**Escalation of commitment in venture capital decision making: Differentiating between domestic and international investors**

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**ABSTRACT**

Drawing upon an escalation of commitment framework, this study investigates how differences between cross-border and domestic venture capital investors in emotional, social and institutional factors affect their decision to terminate an unsuccessful investment. We track the exit outcome of 1060 venture capital investments in 684 European technology companies. Results show that domestic investors have a high tendency to escalate their commitment to a failing course of action while cross-border investors terminate their investments efficiently, even when investing through a local branch. This is explained by cross-border investors having a lower social and emotional involvement with the project and a lower embeddedness in the local economic and social environment, decreasing individual decision biases. Further, they are impacted to a lower extent by normative pressures to further invest from their co-investment network. Local branches of cross-border investors are also shielded from escalation of commitment. We conjecture that their international investment committee acts as an organizational safeguard against individual decision biases. Domestic investors may hence benefit from mimicking the behavior of cross-border investors.

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**Executive Summary**

We explore two novel related research questions. First, does the propensity of international VC investors to escalate their commitment when portfolio companies underperform differ from that of domestic VC investors? We argue that more limited emotional attachment, lower social embeddedness and lower normative pressures faced by international VC investors reduce individual decision biases. We hypothesize that the likelihood of terminating underperforming ventures will be higher for cross-border VC investors than for domestic VC investors, as they are less emotionally and socially attached to the portfolio company and are less prone to normative pressures from their peer network. Our second question addresses whether escalation of commitment differs depending on internationalization mode. Establishment of a local branch office is widely-used to mitigate the frictions associated with geographic and cultural distance. We hypothesize that the likelihood of terminating underperforming ventures will be higher for international VC investors investing from headquarters than for international VC investors investing through a local branch. We also hypothesize that the likelihood of terminating underperforming ventures will be higher for international VC investors investing through a local branch than for domestic VC investors.

To test our hypotheses, we use a unique hand collected sample of technology based companies from seven European countries. The sample contains longitudinal data on 1618 unique rounds of VC investments by 1060 VC investors in 684 ventures from 1994 until 2011. We model the effect of investor origin and investment mode on the hazards of successful and unsuccessful exits in acompeting risks model.

We show that domestic VC investors are more likely to escalate their commitment to a failing course of action and provide novel evidence of contrasting behavior for VCs investing across borders. Whether investing directly or through a local office, cross-border VC investors’ lower emotional involvement with the entrepreneur and lower embeddedness in the local economic and social environment, together with an international decision making committee which acts as organizational safeguard, makes them less likely to escalate their commitment.

We contribute first by showing that being a foreigner can induce more rational decision making regarding the abandonment of underperforming projects. Second, we extend existing literature by hypothesizing and demonstrating empirically that geographical heterogeneity has differential impacts on VC proclivity to escalation of commitment, that is, it depends on whether the VC is a domestic, cross-border or branch investor. Third, we contribute by demonstrating that organizational safeguards can be an effective tool to mitigate the proclivity to escalate commitment. Finally, by providing a more fine-grained classification of trade sales and buy-outs as successful or unsuccessful exits we offer a methodological contribution to the VC exit literature.

For practitioners, our evidence suggests that domestic VC investors may learn from foreign VC investors to improve decision making processes to reduce the problem of escalation of commitment. The finding that branch VCs do not escalate commitment indicates that their organizational safeguards provided by investment committees consisting of both local and head office executives prevents them from escalating commitment. Domestic VC investors may implement this organizational safeguard by having an investment committee comprising international executives, even for evaluating domestic projects, but also adopt anti-embarrassment clauses to protect themselves from a terminated underperforming portfolio company subsequently becoming very successful. As we have demonstrated that cross-border VC or branch VC may terminate investments more easily when portfolio companies do not meet expectations, our evidence indicates that entrepreneurs should carefully evaluate potential investors and target investors that match their needs.

**INTRODUCTION**

Venture capital (VC) investors are professional investors who take equity stakes in young, growth-oriented companies. The VC industry was for long a local industry (Cumming and Dai, 2010; Wright and Robbie, 1998), because geographic proximity to investment targets was deemed essential for efficient deal flow generation and evaluation (Sorenson and Stuart, 2001) and for post-investment monitoring and value adding services (Mäkelä and Maula, 2006). The enhanced domestic competition in maturing VC industries has increasingly driven VC firms to search for investment opportunities abroad (Meuleman and Wright, 2011; Tykvová and Schertler, 2011; Schertler and Tykvová, 2011). As a result, the number of international transactions has now become non-negligible, with one in eight VC-backed companies worldwide now receiving VC from an international investor. A deeper understanding of the international VC phenomenon is hence warranted (Wright, Pruthi and Lockett, 2005).

Research on international VC has largely started from the observation that international VC firms face liabilities of foreignness compared to domestic VC firms, induced by increased geographical, cultural and institutional distances between VC investors and their portfolio companies (Wright et al., 2005). We highlight how international VC firms have an advantage compared to domestic VC firms. More specifically, we argue and show that international VC firms, whether investing from a cross-border entity or from a local branch office, terminate their failing investments more rationally compared to domestic VC firms, who have a higher tendency to escalate their commitment to a failing course of action.

Terminating investments is particularly important for VC investors as about one third of investments eventually fail (Puri and Zarutski, 2012). When investments fail to meet initial expectations, decision makers face a “liquidation dilemma”: they may favor continuing to finance the project to retain the option of improvement or they may decide to terminate, which results in the crystallization of certain losses. Persisting to invest in a poorly performing project that eventually fails, however, not only wastes financial and temporal resources but alternative and more promising investment opportunities are foregone (Li and Chi, 2013). Even for seasoned investors, pulling the plug on underperforming investments is difficult: “[VCs] don’t fail because they backed bad companies but because they keep shoveling money into them” (Hardymon, Lerner, and Leamon, 2007:8). VCs therefore put several mechanisms in place to prevent this irrational behavior (Guler, 2007). Nevertheless, VC firms may still be prone to escalate their commitment to a failing course of action (Birmingham, Busenitz, and Arthurs, 2003; Guler, 2007).

However, previous research has not conceptualized the home country heterogeneity of VC firms and the potential differential implications for escalation of commitment. Our goal is to address this gap by exploring differences in the propensity of international VCs and domestic VCs to escalate commitment when portfolio companies do not meet expectations. We expect that in contrast to domestic VCs, increased cultural and geographical distance faced by international VC firms, leading to lower emotional, social and institutional pressures, reduces their termination decision biases. While most research on international VC disregards the entry mode, the establishment of a local branch office is a widely-used strategy to mitigate the frictions associated with geographic and cultural distance (Dai, Jo and Kassicieh, 2012). This raises the question whether VC firms investing from a branch office resemble more domestic VC firms or VC firms investing from their home country across borders. We therefore further differentiate between international VC firms investing from their home country (cross-border VC firms) and those investing from a local branch office (branch VC firms). This important distinction has been largely ignored in the international VC literature.

We use a unique hand collected sample of technology based companies from seven European countries that received initial VC investment between 1994 and 2004. The sample contains longitudinal data on 1618 unique rounds of VC investments by 1060 VC firms in 684 ventures. We model the effect of investor origin and entry mode on the hazards of successful exits and terminations in acompeting risks model. We show that while domestic VC firms escalate their commitment towards a failing course of action, cross-border VC firms terminate investing in unsuccessful ventures in a rational way. Further, domestic VC firms have a significantly higher probability to escalate commitment compared to branch VC firms. We fail to find differences in the probability to escalate commitment between cross-border VC firms investing from their headquarters or from a local branch, which suggests that the risk of escalation behavior can be reduced through organizational safeguards such as the use of a firm-level investment committee that includes distant members.

Our study makes several contributions. First, we contribute to understanding behavioral differences between domestic and international VC firms, as previous studies on international VC have mainly focused on either the rationale for international investments or on explaining investment success (Mäkelä and Maula, 2006; Wright et al., 2005). We show that being a foreigner may not always be negative but can induce more rational decision making regarding the abandonment of underperforming projects. Second, we add to the few studies that examine unsuccessful exits by VC firms (Cumming and Dai, 2010). More specifically, we extend Guler’s (2007) study, which first showed the escalation behavior in VC investments, by hypothesizing and demonstrating empirically that VC proclivity to escalation of commitment is heterogeneous depending on whether the VC is a domestic, cross-border or branch investor. We document that this geographical heterogeneity manifests itself through international VC firms having an advantage compared to domestic VC firms, as they are less prone to escalate their commitment to a failing portfolio company, and hence can redeploy their financial and temporal resources more efficiently. Finally, by providing a more fine-grained classification of trade sales and buy-outs as successful or unsuccessful exits we offer a methodological contribution to the VC exit literature.

The rest of the paper is organized as follows. We first briefly describe the state of the art of relevant international VC research. Thereafter, hypotheses are developed on the impact of VC firm origin and its investment structure on the probability to escalate commitment. Next, we outline our research method, including the sample, the measurement of escalation of commitment, variables and method of analysis. This is followed by a presentation of the main findings, including robustness tests. Finally, a discussion of the results from both a theoretical and a practical perspective concludes this paper.

**INTERNATIONAL VENTURE CAPITAL**

International VC investors are hampered by liabilities of foreignness, driven by increased geographical, cultural and institutional distance between VC investors and their portfolio companies (Wright et al., 2005). This gives rise to higher information asymmetries and ensuing agency risk (Wright and Robbie, 1998). Research has addressed how international VC firms select, manage and exit their targets. Foreign VC firms are more likely to invest in more information-transparent companies, i.e. in a later stage, a later round or in larger deals (Chemmanur, Hull and Krishnan, 2012; Dai et al., 2012; Schertler and Tykvová, 2011). They prefer to act as non-lead investors, which involves lower resource consumption from the VC investor (Cumming and Dai, 2010; Gupta and Sapienza, 1992). Corporate VC firms and more reputable VC firms – i.e. older, larger, more experienced and with stronger IPO track record – exhibit broader geographic scope (Cumming and Dai, 2010; Gupta and Sapienza, 1992), thus leveraging their reputation in a broader geographic area.

Further, a VC firm’s human and social capital also has a major impact on its probability to invest internationally (Cumming and Dai, 2010; Sorenson and Stuart, 2001). VC firms with more managers with foreign experience invest more intensively abroad (De Prijcker, Manigart, Wright et al., 2012; Schertler and Tykvová, 2011) since they are more familiar with the institutional and legal environment in foreign countries and have better access to international networks. VC firms’ domestic social status is transferable between countries (Guler and Guillén, 2010), leading to higher international deal flow generation for higher status VC firms. Social networks in the VC industry - developed through syndication or joint investments – diffuse information about potential investment opportunities across boundaries, thereby expanding the spatial investment radius of VC investors (Sorenson and Stuart, 2001). Better networked VC firms hence exhibit less local bias (Cumming and Dai, 2010; Sorenson and Stuart, 2001).

A frequently used strategy to address liabilities of foreignness is to syndicate with a local VC firm as this allows outsourcing of monitoring and value adding functions to local co-investors who are not hindered by geographical, cultural or institutional distance (Mäkelä and Maula, 2008; Chemmanur et al., 2012). Additionally, a syndicate comprising both local and international VC investors provides a broader skill set, experience and networks which may generate additional value to portfolio companies (Schertler and Tykvová, 2011; Devigne, Vanacker, Manigart et al. 2013). Co-investing with domestic VC investors is especially valuable for VC firms with less international experience (Meuleman and Wright, 2011) or when entering less institutionally developed countries (Chemmanur et al., 2012; Dai et al., 2012; Guler and Guillén, 2010; Meuleman and Wright, 2011).

Liabilities of foreignness are consistent with international VC firms being less likely than domestic VC firms to have successful exits, controlling for portfolio firm quality and VC firm reputation (Cumming and Dai, 2010; Humphery-Jenner and Suchard, 2013). The probability of a successful exit is nevertheless higher when investing in later stage companies (Humphery-Jenner and Suchard, 2013). Investment success increases when local and international VC firms co-invest, especially when investing in early stage companies (Chemmanur et al., 2012; Cumming and Dai, 2010). Specifically, portfolio companies with both cross-border and local VC investors are about 5% more likely to successfully exit compared with portfolio companies backed by international VC firms only (Dai et al., 2012).

The VC termination decision is as yet not well understood as the literature has devoted limited attention to the influence of the locational heterogeneity of VCs. While most of the international VC literature starts from the assumption that international VC investors face liabilities of foreignness, our study aims to investigate whether international VC investors may have an advantage compared to domestic VC investors when deciding to terminate their investment in an unsuccessful portfolio company. We further distinguish between the internationalization mode of international VC investors, which has largely been neglected in the literature (Manigart and Wright, 2013). Nevertheless, VC investors investing across borders from headquarters face different issues compared to those investing from a local branch office. Hence, we advance the international VC literature by explicitly theorizing about how branch VC investors compare with either cross-border VC investors or domestic VC investors.

**DEVELOPMENT OF hypotheses**

VC firms stage the infusion of capital in their portfolio companies, which grants them the opportunity to gather information to monitor portfolio company progress and provides the flexibility to discontinue funding projects of which the prospects have fallen (Gompers, 1995; Li and Chi, 2013). VC firms are frequently confronted with underperforming portfolio companies, which should make them experts in dealing with these adverse situations (Sahlman, 1990). Nevertheless, VC investors tend to avoid terminating unsuccessful investments, i.e. to escalate their commitment and continue to invest, even when new information shows the portfolio company does not meet expectations (Guler, 2007). This is surprising, as VC firms protect themselves against this decision bias. First, investment and termination decisions typically require recommendations to be approved by one or more investment committees (Wright and Robbie, 1998), rather than by an individual. An individual investment manager’s emotional attachment to a portfolio company with whom (s)he worked closely may avoid accepting new negative information (Guler, 2007). This is consistent with self-justification theory, which suggests psychological pressures as explanation of escalation of commitment to a failing course of action (Sleesman, Conlon, McNamara et al., 2012). Having an investment committee, rather than an individual, deciding on further investments should hence reduce biases and improve the quality of the decision, although political pressures within investment committees may hamper this process (Guler, 2007).

In addition, VC firms frequently co-invest or syndicate investments with other VC firms which should provide a “second opinion” from their peers (Wright and Lockett, 2003). Nevertheless, institutional influences, including coercive and normative pressures from syndicate partners may explain escalation behavior (Guler, 2007). Coercive pressures from co-investors may be contractual, in that terminating investors may be disproportionally diluted or lose their rights (“pay-to-play” clauses). Syndicate partners may also impose normative pressures, as “standing by your venture and invest further even when the conditions get tough” (Guler, 2007:261) is considered the norm in the industry. Failing to comply with this norm may have a negative effect on the VC investor’s reputation and limit access to critical resources, such as future deal flow reciprocated by syndicate partners (Mäkelä and Maula, 2006).

Our study extends this research stream by conceptualizing differences between cross-border and domestic VC firms. We first theorize how emotional, social and institutional differences between cross-border and domestic investors influence different tendencies to escalate commitment to a failing course of action. We then theorize how investing from a local branch may affect escalation of commitment differently from investing cross-border at arms’ length.

**Domestic versus cross-border VC firms**

Compared to domestic VC firms, cross-border VC firms face challenges of larger geographic distance to their portfolio companies but also of cultural and legal differences. These lead to differences in emotional attachment and social embeddedness, which is expected to impact escalation of commitment. Stakeholders of decision makers can give rise to escalation of commitment as decision makers may get emotionally involved with stakeholders or may want to strategically manage the impressions others have of them (Sleesman et al., 2012). The level of escalation of commitment that decision makers face may thus be contingent upon the extent that doing so will portray them in a more favorable light towards external stakeholders. Escalation of commitment is therefore more likely to occur when continuing is more emotionally and socially appropriate than quitting.

A first direct key stakeholder for VC firms is the entrepreneur in whom they invest. Domestic VC firms have frequent social interaction with entrepreneurs, creating positive feelings (De Clercq and Sapienza, 2006) and emotional attachment (Benson and Ziedonis, 2010). This will increase pressure to safeguard the portfolio company, as this is important for the entrepreneur. Emotional attachment to the entrepreneur may therefore lead to a higher probability to escalate commitment (Wong, Yik, and Kwong, 2006; Benson and Ziedonis, 2010). The greater geographical and social distance cross-border VC firms face makes it more difficult for them to have frequent informal contacts and thus to build and maintain high quality social and emotional relationships with entrepreneurs. Moreover, cross-border VC firms generally face a greater cultural distance to the entrepreneur compared to domestic VC firms. This may cause difficulties in effective communication and lead to lower mutual levels of trust and emotional attachment (Guiso, Sapienza, and Zingales, 2008). This leads cross-border VC firms to adopt a more transactional approach, evidenced by the use of high–powered contracts with well-defined and strict benchmarks (Dai et al., 2012). The transactional approach should make it easier for a cross-border VC firm to terminate an investment compared to domestic VC firms (Mäkela and Maula, 2006).

Other local community stakeholders have a strong interest in portfolio company survival. VC firms may escalate their commitment in order to manage the impression of these stakeholders. Domestic VC managers are culturally more proximate to the portfolio company, and more embedded in the local community (Mäkelä and Maula, 2006). They frequently interact with local community stakeholders such as financiers, other local entrepreneurs or policy makers. As a result, they likely have a higher nationalistic bond compared to cross-border VC investors. Domestic VC managers will therefore face higher social pressures from local stakeholders. This may induce them to enroll in impression management by continuing to invest. In contrast, cross-border VC investment managers may decide more easily to divest, as they are less embedded in the portfolio company’s community (Boddewyn, 1983; Mäkelä and Maula, 2006). Social pressures associated with terminating a portfolio company in their home market may hence impact a domestic VC firm more strongly compared to cross-border VC firms terminating an investment in a foreign country, as it is more distant from their local ecosystem. We thus expect domestic VC firms to be more prone to escalate commitment compared with cross-border VC firms.

Syndicate partners, as important stakeholders, also exert strong normative pressures to escalate commitment to a failing course of action, as terminating is expected to be associated with reputation loss and future deal flow within the VC community (Guler, 2007; Mäkelä and Maula, 2006). As both are valuable resources for any VC firm, VCs tend to continue to invest in order not to jeopardize them. We argue that local reputation and deal sourcing is more important for domestic VC investors compared with cross-border VC investors. It is well documented that VC investors exhibit an investment bias towards more proximate portfolio companies (Sorenson and Stuart, 2001; Cumming and Dai, 2010). Some VC investors exhibit less local bias, especially larger VC investors (Sorenson and Stuart, 2001) and VC investors with a broader or more geographically diversified network (Cumming and Dai, 2010). Nevertheless, even the larger and better networked VC investors invest predominantly in their proximity (Sorenson and Stuart, 2001; Cumming and Dai, 2010). This implies that the home environment is more important for VC deal and syndicate partner sourcing compared to *any* international environment, and hence home reputation should be relatively more of a concern compared to international reputation. Cross-border VC investors failing to continue to invest in a portfolio company outside their home market will have a more limited impact on their home reputation. Their access to deal flow and syndicate partners in other markets will mean that their failure to comply to the norms in a particular deal outside their home market will have more limited negative consequences for them. Therefore, cross-border VC investors may feel relatively more secure terminating their investments and thereby deviating from the norms (Podolny, 2005).

For domestic VC investors, in contrast, their local network and reputation in the local VC community is very important. Domestic VC firms hence risk losing relatively more in terms of reputation and deal sourcing compared to cross-border VC investors, and will therefore be more strongly influenced by the normative pressures from their co-investors. Hence:

*Hypothesis 1: The probability that the hazard of a VC firm terminating investment in a portfolio company will deviate from the conditional hazard of success over rounds is higher for domestic VC firms compared to cross-border VC firms.*

**Cross-border investments from headquarters versus from a local branch**

To mitigate liabilities of foreignness, VC firms pursuing an internationalization strategy may establish a local branch, thereby sharing characteristics of both domestic and cross-border VC investors. A local branch ensures proximity to entrepreneurs, thereby reducing asymmetric information problems (Pruthi et al., 2009). When employing local investment professionals in the branches, cultural and institutional differences disappear, further facilitating transfer of knowledge and advice to the portfolio company (De Prijcker et al., 2012; Pruthi et al., 2009).

Establishment of a local branch is the most far-reaching form of local embeddedness a cross-border VC firm can display in the focal country. A VC firm will only be willing to bear the high investment if it envisages expanding its activities in that region. Branches will therefore want to build and maintain a strong local reputation and avoid the cost of negative publicity surrounding the failure of a portfolio company, as a strong reputation is essential to attract high quality deal flow and syndication partners (Mäkelä and Maula, 2006). As a result of the stronger local embeddedness and the strategic importance of the focal country for future investments, VC firms investing through a local branch may be more susceptible to normative pressures from the local investment network and from the local community compared to VC firms investing from their head office. We thus expect the likelihood of escalation of commitment by branches will be higher compared to cross-border VC firms and hence they will have a lower probability of terminating investments in unsuccessful portfolio companies. Hence:

*Hypothesis 2: The probability that the hazard of a VC firm terminating investment in a portfolio company will deviate from the conditional hazard of success over rounds is higher for cross-border VC firms investing through a local branch as opposed to cross-border VC firms investing from headquarters.*

**Comparing a local branch VC firm with a domestic VC firm**

In a corporate VC setting, Benson and Ziedonis (2010) have shown that organizational design impacts investment decisions. In our setting, we argue that the organizational differences between local branches of foreign VC firms and of domestic VC firms will impact their tendency to escalate commitment. While each portfolio company is typically followed by one or two investment managers, all new and follow-on investments have to be approved by an investment committee. Investment committees are specifically designed to mitigate individual biases of the VC investment managers (Guler, 2007). While the investment committee of domestic VC firms will predominantly consist of local investment managers, the foreign head office will typically be represented in the branches’ investment committee that decides on investments and terminations (Pruthi et al., 2009). Hence, local branch decision making differs as it is primarily made by investment committees that combine the expertise and experience of branch executives and head office executives (Pruthi, Wright and Meyer, 2009).

Head office executives have a lower nationalistic bond, an increased geographical and cultural distance, and a lower emotional attachment to local portfolio companies and as a result have a more unbiased view on their performance. The influence of head office executives in the investment committee should therefore at least partially mitigate the probability of escalating commitment, compared to decision making in investment committees of domestic VC firms. We hence expect branch VC firms to have a lower probability to escalate commitment as opposed to domestic VC firms and will therefore have a higher probability of terminating investments in unsuccessful portfolio companies. Hence:

*Hypothesis 3: The probability that the hazard of a VC firm terminating investment in a portfolio company will deviate from the conditional hazard of success over rounds is higher for domestic VC firms as opposed cross-border VC firms investing through a local branch.*

**method**

We test our hypotheses on a sample of VC investments in portfolio companies in Europe. The European VC industry offers an interesting environment in which to examine whether international VC investors face different levels of escalation of commitment compared to domestic VC investors for three reasons. First, the European VC industry is characterized by more international investments compared to the U.S. (Schertler and Tykvová, 2011). Second, Europe is the second largest VC market after the U.S. (Schertler and Tykvová, 2011). Third, despite economic integration in the European Union, European countries still present huge differences in language, culture and legal environments. This allows us to disentangle the effects of geographic distance from those of crossing borders. For example, a Californian investor investing in an East Coast venture faces a huge geographic distance, but no language barrier, while cultural and legal differences between the East and West Coast are limited. In contrast, a German investor from Munich investing in Milan (Italy) will face a lower geographical distance (490km) compared to investing in his or her own country in Berlin (580 km). Nevertheless, in dealing with its Italian portfolio company, the German investor has to cope with a different language, a different legal environment, and a different business culture.

**Sample and data**

The sample is drawn from a hand-collected dataset on European technology companies built by the pan-European VICO project (Bertoni and Marti Pellón, 2011). VC-backed companies were identified by local research teams, as no single commercial database provided an unbiased sample of European VC backed companies covering the period of analysis. Therefore, local sources of information were crucial in the data collection process, and an in-depth country-specific knowledge was essential for the quality of the outcome. Data were first checked for reliability and internal consistency by each local team. Then data were regularly sent to a central data collection unit which ensured that information across countries was consistent and comparable. This two-tier structure allowed the early solution of problems. For instance, particular importance was given to the consistency of the sample frame and in the definitions of accounting variables across countries.[[1]](#footnote-2)

The research team identified 684 VC-backed companies through a variety of secondary sources, including commercial databases VentureXpert, Zephyr, Factiva, Mediargus, Google News, but also through VC firms’ and portfolio companies’ websites, press releases, newspapers and official law gazettes. All portfolio companies were founded in one of seven European countries, comprising Belgium, Finland, France, Germany, Italy, Spain and the United Kingdom. These countries were selected to enable us to study VC decision making behavior in environments with different levels of VC maturity. Sample companies received initial VC financing during 1994-2004 and were followed through 2011, ensuring a variety of investment periods are included in the sample. All companies were independent at start-up and a maximum 10 years old when first raising VC. Some 44% of portfolio companies were founded between 1998 and 2000, 35% between 1986 and 1997 and 21% between 2001 and 2004. The most important industry is software (34%), followed by biotechnology (18%) and ICT manufacturing (16%). Over 25% of sample companies come from the U.K., 19% from Germany, 16% from France and 13% from Italy. Belgian companies represent 12% of the sample and Spanish and Finnish companies approximately 8%.

Our sample contains longitudinal data on 1618 unique VC investment rounds by 1060 different VC firms. The average number of investment rounds a portfolio company receives is relatively constant over time and industries. Each portfolio company received an average of 2.37 VC rounds[[2]](#footnote-3).

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Our unit of analysis is the investment decision of each single VC investor in a portfolio company. Multiple VC investors may co-invest in an investment round, leading to multiple data points. The dataset hence includes 3445 investment decisions, 2399 by domestic VC investors, 568 by cross-border VC investors and 255 by branch VC investors. Almost half (45.4%) of the cross-border VC investors’ investments originate outside the EU. Each VC investor takes part in an average of 1.62 financing rounds per portfolio company.[[3]](#footnote-4) This is higher for domestic VC investors (1.68) and branch VC investors (1.96) and lower for cross-border VC investors investing via a head office (1.57). Successful portfolio companies have more investment rounds compared to unsuccessful (1.78 versus 1.43) for all VC investor origins. Terminated portfolio companies backed by cross-border VC investors receive the lowest number of rounds (1.35), while terminated portfolio companies backed by branch VC investors have the highest number of rounds (1.70).

For each portfolio company, detailed yearly financial statement data were collected from financial accounts through the Amadeus database and country specific databases, from year of investment up to seven years thereafter. The number of patent applications pending and granted were retrieved for each portfolio company from the PATSTAT database. Data were added on financing rounds, exit type and exit timing of each company.

**Measuring escalation of commitment**

Following Guler (2007), a two-stage analysis was implemented to investigate VC firms’ behavior in sequential investment decisions. Controlling for portfolio company characteristics, VC firm characteristics, deal characteristics and market conditions, industry, year and country effects, the hazard of termination is estimated as a function of the number of financing rounds invested in the portfolio company by the focal VC firm. A similar equation is estimated for the hazard of a successful exit. Both hazards are then compared in the second stage. If VC firms are rational and can evaluate the probability of success by staging investments, they should increasingly terminate investments that have a decreasing probability of success. If the updated information on the portfolio company is favorable at each stage, the likelihood of a successful exit - conditional on this new information - increases over time and the probability of termination should hence decrease. If updated information is on the contrary negative, the probability of a successful exit given this updated information declines over time and the likelihood of termination should therefore increase (Benson and Ziedonis, 2010). In sum, if VC firms behave rationally, the probability of termination should be inversely proportional to the conditional likelihood of a successful exit (Guler, 2007).

**Variable definitions**

***Dependent variables.*** As financial return data on individual investments are not available in the European VC industry, the exit route is used as a proxy to evaluate the performance of VC investments (Guler, 2007). The first dependent variable embodies the hazard of successful exit for a portfolio company at time t, while the second dependent variable embodies the hazard of termination at time t. Exits need to be classified as successful or terminated (Birmingham et al., 2003; Guler, 2007). In line with the VC literature, IPOs are categorized as successful exits (Gompers, 1995). Exits through a trade sale or a buy-out are commonly considered a successful exit (Guler, 2007). However, unsuccessful portfolio companies may also be sold for a nominal value to a trade or financial acquirer in a fire sale. To differentiate fire sales from successful exits, we performed bankruptcy-prediction type analyses to classify trade sales and buy-outs as successful exits. This procedure is explained in more detail in Appendix A and resulted in 33% of the trade sales or buy-outs being classified as successful exits.

We identified three ways in which a VC firm may terminate its investment. Following Guler (2007, p264) we coded a “VC firm-investment relationship as terminated if the VC firm did not appear in any of the subsequent investment rounds.” We assumed that the termination event occurred “at the earliest round date at which the VC firm no longer appeared as an investor” (Guler, 2007, p. 264). Second, we assumed that a VC firm terminated its relationship if the focal round was also the final round of financing, suggesting investment inactivity. We classified an investment round as final if no new financing round or exit was observed within 1888 days after the focal round of financing (with 1888 days being the 75 percentile time to exit or to a following round in our sample) and if the 1888 days cut-off occurred before the end of our observation period (31/12/2011) (Guler, 2007). The termination event was then estimated as occurring 1888 days after the focal round. Third, unsuccessful exits, including liquidations, bankruptcies, buy-backs by entrepreneurs and fire sales, are also classified as terminated, as these are mostly caused by the reluctance of the VC firms to further support the venture[[4]](#footnote-5). We assumed that the termination event occurred on unsuccessful exit.

Fewer VC-portfolio company pairs lead to successful exits (634 or 29.7%) compared to terminations (998 or 46.7%). Remaining observations are right censored, for whom no exit or termination has occurred at the end of the observation period. The ratio of successful exits versus terminations is 0.64 for the full sample, but higher for cross-border VC (0.76) and branch VC investment pairs (0.86). The dependent variable measures the time in months from a VC firm’s first investment date in a specific portfolio company until termination or successful exit.

***Independent variables.*** The key independent variables measure VC firm origin and the number of financing rounds invested by each VC firm. VC firm origin is captured by three mutually exclusive dummy variables that equal one if the focal VC firm satisfies the origin condition of the respective dummies and zero otherwise: *domestic VC firm, cross-border VC firm, branch VC firm*. The *ROUNDS (R)* variable captures the investment round number since the initial investment of the focal VC firm. Cash investments occurring within a six months period are aggregated and treated as a single round. To decrease correlation between independent variables, the *ROUNDS* variable is centered by subtracting the mean. The interaction terms between the origin dummies and the *ROUNDS* variable test our hypotheses.

***Control variables.*** We control for portfolio company characteristics, VC firm characteristics, deal characteristics, market conditions, industry, year and country effects. Since the relative efficacy of de-escalation strategies may vary based on the level of project completion (Sleesman et al., 2012), time varying portfolio company characteristics are included: *portfolio company development stage, age, number of patents,* andthe natural logarithm of a portfolio company’s *sales* at the time of VC firm entry.

Table 2 gives an overview of the portfolio company development *stage* at VC entry, depending on VC origin. The majority of investments are made in portfolio companies in the seed and start-up stage (59%). Domestic VC firms make slightly more investments in seed and start-up portfolio companies (60%) compared cross-border VC firms (52%) and branch VC firms (40%).

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Insert Tables 2 and 3 about here

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Table 3 shows that an average portfolio company is 3.4 years old at time of VC firm entry; portfolio company age is not significantly different between the three groups of VC firms. The average portfolio company holds 0.44 *patents* (median: no patents) and generates €1,762,920 (median: €225,000) of *sales* at time of VC entry.

The following VC firm characteristics are included. *VC firm age* is included, as older VC firms are more likely to stage their investments (Chemmanur et al., 2012). Older VC firms are more experienced, and might therefore have a higher probability of successful exits (Dai et al., 2012). Compared to the median cross-border and branch VC firm, a median domestic VC is three years younger at time of first investment. As more experienced VC investors exhibit lower behavioral biases (Gomper, Kover, Lerner et al., 2008), and as a VC firm’s experience may impact the probability of a successful exit (Dai et al., 2012), the number of prior portfolio companies the VC firm invested in is measured. Both a VC firm’s *general experience* and its *country specific experience* are measured, although a high correlation between both variables prevents us from including both variables in the same model. The median domestic VC firm has the lowest general experience (four investments) but the highest country specific experience (three investments). The median cross-border VC firm has no country specific experience, but has invested in 17 portfolio companies worldwide. While the median branch VC firm has the highest *general experience* (78 investments), its *country specific experience* is in between that of domestic and of cross-border VC firms (two investments). Since VC firms’ reputational concerns may impact exit timing, their reputation is included and measured as the *number of IPO exits* (Cumming and Dai, 2010). While the median domestic VC firm has no IPO experience, the median cross-border VC firm and branch VC firm have brought respectively one and three portfolio companies to the stock market before investing in the focal portfolio company. Finally, a dummy variable indicating whether the VC firm is the *lead investor* in the round is included. The lead investor is defined as the largest investor in a specific investment round and is updated for every investment round. Domestic, cross-border and branch VC firms act as lead investor in respectively 62, 40 and 56 percent of the investments.

The following deal characteristics are included: *geographic distance, cumulative amount invested, VC firm entry round, syndication size* and *mixed syndicate*. VC firms that are located closer to their ventures have a lower probability to abandon their investment (Li and Chi, 2013). Geographical proximity impacts a VC firm’s information gathering, monitoring and advising functions, hence *geographical distance* is included and measured by computing the natural logarithm of the physical distance in kilometers between the focal VC firm and the portfolio company’s headquarter. The median distance between a VC firm and its portfolio company is respectively 75, 1091 and 81 kilometers for domestic, cross-border and branch VC firms. The *cumulative amount invested* by a VC firm prior to the focal round is a proxy of its sunk costs, which may influence escalation of commitment. This measure is computed as the sum in millions of euro that the VC firm invested in the portfolio company in all rounds prior to the focal round. Domestic, cross-border and branch VC firms invest a median amount of respectively 1.00, 2.40 and 2.53 million euro in the entry round. The *VC firm entry round* is defined as the round in which the VC firm first appears as an investor in the portfolio company, because the likelihood of termination may be different for VC firms that join the syndicate earlier rather than later (Guler, 2007). While a median domestic and branch VC firm enters the portfolio company in the first investment round, a median cross-border VC firm enters in the second investment round. *Syndication size*, measured as the time-varying cumulative count of VC investors that participated in prior financing rounds or in the focal round, controls for a possible effect of co-investor pressure (Guler, 2007). Respectively 74, 92 and 77 percent of the first round investments of domestic, cross-border and branch VC firms are syndicated. A median cross-border VC firm has twice as many co-investors (4) compared to a median domestic and branch VC firm (2). Finally, a dynamic variable that captures whether there was a syndicate comprised of both domestic and cross-border VC firms is added to control for a possible effect of the syndicate composition (Chemmanur et al., 2012). Domestic, cross-border and branch VC firms enter in a *mixed syndicate* at first investment in respectively 22, 84 and 33 percent of the investments.

To control for general market conditions, the yearly *total number of VC backed IPOs* is added. This can affect a portfolio company’s probability to go public, as well as VC investment practices (Guler, 2007). Finally, companies may exhibit different development patterns depending upon the time when they received their first VC investment. Both the time frame of our study and our focus on high-tech sectors require us to control for the *year of first VC investment*. Companies in different industries may differ in terms of the milestones they need to meet, the number of rounds they typically receive, and the time they take before exiting (Guler, 2007). To control for potential industry and country effects, *industry* and *country dummies* are added.

**Method of Analysis**

Event-history analysis is used to dynamically estimate the investment process through the distributions of the hazards of terminations and successful exits (Guler, 2007). The hazards of termination and successful exits are estimated using the semi-parametric competing risks Cox proportional hazard model, which does not require the distribution of time dependence of the hazard to be specified (Guler, 2007). Coefficients are estimated using partial likelihood estimation. The data is set up so that every individual VC investment round is a spell, leading to 3445 spells. A spell is treated as right censored if it does not result in a successful exit or a termination. Following Guler (2007), successful exits are treated as right censored in the model estimating the hazards of terminations and vice versa. Analyses are clustered on VC firms, as multiple observations for the same VC firm investing in several portfolio companies could lead to correlations between the error structure and the independent variables and thus lead to underestimation of the standard errors.

Potential selection effects are controlled for by using a two-stage model (Rao, Greve and Davis, 2001). First, a probit model for cross-border investor choice is estimated. The inverse Mill’s ratios are then included as an instrument in the second stage event-history analyses. The dependent variable in the probit selection model is a dummy variable taking the value of 1 if the VC investor is a cross-border investor and 0 if a domestic investor. The exogenous variable used to model cross-border investor choice is the OECD Foreign Direct Investment (FDI) Regulatory Restrictiveness Index (lagged one year). This index measures statutory restrictions on FDI, including (i) foreign equity limitations, (ii) discriminatory screening or approval mechanisms; (iii) restrictions on the employment of foreigners as key personnel and (iv) other operational restrictions. The variable varies between 0 (open, no FDI restrictions) and 1 (closed to FDI). Companies active in more open countries should attract more cross-border VC investors. Control variables in the selection model include a dummy variable indicating whether a VC already invested, the age, the natural logarithm of sales and number of patents of the portfolio company and dummies indicating its country, the amount of VC already invested in millions of euros, the syndicate size, industry dummies, first VC investment year dummies. Appendix B shows the selection model. The coefficient of the exogenous variable is significant (p<0.05), suggesting that the instrument is appropriate.

**RESULTS**

**Main analyses**

Table 4 presents the correlation matrix. Most correlations are between -0.5 and 0.5. All variables have variance inflation factors well below the usual warning level of 10 except for the *inverse mills ratio* (16.75) and the *syndication size* variable (10.12). The mean variance inflation factor is 2.52. This indicates that problems of multicollinearity are limited.

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Insert Table 4 about here

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We first measure whether VC firms exhibit escalation of commitment, disregarding the origin of the VC firm. Table 5 reports the results for the hazard of successful exits and termination, controlling for portfolio company, VC firm and general market conditions. Model 1a models the hazard of a successful exit, while model 1b models the hazard of termination. Comparing the distribution of successful exits with termination decisions allows assessment of whether VC firms show escalation of commitment (Guler, 2007). The coefficient of *Rounds* is negative (p<0.01) and that of *Rounds²* is positive (p<0.01) in model 1a. This suggests that the probability of a successful exit decreases with the number of rounds invested, but at a decreasing rate[[5]](#footnote-6). If VC firms act to maximize the probability of success, the probability of termination should hence increase over the number of rounds. Model 1b, which models the hazard of termination, shows however that the rate of termination also decreases over rounds at a decreasing rate: the coefficient of *Rounds* is negative (p<0.01) and that of *Rounds²* is positive (p<0.01). Comparing the coefficient estimates for *Rounds* and *Rounds²* in the termination model with the reverse-signed coefficient estimates for the same variables in the success model tests for deviation of the termination decision from the distribution of successful outcomes (Guler, 2007). Wald tests show that the estimates are significantly different for both *Rounds* and *Rounds²* (p<0.01). Taken together, our results are consistent with Guler (2007) and suggest that VC firms in our European sample escalate their commitment to a failing course of action, as the likelihood of a VC firm terminating an investment declines as it invests in more rounds, even though the probability of success also decreases over rounds.

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Insert Table 5 about here

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Control variables are largely in line with prior findings. A portfolio company’s number of *patents*, *VC firm country experience* and *IPO market conditions* have a significant positive impact on the probability of both a successful and a termination. Portfolio companies that generate higher *sales*, that are located further away from the VC firm (consistent with Dai et al., 2012) and entering a portfolio company in a later round are associated with a higher probability to have a successful exit, although these variables do not impact the probability to be terminated. While *VC firm age* has no impact on the hazard of a successful exit, older VC firms have a higher probability to terminate. Larger *syndicates* have lower probability of termination, but *mixed syndicates* have a higher probability of termination. Finally, *first investment year*, *industry* and portfolio company *country* *dummies* are significant in all models. Other control variables, including the *age* of the portfolio company, a VC firm’s *IPO track record*, investing as the *lead investor*, the *cumulative amount invested* and the *entry stage* have neither a significant impact on the probability to have a successful exit, nor to terminate.

To test the hypotheses on the impact of VC origin on the probability to escalate commitment, we conducted several tests. At a descriptive level, we checked how many VC firms terminated their investments while other VC firms continued to invest in the same portfolio company, while this ultimately led to an unsuccessful outcome. The behavior of the latter can be a sign of escalation of commitment. Both domestic VC investors and cross-border VC investors continue to invest in one in four syndicates where another syndicate member terminates. When a domestic VC continues while another VC terminates, the investment has a 50.2% probability of resulting in an unsuccessful exit, while this percentage drops to 36.1% for cross-border VC firms. Branch VC firms have a higher tendency to continue to invest when other syndicate members terminate, as they do so in one in three cases. However, these continued investments have only a 30.0% probability of ending unsuccessfully. This is consistent with domestic VC firms having a higher tendency to escalate their commitment to a failing course of action compared to cross-border and branch VC firms.

Next, we analyzed the propensity to escalate commitment of domestic VC firms, cross-border VC firms and branch VC firms by estimating the hazards of successful exits and of termination in the subsamples of domestic VC investments (Table 5 - Models 2a and 2b) and of cross-border VC investments (Models 3a and 3b). Due to the low number of spells in the branch VC subsample, the branch VC regression models did not converge. Taken together, Models 2a and 2b suggest that domestic VC firms escalate their commitment, as both the probability of a successful exit (p<0.1) and of termination (p<0.01) decrease over rounds. The coefficient of the *Rounds²* variable is only significant and positive in the termination model. In contrast, Models 3a and 3b suggest that cross-border VC firms do not escalate their commitment. In the cross-border subsample, the probability of a successful exit increases over rounds, as the coefficient of the *Round²* variable is positive (p<0.05), while neither the *Rounds* nor the *Rounds²* variable have significant coefficients in the termination model.

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Insert Table 6 about here

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In a further analysis, we pooled all spells and introduced dummy variables indicating VC firm origin and their interaction terms with the *Rounds* variable.[[6]](#footnote-7) The coefficients of the *inverse mills ratios* are statistically significant in all models indicating that there is a selection bias.

To formally test our first and second hypotheses, escalation of commitment of domestic and branch VC firms is directly compared with the escalation of commitment of cross-border VC firms. Cross-border VC firm is the reference category in Models 1a and 1b in Table 6. Therefore, the interaction variable between *Cross-border VC firms* and *Rounds* is not included in these models. Model 1a estimates the hazard of a successful exit and Model 1b of a termination event. The results show that the *Rounds* variable is not significant in either model, although the coefficient is positive for the success model and negative for the termination model. The interaction term between *Rounds* and *Domestic VC* is significant (p<0.01) and negative in the success sample, suggesting that the probability of having a successful exit declines significantly more over rounds for domestic VC firms compared to cross-border VC firms. Further, there is no difference in the probability to have a successful exit over rounds between branch VC firms and cross-border VC firms. None of the coefficients of the interaction terms are significant in the termination model, indicating that the distribution of termination events over rounds is not significantly different depending on VC firm origin.

The results of all analyses together hence provide further strong support for hypothesis 1: domestic VC firms have a significantly higher probability to escalate commitment to a failing course of action compared to cross-border VC firms. In contrast, we fail to find support for hypothesis 2 as no significant difference was found between branch VC firms and cross-border VC firms in their probability to escalate commitment.

The third hypothesis is tested in models 2a and 2b (Table 6). Domestic VC firms is the reference category and interaction terms between the *Rounds* variable and both the *cross-border* and *branch VC firm dummies* are included. The *Rounds* variable is significant (p<0.01) and negative in both the success and the termination models, indicating that domestic VC firms have a decreasing probability of having a successful exit and a termination event over rounds. Compared to domestic VC firms, the probability of having a successful exit declines significantly less over rounds for branch VC firms (p<0.05, model 2a), but there is no significant difference in probability of termination over rounds between branch VC firms and domestic VC firms (model 2b). Combining these results with the earlier finding that there is no difference between cross-border VC firms and branch VC firms and that they do not escalate their commitment while domestic VC firms do provides strong support for hypothesis 3: branch VC firms are less prone to escalate commitment compared to domestic VC firms. In addition, models 2a and 2b again support the first hypothesis that domestic VC firms have a higher tendency to escalate their commitment than cross-border VC firms (p<0.01).

Figure 1 graphically shows the impact of an additional round of finance on the baseline hazard of a successful exit and of a termination event for each VC firm origin. Domestic VC firms’ probability to both terminate and successfully exit investments declines as they participate in more financing rounds, in contrast to cross-border and branch VC firms. Cross-border and branch VC firms also have a declining probability to terminate investments as they participate in more rounds, but, in contrast, their probability to have a successful exit increases over rounds.

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Insert Figure 1 about here

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**Robustness of results**

Additional models were fitted to test for the robustness and assess the strength of alternative explanations. We focus on three potential concerns.

First, endogeneity might be a concern, as cross-border and branch VC firms might invest in more developed, less risky companies. Therefore, our main analyses controlled for selection biases in various ways. The initial split sample analyses are not prone to selection issues, as the behavior of investors is compared within subsamples of pure domestic and pure cross-border investments. Even if domestic and cross-border investors select different portfolio firms, the split samples should be homogeneous. In the pooled sample analyses, we controlled for endogeneity through inclusion of a selection model and through numerous control variables. Nevertheless, we still might fail to fully control for selection issues.

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Insert Table 7 about here

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To address this concern, we re-ran the foregoing analyses including only VC firms that invested *as from the first investment round*. This should address the concern that cross-border and branch VC firms prefer later stage companies. The pooled sample analyses, including the interaction terms between the *Round* and *VC origin* variables (See Table 7), yield comparable results as in the full sample. We further estimated comparable models, but now only included investors that entered in a second investment round. Again, results are consistent with earlier results although less significant (due to a small sample size). Our key results are hence unlikely to be driven by cross-border and branch VC firms investing in later stage companies.

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Insert Table 8 about here

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Additionally, our initial results might be driven by domestic VC firms being more prone to be the lead investors than cross-border or branch VC firms. As lead investors are more active in their portfolio companies, they might be more emotionally attached to the portfolio firm (Wright and Lockett, 2003) and hence have a stronger tendency to escalate commitment. We therefore tested the propensity of lead and non-lead VC firms to escalate commitment through a sample split procedure. The first subsample comprises investments by lead investors only, the second subsample comprises investments by non-lead investors only. We assessed the propensity to escalate commitment in both subsamples in the same way as in the main analyses. Table 8 provides the output of the models, focusing only on the variables of interest (*Round* and *Round²*). Note that the models were run with all control variables, but these are not reported because of space considerations. The models show that the hazard of a successful exit does not change over rounds for lead investors, but their hazard of termination decreases over rounds. This provides evidence that lead investors escalate their commitment, as the probability of termination decreases over rounds (at a decreasing rate), while the probability of a successful exit does not increase over rounds. Interestingly, the hazard of a successful exit decreases over rounds (at a decreasing rate) for non-lead investors, while the hazard of termination does not change over rounds. This is again consistent with escalation of commitment, as the probability of a successful exit decreases over rounds, while the probability of termination does not increase over rounds. Together, these results suggest that being a lead or a non-lead investor does not drive our findings on cross-border versus domestic investors.

Further, additional models were estimated using alternative control variables. VC firm’s *general experience* is included instead of its *country specific experience*. A high correlation between both variables prevents us from including both variables in the same model. The *IPO market condition* variable is replaced by respectively the *total number of VC-financed ventures* *worldwide*, the *total amount of VC money raised* *worldwide* and the *number of M&As in West Europe*. Because access to capital may affect the likelihood of success, a control for the *cumulative total amount invested in the portfolio company* by all the VC firms prior to the focal round instead of the c*umulative amount invested by the focal VC firm* is included (Guler, 2007). Finally, portfolio company *sales* is replaced by the *number of people employed*. The main results remained unchanged.

A final potential problem is the presence of highly correlated explanatory variables. Multicollinearity makes the parameter estimates unreliable and inflates the standard errors (Van den Poel and Larivière, 2004). An additional difficulty is caused by the time-varying nature of multiple variables in our study. The intercorrelations should therefore be analyzed dynamically. Variables were added sequentially to the main models to assess the stability of the parameters and to ensure that multicollinearity has no harmful impact on the results (Van den Poel and Larivière, 2004). New models were estimated with a correlation cut-off of 0.6 and new control variables were sequentially introduced, based upon a less restrictive cut-off point. The results reveal that the coefficients and significance of the control variables and of the main independent variables remain highly stable in all models. It is hence unlikely that the results are impacted by potential multicollinearity problems.

**Discussion and conclusion**

Organizational decision makers have been shown to escalate their commitment towards a failing course of action (Sleesman, 2012), even when expert decision makers such as VC investors are repeatedly confronted with this decision (Guler, 2007). We contribute to this research by showing how emotional, social and institutional differences related to investing internationally compared to investing domestically, may safeguard VC investors from escalating their commitment to a failing course of action. We extend Guler’s work (2007) by showing how differences in emotional attachment and social embeddedness influence escalation of commitment between different types of VC investing. We show a robust and significant higher probability to escalate commitment for domestic VC investors as opposed to international VC investors, either investing through a local branch or from their headquarters. Interestingly, having a local presence does not lead to a higher escalation of commitment compared to investing across borders. As such, we illustrate how international VC firms may have an advantage over local VC firms, in contrast with the dominant assumption that international VC firms face mainly liabilities of foreignness. Given our methods of analysis, these results are not impacted by endogeneity issues, nor are they explained by geographic distance alone.

Our insights suggest that, in contrast to domestic VC investors, cross-border VC investors are less prone to escalate their commitment when a portfolio company fails to meet its expectations. This is consistent with cross-border investors facing a larger cultural and legal distance. Cross-border VC investors are thus less emotionally attached to the entrepreneur and less socially embedded in the portfolio firm’s community, and hence less prone to emotional, social and normative pressures from portfolio company stakeholders, including the entrepreneur.

Although the employment of local investment managers and proximity to their portfolio companies is expected to make branch VC firms behave similarly to domestic VC firms, results show that branch VC firms behave as cross-border VC firms in terminating underperforming ventures: their probability to escalate commitment is lower than that of domestic VC firms. Moreover, we find no significant difference in escalation probability between cross-border VC firms investing from a head office or through a local branch. This may be explained by branch investment committees including both local and head office executives preventing escalation of commitment. Head office executives are less embedded in the local community and have lower emotional ties to the entrepreneurs, hence effectively shielding them from institutional pressures to continue to invest.

**Implications for research**

Our findings contribute in several ways. First, this study helps to further understand decision making in a VC setting, enriching the debate on whether VC decisions are made rationally or exhibit decision biases (Gompers et al., 2008). While directly measuring decision biases is empirically difficult, current research suggests that some VC investors are more prone to decision biases than others. Experienced investors exhibit less behavioral investment biases (Gompers et al., 2008), and corporate VC investors that invest from dedicated organizational units exhibit less overconfidence compared to corporate VC investors that do not have autonomous VC units (Benson and Ziedonis, 2010). Our findings suggest that international VC investors, whether investing from abroad or from a local branch office, behave more rationally as they are less prone to escalation of commitment compared to domestic VC investors.

Second, we extend insights from international management that dominantly point to liabilities of foreignness. We suggest that being a foreigner may not always be negative but can induce more rational decision making and as a result maximize value creation in the context of the abandonment of underperforming projects. Understanding how foreign VC investors as opposed to domestic VC investors behave when facing underperforming investments is hence important. Second, we extend existing literature by examining VC investor heterogeneity by differentiating between domestic, cross-border and branch VC investors. We extend earlier work by Guler (2007) on escalation of commitment by VC investors by hypothesizing and showing how differences in social embeddedness lead to differences in escalation of commitment among VCs investing from different geographical locations. The findings are of direct relevance for future research on escalation behavior as we showed that organizations investing domestically or across borders exhibit different probabilities to escalate commitment.

Third, we acknowledge that escalation of commitment in investment decisions may be driven by organizational design. Benson and Ziedonis (2010) have shown that organizational design is important in explaining differences in investment behavior of corporate VC programs, with managers from dedicated corporate VC units showing lower levels of overconfidence in investment decisions. While we lack specific information on the organizational composition of the investment committee, survey evidence (Pruthi, Wright and Lockett, 2003) suggests that it is common practice that investment committees from international VC investors are composed of a mix of local and international members. While organizational scholars acknowledge that escalation behavior might be determined by organizational factors, these have been largely ignored in previous studies (Sleesman et al., 2012). Our study hence suggests an interesting environment in which organizational design could be included in future research on decision making behavior and more specifically in escalation of commitment research.

Finally, the classification of trade sales and buy-outs as successful or unsuccessful exits provides a more fine grained classification that offers a methodological contribution to venture capital exit research, which typically views all trade sales and buy-outs either as successful, thereby ignoring fire sales (Guler, 2007), or as unsuccessful, thereby ignoring distress acquisitions and buyouts. We demonstrate that trade sales and buy-outs may be positive as well as negative. This is important for future research on VC exits: a fine-grained approach is warranted to classify trade sales and buy-outs as either positive or negative.

**Implications for practitioners**

Liabilities of foreignness may make foreign VC investors reluctant to invest across borders. We show that being foreign may also have positive effects as it reduces the probability to escalate commitment. Domestic VC investors on the other hand should be cautious when evaluating portfolio companies. As they are likely more prone to escalate commitment, improvements in their decision making processes may help reduce such behavior. Moreover, the finding that branch VCs are less prone to escalate commitment compared to domestic VCs - despite employment of local investment managers and the geographical proximity to the portfolio companies - suggests that their organizational safeguard provided by investment committees consisting of both local and head office executives prevents them from escalating commitment to a failing course of action. Domestic VC investors may hence mimic this organizational safeguard by including distant executives in their investment committees. Further, if foreign syndicate members abandon a project, domestic investors should carefully consider whether and why they should invest further in the same project.

Of course*,* because of their limited allocation of attention and limited life funds, VCs may after some time terminate investments with decreasing probability of success yet subsequently see their former portfolio companies becoming very successful. Our findings emphasize the importance of including anti-embarrassment clauses to protect VCs against this risk. These clauses give VCs the right to claim a proportion of the proceeds of value creation, typically within a specified period after completion (Coibion, Ballegeer and Vanhulle, 2015).As this reduces the anticipated regret should their termination decision prove to be wrong, adding an anti-embarrassment clause when terminating while others continue to invest should further reduce escalation of commitment (Sleesman et al., 2012).

Our study also has important implications for high-tech entrepreneurs. Given the difficulty in raising finance from outside investors, high-tech entrepreneurs are often under pressure to accept finance whenever and wherever they can find it. Yet, as we have demonstrated, not all VC investors have the same commitment to portfolio companies that do not meet expectations. While attracting cross-border VC or branch VC may be beneficial for portfolio companies when they perform well (Devigne et al., 2013), they terminate investments more easily when portfolio companies do not meet expectations. We hence provide further evidence that entrepreneurs in their search for finance should carefully evaluate and target investors that match their needs.

**Limitations and directions for future research**

As with all research, this study has limitations which provide opportunities for further research. First, our focus on VC poses the question about the generalizability of our results to other contexts. The finding that organizational safeguards may limit escalation of commitment to a losing course of action likely relates to other contexts. VC is an example of a general context where organizational safeguards like making decisions as a team rather than as an individual, co-investing with other VC firms or staging the investments, minimizes the risk of escalation of commitment. Nevertheless, extending our findings to other settings, such as other providers of entrepreneurial finance, might be relevant. Second, a classification of exits based on actual returns to VC investors would provide a more fine-grained categorization. Such data is however unavailable in the current database. Future research might usefully focus on developing databases to encompass this data. Third, our study adopted a novel sample of European firms. Additional studies might usefully examine the issues addressed here in other regions such as North America and Asia to establish whether our findings apply to other institutional contexts. Fourth, although we note that cross-border investors typically have an international decision making committee with lower social involvement and lower embeddedness in the local economic and social environment, we do not have specific information on the composition of the investment decision committee. Explicitly examining the impact of organizational characteristics on investment decision making might be fruitful.

Finally, it may be argued that our findings could be explained as rational behavior by VC investors, for example through using a real options perspective (Li and Chi, 2013). A real options view would explain continued investment as being due to rational behavior associated with the value of the VC’s call option on the portfolio company’s upside potential becoming worthless if they terminate. In this view, the option is more valuable with higher uncertainty (Li and Chi, 2013), but also with remaining time to expiration (Baldwin, 1988; Dixit, 1989). However, VC investments have a finite time horizon and investors face pressure to exit before the end of the fund life, considerably limiting the call option value. Second, VC investors manage a portfolio of investments, but have a limited capability regarding the number of investments they can monitor effectively (Shepherd, Armstrong and Levesque, 2005; Cumming and Dai, 2011). Continuing to invest in a failing course of action creates an opportunity cost, as it detracts the attention of VC investors from potentially more value creation projects. This portfolio view incites VC investors to terminate investments early rather than late (Li and Chi, 2013). Both explanations suggest a lower option value to the VC investor, suggesting that the VC would not hold on to underperforming projects. This is at variance with the fine-grained insights from an escalation of commitment perspective that we have presented.

To conclude, notwithstanding these observations, our focus on international organizational structures as safeguards against escalation of commitment helps extend the literature relating to both dealing with under-performing foreign activities and boundaries of the liabilities of foreignness. More specifically we extend the international VC literature by emphasizing the salience of encompassing behavior relating to failed investments and of examining the heterogeneity of the location of VC investors when making investment decisions.

**FIGURES AND TABLES**

**Table 1: Average number of investment rounds by venture capital firm origin and exit success versus termination**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | All VC firms | Domestic VC firm | Cross-border VC firm | Branch VC firm |
| Full sample | 1.62 | 1.68 | 1.57 | 1.96 |
| Successful exit | 1.78 | 1.78 | 1.78 | 2.38 |
| Termination | 1.43 | 1.51 | 1.35 | 1.70 |

**Table 2: Venture capital firm stage of entry**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Investor Entry Stage | Full sample | % | Domestic VC firm | % | Cross-border VC firm | % | Branch VC firm | % |
| Seed / Start-up | 1161 | 58.52 | 853 | 60.49 | 188 | 52.37 | 51 | 39.54 |
| Expansion | 796 | 40.12 | 538 | 38.16 | 168 | 46.80 | 72 | 55.81 |
| Later Stage | 27 | 1.36 | 19 | 1.35 | 3 | 0.84 | 4 | 3.10 |
| Total | 1984 | 100.00 | 1410 | 100.00 | 359 | 100.00 | 129 | 100.00 |
| Missing | 152 | - | 22 | - | 1 | - | 2 | - |

**Table 3: Descriptive statistics at first investment of the focal venture capital firm**

**Table 4: Correlations (N=1552)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| *Independent variables* |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 | ROUNDS (centered) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 2 | Domestic VC firm x R | ***0.78*** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 3 | Cross-border VC firm x R | ***0.47*** | 0.00 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4 | Branch VC firm x R | ***0.41*** | -0.01 | -0.01 |   |   |   |   |   |   |   |   |   |   |   |   |   |
| *Selection variable* |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 5 | Inverse Mills Ratio | ***-0.34*** | ***-0.28*** | ***-0.15*** | ***-0.11*** |   |   |   |   |   |   |   |   |   |   |   |   |
| *Portfolio company characteristics* |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 6 | Portfolio company age | ***0.42*** | ***0.36*** | ***0.19*** | ***0.12*** | ***-0.22*** |   |   |   |   |   |   |   |   |   |   |   |
| 7 | Patents | 0.00 | 0.01 | -0.01 | -0.01 | ***-0.20*** | *0.06* |   |   |   |   |   |   |   |   |   |   |
| 8 | Sales (LN) | ***0.28*** | ***0.25*** | ***0.10*** | ***0.09*** | ***-0.25*** | ***0.61*** | ***0.09*** |   |   |   |   |   |   |   |   |   |
| *VC firm characteristics* |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 9 | VC firm age | 0.04 | 0.01 | *0.05* | 0.02 | -***0.09*** | *0.06* | 0.01 | 0.02 |   |   |   |   |   |   |   |   |
| 10 | VC firm country experience | ***0.12*** | ***0.16*** | -0.02 | 0.02 | -0.02 | ***0.08*** | 0.02 | ***0.08*** | 0.00 |   |   |   |   |   |   |   |
| 11 | VC firm IPO track record | ***0.12*** | 0.01 | ***0.14*** | ***0.10*** | ***-0.22*** | *0.07* | ***0.09*** | **0.07** | ***0.13*** | *0.06* |   |   |   |   |   |   |
| 12 | Lead investor | ***-0.11*** | ***-0.11*** | -0.02 | -0.04 | ***0.40*** | ***-0.09*** | ***-0.09*** | ***-0.08*** | -0.02 | *0.06* | ***-0.10*** |   |   |   |   |   |
| *Deal characteristics* |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 13 | Distance (LN) | -0.01 | *-0.06* | ***0.12*** | **-0.07** | ***-0.21*** | **0.07** | ***0.11*** | ***0.13*** | 0.03 | *-0.06* | ***0.13*** | ***-0.10*** |   |   |   |   |
| 14 | Cumulative amount invested by VC | ***0.66*** | ***0.44*** | ***0.48*** | ***0.21*** | ***-0.32*** | ***0.40*** | *0.06* | ***0.27*** | 0.04 | ***0.16*** | ***0.19*** | *-0.06* | ***0.11*** |   |   |   |
| 15 | Syndication size | ***0.37*** | ***0.31*** | ***0.14*** | ***0.13*** | ***-0.79*** | ***0.38*** | ***0.14*** | ***0.29*** | ***0.09*** | 0.01 | ***0.18*** | ***-0.43*** | ***0.21*** | ***0.33*** |   |   |
| 16 | Mixed syndicate | ***0.16*** | ***0.14*** | ***0.09*** | 0.01 | ***-0.62*** | ***0.16*** | ***0.15*** | ***0.19*** | *0.06* | 0.00 | ***0.20*** | ***-0.37*** | ***0.23*** | ***0.20*** | ***0.57*** |   |
| *Market conditions* |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 17 | IPO market conditions | ***-0.28*** | ***-0.25*** | ***-0.11*** | ***-0.09*** | ***0.18*** | ***-0.31*** | *-0.05* | ***-0.21*** | -*0.06* | -***0.09*** | *-0.06* | ***0.14*** | -0.01 | ***-0.22*** | ***-0.26*** | ***-0.09*** |

Significance levels: ***bold and*** ***italic***: p<0.001; **bold**: p<0.01; *italic*: p<0.05

**Table 5: Cox models predicting the hazard of exit: Full sample and split samples**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   |   | Base Models: Full Sample | Domestic VC Investments | Cross-Border VC Investments |
|   |   | Success | Termination | Success | Termination | Success | Termination |
|   |   | 1a | 1b | 2a | 2b | 3a | 3b |
| *Independent variables* |   |   |   |   |   |   |   |   |   |   |   |   |
|   | Rounds | -0.620 | \*\* | -0.990 | \*\* | -0.640 | \*\* | -1.282 | \*\* | -1.355 |   | -0.676 |   |
|   | Rounds² | 0.080 | \*\* | 0.127 | \*\* | 0.076 |   | 0.164 | \*\* | 0.217 | \* | 0.086 |   |
| *Selection variable* |   |   |   |   |   |   |   |   |   |   |   |   |
|   | Inverse Mills Ratio | -0.743 | \*\* | -1.040 | \*\* | -0.940 | **†** | -1.142 | \* | 1.545 |   | -2.760 | **†** |
| *Portfolio company characteristics*  |
|   | Portfolio company age | -0.020 |   | 0.054 |   | 0.008 |   | 0.070 | **†** | 0.308 | **†** | 0.091 |   |
|   | Patents | 0.073 | \* | 0.063 | \*\* | 0.067 | **†** | 0.061 | \* | 0.270 |   | 0.190 | \* |
|   | Sales (LN) | 0.127 | \*\*\* | -0.014 |   | 0.118 | \*\* | -0.004 |   | -0.076 |   | -0.207 | \* |
| *VC firm characteristics* |   |   |   |   |   |   |   |   |   |   |   |   |
|   | VC firm age | -0.001 |   | 0.003 | \*\* | -0.004 |   | 0.003 | \*\* | 0.003 |   | 0.016 |   |
|   | VC firm country experience | 0.001 | \* | 0.001 | \* | 0.001 | **†** | 0.002 | \*\* | 0.021 |   | -0.000 |   |
|   | VC firm IPO track record | -0.001 |   | -0.005 |   | 0.021 | \*\* | -0.028 |   | -0.004 |   | -0.015 |   |
|   | Lead investor | -0.085 |  | -0.155 |   | 0.104 |  | -0.033 |   | -0.736 | \* | -0.875 |   |
| *Deal characteristics*  |   |   |   |   |   |   |   |   |   |   |   |   |
|   | Distance (LN) | 0.082 | \* | 0.005 |   | 0.104 | \*\* | -0.032 |   | -0.111 |   | 0.143 |   |
|   | Cumulative amount invested | 0.023 |   | 0.009 |   | 0.007 |   | 0.044 |   | -0.049 |   | -0.028 |   |
|   | VC firm entry round | 0.293 | \*\*\* | 0.078 |   | 0.314 | \*\*\* | 0.152 |   | 0.284 |   | 0.143 |   |
|   | Syndication size | -0.028 |   | -0.162 | \*\* | -0.062 |   | -0.194 | \* | 0.260 | **†** | -0.320 | **†** |
|   | Mixed syndicate | 0.234 |   | 0.473 | \*\* | 0.161 |   | 0.512 | \* | -0.780 |   | 0.855 |   |
| *Market conditions* |   |   |   |   |   |   |   |   |   |   |   |   |
|   | IPO market conditions | 0.002 | \* | 0.003 | \*\*\* | 0.002 | \* | 0.003 | \* | 0.002 |   | 0.008 | \*\* |
| *Other*  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | Investor entry stage | x | x | x | x | x | x |
|   | First investment year | x | x | x | x | x | x |
|   | Portfolio company industry | x | x | x | x | x | x |
|   | Portfolio company country | x | x | x | x | x | x |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   | Observations | 1,382 | 1,382 | 962 | 962 | 280 | 280 |
|   | Log likelihood | -1518 | -1710 | -963 | -1164 | -203 | -181 |

\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, **†** p<0.1 (conservative two-tailed tests)

The dependent variable is the hazard of successful exits (Models a) and termination (Models b). Models 1a and 1b employ the full sample; Models 2a and 2b include domestic investments only; Models 3a and 3b include cross-border investments only. The coefficients of the following dummy variables are not reported due to space considerations: investor entry stage; first investment year; portfolio company industry; portfolio company country

x: variables are included in the models

**Table 6: Cox models predicting the hazard of exit: Full sample, interactions with VC origin**

|  |  |  |
| --- | --- | --- |
|   |   | Comparison of VC Firm Origins |
|   |   | Success | Termination | Success | Termination |
|   |   | 1a | 1b |   | 2a | 2b |
| *Independent variables* |   |   |   |   |   |   |   |   |
|   | Rounds | 0.118 |   | -0.100 |   | -0.257 | \* | -0.282 | \* |
|   | Domestic VC firm | 0.022 |   | -0.154 |   |   |   |   |   |
|   | Cross-border VC firm |   |   |   |   | -0.022 |   | 0.154 |   |
|   | Branch VC firm | -0.341 |   | 0.069 |   | -0.363 |   | 0.223 |   |
|   | Domestic VC firm \* R | -0.375 | \*\* | -0.181 |   |   |   |   |   |
|   | Cross-border VC firm \* R |   |   |   |   | 0.375 | \*\* | 0.181 |   |
|   | Branch VC firm \* R | -0.045 |   | -0.100 |   | 0.331 | \* | 0.082 |   |
| *Selection variable* |   |   |   |   |   |   |   |   |
|   | Inverse Mills Ratio | -0.653 | † | -0.805 | \*\* | -0.653 | † | -0.805 | \*\* |
| *Portfolio company characteristics* |
|   | Portfolio company age | -0.023 |   | 0.039 |   | -0.023 |   | 0.039 |   |
|   | Patents | 0.070 | \* | 0.071 | \*\*\* | 0.070 | \* | 0.071 | \*\*\* |
|   | Sales (LN) | 0.126 | \*\*\* | -0.015 |   | 0.126 | \*\*\* | -0.015 |   |
| *VC firm characteristics* |   |   |   |   |   |   |   |   |
|   | VC firm age | -0.002 |   | 0.003 | \*\* | -0.002 |   | 0.003 | \*\* |
|   | VC firm country experience | 0.001 | \* | 0.001 | \* | 0.001 | \* | 0.001 | \* |
|   | VC firm IPO track record | -0.002 |   | -0.007 |   | -0.002 |   | -0.007 |   |
|   | Lead investor | -0.115 |   | -0.156 |   | -0.115 |   | -0.156 |   |
| *Deal characteristics*  |   |   |   |   |   |   |   |   |
|   | Distance (LN) | 0.078 | \* | -0.001 |   | 0.078 | \* | -0.001 |   |
|   | Cumulative amount invested | 0.010 |   | -0.005 |   | 0.010 |   | 0.005 |   |
|   | VC firm entry round | 0.304 | \*\*\* | 0.107 |   | 0.304 | \*\*\* | 0.107 |   |
|   | Syndication size | -0.004 |   | -0.133 | \*\* | -0.004 |   | -0.133 | \*\* |
|   | Mixed syndicate | 0.208 |   | 0.506 | \*\* | 0.208 |   | 0.506 | \*\* |
| *Market conditions* |   |   |   |   |   |   |   |   |
|   | IPO market conditions | 0.002 | \* | 0.003 | \*\*\* | 0.002 | \* | 0.003 | \*\*\* |
| *Other*  |  |  |  |  |  |  |  |  |
|   | Investor entry stage | x | x | x | x |
|   | First investment year | x | x | x | x |
|   | Portfolio company industry | x | x | x | x |
|   | Portfolio company country | x | x | x | x |
|   |   |   |   |   |   |   |   |   |   |
|   | Observations | 1,382 | 1,382 |   | 1,382 | 1,382 |
|   | Log likelihood | -1,516 | -1,716 |   | -1,516 | -1,716 |

\*\*\* p<0.001, \*\* p<0.01, \* p<0.05, **†** p<0.1 (conservative two-tailed tests)

The dependent variable is the hazard of successful exits (Models a) and termination (Models b) in the full sample. Cross-border VC firm is the reference category in the first two models, and Domestic VC firm is the reference category in the last two models. The coefficients of the following dummy variables are not reported due to space considerations: investor entry stage; first investment year; portfolio company industry; portfolio company country

x: variables are included in the models

**Table 7: Cox models predicting the hazard of exit: First-round sample, interactions with origin**



The dependent variable is the hazard of successful exits and termination in the sample of first round investments only. Cross-border VC firm is the reference category in Panel A, and Domestic VC firm is the reference category in Panel B. The coefficients of the control variables are not reported due to space considerations.

**Table 8: Cox models predicting the hazard of exit: Lead versus non-lead sample**



The dependent variable is the hazard of successful exits and termination in the subsample of lead investments (Panel A) and of non-lead investments (Panel B). The coefficients of the control variables are not reported due to space considerations.

**Figure 1: Impact of *ROUNDS* on the baseline hazard of exit**

Figure 1 shows how the baseline hazard of exit changes over rounds. The exit hazard over rounds is not different for unsuccessful exits and for successful domestic VC firm exits. The impact of additional investment rounds on the hazard of a successful exit is significantly different between domestic VC firms and respectively cross-border and branch VC firms. The impact of additional investment rounds on the hazard of a successful exit between cross-border and branch VC firms is not significantly different.

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**Appendix A: Classification of trade sales and buyouts**

Based upon the characteristics of the companies for which it is known whether the exit was successful or not, we developed a model to predict whether a trade sale or buyout exit was successful. This approach is comparable with failure prediction models (see e.g. Ohlson, 1980; Altman and Sabato, 2007). The prediction model used the exit information of the known exits in the full dataset (759 portfolio companies). We classified an exit as successful if it was an IPO (54 portfolio companies), or if the exit value was higher than the amount invested in a trade sale (35 portfolio companies) or a buy-out (5 portfolio companies). Unsuccessful exits comprised liquidations (147 portfolio companies), buy-backs (31 companies) and buy-out or trade sale exits with a transaction value below the total amount invested (11 portfolio companies).

The 94 successful exits and 189 unsuccessful exits were used as the learning sample in our logit models (Ohlson, 1980; Altman and Sabato, 2007). Two different logit models, including different sets of variables, were estimated in order to test the robustness of our classification. The dependent variable in both models is a dummy variable, taking the value of one if the exit was successful. Both models have a high predictive power, with adjusted R² values of 0.63 (model 1) and 0.60 (model 2). The variables were included based on their significance and their predictive power (Ohlson, 1980; Altman and Sabato, 2007). Both logit models include portfolio company characteristics: the first round investment amount, the pre-exit cash flow, assets and the ratio of value adding over payroll expenses. We also included dummy variables to control for the first investment year and for the portfolio company’s industry and country characteristics. Model 1 further includes the time between first investment and exit, the pre-exit sales, the long term debt over total assets ratio and the sales over total assets ratio. Model 2 includes the portfolio company’s pre-exit value adding, amount of cash holdings and its value adding over total assets ratio, as sales information is not available for all companies. The highest variance inflation factor was 3.72, which is well below the usual threshold level of 10 (Rao et al., 2001).

The outcome of the learning models served as input to classify portfolio companies for which insufficient information is available to classify their exit as successful. We first estimated the exit year for those companies for which the exact exit time was lacking. Thereafter, we estimated the likelihood of the exit being successful. We therefore calculated the logit scores predicted by the two classification prediction models based upon pre-exit company characteristics, year, industry and country dummies. Companies with logit scores for both models below 0.25 were classified as having been unsuccessfully exited (74 companies or 9.75%) and companies with logit scores for both models above 0.75 as having been successfully exited (155 companies or 20.42%). Companies with a logit score between 0.25 and 0.75, with contradicting scores on both models or without pre-exit accounting data were not classified and treated as right censored data in our main analyses (229 companies or 30.17%).

This leads to a total of 249 companies categorized as having experienced a successful exit, and 263 portfolio companies categorized as having been unsuccessfully exited. The remaining 247 companies were treated as censored, the majority because key data was lacking (200 companies) or because the logit scores of the two models were contradicting or inconclusive (29 companies). An unsuccessful exit is associated with a termination event.

**Appendix B: Probit selection model**



The dependent variable is a dummy variable taking the value of 1 if the VC investor is cross-border and 0 if domestic. The exogenous variable is the one-year lagged OECD FDI Regulatory Restrictiveness Index.

1. More information on the data collection process is provided in Bertoni and Marti Pellón (2011). As government VC firms exhibit an investment pattern that differs from all other VC investor types, we exclude these investments in order to test the hypotheses. [↑](#footnote-ref-2)
2. This is lower than the average of 4.05 VC rounds in U.S. portfolio companies, as reported by Guler (2007). This is consistent with more European VC investors providing a single investment round. [↑](#footnote-ref-3)
3. This is consistent with an average of 1.93 investment rounds per VC per portfolio company, as reported by Guler (2007). More extensive descriptive details are available from the authors. [↑](#footnote-ref-4)
4. Note that Guler (2007) considered bankrupt or defunct companies as censored. [↑](#footnote-ref-5)
5. The turning point from negative to positive occurs outside the range of observation in our sample for both successful exit and termination models. This is true for all subsequent analyses. [↑](#footnote-ref-6)
6. We do not include *Rounds*² in these analyses, as *Rounds*, *Rounds*² and their interaction terms are too highly correlated. Moreover, the relationship between the hazard rate and investment rounds is monotonously decreasing and not curvilinear, except for a very small minority of observations. Both observations together warrant not including *Rounds²* in the models with origin interaction dummies. [↑](#footnote-ref-7)