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Cross-Border Venture Capital Investments: The Impact of Foreignness on Returns

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Abstract

This study is set against the background of the growing internationalization of venture capital (VC) investing and is the first global comparison of the returns generated by individual domestic and cross-border deals. We examine investments worldwide during 1971 to 2009 and find that cross-border investments significantly underperform compared with equivalent domestic investments. Returns are negatively affected by geographic distances, cultural disparities, and institutional differences between the home and host countries. Returns on cross-border and domestic deals also decline after the late 1990s. International portfolio diversification and the saturation of domestic markets may explain why VC investors make cross-border investments despite poor expected returns.

JEL classification: G24, G32, G33, G34, G1.

Keywords: venture capital, cross-border, return, IRR, PME, foreignness, distance.

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1. Introduction

This study examines the returns generated by venture capital (VC) investments in domestic and cross-border deals. Venture capital (VC) firms are specialized financial intermediaries which raise funds from investors. The VC firms then invest the funds in innovative new businesses, so-called portfolio companies, with a view to realising their investments after approximately 5–7 years (e.g. Sahlman 1990; Black and Gilson 1998; Gompers and Lerner 2004). In a domestic deal, a VC firm invests in its home country; in a cross-border deal, it invests outside its home country. VC firms are experts at investing in inherently risky and informationally opaque start-up ventures (e.g. Gorman and Sahlman 1989; Gompers 1995; Amit, Brander, and Zott 1998). The high information asymmetries involved in such investments give rise to adverse selection prior to investment and agency conflicts post-investment. In order to limit these problems, VC firms closely screen potential investee companies; conduct careful due diligence; and align entrepreneurs' incentives with firm value through monitoring, governance, contracts, and other mechanisms, including staged financing (e.g. Sahlman 1990; Admati and Pfleiderer 1994; Wright and Robbie 1998; Manigart and Wright 2013). By resolving information problems and incentive conflicts, and by providing portfolio companies with advice, expertise, and access to networks, VC investors are able to add value to their investments (e.g. Gorman and Sahlman 1989; Sapienza 1992; Sapienza, Manigart, and Vermeir 1996; Devigne, Vanacker, Manigart, and Paeleman 2013).

The effectiveness of these specialized methods, mechanisms, and practices is often believed to depend crucially on VC investors' familiarity with local markets; their access to local information, knowledge, and networks; and the proximity between VC investors and their investee (portfolio) companies in order to maintain close links, frequent interaction, and valuable reputational capital (e.g. Cumming and Johan 2007; Chen, Gompers, Kovner, and

Lerner 2010; Dai, Jo, and Kassicieh 2012; Hain, Johan, and Wang 2015; Wuebker, Kraeussl, and Schulze 2016). As a result, VC investing has long been thought to be an inherently local business (Wright and Robbie 1998; Cumming and Dai 2010; Dai et al. 2012).

In apparent defiance of this view, the two decades prior to the financial crisis of 2007 saw a large increase in the number and size of cross-border VC investments. Aizenman and Kendall (2012) report an increase in worldwide cross-border VC investment deals from 15% of global deals in the early 1990s to over 40% in 2007. More recently, cross-border investing by US VC firms has risen sharply, with early-stage VC investments increasing from under 10% to more than 30% of VC deals in 2013 (Wuebker et al. 2016). In this context, more than 70% of VC deals in Asia are funded by foreign VC firms (Dai et al. 2012).

Against this background of increasing VC internationalization, we examine the returns performance of cross-border and domestic VC investments. VC investors may require higher or lower returns from cross-border investments than from domestic investments. On the one hand, VC firms investing abroad are likely to encounter 'liabilities of foreignness' due to geographic distances, cultural disparities, and institutional differences between VC investors and their portfolio companies (Zaheer 1995; Wright, Pruthi, and Lockett 2005; Sojli and Tham 2017; Taussig 2017; Wu and Salomon 2017). As a result, cross-border investing gives rise to higher transaction costs (e.g. Portes and Rey 2005) and greater costs due to more severe information asymmetries and agency conflicts (Wright and Robbie 1998; Wuebker et al. 2016). In this case, VC investors require higher returns from cross-border investments to compensate for the additional costs. On the other hand, cross-border investing facilitates portfolio diversification; thus, VC investors with portfolios predominantly invested in domestic ventures may accept lower returns from cross-border investments (e.g. Poterba and French 1991). High levels of VC funds chasing limited numbers of promising investment opportunities may also drive VC investors to resort to cross-border investing, even though

they expect these investments to generate relatively low returns (Gompers and Lerner 2000). In a previous study of cross-border returns, Cumming, Fleming, and Schwienbacher (2009) find that Asian-Pacific VC firms investing in US-based portfolio companies experience returns that are lower than their domestic investments. Cumming et al. (2009) use hand-collected and largely proprietary data to assess the performance of 468 individual investments by VC firms in 12 Asian countries during 1989–2001 based on each investment's internal rate of return (IRR).

While Cumming et al. (2009) are able to calculate investment returns due to their access to proprietary data, most other previous VC studies lack sufficiently detailed deal-level data to compute direct measures of performance such as IRR or public market equivalent (PME) for individual investments. Because of data limitations, most studies measure performance in terms of the likelihood of successful VC exit (e.g. Hochberg, Ljungqvist, and Lu 2007) rather than IRR or PME. Bengtsson and Hsu (2015) explicitly note the use of exit success as a limitation of their analysis.[1] Devigne, Manigart, and Wright (2016) highlight that the existing evidence on VC returns at deal level is limited and call for further research in order to understand the variation of returns. We are able to overcome this limitation by using detailed cash-flow data on individual VC investments obtained from the Centre of Private Equity Research (CEPRES) to calculate actual returns on individual VC investments.[2] Our study contributes to the literature by comparing the returns of individual domestic and cross-border VC investments using a sample of 6,529 domestic and cross-border VC deals made worldwide during 1971–2009. To the best of our knowledge, this is the first study to find that the underperformance of cross-border investments relative to

[1] With respect to their analysis of exit as a measure of VC success, Bengtsson and Hsu (2015) point out that an 'important caveat for this part of our analysis is that we equate the investment outcome with the company's exit mode *due to data limitations*. This outcome variable is a coarse measure of investment performance, though it is commonly used in the entrepreneurship literature' (p. 340; italics added).

[2] While previous studies have used CEPRES (e.g., Franzoni, Nowak, and Phalippou 2012, Krohmer, Lauterbach, and Calanog 2009, Cumming, Schmidt, and Walz 2010, Cumming and Walz 2010), none of these previous studies compare the returns of domestic and cross-border investments .

equivalent domestic investments is a global and persistent phenomenon. We base this conclusion on our analysis of the returns and other performance measures of a broad global sample of VC investments, comprising large numbers of home and destination countries and spanning more than three decades.

Our results show that cross-border deals generate lower returns than equivalent domestic deals in terms of return-based performance. We address differences in the targeted selection and risk of VC investors and conclude that the observed return differentials amount to cross-border underperformance. We find that geographic distances, cultural disparities, and institutional differences between the home countries of VC investors and portfolio companies negatively affect cross-border returns. Additional tests show that VC firms benefit from cross-border investing by achieving portfolio diversification and overcoming shortages of domestic investment opportunities in saturated markets. Diversification, and the saturation of domestic markets, may explain why VC investors are attracted to cross-border investing despite the poor returns performance of cross-border deals.

Our study helps to resolve conflicting evidence in prior studies which examine the effect of geographic distances between US VC investors and portfolio companies on VC exit performance (Chen et al. 2010; Cumming and Dai 2010; Bengtsson and Hsu 2015). For example, Chen et al. (2010) report that non-local deals outperform local deals in terms of initial public offering (IPO) exit probabilities, while Cumming and Dai (2010) find that local exit deals outperform non-local deals. Bengtsson and Hsu (2015) focus on the ethnicity of VC investors and founders of entrepreneurial companies and find that while shared ethnicity increases the likelihood of investment, it reduces exit performance. We explore what happens when VC investments cross borders and examine the impact of geographic distances, cultural disparities, and institutional differences in a similar way to the studies of Nahata, Hazarika, and Tandon (2014) and Dai and Nahata (2016). Like other cross-border performance studies,

Nahata et al. (2014) and Dai and Nahata (2016) measure performance purely in terms of IPO exit probabilities.

Our study lies at the intersection of the literature of several academic fields including economics, finance, entrepreneurship, management, and international business, as outlined in section 2. Focusing largely on entrepreneurial finance, our study contributes to the growing literature on the internationalization of VC and private equity (PE) investment and on cross-border VC/PE activity and flow (e.g. Schertler and Tykvová 2011; Tykvová and Schertler 2011; Schertler and Tykvová 2012; Dai et al. 2012; Li and Zahra 2012; Cao, Cumming, Qian, and Wang 2015). It also contributes to the literature on the performance of cross-border VC investments in terms of the ability of VC investors to achieve successful exits (e.g. Wang and Wang 2012; Humphery-Jenner and Suchard 2013; Bertoni and Groh 2014; Nahata et al. 2014; Cumming, Knill, and Syvrud 2016; Dai and Nahata 2016). In the context of this literature, our study builds on the existing research about the ways in which exit performance is affected by geographic distances, cultural/ethnic disparities, and institutional differences between the locations of US VC providers and those of their portfolio companies (Chen et al. 2010; Cumming and Dai 2010; Bengtsson and Hsu 2015) and between the locations of international VC providers and their portfolio companies (Nahata et al. 2014; Dai and Nahata 2016). Our study is also related to the literature on syndication and networks in cross-border investments (Hursti and Maula 2007; Guler and Guillén 2010; Meuleman and Wright 2011; Jääskeläinen and Maula 2014; Reuer and Ragozzino 2014; Hain et al. 2015; Chemmanur, Hull, and Krishnan 2016; Meuleman, Jääskeläinen, Maula, and Wright 2017).

The remainder of this paper is organized as follows. Section 2 reviews the literature and develops our hypotheses. Section 3 describes the data and methodology, and section 4 presents our analysis and results. Section 5 concludes the paper.

2. Literature, Conceptual Framework, and Hypotheses

VC firms are experts at bearing risk and dealing with the information and agency problems (adverse selection and moral hazard) which complicate investments in promising, young entrepreneurial businesses characterized by high information asymmetries, high risk, and high potential (e.g. Gorman and Sahlman 1989; Gompers 1995; Amit et al.). Such ventures typically have little or no trading records or other information, such as balance sheets and past cash flow data, which are used in traditional valuation methods. Moreover, these ventures frequently operate in innovative industries with no established benchmark companies. VC firms have developed methods to limit the information and agency problems arising from such investments. Such methods include screening, due diligence, contracting, monitoring, governance, and staged financing (e.g. Sahlman 1990; Admati and Pfleiderer 1994; Wright and Robbie 1998; Manigart and Wright 2013).

The effectiveness of these specialized methods, mechanisms, and practices is often believed to depend crucially on VC investors' familiarity with local markets; their access to local information, knowledge, and networks; and the proximity between VC investors and their investee (portfolio) companies in order to maintain close links, frequent interaction, and valuable reputational capital (e.g. Cumming and Johan 2007; Chen et al. 2010; Dai et al. 2012; Hain et al. 2015; Wuebker et al. 2016). Significant distances between VC firms and portfolio companies are likely to increase information asymmetries between investors and investees, causing more pronounced adverse selection and moral hazard (e.g. Dai et al. 2012; De Prijcker, Manigart, Wright, and De Maeseneire 2012; Hain et al. 2015; Dai and Nahata 2016). Distance may thus increase the costs to VC firms of identifying and screening suitable investment opportunities (Cumming and Dai 2010; Wuebker et al. 2016). VC firms typically

conduct due diligence which is more rigorous, and hence, costlier for remote ventures (Nahata et al. 2014). In this regard, Wright, Lockett, and Pruthi (2005) report significant differences in the risk assessments and information sources which are used in targeted selection between foreign and domestic investors.

Non-local and cross-border investors are at a disadvantage relative to local investors in terms of access to portfolio companies, local information, networks, reputational capital, and resources, and typically incur higher information and transaction costs (Nahata et al. 2014). The higher costs of contracting and monitoring cross-border portfolio companies result in lower firm value and lower value added (Sapienza et al. 1996; Sorensen and Stuart 2001; Dai et al. 2012; Wuebker et al. 2016). Mäkelä and Maula (2008) confirm that local VC firms are more knowledgeable about portfolio companies' markets than foreign VC firms. The general partners of VC firms provide advice and monitoring to portfolio companies during meetings held at the companies' offices; in this context, geographic distance increases the costs and the amount of time involved for the partners (Hain et al. 2015). Chemmanur et al. (2016) find that the absence of (geographic) proximity makes it more difficult for VC firms to move scarce human capital, such as skilled general partners of VC firms, to a portfolio company's location. As a result, it is costlier to screen, monitor, advise, and support more distant portfolio companies.

This advantage of local investors and investments is the focus of several studies from a range of academic disciplines including entrepreneurial and corporate finance, economics, and international business. Studies in international business and management, based on the seminal study by Zaheer (1995), refer to the disadvantage of not being local as the 'liability of foreignness'. Studies in asset pricing and corporate finance refer to investors' preferences for more familiar local rather than non-local investments as 'home bias' (Poterba and French 1991; Coval and Moskowitz 1999). Other studies show that VC firms investing abroad

encounter the 'liability of foreignness' problem (Wright et al. 2005; Nahata et al. 2014; Dai and Nahata 2016).

In order to compensate for the higher costs of cross-border investing as a result of the liability of foreignness, VC firms are likely to require higher returns from cross-border investments than from equivalent domestic investments. However, cross-border investing facilitates portfolio diversification; thus, VC investors with portfolios predominantly invested in domestic ventures may accept lower returns from cross-border investments (e.g. Poterba and French 1991). A lack of promising investment opportunities in their home countries, or rigorous competition for attractive deals because of excess funds available to VC investors, may also motivate VC firms to embark on cross-border ventures even if they expect them to generate relatively low returns (Gompers and Lerner 2000). With regard to 53 VC funds based in 12 countries in the Asia-Pacific region, Cumming et al. (2009) find that these funds achieve lower internal rates of return (IRR) for investments in US portfolio companies than for domestic investments. At a global level, whether VC investors require higher or lower returns from cross-border investments than from domestic investments remains a question to be resolved empirically.

Comparisons of the performance of VC firms show that the firms' selection criteria and investment behaviour may also differ between home and cross-border investments. Empirical evidence confirms that VC investors select different types of venture at home and abroad. The results of Dai et al. (2012) suggest that VC investors mitigate the higher information and monitoring costs of investing abroad by investing in later financing rounds and in larger, more mature companies which are more transparent and less costly to screen and monitor. VC investors also self-select cross-border investments. Cumming and Dai (2010) find that investments in more distant firms tend to be undertaken by more reputable and experienced VC investors acting in syndicates in order to spread the risk. Thus, when

comparing the returns generated by domestic and cross-border investments, it is essential to control for targeted selection and VC self-selection in order to compare equivalent domestic and cross-border investments.

Based on the foregoing reasoning, we formulate our first testable hypothesis as follows.

H1: *All else being equal, there is no difference in performance between domestic and cross-border VC investments.*

We measure absolute returns in terms of IRR and also measure the returns relative to a market benchmark in the form of PME. In addition to returns, we also examine exit performance. To the best of our knowledge, all prior studies of non-local and cross-border VC investments measure performance in terms of exit success. Following Giot and Schwienbacher (2007), they evaluate performance on the basis of whether and how quickly VC investors successfully exit their investments. Existing evidence on the exit performance of investments by US VC firms in local and non-local US portfolio companies is mixed (Chen et al. 2010; Cumming and Dai 2010; Bengtsson and Hsu 2015). While Chen et al. (2010) find that non-local deals of US VC firms outperform local deals in terms of their IPO exit probabilities, Cumming and Dai (2010) discover that local exit deals outperform non-local deals. Bengtsson and Hsu (2015) focus on the ethnicities of VC investors and founders of entrepreneurial companies and find that shared ethnicity increases the likelihood of investment but reduces exit performance. Our analysis of VC investments across borders is closely related to Dai et al. (2012), Li, Vertinsky, and Li (2014), Nahata et al. (2014), and Dai and Nahata (2016).

It is possible that foreign VC firms are less committed to their portfolio companies than local VC firms and may withdraw more quickly when a portfolio company's

performance is disappointing. In this regard, VC firms' premature exits may damage portfolio companies (Mäkelä and Maula 2008). Alternatively, their lower levels of commitment and local embeddedness may enable foreign VC firms to make more efficient exit decisions (Devigne et al. 2016). Whatever the circumstances, exit decisions may have implications for returns: foreign investors' premature exits may result in reduced returns, while more efficient exit decisions may lead to increased returns for cross-border investments. Longer periods of investment in portfolio companies not only cause higher monitoring costs but also liquidity problems for VC backers. If cross-border investments require greater effort and money spent on advising and monitoring portfolio companies, the higher costs of carrying cross-border investments relative to domestic investments may tip the balance in favour of earlier exits from cross-border investments (Cumming and Johan 2007; Espenlaub, Khurshed, and Mohamed 2015).

In the final part of our analysis, we explore possible reasons why the returns of domestic and cross-border investments differ. In hypothesis 1, we focus on a binary definition of foreignness. Now, we examine the impacts of geographic distances, cultural disparities, and institutional differences. Studies show that geographic distances, cultural disparities, and institutional differences between home and host countries affect the exit performance of VC cross-border investments (Mäkelä and Maula 2008; Guler and Guillén 2010; Li et al. 2014; Nahata et al. 2014; Dai and Nahata 2016). Evidence from the literature suggests that geographic distances and institutional differences have a negative impact on exit performance while the direction of the impact of cultural disparities is mixed. Our study contributes to this literature by examining the impact of geographic distances, cultural disparities, and institutional differences on returns rather than on exit success.

First, we explore whether there is a difference between investments across a single, shared land border and investments across multiple borders. Investments across a single land

border may involve less costly travel. Chemmanur et al. (2016) find that greater travel time adversely affects the exit success of cross-border VC investments. However, travel costs may depend to a greater extent on geographic distance; thus, in the next step, we examine the impact of geographic distance. Prior studies show mixed results with some reporting that greater geographic distance reduces exit performance (Cumming and Dai 2010) while others report a positive effect (Chen et al. 2010) or no significant effect after controlling for other measures of distance (Li et al. 2014; Dai and Nahata 2016). Consequently, we formulate the following hypothesis.

H2a: *A VC firm's performance in cross-border deals is unrelated to the geographic distance between the home countries of the VC firm and its portfolio company (after controlling for other measures of distance).*

Because of colonial linkages, geographically distant countries may share similar languages, cultures, and institutions. However, because of historical accidents and conflicts, nearby or neighbouring countries may differ greatly not just in terms of their languages but also their cultures and institutional frameworks. Consequently, because geographic distances may not adequately capture the liability of foreignness, we also examine cultural disparities and institutional differences, following Li et al. (2014), Nahata et al. (2014), and Dai and Nahata (2016). VC investors' lack of awareness of local cultural and social practices in unfamiliar cross-border environments can be a source of conflict between a VC firm and its portfolio company, thereby increasing agency costs and reducing VC performance (Nahata et al. 2014). Cultural disparities and institutional differences can adversely affect levels of trust, reputation, financial contracting, and company performance (Li et al. 2014; Nahata et al. 2014). Cultural disparity is commonly measured using Kogut and Singh's (1988) approach, based on the cultural measures (power distance, individualism, masculinity, and uncertainty avoidance) developed by Hofstede (1980). This approach is also used by Li et al. (2014),

Nahata et al. (2014), Hain et al. (2015), and Dai and Nahata (2016), among others. Li et al. (2014) find that cultural disparity reduces exit success, while Nahata et al. (2014) report that greater cultural disparity increases exit success. Nahata et al. (2014) argue that greater cultural disparity motivates VC investors to engage in closer pre-investment due diligence and screening; this in turn increases exit success. Focusing on the impact of cultural disparity on returns performance (as opposed to exit success), we test the following hypothesis.

H2b: *A VC firm's performance in cross-border deals is negatively related to the greater cultural disparity between the home countries of the VC firm and its portfolio company.*

VC investors encounter greater unfamiliarity and liability of foreignness in countries with institutional frameworks which differ from those in their home country. In a different institutional environment, a VC firm's familiar practices are likely to be at odds with local institutionalized practices with regard to deal selection, contracting, monitoring, and advising (Li et al. 2014). For example, VC firms from countries with strict and well-enforced legal rules and regulations rely on financial and accounting information to evaluate proposals and assess investment risk. However, in countries with weak institutional environments, VC firms must depend instead on personal contacts in order to access relevant information and enforce agreements (La Porta, Lopez-de-Silanes, Shleifer, and Vishny 1998; Cumming, Fleming, and Schwienbacher 2006; Cumming, Schmidt, and Walz 2010; Li et al. 2014). VC firms which are used to the effective legal protection of investors and contract enforcement in their home countries find they can no longer employ complex, state-contingent contracts in host countries with weak legal institutions (Guler and Guillén 2010). In this regard, Chemmanur et al. (2016) examine the impact of legal systems on exit success but find no significant impact. Measuring institutional differences using the World Governance Index, Li et al. (2014) find that such differences significantly reduce VC exit success. We examine the impact on VC

cross-border returns of three dimensions of institutional difference: the difference in the legal systems of home and host countries (based on La Porta et al. 1998, similar to Chemmanur et al. 2016), and differences in regulatory quality and political stability (similar to Li et al. 2014). Thus, we formulate the following hypothesis.

H2c: *A VC firm's performance in cross-border deals is negatively related to pronounced institutional differences between the home countries of the VC firm and its portfolio company.*

3. Data and Methodology

3.1. Data sources and sample

Our data on individual VC investments are obtained from the Centre of Private Equity Research (CEPRES).[3] CEPRES and its data are described in detail in Franzoni, Nowak, and Phalippou (2012). CEPRES data are used in a number of studies, including those of Krohmer, Lauterbach, and Calanog (2009), Cumming et al. (2010), Cumming and Walz (2010), and Franzoni et al. (2012).

Through their special data-collection method (based on the so-called 'Private Equity Analyser'), CEPRES effectively anonymizes all information relating to investments in order to meet the confidentiality requirements of the VC and PE firms which provide data to CEPRES. This technique means that no third parties are able to identify the performance of individual firms, funds, or managers. The importance of such anonymity is that it eliminates the incentives for VC and PE firms to overstate the results which they report to CEPRES. The

[3] CEPRES is a private data provider established in 2001 which offers information on VC deals worldwide.

lack of anonymity in other databases may result in overstating and backfilling information, a situation which amounts to positive self-reporting bias.

Another important advantage of the CEPRES database is the availability of detailed information on cash flow at the level of individual VC investments. Other databases either lack this information or provide cash flow or IRR data only at the fund level.

We start with all 14,224 observations in CEPRES for VC investments made from January 1971 to December 2009. We exclude 2,484 partial exits and non-exits and 5,057 buyout investments.[4] Of the remaining 6,683 observations, we have insufficient cash flow data for 154 deals. This leaves us with 6,529 observations on fully realized VC investments exited through IPOs, mergers and acquisitions (M&A), or liquidations (write-offs). We split our sample into four geographic regions in accordance with the locations of the VC investors: North America, Europe (excluding the UK), the UK, and the rest of the world (ROW). Our sample comprises 4,334 observations for North America, 839 for Europe, 363 for the UK, and 993 for the ROW.[5] We classify investments as domestic (cross-border) if a VC firm and its portfolio company are located in the same country (different countries).[6]

3.2. Methodology

In this section, we discuss the methodology used in our analysis. In order to measure the financial returns of VC investments, we calculate IRR based on all cash flow to VC investors (both outflow and inflow). This cash flow is reported in the CEPRES database. Except for a few studies which use proprietary data (e.g. Cumming et al. 2009), most Prior

[4] We focus on fully exited (realized) deals to avoid issues related to the accuracy of the estimated net asset values (NAVs) of unrealized deals or timing issues about when the NAVs are reported. We examine the sensitivity of our results to the inclusion of partial exits and non-exits in the robustness section.
[5] Appendix A provides a breakdown of the distribution of VC deals by region during 1971 to 2009.
[6] We observe the countries of origin of VC firms and portfolio companies at the time of the investments. A limitation of our data is that we do not observe relocations to other countries by either the VC firms or the portfolio companies after the initial investments.

research is limited to observing IRR at the fund level. Because we have access to cash flow data, we are able to calculate IRR based on actual (not proxied) cash flow at the level of individual VC investments.[7] The cash flow is converted into US dollars, following the approach adopted by Franzoni et al. (2012). Cash flow is not adjusted for management fees, interest, or carried interest. VC firms commonly use IRR to evaluate their investments in-house and are often reluctant to disclose IRR figures. Moreover, if the firms do disclose their IRR figures, they have incentives to overstate them. As a result, reliable IRR data at the level of individual VC investments were not previously available to researchers. Some studies are able to calculate IRR but only at the level of an overall VC fund (rather than at the level of individual investments held within a fund, as we do here). However, an understanding of investment level returns is crucial for VC firms so that they can allocate capital efficiently between domestic and cross-border investments and for VC fund investors so that they can select appropriate funds.

We observe the stream of cash flow between the start date of each investment and the final liquidation (exit) date. We then calculate the IRR as the discount rate which equates the present value of the net cash flow to zero. The cash flow consists of investments in portfolio companies, dividend repayments, and proceeds from exiting the investments.[8]

In addition to IRR, our analysis uses PME. IRR is an absolute measure of performance in the sense that it is not measured relative to a benchmark. In contrast, PME is a relative performance measure which compares a VC investment to an equivalently timed investment in the relevant public market. PME has been interpreted as a market-adjusted multiple of invested capital in that a PME greater than one means that investors in a given VC deal gain more wealth than they would have achieved if they had invested in the public

[7] Note that the IRR estimated in our analysis are gross returns as opposed to returns net of fees and the costs (transaction, search, and monitoring) incurred by VC firms when undertaking and managing investments.
[8] In our analyses, we winsorize IRR at 1%.

markets. We calculate PME as the ratio of discounted cash inflow to discounted cash outflow, where the discount rate is the total return in the corresponding stock market. For investments in US portfolio companies, we use the S&P 500 index to act as a proxy for the public market, as in Kaplan and Schoar (2005). For investments outside the US, we use the corresponding local stock market index. Sorensen and Jagannathan (2015) present rigorous economic underpinnings for PME and show that PME is equivalent to measuring performance using Rubinstein's (1976) dynamic version of the capital asset pricing model (CAPM). The authors show that under reasonable assumptions about investor utility, PME is robust and valid regardless of the beta of an investment, even when the beta is time varying. They conclude that with 'PME, investors can evaluate risk-adjusted performance without explicitly calculating any betas or even knowing the risk of the underlying investments' (Sorensen and Jagannathan 2015, p. 44). Hence, we interpret PME as a risk-adjusted measure of performance.

In our initial multivariate analysis, we regress VC performance on whether or not a portfolio company is domestic or cross-border. Subsequent analyses relate VC performance to measures of distance between a VC firm and a portfolio company. *VC performance* (the dependent variable) is measured as either IRR or PME. In order to account for the endogeneity of the cross-border indicator arising from an (un)observable difference in VC backers' selection criteria and investment behaviour at home and abroad, we estimate a two-stage Heckman model. At the first stage, we estimate a probit model of the probability of an investment being cross-border with the *cross-border* indicator (coded one for a cross-border investment and zero otherwise) as the dependent variable. The instrument used at the first stage is the capital inflow into the VC industry of the VC

provider's home country in the year of the investment.[9] At the second stage, we estimate VC performance by including the inverse Mills ratio based on the estimates of the first stage among the control (explanatory) variables. The explanatory variable of interest is the *cross-border* indicator. As control variables, we include deal and VC characteristics such as *VC experience*, *investment size*, *fund age*, and indicators of *syndication*, the *financing stage*, the *industry* of the portfolio company, and the *year* of investment (the deal year).[10] We also control for country-specific stock market liquidity (based on the portfolio company's country of origin) in the year prior to VC exit. Further, we use bootstrapped standard errors. In addition to the two-stage model, we estimate mixed-effects models based on Hesketh, Skrondal, and Pickles (2005) which control for observable and unobservable heterogeneity, including differences between domestic and cross-border investments, and for the impact of outliers.

In our initial analysis, we use a binary indicator which captures whether a portfolio company is domestic or cross-border. In a subsequent analysis, we examine an additional binary indicator (*cross-border not sharing border*) to differentiate between neighbouring countries and foreign countries without shared borders. In the final part of our analysis, we investigate whether distance between a VC firm and a portfolio company affects performance. We use three different measures of distance relating to geographic distances, cultural disparities, and institutional differences between countries of VC firms and portfolio companies. Geographic distances between VC firms and portfolio companies are measured as the physical distances between the capitals of the respective home countries. As in Dai and Nahata (2016), we quantify cultural disparities between the countries of VC firms and

[9] We expect that aggregate capital inflow into the VC industry of a given country make it more likely that VC firms invest abroad as competition among VC firms for domestic investments becomes more intense. This causes VC firms to search out investment opportunities abroad.

[10] The CEPRES database we use only shows whether an investment is syndicated or not. Unfortunately, we cannot distinguish between domestic and foreign syndication.

portfolio companies using the four cultural dimensions of Hofstede, Hofstede, and Minkov (2010), who follow the approach of Kogut and Singh (1988).[11] The four dimensions relate to power distance, individualism, masculinity, and uncertainty avoidance. The Hofstede et al.'s (2010) framework is the most widely used and recognized framework for measuring cultural disparities in different disciplines, including international business and management research (Sivakumar and Nakata 2001; Kirkman, Lowe, and Gibson 2006). We obtain data from Geert Hofstede's website (www.geerthofstede.nl) and use the Cartesian distance measure to calculate culture disparity (see Appendix B for details of this measure). We use three measures of institutional differences between the home countries of VC firms and portfolio companies: differences in the regulatory quality, political stability, and the legal systems. Appendix B provides details of data sources and definitions of the variables. All variables are from CEPRES except for those representing market liquidity, differences in regulatory quality, and differences in political stability, which are collected from the World Bank online database, and the variable representing differences in legal systems, which is based on data collected from Rafael La Porta's website.

In order to examine the effect of explanatory variables on the time from a VC investment to the VC exit or, more accurately, on the exit hazard rate defined as the inverse of the time to exit, we estimate the Cox proportional hazard model. The hazard function measures the likelihood of a VC firm to exit its investment within a small time interval, conditional on VC and market characteristics. The interesting feature of the Cox proportional hazard model is that it does not require any distributional assumptions about the exit rate. The coefficients of the Cox proportional hazard model are estimated through maximum likelihood estimation. A positive coefficient suggests that a unit increase in the covariate accelerates the exit, while a negative coefficient decelerates the exit. Specifically, we estimate a frailty Cox

[11] For detailed discussions of Hofstede measure see Beugelsdijk, Kostova and Roth (2017)

model which is similar to a fixed-effects model in a linear regression. Our model controls for 'fixed effects' in terms of heterogeneity across VC firms. The model estimates an additional parameter theta, which indicates the presence of such heterogeneity.

4. Results

4.1. Univariate analysis

Devigne et al. (2016) highlight the need for further research on the variation of VC deal-level returns across different exit routes. Panel A of Table 1 reports the annual rates of return earned by VC firms from fully exited investments as measured by the IRR. The figures are presented by regions (North America, the UK, Continental Europe, and the ROW) and exit routes (IPOs and M&A). In almost all regions and for all exit routes, cross-border investments generate lower IRR than domestic deals (except for investments exited through IPOs by VC firms in the ROW).[12]

Next, we examine the PME, which we interpret as a measure of relative and risk-adjusted performance as outlined in section 3. Panel B of Table 1 shows that the mean PMEs for domestic investments range from 2.02 to 2.86 depending on region. PMEs above 2 suggest that the wealth generated by VC investments in domestic portfolio companies is more than twice the wealth generated by investments in public markets. In contrast, the mean PMEs for cross-border investments range from just 1.4 to 1.7. We find statistically significantly higher PMEs for domestic investments in almost all regions except for the ROW. In North America, the mean domestic PME is twice that of cross-border investments.

[12]Median IRR for the ROW also show that domestic investments outperform cross-border investments. The average and median returns on domestic investments by ROW VC firms are comparable to those reported for Asia-Pacific VC firms during 1989–2001 in Cumming et al. (2009).

The difference between domestic and cross-border PMEs is particularly pronounced for investments which were exited through IPOs, with the domestic PMEs in North America being almost three times the cross-border PMEs. We find a similar pattern for the median PMEs of North American VC firms. With such firms, median PMEs are significantly higher for domestic investments than cross-border investments. However, differences in medians are not statistically significant for the other regions. The magnitude of our overall median PME for domestic North American investments is comparable to that reported by Harris, Jenkinson, and Kaplan (2014).

[TABLE 1 HERE]

We examine whether VC investors select deals abroad which are systematically different from their domestic deals and whether certain types of VC backers self-select cross-border investments. Our univariate analysis in Table 2 examines the characteristics of cross-border and domestic investments. Table 2 presents the figures by regions. With regard to VC firms from all four regions, we find that those firms engaging in cross-border investments are on average significantly older (more experienced) than those involved in domestic investments. The average (mean) difference in age between firms backing cross-border portfolio companies compared with those investing in domestic companies is broadly similar at approximately 2.5–2.7 years for VC firms in all regions except North America.[13] Among North American VC firms, the age difference is much more pronounced and is between seven and nine years (based on medians and means respectively). This clearly shows that cross-border investments are undertaken by seasoned VC firms, a finding which is consistent with those for the US reported by Cumming and Dai (2010).

[13] Based on median age, the results are broadly the same with the exception of the ROW, where the difference in medians is only half a year.

We find a similar but weaker effect in terms of the age of VC funds (rather than VC firms). Across all regions, it appears that cross-border deals are carried out by older funds. However, this difference between domestic and cross-border deals is marginally significant (at 10%) based on the means of fund age; based on medians, the difference is insignificant. Perhaps the fund age difference reflects a tendency of funds to invest first in domestic deals perceived to be less risky and to delay 'gambling' on potentially more risky cross-border investments until the funds have matured. Thus, once earlier domestic deals show signs of success, VC firms are safe in the knowledge that they can offset the potential risk of cross-border deals against their existing domestic successes.

On average, cross-border deals are larger in size than domestic deals except for those undertaken by Continental European VC firms, whose cross-border deals are smaller than domestic deals. This may be because European VC firms invest in cross-border regions with relatively underdeveloped institutions and capital markets.

In each of the four regions, cross-border investments are exited more quickly than domestic investments. This finding is consistent with the higher costs of screening, monitoring, and fostering cross-border investments which cause VC backers to exit cross-border investments more quickly than domestic investments. This result may also be driven by the propensity of VC firms to invest in cross-border ventures only later in the life of VC funds, leaving less time to realize investments before funds are wound up.

Liquidity is defined as the level of stock market activity which VC firms face in a portfolio company's country of origin. Table 2 shows average liquidity across the four regions. Liquidity is higher for North American VC firms investing in domestic companies than the liquidity these North American VC firms face when investing abroad. These results are clearly unsurprising given the highly developed North American capital markets.

Focusing on VC firms in other regions, we find that European and UK VC investors face more liquidity in their domestic markets than in their cross-border destinations. In contrast, VC firms in the ROW seem to come from countries with markets which are on average less liquid than the markets in their cross-border destinations. In sum, most VC firms find lower liquidity in their cross-border destinations than in their domestic markets.

In terms of syndication, our results show significant differences between domestic and cross-border VC deals, with cross-border deals being more likely to be syndicated in all regions except in the ROW. In particular, North American and UK VC firms syndicate cross-border deals more frequently than domestic deals. UK VC firms are more than twice as likely to syndicate cross-border deals than domestic deals, and among North American VC firms, the frequency of syndicating cross-border deals is 54% higher than for domestic deals. We observe the opposite among VC firms in the ROW: these firms more frequently syndicate domestic deals, with approximately 70% of their domestic deals being syndicated compared with just 40% of their cross-border deals. Among Continental European VC firms, the proportion of syndicated deals is very similar for all (domestic and cross-border) deals. Because a high proportion of syndication may reflect VC investors' demand for risk (or loss) sharing (e.g. Lerner 1994), our results may suggest that North American and UK VC firms perceive cross-border deals to be risky. In contrast, it is domestic deals which are seen to be riskier by VC firms in the ROW.

In terms of the breakdown of financing stages, we find a consistent pattern among all cross-border deals, with approximately two-thirds of investments at the early stage, one-fifth at the expansion stage, and the rest (approximately 13–16%) at the later stage. This pattern is similar to the breakdown across financing stages of domestic deals by VC firms in the ROW. This finding may suggest a degree of convergence in terms of a global investment pattern. The breakdown in the three other regions is broadly similar, although there are some

differences. Notably, North American VC firms have a greater tendency to invest at early stages domestically rather than abroad. This approach may reflect the aversion of such VC firms to the higher risk of cross-border early-stage investments compared with domestic early-stage deals. European and UK VC firms differ from the global pattern in terms of their domestic deals, with a greater preference for expansion-stage investments in domestic deals compared with other stages.

In terms of industry sector, there is evidence of investment clustering. North American and ROW VC firms are more likely to invest in the IT sector, while European and UK VC firms are more likely to invest in industrials. In contrast to these regional variations, there is little difference between domestic and cross-border deals in each region (except for the biotechnology industry).[14]

In conclusion, compared with domestic investments, cross-border deals are conducted by older VC firms and later in the life of a VC fund. Cross-border deals are larger (based on investment size) and more likely to be syndicated at later financing stages and in the biotechnology sector. In terms of performance, we find that cross-border investments are exited more quickly but at the expense of returns and with lower IPO frequency. The lower IRR and the shorter holding periods may both be due to systematic differences between domestic and cross-border investments. These differences could be because VC firms target mature companies and later-stage financing when crossing borders. Hence, the risk/return profile of these investments may differ from domestic VC investments. Using PME as a risk-adjusted measure of performance, we nevertheless find that domestic investments outperform cross-border investments in almost all regions. In the next section, we examine the

[14] Panel B of Table 2 shows the natural logarithms of *VC age*, *fund age* and *investment size* which are used in our multivariate analysis.

performance of domestic and cross-border investments in the context of a multivariate analysis.

[TABLE 2 HERE]

4.2. Multivariate analysis

In order to conduct a formal test of hypothesis 1 (which posits that cross-border and domestic VC investments generate the same returns), we estimate two-stage Heckman models. The first stage (reported in panel A of Table 3) estimates the probability of a given deal being a cross-border investment; the second stage regresses deal-level performance on the *cross-border* indicator and a range of control variables.[15] Performance is measured as IRR in panel B and PME in panel C. We control for risk by including indicators for the financing stage. Studies suggest financing stage as a suitable proxy for deal risk (Sahlman 1990; Ruhnka and Young 1991; Seppa and Laamanen 2001; Cornelli, Kominek, and Ljungqvist 2013).

The results are shown in Table 3.[16] Panel A of the table shows the results for IRR. We find a statistically significant negative coefficient of the *cross-border* indicator in each of the four regressions (models I–IV). This finding is consistent with our univariate analysis reported in Table 1. Our multivariate analysis confirms this cross-border effect in terms of lower IRR, even after controlling for risk and other potential determinants of performance. The magnitude of this *cross-border* coefficient ranges from -0.27 for the UK to -0.156 (for the ROW). This result suggests that cross-border investments have significantly lower IRR

[15] We focus here on the second stage of the two-stage models. The first stage involves a probit model with *cross-border* as the dependent variable and aggregate capital inflow as an instrument, as outlined in section 3. The results of this first stage are discussed in greater detail in the extensions of our baseline analysis in section 4.5.

[16] There is no evidence of multicollinearity among the variables used in our study. Appendix C provides a correlation matrix for the variables used in the analysis.

on average, statistically and economically, than comparable domestic investments for VC firms based in any of the four regions. The *cross-border* coefficient in North America (model 1) is -0.192, indicating that, all else being equal, cross-border investments by North American VC firms underperform equivalent domestic investments by 19% in terms of IRR. With regard to VC firms in other regions, cross-border underperformance ranges from 16% for VC investors in the ROW to 27% for the UK.

In panel B of Table 3, the dependent variable is the risk-adjusted measure of performance (*PME*). Consistent with the IRR results in panel A and the univariate analysis (Table 1), we find that the *PME* for cross-border investments is lower than the *PME* for domestic investments. This result confirms that domestic investments outperform cross-border investments and that this performance difference persists after controlling for risk and other known performance determinants.

Next, we examine whether this cross-border effect is a long-term feature of the VC industry or whether it is concentrated in the early years of the internationalization of VC investments. The literature finds that the period prior to the late 1990s is characterized by high returns on VC investments in North America, while the subsequent period experienced significantly lower VC fund returns and large capital inflow resulting in the saturation of the VC industry (Harris, Jenkinson, and Kaplan 2014). We examine whether this performance decline occurred equally among cross-border and domestic investments. A priori, we may expect that high capital inflow into a saturated industry leads to a decline in the performance of domestic and cross-border investments. However, some of this decline may be offset by positive learning effects derived from cross-border investments. Thus, we may expect less of a performance decline among cross-border investments initiated in the late 1990s. Harris et al. (2014) show that the decline in VC performance started in the late 1990s. The literature

(e.g. Aizenmann and Kendall 2012) also suggests that cross-border VC investing accelerated during the 1990s because of shortages in profitable domestic investment opportunities. We use 1997 as the cut-off point to divide our sample. Further, we include a binary indicator (*post-1997*) coded as zero for investments made up to 1997 and as one thereafter. We include *post-1997* in our multivariate analyses both on its own (un-interacting) and interacting with the cross-border indicator.[17]

Table 3 reports a significant negative coefficient for the un-interacted *post-1997* variable, suggesting that performance declined for all investments, namely for domestic and cross-border deals, after the late 1990s. The coefficients of the interaction terms *cross-border* and *post-1997* are positive and in some cases as large (in absolute terms) as the cross-border coefficient. However, because these coefficients do not differ from zero at conventional levels of statistical significance, it appears that the performance differential between cross-border and domestic investments remains unchanged post-1997. This result leads us to conclude that the cross-border effect is a permanent feature.

We consider several further moderating factors.[18] We report our results in Table 3 separately for four broad regions. This regional breakdown is based on the origin of the VC investors. We observe underperformance of cross-border investments in all four regions despite the differences between these regions in terms of the institutional and cultural environments in which VC firms operate. We further explore whether our results depend on the destination (as opposed to the origin) of cross-border deals. To this end, we separate the cross-border indicator used in our multivariate analysis reported in Table 3 into three binary variables depending on deal destination. Focusing on the investments by North American VC

[17] We also use 1998 and 1999 as cut-off points. Our results remain unchanged.
[18] The results of the additional analyses, including deal destination and VC experience as moderating factors, are not tabulated here but are available from the authors on request. We are grateful to an anonymous referee for suggesting this analysis of moderating factors.

firms, we find that cross-border deals in the ROW underperform domestic deals the most, by more than 10% (the coefficient of cross-border deals in the ROW is -0.11). Investments in the UK underperform the least (2.5%), with the underperformance of deals in Europe at 6%. While the magnitude of underperformance appears to vary by destination, we conclude that cross-border investments consistently underperform domestic investments worldwide.

Next, we examine whether our results differ for subsets of VC firms, specifically whether more experienced VC investors show less cross-border underperformance. Measuring experience as *VC Age*, which represents the number of years a VC firm has been in business, we extend the models reported in Table 3 by including as an additional variable the *cross-border* indicator interacting with a binary variable coded one for the most experienced quartile of VC firms (and zero otherwise). We find the coefficient of this interaction term statistically not different from zero in all regions except ROW (where it is positive but statistically significant at only 10%). We conclude that there is no evidence of a differential effect of cross-border investing for top-tier VC investors.

All of our multivariate analyses control for a range of statistically significant determinants of performance. Specifically, the control variables include *VC age*, *investment size*, *investment duration*, *fund age*, *liquidity*, *syndication*, *financing stage*, *year*, and *industry*. Except for *fund age* and *syndication*, we find that all of these control variables have a statistically significant impact on VC firms' performance. *VC age* increases IRR and PME in all regions, suggesting that more experienced VC backers are better at selecting, nurturing, and exiting investments. Large investments are associated with lower IRR and PME in all regions. This suggests that VC providers require higher returns for smaller investments to compensate them for higher (business) risk. We find that *investment duration* (i.e. the holding period, or time to exit, of VC backers) has a significantly positive impact on IRR and PME in

all regions. It appears that VC backers require higher returns to compensate them for longer holding periods. Investments which are held for a longer period are likely to be early-stage investments for which VC backers require higher average returns to compensate for (liquidity, etc.) risk. Another possible reason for this positive impact of *Investment Duration* on IRR could be the tendency of VC investors to hold promising (and ultimately profitable) investments longer in order to maximize the future gains from a successful exit.

Next, we examine the impact of market liquidity on IRR and PME. Cumming, Fleming, and Schwienbacher (2005) focus on variations in the liquidity of exit markets in terms of 'liquidity risk'. They find that when the liquidity of exit markets is high, VC firms tend to invest more in later-stage rather than early-stage ventures. Cochrane (2005) documents that early-stage returns are higher than later-stage returns. Based on the foregoing studies, one may expect that the returns to VC firms are likely to be low when market liquidity is high. This reasoning may suggest that *liquidity* has a negative coefficient in our models. However, because we control for the financing stage, we should not expect to find an incremental negative impact of market liquidity on IRR and PME.[19] Nevertheless, we find statistically significant negative coefficients of *liquidity* in all of the models. Our results suggest that over and above the impact of liquidity on VC investment decisions (specifically the choice of financing stage), more liquid markets motivate VC firms to 'rush to exit' at the expense of lower returns.

The coefficient of the inverse Mills ratio (*lambda*) is statistically significant at the 10% level in only some of the regions, specifically in the models for North America and Europe in panel A, and only in Europe in panel B. This finding suggests that adjusting for selection bias and endogeneity is only important in some of the regions, thereby confirming

[19] We thank an anonymous referee for helping to clarify our interpretation.

that the cross-border effect which we document is not the result of differential deal selection by VC backers. Instead, our results show that cross-border deals underperform *equivalent* domestic deals. In the section 4.6, we discuss alternative modelling approaches, including mixed-effects models and propensity score matching, and conclude that our finding of cross-border underperformance is robust.[20]

In conclusion, our results show that cross-border investments have significantly lower returns (in terms of IRR and PME) than domestic investments after controlling for risk, which has financing stage as a proxy, and a range of other potential determinants of performance. On the basis of our results, we do not find support for hypothesis 1.

[TABLE 3 HERE]

4.3 Alternative measures of performance

We test differences between cross-border and domestic investments in terms of exit routes and time to exit. In the absence of detailed cash flow data, prior studies focus on exit success as a proxy of VC performance measurement. Our analysis examines the robustness of this approach in the context of examining cross-border investments.

Some exit routes benefit VC investors more than others. IPO exits and exits through M&A, such as trade sales or secondary buyouts, generate positive financial returns (IRR, as reported by Cumming 2008), while write-offs (liquidations) typically result in the loss of the VC investments (Cumming 2008; Dai. et al. 2012). 'Successful' exits also enhance venture capitalists' reputations and provide opportunities to raise additional funds from limited partners (LPs). Our first measure of exit performance is the so-called 'success ratio', which

[20] The results of propensity score matching are discussed in section 4.6. The unreported mixed-effects models are presented in Table 7 but without the measures of distance. The results of the unreported analyses are available from the authors on request.

reflects the frequency of 'successful' exits from portfolio companies. A narrow measure of the success ratio considers only IPO exits as successes and is defined as the ratio of IPO exits to all exits. A broader version of the success ratio which considers both IPO and M&A exits as successes is defined as the ratio of IPO and M&A exits to all exits. Prior studies have examined the success ratio as an indicator of VC performance (e.g. Hochberg et al. 2007; Chen et al. 2010; Cumming and Dai 2010; Wang and Wang 2012; Nahata et al. 2014; Dai and Nahata 2016).

Our second measure of performance is the length of VC backers' holding periods in terms of the time from the first VC investment in a given portfolio company to the exit of the VC backer. Prior evidence suggests that VC backers realize their investments, on average, after 7 years, with the time to exit ranging from 6.5 years to more than 8 years, depending on the exit route (Giot and Schwienbacher 2007).

Panel A of Table 4 shows that the M&A route is the most common type of successful exit, followed by IPOs. Focusing on IPO exits, we find no significant difference between cross-border and domestic investments in the proportion of IPO exits in all regions, except North America. With regard to North American VC firms, we find that IPO exits are less likely for cross-border investments, with only 6% of cross-border deals resulting in an IPO exit. On the basis of this success ratio, cross-border investments are less successful than domestic deals for North American VC firms. However, perhaps IPO frequency is not an appropriate indicator of success, given that an M&A exit can also be attractive in terms of returns. Defining the success ratio more broadly as the combined proportion of IPO and M&A exits relative to all exits, we find no significant difference between domestic and cross-border deals.

Panel B of Table 4 reports the investment-holding period (the time to exit) by region and exit route. The results of the full sample show that irrespective of the location of the VC firms, cross-border investments are exited more quickly than domestic investments. This finding is consistent with the higher costs of screening, monitoring, and fostering cross-border investments, tipping the balance towards quicker exits from cross-border than domestic investments. This result may also be driven by the propensity of VC firms to invest in cross-border ventures only later in the lives of their VC funds, leaving less time to realize investments before the funds are wound up (see Table 2). Examining the results separately by region and exit route, we find the same type of cross-border effect (a shorter cross-border holding period) for all of the investments by North American VC firms irrespective of exit route. We also find the same effect for all IPO exits irrespective of region. However, outside North America, VC firms have longer holding periods in cross-border investments which are exited through M&A than for their corresponding domestic investments. Judging the performance of VC investments in terms of time to exit, it appears that cross-border investments are more successful than domestic investments, at least for North American VC firms.

Given the conflicting evidence on the exit success of cross-border investments by North American VC firms in panels A and B, we suspect that exit behaviour is driven primarily by country-specific and other macro factors and does not reflect the selection and value-adding behaviour of North American VC backers.

[TABLE 4 HERE]

In order to examine whether cross-border deals are exited more quickly even after controlling for macro factors and VC and deal characteristics, we estimate a multivariate Cox hazard model. Table 5 shows the results of this model with the *holding period* (time to exit)

as the dependent variable and an indicator for cross-border deals, controlling for *VC age*, *fund age*, *investment size*, market liquidity (*liquidity*), *syndication*, *financing stage*, investment *year*, and *industry* of the portfolio company. We find that, all else being equal, VC firms exit cross-border investments significantly more quickly than domestic investments. This effect is observed in all four regions and is strongest in the UK and weakest in North America.

Next, we examine whether the exit behaviour of VC firms and the cross-border effect on exits differ before and after the late 1990s. Speedier exits in the latter period may be due to a learning effect whereby VC firms become better over time at achieving quicker exits. Since VC cross-border investing is a more recent activity than domestic investments, we may expect this learning effect to impact cross-border deals in particular. To this end, we define a time indicator which takes the value of zero for all investments in the years up to 1997 and one thereafter.

In the models shown in Table 5, we include the *post-1997* indicator and interact it with the *cross-border* indicator. The coefficient of *post-1997* is positive and significant for Europe and the UK, showing increasing exit rates since the late 1990s in these regions possibly due to a learning effect. The coefficient of *post-1997* interacting with *cross-border* is also positive and significant in all regions, suggesting that the increase in exit speed has been particularly pronounced for cross-border investments.

Consistent with prior studies (Giot and Schwienbacher 2007; Espenlaub et al. 2015), we find that larger deals are exited more quickly. Investment size may increase the VC backers' marginal costs of continuing with an investment (in terms of monitoring and advisory costs) relative to marginal benefits, thereby tipping the balance in favour of an earlier exit.

Fund age at the time of VC investments is also a significant determinant of exit rates. Investments from funds which are more mature at the time of the investments have higher exit rates than investments made from younger funds. In some regions, the effect of fund age is particularly strong for the oldest quartile of funds (as shown by *Fund age x top25th*).

Finally, we examine the impact of the liquidity in the stock market of the investment region (i.e. the region of the portfolio company's country of origin). Based on the findings of Black and Gilson (1998), Cumming et al. (2006), and Wang and Wang (2012), we expect more liquid capital markets to facilitate speedier exits and higher exit rates. Consistent with this conjecture, we find that *Liquidity* has a strongly significant positive impact on exit rates in all four regions.

As a final control variable, we include in Table 5 an indicator of syndicated investments. Consistent with Giot and Schwienbacher (2007), we find that syndicated investments have higher exit rates than other investments. This suggests that by combining expertise and networks, syndicates are able to facilitate speedier exits.

After controlling for a number of factors, our results show that cross-border investments are exited more quickly than domestic investments. However, if we were to conclude from this that cross-border investments are more successful than domestic investments, this would be at odds with our analysis of returns performance in Table 3. Our results suggest that VC investors may choose to invest abroad to benefit from shorter holding periods, but they do so *at the expense of returns*. Our results highlight that alternative measures of performance may result in fundamentally different assessments of success.

[TABLE 5 HERE]

4.4 The effect of distance

So far our analysis examines the difference between domestic and cross-border investing using a simple binary indicator. Our results suggest that foreignness (as captured by our *cross-border* indicator) is a liability. In this section, we try to unpack the aspects of foreignness which drive our results. In our earlier analysis, we treat investments by US VC firms in Canada the same as a US VC firm investing in China. Clearly, the latter process is significantly costlier to an investing US VC firm than the former because of the greater geographical distance involved as well as cultural and regulatory differences, and differences in political risk.

In panel B of Table 6, our analysis breaks down cross-border investing into ventures in neighbouring countries (which share a land border) and non-neighbouring countries.[21] In addition to *cross-border* (which continues to be coded as one if a VC firm invests in a foreign country and zero otherwise), we now also include the binary variable *cross-border (not sharing)* to capture the effect of investments in non-neighbouring countries. *Cross-border (not sharing)* is coded as one if the deal is located in a non-neighbouring foreign country and zero otherwise.

Panel B of Table 6 reports the results of a mixed-effects model of IRR for North America and Europe.[22] In both regions, we find the coefficient of *cross-border (not sharing)* to be significant and negative, with a coefficient which is almost three times as large in absolute terms than that of the *cross-border* indicator. The latter coefficient is slightly smaller than in our earlier analysis reported in Table 3 (models I and II of panel A) but is still

[21] Panel A of Table 6 reports descriptive statistics for the additional variables used in the analyses presented in panels B and C of Table 6.

[22]The mixed-effects analyses in panels B and C of Table 6 model *investment year* and *industry* of the portfolio company as fixed effects and *financing stage* as random effects. Our choice between fixed and random effects is based on likelihood ratio tests. Following common practice in the relevant literature (e.g. Chemmanur et al. 2016; Degeorge, Martin, and Phalippou 2016), industry fixed effects are included to control for unobserved time-invariant industry characteristics. Our results may be biased if the unobserved industry characteristics are time variant. We thank an anonymous referee for noting this issue.

statistically significant and negative. The difference between the *cross-border* and *cross-border (not sharing)* coefficients is statistically significant, suggesting that cross-border investments involving countries which do not share a land border underperform compared with domestic investments significantly more than cross-border investments in neighbouring countries. We conclude that there is a significant negative 'cross-cross-border effect'.[23]

Next, we examine whether the cross-border effect is driven by geographic distances, cultural disparities, or institutional differences between VC investors and portfolio companies. Studies report mixed evidence on the impact of geographic distances, cultural disparities, and institutional differences between VC firms and portfolio companies on the likelihood of a successful exit, typically an IPO exit (Chen et al. 2010; Cumming and Dai 2010; Nahata et al. 2014; Chemmanur et al. 2016; Dai and Nahata 2016). Consistent with past evidence (Li et al. 2014; Nahata et al. 2014; Dai and Nahata 2016), we predict that geographic distances have no significant effect after controlling for other distance measures (see hypothesis 2a). However, we expect that cultural disparities and institutional differences reduce exit performance, as predicted by hypotheses 2b and 2c (see section 2).

Unlike all prior studies of cross-border performance, our analysis measures performance based on deal-level returns (IRR) rather than a proxy of performance based on exit success (Hochberg et al. 2007). We use five different measures of distance, disparity, and difference: the logarithm of geographic distances (in miles) the cultural disparities between the countries of VC firms and portfolio companies, calculated as differences between countries in terms of Hofstede et al.'s (2010) four cultural dimensions (power distance, individualism, masculinity, and uncertainty avoidance); and three measures of institutional differences between the home countries of VC firms and their portfolio companies

[23] We thank an anonymous referee for suggesting this term and the associated analysis.

(differences in regulatory quality, political stability, and the legal systems). See section 2 and Appendix B for details of variables and data sources.

Consistent with hypotheses 2b and 2c (see section 2), but contrary to the null hypothesis 2a, our results in panel C of Table 6 show that all five measures which capture geographic distances, cultural disparities, and differences in institutional environments have significant negative impacts on the returns performance of VC deals. The *cross-border* indicator also remains significant at the 10% level (except in model IV for the ROW). This suggests that a residual negative impact of foreignness remains over and above the negative impacts of geographic distances, cultural disparities, and institutional differences. In the next section, we examine further possible explanations for this cross-border effect.

[TABLE 6 HERE]

4.5 Extensions

In order for our conclusion that cross-border investments underperform domestic investments to be valid, we need to demonstrate that the differences in returns are not merely due to differences in risk. This part of our analysis examines the relative risk of cross-border and domestic deals. Note that there is no generally accepted measure of risk in the context of PE investments. This lack of a common measure is because one cannot observe a time series of market valuations for non-traded assets (such as PE stakes); thus, standard methods which are used to assess risk for standard traded assets are infeasible. As a result, in PE research, there are no standard approaches to correct for risk. Following Degeorge, Martin, and Phalippou (2016), we approximate investment risk in several ways. First, we examine the VC providers' risk of wealth loss based on the investment multiples of domestic and cross-border investments in each of the four regions. Column (1) of Table 7 shows the proportions of domestic and cross-border VC investments with investment multiples of zero; namely, deals

which result in bankruptcies (write-offs) and thus a complete loss of wealth for VC providers. The second column (entitled 'Capital loss') shows the proportions of deals with investment multiples of less than one which result in (at least) a partial loss of wealth for VC providers. Using tests of differences in proportions, we conclude that there are no statistically (or economically) significant differences between domestic and cross-border investments for both these measures of risk. Next, we measure the systematic risk of VC investments in terms of their betas; namely, in terms of the sensitivity of the IRR of VC investments relative to returns on the stock market indices for the home countries of the portfolio companies. Following Axelson, Strömberg, and Sorensen (2013) and Degeorge et al. (2016), we estimate beta as the slope in a regression of IRR on the corresponding stock market return. We find no statistically significant differences between the betas of domestic and cross-border investments in any of the four regions.

The final part of the analysis reported in Table 7 addresses the question of whether cross-border investing helps VC firms to diversify fund risk. Column (3) of Table 7 shows the betas of cross-border investments relative to the stock markets of VC providers' home countries. We compare the resulting 'home betas' in column (3) to the 'host betas', shown in column (2), which are calculated relative to the stock markets in the portfolio companies' countries. If VC providers are able to diversify their portfolios by investing abroad, we expect the IRR of cross-border deals to be less sensitive to the VC firms' domestic stock indices than to the stock indices of the portfolio companies' countries. In other words, we expect to find the home betas to be lower than the host betas. Our results confirm that the home betas are statistically significantly lower than the host betas. While the host betas range between 2.5–2.8, the home betas range between 1.2–1.4 for all regions except in the ROW. Our results suggest that VC firms from North America, Europe, and the UK significantly reduce their

exposure to (home) market risk by investing abroad. Consequently, they should expect lower returns from cross-border than from domestic investments.

[TABLE 7 HERE]

Our final analysis examines another possible motive for VC firms to invest in cross-border deals (besides diversification). Past evidence suggests that higher capital inflow into domestic VC industries has led to more competition among VC firms for promising deals. Gompers and Lerner (2000) refer to this as 'money chasing deals'. In a saturated domestic VC market characterized by an excess of funds and a shortage of investment opportunities, VC firms may seek investment opportunities abroad (Schertler and Tykvová 2011). We estimate a probit model to investigate the likelihood of a VC firm investing in cross-border deals. This investigation is the first stage of the Heckman model reported in panel A of Table 3. Our explanatory variable of interest measures aggregate capital inflow into the domestic VC market (*ln capital inflow*). If cross-border investments are driven by limited domestic investment opportunities and saturation of the domestic VC market, we expect a positive coefficient for *ln capital inflow* in the probit model. The results of the probit model show a significant positive coefficient of *ln capital inflow*, which is consistent with the saturation argument.

Overall, the results of our extended analysis show that VC firms benefit from cross-border investing by achieving portfolio diversification and overcoming shortages of domestic investment opportunities in saturated markets. These benefits may explain the attraction of cross-border investing to VC investors, despite the poor returns performance of cross-border deals relative to domestic investments.

4.6 Robustness

We explore whether our models are subject to bias due to the non-randomness of VC exit decisions by using an approach similar to that of Cumming et al. (2009). In the sample used for our foregoing baseline analyses, we include only fully exited investments. As a robustness check, we start with a sample including all (fully exited, partially exited, and unexited) investments. We estimate a Heckman model for IRR similar to that reported in Table 3. In addition to the probit model of a VC firm's decision to invest cross-border (as in Table 3), the extended Heckman model includes a second probit model of a VC firm's decision to exit its investment fully.[24] We find no evidence of significant bias; thus, our results are qualitatively unchanged in all regions. The coefficients for our variable of interest, the c*ross-border* indicator, with regard to the four regions remain broadly in line with those reported in our baseline analysis in Table 3 (see Appendix D).

Our baseline analysis controls for deal syndication but not for possible endogeneity of syndication choice. In order to check the robustness of such possible endogeneity, we estimate a Heckman model for IRR with a probit stage which models the syndication decision, following Tian (2012).[25] The results of this Heckman model remain qualitatively unchanged with the coefficient of interest, for the c*ross-border* indicator, broadly the same as in our baseline analysis in Table 3 (see Appendix D).

Our baseline analysis includes standard control variables for VC firms and funds; however, we examine whether omitting certain other VC control variables biases our results. Specifically, we control for the 'busyness' of VC fund managers, following the literature on the trade-off between VC fund size and investment monitoring quality (Kanniainen and Keuschnigg 2003; Cumming 2006; Cumming and Walz 2010). *Busyness* is defined as the

[24] Full exits are coded one, while partial exits and no exits are coded zero. Explanatory variables are *investment duration* and *economic conditions at exit*, as in Cumming et al. (2009). The estimated coefficient of the lambda of this full-exit probit model is statistically insignificant.

[25] Syndication is modelled as a function of the logarithms of *capital inflow*, *VC age*, *fund age*, and *investment size*. Unfortunately, the database we use does not allow us to differentiate between domestic and foreign syndication.

portfolio (fund) size per fund manager and is intended to measure the impact of lower amounts of managerial time and resources available for any one investment in larger funds. Adding *busyness* to the second stage of the Heckman model of IRR reported in Table 3, we find that *busyness* has a statistically significant (at 5%) negative coefficient which ranges between -0.07 in ROW and -0.12 in North America. However, comparing the cross-border coefficients of our baseline model with those of the extended model, we find that our key result, the cross-border effect, remains virtually unchanged in all regions (see Appendix D).

Our baseline model in Table 3 includes year dummies for the investment years and controls for market conditions (in terms of market liquidity) at the times of exit. Next, we examine whether further controls for changes in market conditions during the investment-holding periods (i.e. from investments to exits) affect our results. To this end, we measure the average returns of the Morgan Stanley Capital International (MSCI) index and the average risk-free returns between the dates of investment and the dates of exit. Including these additional control variables does not qualitatively affect our main results of interest; namely, our estimates of the coefficient of the *cross-border* indicator (see Appendix D).

Finally, we examine the robustness of our results using propensity score matching. We match each cross-border deal with an equivalent domestic deal based on the propensity score estimated using *VC age*, *investment size*, *fund age*, *investment duration*, *liquidity*, *syndication*, and *financing stage*. Using caliper radius matching, we classify a domestic investment as a match for a cross-border investment when the propensity scores for both investments vary by no more than 1% (following e.g. Dehejia and Wahba 2002). We employ t-tests and Wilcoxon tests to confirm that the cross-border and matched domestic investments are not significantly different in terms of their mean and median characteristics. Using the sample of matched observations, we estimate a mixed-effects model (similar to the models reported in Table 3). Consistent with our prior results in Table 3, we find that the *cross-*

border coefficient is lower than in our earlier analyses; however, it is still both statistically and economically significant (see Appendix D).[26]

Overall, our results on the underperformance of cross-border investments remain robust. With regard to North America, we find *cross-border* coefficients ranging from -0.119 to -0.196, from which we conclude that, all else being equal, the cross-border investments of North American VC firms underperform their domestic investments by between 12 and 20% in terms of IRR. Globally, our results are similarly robust, indicating cross-border investment underperformance between 22 and 25% for European VC investors, 25 and 28% for UK VC investors, and comparatively lower underperformance between 15 and 17% in the ROW.

5. Conclusion

Against the background of increasing cross-border financial flow, we examine the returns performance of cross-border VC investments. Because of data limitations, the literature analyses cross-border performance in terms of the likelihood of successful VC exit and reports conflicting results. The main contribution of our study is that we are able to estimate actual returns using detailed cash flow data which was unavailable to prior studies. We calculate IRR and PME for 6,529 deals conducted by VC firms in North America, the UK, Continental Europe, and the ROW during 1971–2008. We show that cross-border deals underperform domestic deals in terms of IRR by 12% to 28% depending on the region and research design. Similarly, we find significant cross-border underperformance in PME. Comparing deals before and after the late 1990s, performance is lower for all investments in

[26] Because propensity score matching is solely based on observable characteristics, it only addresses concerns of selection bias and endogeneity due to observable differences between treatment and control groups (e.g. Dehejia and Wahba 2002). In contrast, the two-stage Heckman models in Table 3 allow for endogeneity due to unobservable differences and omitted variables.

the latter period; however, the performance differential between domestic and cross-border investments remains unchanged.

Geographic distance, cultural disparity, and institutional differences between the home countries of a VC investor and a portfolio company negatively affect cross-border returns but do not fully explain cross-border underperformance. Moreover, our analysis confirms that differences in risk are unlikely to explain the variation in returns between cross-border and domestic investments. Further analysis shows that VC firms benefit from cross-border investing by achieving portfolio diversification and overcoming shortages of domestic investment opportunities in saturated markets. These benefits may explain the attraction of cross-border investing to VC firms despite the poor returns performance of cross-border deals relative to domestic investments. While VC firms may choose to invest abroad for many reasons, our results suggest that they should not expect to achieve higher deal-level returns when they do so.

Our results are of clear relevance to VC fund managers (general partners) in guiding their portfolio decisions, including their considerations of relocating portfolio companies (Cumming et al. 2009). The results should also prove useful to investors (limited partners) in VC funds who need to understand the relative performance of cross-border and domestic investments in order to make sound fund-selection decisions and influence investment patterns. The negative impact of institutional differences on VC returns which we observe will be of interest to policymakers and regulators.

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Table 1: Returns and PMEs at exit

This table shows the mean and median IRR and PMEs by exit routes and regions of VC firms. We show the results for the full sample and for IPOs and M&A exits separately. Panel A shows IRR and panel B shows PMEs. We use statistical tests to assess whether the performance of cross-border investments differs significantly from domestic deals. The t-test for each mean is based on an unequal sample and unequal variance. The test for differences in medians is the Wilcoxon test. ***, **, and * indicate significance at the 1%, 5%, and 10%, levels respectively.

Panel A: IRR	North America		Europe (Ex. UK)		UK		ROW	
	Dom	Cross-border	Dom	Cross-border	Dom	Cross-border	Dom	Cross-border
Full sample								
Mean	46.69	28.73**	43.02	24.47***	34.16	18.90**	27.54	41.69**
Median	24.76	21.45*	17.52	23.68*	19.99	14.99*	27.15	24.32*
No of obs	***3945***	***389***	***553***	***286***	***258***	***105***	***794***	***199***
IPO								
Mean	125.33	114.62*	112.86	101.91*	117.69	103.76*	85.88	118.09***
Median	42.63	39.32	30.42	40.72*	27.52	18.013*	45.69	41.67
No of obs	***861***	***25***	***82***	***41***	***69***	***28***	***95***	***23***
M&A								
Mean	77.58	49.99**	78.11	40.73**	54.47	37.94**	98.87	66.83**
Median	11.30	12.30	12.18	11.27	13.79	10.57	12.19	11.47
No of obs	***1575***	***195***	***342***	***139***	***136***	***58***	***542***	***118***
Panel B: PME								
Full sample								
Mean	2.86	1.40**	2.02	1.49*	2.04	1.74*	1.30	5.10**
Median	1.20	0.89*	1.05	1.03	1.40	1.12	1.02	2.05*
No of obs	***3945***	***389***	***553***	***286***	***258***	***105***	***794***	***199***
IPO								
Mean	7.96	2.79***	2.52	1.86**	2.58	1.95*	2.05	6.66
Median	3.92	1.12**	1.54	1.00	1.06	0.88	1.98	1.08*
No of obs	***861***	***25***	***82***	***41***	***69***	***28***	***95***	***23***
M&A								
Mean	4.12	2.19**	2.20	1.71*	2.21	1.48*	1.92	4.48***

Median	2.45	0.98*	1.47	1.06	1.33	1.11	1.06	2.08**
No of obs	***1575***	***195***	***342***	***139***	***136***	***58***	***542***	***118***

Table 2: Descriptive statistics of deal characteristics

This table provides descriptive statistics for domestic and cross-border deals by regions. *VC age* is the age (years in business) of a VC firm at the time of an initial investment in a portfolio company. *Fund age* is the age of a fund measured from the date of the fund's initiation to the date of an investment. *Investment size* is the total amount invested by a VC firm in a portfolio company. *Investment duration* is the time between an initial VC investment and the VC exit date (in years). *Liquidity* is the stock market liquidity of a portfolio company's country measured as the total value of shares traded on the stock exchange(s) divided by the country's gross domestic product (GDP). *Syndication* is a binary variable equal to one for syndicated deals and zero otherwise. We show figures for each of three *financing stages* (*early*, *expansion*, and *later stage* investments). Panel B shows natural logarithmic transformations of *VC age*, *fund age* and *investment size*. We use a statistical test to assess whether cross-border characteristics differ significantly from domestic characteristics. The t-tests for the means are based on unequal samples and unequal variances. Differences in medians are tested using the Wilcoxon test. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

Panel A Variables	**North America**		**Europe (Ex. UK)**		**UK**		**ROW**	
	Dom	**Cross-border**	**Dom**	**Cross-border**	**Dom**	**Cross-border**	**Dom**	**Cross-border**
VC age (years)								
Mean	4.64	13.65**	8.36	11.12*	10.56	13.05*	5.17	7.66*
Median	4.00	11.00**	7.50	10.00*	8.92	10.75*	4.54	5.00
Fund age (years)								
Mean	2.35	3.94*	1.72	2.09*	1.88	2.89*	2.31	3.61*
Median	2.08	2.25	1.15	1.13	1.25	1.10	1.50	2.13
Investment size (USD million)								
Mean	4.69	6.28**	4.39	2.16**	3.01	4.93*	5.15	7.13*
Median	1.15	2.15**	2.02	1.51**	1.86	2.00*	2.30	2.54
Investment duration (years)								
Mean (years)	4.74	3.44**	3.88	3.20*	3.98	3.15*	3.90	3.10**
Median (years)	4.00	3.14*	3.32	3.11*	3.50	3.01*	3.42	3.08*
Liquidity								
Mean	1.46	0.91***	1.10	0.84**	1.29	1.01*	0.56	1.20**
Median	1.24	0.75***	1.01	0.81*	1.15	0.86*	0.55	0.94**
Syndication (binary)								
Yes	36.70	56.98**	48.56	49.43	32.97	72.97**	68.93	40.07**
No	63.30	43.09**	51.44	50.57	67.03	27.03**	31.07	59.94**
Financing stages (binary)								
Early	72.26	67.23***	59.47	67.84	53.06	66.06	67.56	61.52
Expansion	23.81	19.79***	38.85	18.92***	37.51	18.04**	19.61	21.73
Later	3.94	12.98***	1.68	13.23***	9.44	15.90*	12.83	16.75
Industry (binary)								
Biotechnology	2.58	7.26**	6.89	12.95**	6.71	9.68**	7.191	2.91***
Consumer Goods and Services	16.77	11.33*	11.20	15.59	10.95	13.32	11.403	20.00***
Financials	2.38	2.26	2.22	4.54**	2.02	2.61	2.29	3.20
Industrials	16.42	19.53*	58.20	51.30	58.76	53.05	1.50	21.43
Information Technology	60.34	57.11	19.12	15.10	18.17	20.04	59.13	52.38*
Others	1.51	2.51*	2.37	0.52*	3.39	1.29*	0.48	0.09**
No of deals	***3945***	***389***	***553***	***286***	***258***	***105***	***794***	***199***

Table 2 continued

Panel B: Logarithm transformations								
VC age (years)								
Mean	1.63	2.47	2.44	2.37	2.33	2.63	1.81	2.19
Median	1.55	2.32	2.38	2.27	2.26	2.47	1.66	1.69
Fund age (years)								
Mean	0.94	1.49	0.75	0.81	0.82	1.09	0.87	1.39
Median	0.92	0.88	0.21	0.14	0.38	0.11	0.55	0.81
Investment size (USD million)								
Mean	1.77	1.87	1.05	1.01	1.22	1.74	1.79	2.04
Median	0.38	0.84	1.01	0.74	0.78	0.88	0.88	1.02

Table 3: Multivariate analysis (two-stage model)

This table presents the results of a two-stage Heckman model of VC performance. Stage 1 in panel A shows the probability of investing in cross-border deals using probit models. The dependent variable is equal to one if the investment is a cross-border deal and zero otherwise. At stage II, the dependent variable is *IRR* measured as annualized IRR in panel B. The dependent variable is *PME* in panel C. *Capital inflow* is the logarithm of the total amount of funds in the VC industry. *Cross-border* is one for cross-border investments and zero otherwise. We include a binary indicator, *post-1997*, which is equal to zero for investments up to 1997 and one thereafter. *Cross-border x post-1997* is *cross-border* interacting with *post-1997*. *Ln VC age* is the natural logarithm of age (years in business) of a VC firm at the time of an initial investment in a portfolio company. *Ln fund age* is the natural logarithm of fund age measured from the date of a fund's initiation to the date of an investment. *Ln investment size* is the natural logarithm of the total amount invested by a VC firm in a portfolio company. *Investment duration* is the number of years from an initial VC investment to VC exit. *Ln fund age* top25th is the natural logarithm of fund age for funds above the 75th age percentile and zero otherwise. *Liquidity* is the stock market liquidity of a portfolio company's country measured as the total value of shares traded on the stock exchange(s) divided by the country's *GDP*. *Syndication* is a binary variable equal to one for syndicated deals and zero otherwise. [a]We include two binary *financing stage* indicators for *expansion* and *later stage* investments (with *early stage* as the base). We also include dummies for a portfolio company's *industry* and (investment) *year*. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels respectively.

Panel A	Model I: North America		Model II: Europe (Ex. UK)		Model III: UK		Model IV: ROW	
Variables	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*
Ln capital inflow	0.013***	(0.000)	0.027**	(0.016)	0.012**	(0.036)	0.003	(0.115)
Ln VC age	0.002**	(0.039)	0.001**	(0.002)	0.011***	(0.000)	0.004	(0.234)
Ln fund age	0.014*	(0.091)	0.097*	(0.074)	0.104**	(0.017)	0.072*	(0.092)
Ln investment size	0.041**	(0.041)	0.068***	(0.005)	0.020**	(0.037)	0.020**	(0.041)
Liquidity	0.023***	(0.000)	0.002*	(0.096)	0.027**	(0.022)	0.012*	(0.064)
Syndication	0.016**	(0.029)	0.003*	(0.087)	0.009*	(0.052)	0.006	(0.184)
Industry[a]	*Present*		*Present*		*Present*		*Present*	
Financing stage[a]	*Present*		*Present*		*Present*		*Present*	
Investment year [a]	*Present*		*Present*		*Present*		*Present*	
Pseudo R-square	0.166		0.131		0.089		0.111	
No of obs	***4334***		***839***		***363***		***993***	

Table 3 continued

Panel B	Model I: North America		Model II: Europe (Ex. UK)		Model III: UK		Model IV: ROW	
Variables	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*
Cross-border	-0.192**	(0.033)	-0.232**	(0.017)	-0.270**	(0.023)	-0.156**	(0.017)
Post-1997 × cross-border	0.047	(0.130)	0.173	(0.207)	0.036	(0.193)	0.250	(0.135)
Post-1997	-0.339**	(0.021)	-0.379**	(0.032)	-0.117	(0.108)	-0.252**	(0.037)
Ln VC age	0.011**	(0.023)	0.015**	(0.030)	0.018**	(0.012)	0.050**	(0.015)
Ln fund age	-0.141	(0.309)	-0.126	(0.192)	-0.233	(0.226)	0.264	(0.781)
Ln investment size	-0.238***	(0.000)	-0.263***	(0.000)	-0.320***	(0.000)	-0.373***	(0.000)
Investment duration	0.065**	(0.030)	0.050**	(0.045)	0.091**	(0.030)	0.055*	(0.088)
Ln fund age top25th	0.066	(0.398)	0.057	(0.223)	-0.059	(0.762)	-0.276	(0.652)
Liquidity	-0.188**	(0.024)	-0.273**	(0.011)	-0.178**	(0.026)	-0.422**	(0.050)
Syndication	0.014	(0.743)	0.012	(0.222)	0.104	(0.458)	0.353*	(0.086)
Constant	0.173***	(0.000)	0.037**	(0.044)	0.152**	(0.027)	0.154**	(0.022)
Lambda	0.605*	(0.090)	-0.477*	(0.096)	0.201	(0.244)	-0.117	(0.314)
Industry[a]	*Present*		*Present*		*Present*		*Present*	
Financing stage[a]	*Present*		*Present*		*Present*		*Present*	
Investment year [a]	*Present*		*Present*		*Present*		*Present*	
Adj R-square	0.141		0.077		0.044		0.066	
No of obs	***4334***		***839***		***363***		***993***	

Table 3 continued

Panel C	Model I: North America		Model II: Europe (Ex. UK)		Model III: UK		Model IV: ROW	
Variables	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*
Cross-border	-0.018**	(0.020)	-0.020**	(0.016)	-0.023**	(0.042)	-0.016**	(0.035)
Post-1997 × cross-border	0.002	(0.477)	0.004	(0.356)	0.007	(0.381)	0.041	(0.270)
Post-1997	-0.019*	(0.078)	-0.024*	(0.053)	-0.021*	(0.092)	-0.061*	(0.083)
Ln VC age	0.001**	(0.032)	0.007**	(0.040)	0.001**	(0.012)	0.002**	(0.017)
Ln fund Age	-0.006	(0.306)	-0.011	(0.144)	-0.004	(0.766)	0.022	(0.254)
Ln investment size	-0.015***	(0.000)	-0.010***	(0.000)	-0.009***	(0.000)	-0.058***	(0.000)
Investment duration	0.003**	(0.021)	0.004**	(0.024)	0.002**	(0.029)	0.006*	(0.056)
Ln fund age top25th	0.023	(0.391)	0.008	(0.499)	0.009	(0.756)	-0.036*	(0.065)
Liquidity	-0.034**	(0.040)	-0.032**	(0.033)	-0.017**	(0.023)	-0.029*	(0.075)
Syndication	0.003	(0.219)	0.004	(0.216)	0.005	(0.663)	0.036*	(0.089)
Constant	0.014***	(0.000)	0.018**	(0.031)	0.016**	(0.023)	0.014**	(0.000)
Lambda	0.021	(0.133)	-0.034*	(0.081)	0.010	(0.255)	0.014	(0.261)
Industry	*Present*		*Present*		*Present*		*Present*	
Financing stage	*Present*		*Present*		*Present*		*Present*	
Investment year	*Present*		*Present*		*Present*		*Present*	
Adj R-square	0.13		0.084		0.050		0.074	
No of obs	***4334***		***839***		***363***		***993***	

Table 4: Investment types and holding periods (time to exit)

Panel A shows the exit numbers by exit type and region. Full-sample proportions are relative to total (domestic and cross-border) exits by region. Proportions for each of the exit routes (IPO, M&A, and write-offs) are relative to either domestic or cross-border exits by region. The Z-test for the proportions is based on an unequal sample and unequal variance. Panel B shows the means and medians of investment durations (in years) by the method of exit and the region of VC firms. The t-test for each mean is based on an unequal sample and unequal variance. The t-test for each median is based on the Wilcoxon test. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

Panel A	North America		Europe (Ex. UK)		UK		ROW	
	Dom	Cross-border	Dom	Cross-border	Dom	Cross-border	Dom	Cross-border
Full sample								
Proportions	0.910	0.090***	0.659	0.341**	0.711	0.289**	0.800	0.200***
No of obs	***3945***	***389***	***553***	***286***	***258***	***105***	***794***	***199***
IPO								
Proportions	0.218	0.064**	0.148	0.143	0.267	0.266	0.120	0.116
No of obs	***861***	***25***	***82***	***41***	***69***	***28***	***95***	***23***
M&A								
Proportions	0.399	0.501	0.618	0.486*	0.527	0.552	0.683	0.593
No of obs	***1575***	***195***	***342***	***139***	***136***	***58***	***542***	***118***
Write-offs								
Proportions	0.383	0.434	0.233	0.371	0.205	0.181	0.198	0.291
No of obs	***1509***	***169***	***129***	***106***	***53***	***19***	***157***	***58***

Table 4 continued

Panel B	North America		Europe (Ex. UK)		UK		ROW	
	Dom	Cross-border	Dom	Cross-border	Dom	Cross-border	Dom	Cross-border
Full sample								
Mean (years)	4.74	3.44**	3.88	3.20*	3.98	3.15*	3.90	3.10**
Median (years)	4.00	3.14*	3.32	3.11*	3.50	3.01*	3.42	3.08*
No of obs	***3945***	***389***	***553***	***286***	***258***	***105***	***794***	***199***
IPO								
Mean (years)	6.98	4.69**	6.08	4.68**	5.96	4.12**	4.73	3.12**
Median (years)	6.88	4.17**	4.50	4.02*	4.51	4.00*	4.25	3.01**
No of obs	***861***	***25***	***82***	***41***	***69***	***28***	***95***	***23***
M&A								
Mean (years)	4.49	3.10*	4.37	4.83*	3.39	4.03*	3.43	4.82**
Median (years)	3.97	3.09**	3.99	3.09*	3.01	3.83*	3.17	4.35**
No of obs	***1575***	***195***	***342***	***139***	***136***	***58***	***542***	***118***
Write-offs								
Mean (years)	2.13	1.90	2.02	2.02	2.85	2.45	1.83	2.11
Median (years)	1.87	1.71	1.62	1.01	2.09	1.87	1.75	1.57
No of obs	***1509***	***169***	***129***	***106***	***53***	***19***	***157***	***58***

Table 5: Cox proportional hazard model

This table shows a Cox proportional (frailty) model of the VC exit rates estimated using maximum likelihood estimation. *Cross-border* equals one for cross-border investments and zero otherwise. We include an interaction term of *cross-border* with *post-1997*, another interaction term of *cross-border* with *Ln VC age*, and a third with *Ln investment size*. *Ln VC age* is the natural logarithm of age (years in business) of a VC firm at the time of an initial investment in a portfolio company. *Ln fund age* is the natural logarithm of fund age measured from the date of a fund's initiation to the date of an investment. *Ln investment size* is the natural logarithm of the total amount invested by a VC firm in a portfolio company. *Ln fund age top25th* is the natural logarithm of the age of funds for funds above the 75th age percentile and zero otherwise. *Liquidity* is the stock market liquidity of a portfolio company's country measured as the total value of shares traded on the stock exchange(s) divided by the country's GDP. *Syndication* is a binary variable equal to one for syndicated deals and zero otherwise. *Theta* is an indicator of heterogeneity (frailty). [a]We include two binary *financing stage* indicators for *expansion* and *later stage* investments (with *early stage* as the base). We also include dummies for a portfolio company's *industry* and (investment) *year* for the years up to 1997. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels respectively.

Variables	Model I: North America		Model II: Europe (Ex. UK)		Model III: UK		Model IV: ROW	
	Coeff	*Hazard ratio*	*Coeff*	*Hazard ratio*	*Coeff*	*Hazard ratio*	*Coeff*	*Hazard ratio*
Cross-border	1.375***	3.955	1.689**	5.417	2.519***	12.411	2.329***	10.267
Cross-border × post-1997	2.324***	10.221	0.248*	1.281	1.185**	3.269	2.522**	12.459
Post-1997	0.276	1.318	0.915**	2.496	0.773*	2.167	0.377	1.458
Ln VC age	-0.018**	0.982	0.007*	1.007	0.002	1.002	0.002	1.002
Ln fund age	0.153**	1.165	0.116*	1.122	0.380**	1.462	0.285*	1.330
Ln investment size	0.221**	1.247	0.132**	1.141	0.127**	1.135	0.294**	1.341
Ln fund age top25th	0.030	1.030	0.167**	1.182	0.077	1.080	0.040	1.041
Liquidity	0.258***	1.295	0.853***	2.346	0.806**	2.238	0.205**	1.228
Syndication	0.482***	1.619	0.103*	1.108	0.145*	1.156	0.138	1.148
Theta	*0.799***		*0.208***		*0.163***		*0.998****	
Industry[a]	*Present*		*Present*		*Present*		*Present*	
Financing stage[a]	*Present*		*Present*		*Present*		*Present*	
Investment year [a]	*Present*		*Present*		*Present*		*Present*	
Pseudo R-square	0.166		0.141		0.090		0.111	
No of obs	***4334***		***839***		***363***		***993***	
Censored obs	***512***		***316***		***105***		***255***	

Table 6: Multivariate analysis of VC performance

This table presents the results of mixed-effects models of VC performance. Panel A shows the descriptive statistics for the additional variables used in panels B and C which measure the absence of a shared land border (*cross-border not sharing*), geographic distance, cultural disparity, and regulatory differences between a VC firm's and portfolio company's home countries. Panel B shows the impact of cross-border investing on performance in countries with and without shared land borders. The dependent variable is *IRR* and is measured as annualized IRR. *Cross-border* is one for cross-border investments and zero otherwise. *Cross-border (not sharing)* is one for cross-border investments in countries without a land border with the VC firm's home country and zero otherwise. All other variables are defined as in Table 3. Panel C shows the impact of measures of distance and regulatory and institutional differences on performance (IRR). *Geographic distance* is measured as the distance between the capitals of the respective countries of VC firms and portfolio companies. *Cultural distance* is determined as the differences in the Hofstede measures of culture (from Geert Hofstede's website) between the home countries of VC firms and their portfolio companies. *Regulatory quality (diff)* and *political stability (diff)* are the differences in the average scores of regulatory quality and political stability (as in Kaufmann, Kraay, and Mastruzzi 2007, based on data from the World Bank). *Legal system (diff)* is a binary variable which takes a value of one if the countries of a VC firm and portfolio company have different legal systems and zero otherwise (based on data from Rafael La Porta's website). Other control variables are as defined in Table 3. ***, **, and * indicate 1%, 5%, and 10% conventional levels respectively. [a]The mixed-effects analyses in panels B and C model *investment year* and portfolio company *industry* as fixed effects and *financing stage* as random.

Panel A: Descriptive Statistics	**Cross-border (all regions)**		
	Mean	***Median***	***STD***
Cross-border (not sharing)	0.793	1.00	0.231
Geographic distance (miles)	4651	4255	2610
Cultural distance (#)	9.87	10.91	5.44
Regulatory quality (diff)	2.00	4.00	37.00
Political Stability (diff)	5.00	1.00	41.00
Legal system (diff)	0.351	0.000	0.403
Logarithmic values			
Geographic distance	8.755	8.355	1.184
Cultural distance	2.105	2.187	0.645

Table 6 continued

Panel B: Mixed-effects models of IRR in (non-)neighbouring countries	North America		Europe	
	Coeff	*P-value*	*Coeff*	*P-value*
Cross-border	-0.151**	(0.024)	-0.205**	(0.033)
Cross-border not sharing border	-0.417***	(0.001)	-0.588***	(0.000)
Ln VC age	0.020**	(0.011)	0.024**	(0.021)
Ln fund age	-0.156	(0.254)	-0.121	(0.301)
Ln investment size	-0.305***	(0.000)	-0.286***	(0.000)
Investment duration	0.082***	(0.000)	0.074***	(0.000)
Ln fund age top 75th	0.085	(0.251)	0.099	(0.351)
Liquidity	-0.267***	(0.000)	-0.302***	(0.000)
Syndication	0.025	(0.254)	0.021	(0.251)
Constant	0.221***	(0.000)	0.042***	(0.000)
Pseudo R-square	***0.131***		***0.110***	
No of Obs	***4334***		***839***	
Industry, stage, investment year[a]	Y		Y	

Table 6 continued

Panel C: Mixed-effects models of IRR with distance measures	Model I: North America		Model II: Europe (Ex. UK)		Model III: UK		Model IV: ROW	
	Coeff	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*
Cross-border dummy	-0.178*	(0.073)	-0.105*	(0.092)	-0.132*	(0.061)	-0.101	(0.118)
Ln (geographic distance)	-0.181*	(0.080)	-0.120*	(0.090)	-0.113*	(0.058)	-0.173*	(0.055)
Ln (cultural distance)	-0.294*	(0.084)	-0.257*	(0.094)	-0.276*	(0.092)	-0.368*	(0.082)
Regulatory quality (diff)	-0.004***	(0.004)	-0.005**	(0.046)	-0.002**	(0.021)	-0.002*	(0.091)
Political stability (diff)	-0.002*	(0.075)	-0.003*	(0.059)	-0.002*	(0.072)	-0.003*	(0.052)
Legal system (diff)	-0.068	(0.478)	-0.103	(0.329)	-0.050	(0.601)	-0.011	(0.293)
Post-1997	-0.518***	(0.000)	-0.250**	(0.024)	-0.483***	(0.000)	-0.362***	(0.008)
Ln VC age	0.018***	(0.001)	0.030***	(0.000)	0.028***	(0.000)	0.055***	(0.000)
Ln fund Age	-0.155	(0.254)	-0.215	(0.132)	-0.196	(0.161)	-0.072	(0.688)
Ln investment size	-0.293***	(0.000)	-0.246****	(0.000)	-0.332***	(0.000)	-0.500***	(0.000)
Investment duration	0.082***	(0.000)	0.082***	(0.000)	0.080***	(0.000)	0.034	(0.168)
Ln fund age top25th	0.095	(0.394)	0.075	(0.544)	0.039	(0.727)	0.037	(0.364)
Liquidity	-0.269***	(0.000)	-0.360	(0.308)	-0.267***	(0.000)	-0.263***	(0.005)
Syndication	0.014	(0.291)	0.015	(0.187)	0.011	(0.390)	0.364**	(0.025)
Constant	0.205***	(0.000)	0.166**	(0.041)	0.174***	(0.000)	0.144***	(0.000)
Industry	*Present*		*Present*		*Present*		*Present*	
Financing stage	*Present*		*Present*		*Present*		*Present*	
Investment year	*Present*		*Present*		*Present*		*Present*	
Pseudo R-square	0.137		0.120		0.109		0.117	
No of obs	***4334***		***839***		***363***		***993***	

Table 7: Alternative measures of risk (domestic vs cross-border deals)

This table shows a comparison of domestic and cross-border deals using alternative measures of risk. Bankruptcy is calculated as the fraction of investments where the investment multiple is equal to zero. Capital loss is the fraction of investments where the multiple is less than one. Systematic risk is measured as the sensitivity of IRR to the local market index of VC firms with regard to domestic deals (1), the local market index of portfolio companies with regard to cross-border deals (2), and the local market index of VC firms with regard to cross-border deals. ***, **, * indicate 1%, 5%, and 10% conventional levels respectively.

	Bankruptcy		**Capital loss**		***Systematic risk***				
Regions	***Domestic***	***Cross-border***	***Domestic***	***Cross-border***	***Domestic deals (local index of VC) (1)***	***Cross-border deals (local index of portfolio) (2)***	***Cross-border deals (local index of VC) (3)***	***Diff (1)–(2)***	***Diff (2)–(3)***
North America	17%	20%	29%	31%	2.519	2.402	1.343	1.112	2.113**
Europe	15%	18%	25%	32%	2.749	2.661	1.394	1.021	3.022***
UK	18%	19%	22%	24%	2.692	2.511	1.241	1.512	2.590**
ROW	23%	24%	29%	33%	2.681	2.784	2.567	-1.041	1.481

Appendix A: Distribution of venture capital deals by region from 1971–2009

	All deals (number)	North America (NA)			EU (Ex. UK)			UK			ROW		
Investment years		**Domestic deals (number)**	**Cross-border (CB) (number)**	**CB to total NA (%)**	**Domestic deals (number)**	**Cross-border (CB) (number)**	**CB to total EU (%)**	**Domestic deals (number)**	**Cross-border (CB) (number)**	**CB to total UK (%)**	**Domestic deals (number)**	**Cross-border (CB) (number)**	**CB to total ROW (%)**
1971–1980	35	35	0	0	0	0	-	0	0	-	0	0	-
1981–1990	850	691	50	6.75	39	16	29.09	11	12	52.17	29	2	6.45
1991–2000	4435	2595	194	6.95	424	216	33.75	178	77	30.20	621	130	17.31
2001–2009	1209	624	145	18.86	91	54	37.24	67	17	20.24	145	66	31.28
Total	**6529**	**3945**	**389**	**8.97**	**554**	**286**	**34.05**	**256**	**106**	**29.28**	**795**	**198**	**19.94**

Appendix B: Definitions of variables

Variable	Definition of variable
Cross-border	A dummy variable taking a value of one if a portfolio company and the VC firm are located in different countries and zero otherwise.
Cross-border not sharing	A dummy variable taking a value of one if a portfolio company is located in a country which does not share a border with the home country of the VC firm, and zero otherwise.
Geographic distance	Measured as the distance in miles between the capitals of the countries of a VC firm and portfolio company. We obtain the data from the CEPII website (www.cepii.fr/anglaisgraph/bdd/distances.htm).
Cultural distance	As in Dai and Nahata (2016), we follow the approach of Kogut and Singh (1988) and use the Hofstede measures of culture (i.e. power distance, individualism, masculinity, and uncertainty avoidance) to compute the cultural distance between a VC firm and a portfolio company. The data are obtained from Geert Hofstede's website (www.geerthofstede.nl). The following Cartesian distance measure is used to calculate cultural disparity: $\text{Hofstede cultural difference} = \frac{\left(\sum_{i=4}^{4}\left(C_{Local,i} - C_{cross-border,i}\right)^2\right)^{\frac{1}{2}}}{4}$, where $C_{local,\,i}$ is the local VC firm's culture based on measure *i* and $C_{cross\text{-}border,\,i}$ is the cultural measure of a portfolio company based on measure *i*.
Regulatory distance	This is the difference in the regulatory quality score between the home countries of a VC firm and portfolio company. The score value for each country ranges between 0 and 100. The data are obtained from the Worldwide Governance Indicator (WGI) of the World Bank website (http://data.worldbank.org/data-catalog/worldwide-governance-indicators).
Political distance	This is the difference in the political stability score between the home countries of a VC firm and portfolio company. The score value for each country ranges between 0 and 100. The data are obtained from the WGI of the World Bank website (http://data.worldbank.org/data-catalog/worldwide-governance-indicators).
Legal system difference	As in Chemmanur et al. (2016), this is a dummy variable coded 1 if the (common or civil law) origins of the legal systems of the home countries of a VC firm and portfolio company differ, and zero otherwise. The data are obtained from Rafael La Porta's website (http://faculty.tuck.dartmouth.edu/rafael-laporta/research-publications).
Capital inflow	The aggregate amount of capital inflow into the VC industry in the home country of a VC firm in the year of investment. The data are obtained from the Preqin database.
Ln VC age	Natural logarithm of the age (years in business) of a VC firm at the time of an initial investment in a portfolio company.
Ln investment size	Natural logarithm of the total amount invested by a VC firm in a given portfolio company (in USD million).

Appendix B continued

Ln fund age	Natural logarithm of a fund's age measured in years from the date of the fund's initiation to the date of a VC investment in a given portfolio company.
Ln fund age top25th	Natural logarithm of a fund's age for older funds, specifically funds above the 75th age percentile, and zero otherwise.
Investment duration	The time between an initial VC investment and the VC exit date (in years).
Liquidity	Stock market liquidity of a portfolio company's country of origin measured as the ratio of the value of shares traded on the country's stock exchange(s) divided by the country's GDP.
Syndication	A binary variable equal to one if the investment is syndicated and zero otherwise.
IRR	The internal rate of return (IRR) based on detailed information of investment cash flow, as described in section 3. IRR is winsorized at 1% in all analyses.
PME	Public market equivalent, as described in Section 3.
Post-1997	Binary indicator equal to zero for investments up to 1997 and one thereafter.
Year	A set of binary indicator variables for the year of a VC investment.
Financing stage	Binary variables for a financing stage. We include an indicator for investments in expansion stages (zero otherwise) and another for investments in later stages (zero otherwise). Early stage investments are used as the base.
Industry	A set of binary industry variables for a portfolio company's primary industry focus. We include indicators for biotechnology, consumer goods and services, financials, industrials, and information technology, treating 'others' as the base.

Appendix C: Correlation matrix

Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Fund age	**(1)**	1												
VC age	**(2)**	0.169	1											
Investment size	**(3)**	-0.115	0.281	1										
IRR	**(4)**	0.025	-0.003	-0.037	1									
PME	**(5)**	-0.006	-0.012	-0.005	0.003	1								
Holding period	**(6)**	0.019	0.208	0.515	-0.032	-0.012	1							
Liquidity	**(7)**	0.011	-0.058	0.032	-0.020	-0.002	0.133	1						
Syndication	**(8)**	-0.092	0.018	0.034	0.020	-0.019	0.119	0.019	1					
IPO	**(9)**	0.020	-0.002	-0.149	0.163	-0.003	-0.250	-0.006	0.022	1				
M&A	**(10)**	0.013	-0.057	-0.033	0.145	-0.008	-0.046	-0.035	-0.039	-0.231	1			
Early	**(11)**	-0.033	0.118	-0.050	-0.039	0.018	0.072	-0.039	0.141	-0.088	-0.020	1		
Expansion	**(12)**	0.034	-0.147	0.033	-0.003	-0.004	-0.135	0.059	-0.144	0.053	-0.022	-0.734	1	
Later	**(13)**	0.005	0.014	0.030	0.059	-0.004	0.065	-0.017	-0.023	0.061	0.057	-0.526	-0.192	1

Appendix D: Robustness

This table shows the coefficients of cross-border indicators for different models by regions. The results are reported by the baseline Heckman model (1), the three-stage Heckman model (2), the instrumental variable for syndication (3), market conditions and busyness (4), and propensity score matching (5). The control variables are as reported in the prior tables. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

	Model I: North America		Model II: Europe (Ex. UK)		Model III: UK		Model IV: ROW	
Coefficient of cross-border indicator	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*	*Coeff*	*P-value*
(1) Baseline Heckman model (from Table 3)	-0.192**	(0.033)	-0.232**	(0.017)	-0.270**	(0.023)	-0.156**	(0.017)
(2) Heckman model with two probit stages (for exit decision and for cross-border investing)	-0.196**	(0.041)	-0.248**	(0.028)	-0.278**	(0.033)	-0.166**	(0.025)
(3) Heckman model with instrumental variable for *syndication*	-0.1843**	(0.045)	-0.2204**	(0.019)	-0.2592**	(0.026)	-0.1498**	(0.019)
(4) Heckman model with additional stage II variables (market conditions, busyness)	-0.179**	(0.044)	-0.229**	(0.020)	-0.254**	(0.025)	-0.145**	(0.018)
(5) Mixed-effects model with propensity score matching	-0.119**	(0.032)	-	-	-	-	-	-