

INVESTING ACTIVITIES

Δ Cash

− Net cash provided by/used in operating activities

− Net cash provided by/used in financing activities

Net cash provided by/used in investing activities

B.4.2 Cost of sales method

Item

OPERATING ACTIVITIES

Net profit/loss

+ Depreciation of cost of goods sold

+ Depreciation of selling expenses

+ Depreciation of administrative expenses

+ Depreciation of R&D expenses

+ Depreciation of other operating expenses

+ Unspecified depreciations

− Group contributions
− Shareholders' contributions
− Appropriations
− Δ Accounts receivable
− Δ Current receivables from group/associated companies
− Δ Other current receivables
− Δ Work in progress
− Δ Other inventories
+ Δ Current liabilities to credit institutions
+ Δ Accounts payable
+ Δ Current liabilities to group/associated companies
+ Δ Other current liabilities
+ Δ Deferred taxes

Net cash provided by/used in operating activities

FINANCING ACTIVITIES

Group contributions
+ Shareholders' contributions
+ Appropriations
− Dividends
+ Δ Bonds
+ Δ Non-current liabilities to credit institutions
+ Δ Non-current liabilities to group/associated companies
+ Δ Other non-current liabilities
+ Δ Nominal share capital
+ Δ Share premium reserve
+ Δ Revaluation reserve
+ Δ Other restricted equity

Net cash provided by/used in financing activities

INVESTING ACTIVITIES

Δ Cash
− Net cash provided by/used in operating activities

− Net cash provided by/used in financing activities

Net cash provided by/used in investing activities

B.5 Abridged annual reports: Cash flow statement

This section shows how we construct cash flow statements for companies that submit abridged annual reports to the Swedish Companies Registration Office.

B.5.1 Nature of expense method

Item

OPERATING ACTIVITIES

Net profit/loss

+ Depreciation

− Group contributions

− Shareholders' contributions

− Appropriations

− Δ Total current receivables

− Δ Total inventories

+ Δ Total current liabilities

+ Δ Deferred taxes

Net cash provided by/used in operating activities

FINANCING ACTIVITIES

Group contributions

+ Shareholders' contributions

+ Appropriations

− Dividends

+ Δ Bonds

+ Δ Total non-current liabilities

+ Δ Nominal share capital

+ Δ Share premium reserve

$+ \Delta$ Revaluation reserve

$+ \Delta$ Other restricted equity

Net cash provided by/used in financing activities

INVESTING ACTIVITIES

Δ Cash

$-$ Net cash provided by/used in operating activities

$-$ Net cash provided by/used in financing activities

Net cash provided by/used in investing activities

B.5.2 Cost of sales method

Item

OPERATING ACTIVITIES

Net profit/loss

$+$ Depreciation of cost of goods sold

$+$ Depreciation of selling expenses

$+$ Depreciation of administrative expenses

$+$ Depreciation of R&D expenses

$+$ Depreciation of other operating expenses

$+$ Unspecified depreciations

$-$ Group contributions

$-$ Shareholders' contributions

$-$ Appropriations

$- \Delta$ Total current receivables

$- \Delta$ Total inventories

$+ \Delta$ Total current liabilities

$+ \Delta$ Deferred taxes

Net cash provided by/used in operating activities

FINANCING ACTIVITIES

Group contributions

$+$ Shareholders' contributions

$+$ Appropriations

$-$ Dividends

$+ \Delta$ Bonds

$+ \Delta$ Total non-current liabilities

$+ \Delta$ Nominal share capital

$+ \Delta$ Share premium reserve

$+ \Delta$ Revaluation reserve

$+ \Delta$ Other restricted equity

Net cash provided by/used in financing activities

INVESTING ACTIVITIES

Δ Cash

$-$ Net cash provided by/used in operating activities

$-$ Net cash provided by/used in financing activities

Net cash provided by/used in investing activities

C Internet Appendix Figures

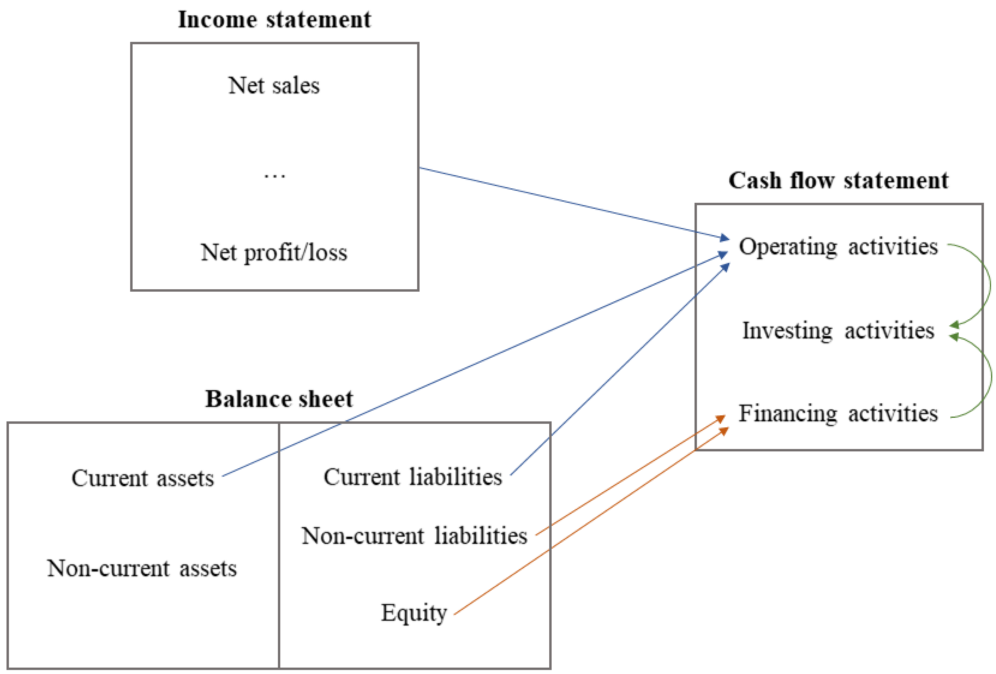


Figure IA.1. Financial statements. This figure illustrates how we use items from the income statement and balance sheet account categories to construct the cash flow statement activities.