

DO REPEATED PLAYERS WIN THE GAME? EVIDENCE FROM PRIVATE EQUITY AND VENTURE CAPITAL SYNDICATION

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Abstract

This study offers novel insights to private equity and venture capital (PEVC) syndication by theorizing and examining the contrasting effects of one-off versus repeated syndication on PEVC performance. Using a large dataset from 1985 through 2017, we show that syndication formation enhances performance, while repeated syndications adversely affect performance. Further analysis reveals that the negative effect is attenuated when syndications consist of experienced members, investments in high-tech deals and in different countries. Results are robust after addressing sample selection and endogeneity concerns. This study contributes to the literature by providing nuanced insights to the costs and benefits of PEVC syndication.

Keywords: repeated collaboration; syndication; venture capital

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1. INTRODUCTION

Private equity and venture capital (PEVC) syndication is defined as a network of PEVC firms investing in a common set of portfolio companies. Given significant uncertainty regarding how a new investment in a set of portfolio companies is expected to perform, PEVC firms form a syndication to diversify potential risks associated with their investments (Dai & Nahata, 2016; Hopp, 2010; Dimov & Milanov, 2010; Sørensen, 2007). Prior studies document that most PEVC investments are syndicated (see for instance Wright & Lockett, 2003; Manigart et al., 2006; Jääskeläinen, 2012; Tian, 2012). Syndication enables portfolio companies to access the diverse resources and experience of the PEVC firms, and allows them to sustain profitability and long-term survival (Casamatta & Haritchabalet, 2007; Lerner, 1994b; Lockett & Wright, 2001; Stuart et al., 1999; Sorenson & Stuart, 2001; Ter Wal et al., 2016). Nevertheless, syndication entails competitive tensions among PEVCs that adversely affect the collaboration process and investment performance (Das & Teng, 2000; Kim & Park, 2021; Makarevich, 2018).

The conflicting views on the possible outcomes of syndications prompted us to explore the role of PEVC syndication over subsequent time horizons. From a network perspective, PEVCs have an incentive to improve their competitive position by forming a non-redundant syndication (Burt, 1992; Granovetter, 1973, 1985). In contrast, PEVCs can extend their ties with each other by investing jointly in a sequence of investment opportunities to take advantage of trust that has been developed between them (Kogut et al., 2007; Podolny, 1994). Therefore, it is theoretically imperative to examine the effects of one-off versus repeated syndications¹ on PEVC performance. When PEVCs syndicate for the first time, some of them may decide not to syndicate in the future (one-off syndication). Others could choose to syndicate in the future (repeated syndication). Hence the focus of this study is to explore the performance implications

¹ We use the term one-off syndication interchangeably with first-time syndication and repeated syndication interchangeably with follow-on syndication throughout the paper.

of one-off and repeated syndications, respectively. Further, PEVCs often use syndication to accumulate experience through learning opportunities (Yang et al., 2009; Zahra et al., 1999, 2006). To exploit learning opportunities, PEVCs often engage in repeated syndication to experience and integrate diverse and useful routines that ultimately enhance their capability (Levinthal & March, 1993; Yang et al., 2009). Hence, there is a need to explore experience-related contingency factors that change the relationship between repeated PEVC syndication and performance.

To address these opportunities, this study examines the effects of one-off syndication (*syndication formation*) versus repeated syndications (*repeated syndication*) on PEVC performance. While *syndication formation* refers to a one-off collaboration between two PEVC managers, *repeated syndication* involves members who have previously syndicated and shared their resources and expertise (Dahlander & McFarland, 2013; Kogut et al., 2007). Such distinction is theoretically valuable and associated with two different types of inter-organizational relationship that do not necessarily lead to positive outcomes (Cohen et al., 1972; Gompers et al., 2016). Moreover, we test the moderating effects of experience intensity (i.e. frequently repeated syndication experience), experience diversity (i.e. difference in age-based experience), and acquisitive experience (i.e. high-tech investments). These contingency factors are of significant importance, because PEVCs leverage on their experiences to better extract and expropriate the value from their syndication network (Yang et al., 2009; Zahra et al., 1999, 2006).

Our measure of *syndication formation* is constructed when PEVC managers syndicate for the *first time* (Lerner, 1994b; Hochberg et al., 2007), while *repeated syndication* is computed by adapting prior approaches (see De Clercq & Dimov, 2004; Dahlander & McFarland, 2013; Bellavitis et al., 2019; Seo et al., 2020).² We use a unique and exhaustive global dataset on

² Section 3.2 provides detailed discussions of our measures of *syndication formation* and *repeated syndication*.

PEVC investments between 1985 and 2017 provided by the Centre of Private Equity Research (CEPRES). On the one hand, we find that one-off syndication formation is beneficial and enhances investment performance. On the other hand, repeated syndication between a pair of PEVCs adversely affects investment performance. We also show that frequently repeated syndication experience and difference in age-based experience attenuate the negative impact of repeated syndications on performance. We find that frequent and repetitive syndications enhance PEVC performance from negative 8% to positive 18%, compared with negative 9% to positive 13% when one of the syndicated members is experienced. Moreover, high-tech investments are associated with negative performance, but through repeated syndications the performance improves from negative 3% to positive 7%.

The performance of syndicated investments can only be measured for realized deals, meaning we had to apply sample selection to exclude those not realized by the end of the sample period. To address sample selection bias, we use the two-stage Heckman model. Another possible concern related to our analysis is that the effect of repeated syndication on PEVC performance might be due to investment characteristics rather than our measure of interest (repeated syndication). We address this possible concern by using the entropy balancing method, which involves matching one-off and repeated syndication investments by firm age, fund age, industry experience, equity investment and volatility index. It can be argued that repeated syndication might not be exogenous to the performance. Stated differently, past performance is likely to influence PEVC tendency to syndicate in the future. Hence, repeated syndication is not exogenous to the performance and is possibly endogenous. To account for this endogeneity, we need an instrument that is highly correlated with repeated syndication, but not the performance. We construct a concentration index similar to Tian (2012) and use this index as an instrument in the two-step IV model.³ We use the Hausman test and J-test to ensure

³ In Section 4.3, we discuss the construction of the index in detail.

that orthogonality and overidentification criteria are satisfied. Overall, our baseline results are robust controlling for sample selections and possible endogeneity concerns.

Our study contributes to the entrepreneurial finance and PEVC syndication literature (see for instance Gompers et al., 2016; Sorenson & Stuart 2001; Meuleman et al., 2009; Tykvová & Schertler, 2014; Jääskeläinen, 2012) by investigating separately the effects of one-off and repeated syndication on performance. By considering the time horizon of the syndication, we examine the heterogeneous effects of one-off (i.e. syndication formation) versus repeated syndication on investment performance. We find that repeated syndication hampers investment performance by bolstering structural inertia and free-riding opportunities (Kaplan & Strömberg, 2004; Li & Rowley, 2002). We emphasize the importance of the time horizon when forming and maintaining a syndication network. Further, by exploring the experience-related contingency factors that change the core relationships, we provide a granular understanding of the relationship between syndication and performance (Yang et al., 2009; Zahra et al., 1999, 2006). We show that repeated syndication has a positive impact on performance under the following conditions: (i) when the repeated syndication is more frequent; (ii) when there is variation in the age-based experience between syndicated members; and (iii) when the repeated syndication invests in high-tech portfolio companies or cross-border. Overall, our study provides a dynamic view of PEVC syndication by underscoring the benefits and costs of syndication formation versus repeated syndication.

The rest of the paper is structured as follows: Theory and hypotheses development are in Section 2, methodology and data in Section 3, the results are in Section 4, and the conclusion is in Section 5.

2. THEORY AND HYPOTHESES DEVELOPMENT

2.1. Duality of syndication

For PEVC, the decision to syndicate largely depends on the trade-off between the benefits and costs of syndication for each member (Manigart et al., 2006). The prime motive for PEVCs to form a syndication is related to the need to diversify the risks associated with their portfolio company (Lerner, 1994b; Sorenson & Stuart, 2001; Manigart et al., 2006; Jääskeläinen, 2012). Syndication enables PEVCs to allocate resources, expertise and efforts to the selection of investments that potentially create value (Dimov & Milanov, 2010; Das et al., 2011; Tian, 2012). PEVCs use syndication as a short-term strategy to quickly achieve their financial goals on the basis of shared economic interests (Dahlander & McFarland, 2013; Zhang et al., 2017). Hence, PEVCs dedicate significant effort when syndicating for the first time to maximize the success of their investments and enhance their opportunities for future collaboration in other portfolio companies' investments (Lerner, 1994a; Manigart et al., 2006; Hochberg et al., 2007). Syndication formation that is based on short-term strategies could motivate PEVCs to increase their commitments and encourage syndicate members to work more diligently and efficiently (Dahlander & McFarland, 2013; Zhang et al., 2017). Since syndication formation enables strangers without prior ties to collaborate together, the conflict of interest between the syndicated PEVC members is likely to be minimal. Therefore, the allocation of resources and monitoring of the portfolio company will be more effective to maximize the investment returns for each syndicated member (Sorenson & Stuart, 2001; Kaplan & Strömberg, 2004).

In sum, we have postulated that syndication formation motivates its members and increases their commitments to maximize the returns with the view to enhance future collaboration opportunities. Hence, we formulate the following hypothesis.

Hypothesis 1: Syndication formation is positively associated with PEVC performance.

Inter-organizational tensions often exist in syndication networks due to multiple PEVC managers with different value criteria. Repeated collaboration can benefit a consortium of PEVC managers by enabling them to resolve inter-organizational tensions and challenges in commitments that may arise during the investment holding period (Das & Teng, 2000; Kim & Park, 2021; Makarevich, 2018). Once inter-organizational relationships mature through repeated syndications, individual members develop mutual trust and a strong team identity (Granovetter, 1973). Furthermore, syndicated (collaborated) members learn about the skills, personal values and behavioral habits of others through repeated interaction (Argote, 2013). Hence, syndication facilitates the flow of information among the interacting parties (Podolny, 2001) and prevents competition between PEVC managers after investment opportunities are disclosed by aligning the interests of its members (Casamatta & Haritchabalet, 2007).

Trust and information symmetry benefits repeated syndications; nevertheless, they may foretell only part of the repeated syndication effects. Building on the logic of structural inertia, convergent thinking and opportunism, we hypothesize the pitfalls of repeated syndication.

First, repeated syndication could lead to structural inertia among PEVC managers, making them reluctant to have other partners on board (Li & Rowley, 2002). This is due to the sense of attachment emerging from shared experiences and investments in a repeated relationship (Dahlander & McFarland, 2013; Gompers et al., 2016; Seabright et al., 1992). Therefore, the structures, routines, processes and competencies of PEVC syndicates will be constrained by past inertial pressures formed through repeated syndications (Sørensen & Stuart, 2000), which is likely to hamper investment performance.

Second, repeated syndication could impede the divergent thinking process while selecting and managing investments and portfolio companies. Despite the trust and cohesion benefits of repeated syndication, its members will be reluctant to new ideas and changes. For instance, repeated interactions could lead syndications to become closed networks, where their

members often fail to challenge collectively held beliefs and become trapped in their own nets (Gargiulo & Benassi, 2000; Gompers et al., 2016; Ter Wal et al., 2016). For this reason, repeated collaborators tend to converge too quickly on prior familiar solutions rather than carefully discussing diverse alternatives before they come to a conclusion (Skilton & Dooley, 2010). Syndication consisting of repeated collaborators is less likely to utilize new and diverse knowledge in their problem solving (Seo et al., 2020), which could adversely affect the performance.

Third, repeated syndication provides free-riding opportunities for its members. Repeated syndication increases visibility of each member's contribution to the consortium (Albanese & Van Fleet, 1985). Such visibility can trigger opportunism for some parties to exploit other parties' interests through free-riding (Tidstöm, 2014). Put differently, syndicated members could potentially focus on their private interests instead of the interests of all parties involved in the syndications (Bengtsson & Kock, 1999; Lado et al., 1997). Therefore, repeated syndications could promote free-riding problems and cause each individual PEVC to spend less time and effort on screening and monitoring the portfolio companies, leading to a negative outcome (Kaplan & Strömberg, 2004; Espenlaub et al., 2014).

In sum, we postulate that repeated syndication will prompt structural inertia, convergent thinking and free-riding tendency, thereby adversely affecting the performance of repeated syndication. Therefore, we formulate the following hypothesis.

Hypothesis 2: Repeated syndication is negatively associated with PEVC performance.

2.2. Experience and syndication

Given the non-trivial nature of the negative relationship between repeated syndication and PEVC performance, we explore deeper into its sources by considering several experience-related contingencies. Inter-organizational literature on syndication has revealed that PEVCs leverage on their experiences to better extract and expropriate the value from their syndication

network (Yang et al., 2009; Zahra et al., 1999, 2006). Following these prior studies, we explain the moderating effects of experience intensity (i.e. frequently repeated syndication experience), experience diversity (i.e. difference in age-based experience), and acquisitive experience (i.e. high-tech investments) on the core relationship between repeated syndication and PEVC performance.

Experience intensity: Frequently repeated syndication experience (i.e. shorter intervals between the first and next syndication) is likely to enhance processing of information and create more opportunities that help syndicated members to build a sense of trust and reciprocity (Sorenson & Stuart, 2001). Consistent with this disposition, syndicated members subject to excessive frequent collaboration can easily learn from each other through syndication experience (Fried & Hisrich, 1994). As such, highly recurrent syndication experience will enable PEVCs to learn and share new knowledge, secure more accurate information, and bring high-quality investment opportunities (Sorenson & Stuart, 2001). In sum, frequently repeated syndication is likely to offset the adverse effects of repeated syndication in that trust and reciprocity built through intense and frequent interactions could motivate PEVCs to avoid structural inertia and minimize the tendency of free-riding. Formally:

***Hypothesis 3:** Frequently repeated syndication attenuates the negative relationship between repeated syndication and PEVC performance.*

Experience diversity: While convergent thinking is prevalent in repeated syndication that hampers learning (Gargiulo & Benassi, 2000; Ter Wal et al., 2016), we argue that the difference in age-based experience of syndicated PEVC managers will offset this pitfall by providing learning opportunities and encouraging divergent thinking. Younger PEVCs provide flexibility and creativity to the syndication, whereas more mature PEVCs carry distinct knowledge because of their well-embedded routines derived from prior investment experience (Kotha et al., 2011; Nahata, 2008; Sørensen & Stuart, 2000). Such complementarity can reinforce the

benefit from repeated syndications to improve the investment screening and selection process. For instance, diversity in age-based experience could enhance the decision-making process in repeated syndications, which includes opportunity assessment, recruiting the right management team, and the exit timing. Specifically, the difference between young and mature firms enriches the supply of diverse ideas and fosters a greater awareness in sensing problems (Eisenhardt & Schoonhoven, 1996; Kotha et al., 2011). In sum, diversity in age-based experience strengthens the deal selection and investment management abilities of repeated syndications by encouraging divergent thinking and providing learning opportunities to enhance the performance. Formally:

***Hypothesis 4:** Difference in age-based experience attenuates the negative relationship between repeated syndication and PEVC performance.*

Acquisitive experience: Acquisitive experience is a particularly important facet of experience accumulation when knowledge assets lack mobility and are very difficult to articulate and imitate without direct observation (Inkpen & Dinur, 1998). Likewise, most of the high-tech companies' value lies in their intangible assets, and PEVCs should be alert to the fast-changing technological environment and competition (Colombo & Grilli, 2010; Croce et al., 2013). Despite the higher expected returns of the high-tech investments due to their growth potential, they entail significant uncertainty for PEVCs (Colombo & Grilli, 2010). For instance, portfolio companies in the high-tech sector are different from those in non-high-tech sectors in that most high-tech companies tend to have limited track records (Grilli & Murtinu, 2014). Given the uncertain surroundings, PEVCs are prone to divergent thinking processes in order to respond effectively to the technological changes and competition dynamics. However, divergent thinking processes triggered by high-tech investments could delay the decision-making process in syndications. Since rapid technological changes require a quick response, failure to take timely action by syndicated members could heighten the negative effect of repeated syndications on PEVC performance. Formally:

Hypothesis 5: High-tech investment accentuates the negative relationship between repeated syndication and venture capital performance.

3. METHODS

3.1 Data and sample

We source our data on worldwide venture capital syndications from CEPRES. To be included in the CEPRES database, all General Partners (GPs) are required to report the entire history of deals conducted in the past. This is critical in our setting and mitigates the possibility of over- or under-stating one-off syndication or repeated syndication due to incomplete data coverage. The database provides detailed information on individual PEVC investments that we require to compute our variables of interest. The database has detailed information on cash flows at the level of each PEVC investment relevant for computing the internal rate of return (IRR) and public market equivalent (PME) at the individual deal level. Other databases (including VentureXpert) often provide performance measures such as IRR at the fund level, but our study focuses on performance at the deal rather than at the fund level. PEVC managers syndicate to invest in a specific portfolio company (deal) often using multiple funds. Unlike the fund data, the deal-level data allow us to estimate the impact of repeated syndication on performance. We do not preclude the possibility that new PEVC managers enter the sample while others exit over our sample period from 1985 through 2017.

A further benefit of the CEPRES database is that all investment data are anonymized based on PEVC confidential data requirements. Therefore, overstating the performance when providing the data is very unlikely to happen which minimizes bias in reporting. In other words, self-reporting bias is mitigated when using the CEPRES database. The database has been used by a number of previous studies related to PEVCs (Franzoni et al., 2012; Buchner et al., 2018; Cumming et al., 2010; Krohmer et al., 2009).

3.2 Variables

Dependent variables

We use two measures of performance. The first is the IRR which we compute at the deal level. The IRR is computed as the discount rate, which equates the present value of the net cash flow to zero. The CEPRES database provides information on the cash flows invested from entry to exit, including dividend repayments and proceeds from exit. The second measure is PME which is computed by discounting the venture capital investment's cash inflow and outflow relative to a public benchmark (Buchner et al., 2018).

Independent variables

Our key variables of interest are *syndication formation* (= one-off syndication) and *repeated syndication*. The data provided by CEPRES allow us to directly observe when ties are formed and whether these ties are repeated over subsequent periods, as the database lists all PEVC managers investing in a specific portfolio company. Our identification strategy makes a significant contribution to inter-organizational alliance and syndication literature. In contrast to Sorenson and Stuart (2001) or Tykvová and Schertler (2014), we do not use a pairwise combination or matching approach given our focus on repeated syndication. While these papers focus on the probability of a syndication formation, we go beyond syndication formation and carefully quantify the repeated syndication of a specific PEVC dyad. Further, similar to De Clercq and Dimov (2004) and Bellavitis et al. (2019), we identify the number of prior interactions between syndicated members. It is worth noting that measures used in these papers are limited by data availability related to the syndications. Given the breadth and depth of the CEPRES data, we follow a specific PEVC dyad across time, deals and industries, and count the number of prior syndications within a five-year horizon. Hence, we go beyond these prior studies by concentrating on a focal PEVC manager within a specific deal environment and consider the entirety of prior PEVC syndications of a specific dyad across the sample.

Our first measure of *syndication formation* is constructed when PEVC manager i and j syndicate for the *first time*. To compute this measure, we start with all PEVC deal observations in our sample. We focus on syndicated deals where at least two PEVC managers are investing in the same portfolio company, since *syndication formation* requires a minimum of two syndicated PEVC firms. Next, we search for company deals where at least two distinct PEVC investment managers have been co-investing within one year of reporting. We identify this as syndication. We choose one year because of the possible delay of PEVCs reporting their investments to CEPRES. It is well established in the PEVC literature that PEVC firms tend to invest in portfolio companies using multiple funds (Kaplan & Strömberg, 2004; Tian, 2012). Our measure of syndication formation is based on the PEVC managers rather than the specific funds used to invest in the portfolio company.

The second measure of repeated syndication is based on prior studies (De Clercq & Dimov, 2004; Dahlander & McFarland, 2013; Bellavitis et al., 2019; Seo et al., 2020). We use the cumulative number of prior collaborations on previous deals over a five-year period (suggested by Hochberg et al., 2007) as a measure of repeated syndication. We compute repeated syndication as follows:

$$Repeated\ Syndication_i = \sum_{k=1}^K Tie_{ik}$$

where Tie_{ik} is the number of prior events of syndication on previous deals in which we accumulate the number of collaborations of Tie_k on deals i minus 1 to correct for the first syndication formation. Tie_k here includes all possible dyads of investment managers. For each syndicated deal, we identify all possible dyads to which we assign a unique PEVC Syndication ID. This allows us to identify repeated syndication of any possible dyad within a five-year period prior to a specific deal. We use five years because PEVCs typically make investments in the first five years and plan their exits beyond the five years (Gompers et al., 2008). Hence,

a period of five years allows us to capture possible collaboration among PEVC pairs. This identification approach ensures that we only include actual syndication formations, distinctly identify specific investment managers, and track those unique PEVC dyads (Syndication ID) on a rolling basis throughout our sample. Hence, our repeated syndication variable is a time-variant measure.

In our sample, we identify 2,226 syndication formations. There are 611 pairs in our sample that continue to collaborate after the initial syndication formation. On average, a specific pair repeats their collaboration 2.87 times. For repeaters, the average repeated syndication is 6.27 times compared to 49 for the maximum number of collaborations between the pairs.

Figure 1 illustrates the identification process described above across three different points of time. For instance, let us assume four distinct PEVC managers syndicate in portfolio company (PC) investment α in 2013 ($t=0$). We can identify six syndication formations (a-b, a-c, a-d, b-c, b-d, c-d). Assume that in 2014 ($t=1$), four distinct PEVC investment managers syndicate in PC β . In this case, PEVC a , PEVC c and PEVC d have already been collaborating and hence they have not formed a new tie; instead, it is identified as a repeated syndication. Further, three new ties are formed (a-e, c-e, d-e). A year later ($t=2$), three distinct PEVC investment managers syndicate on PC γ . Since one dyad has already been formed in this round of syndication, we can identify one repeated syndication (c-d) and two new ties (c-f, b-f). We carefully follow the entire sample of PEVC syndicated deals from syndication formation to repeated syndication.

Insert Figure 1 about here

As sometimes multiple PEVC managers syndicate, in Figure 2 we report the proportion for different syndicate sizes. We can identify that the majority of deals in our sample (53%) are syndicated between a distinct pair of PEVC managers, followed by three syndicators (22%) and four syndicators (11%). A deal is most frequently syndicated by two distinct PEVC managers.

In Figure 3 we depict the frequency of repeated syndications for different sizes of distinct syndicates (i.e. dyad, three syndicators, four syndicators, etc.). Here, a difference in distinct syndicators that repeatedly syndicate becomes obvious: for one repeated syndication the distribution is rather dispersed with high frequencies of two and three distinct syndicators, whereas with increased repeated syndication we can identify that the majority of repeated syndicators is between two specific PEVC managers. It appears that it is the same two specific PEVC managers that repeatedly syndicate, not the same five or six specific PEVC managers that all decide to syndicate again. In other words, a dyad including two distinct PEVC managers most frequently collaborates repeatedly compared to three or more syndicated managers. In fact, only about 6% repeat their collaboration for a distinct three-way syndicate constellation. This means that the same three PEVC managers are syndicating again. As such, frequently repeated syndications (+2 times) are observed primarily for dyads of two specific PEVC managers.

Insert Figure 2 and Figure 3 about here

Moderating variables

To examine the moderating effect of experience intensity, we include a couple of variables such as the top quartile of repeated syndications between pairs as frequent collaborators and the bottom quartile of repeated syndication as sporadic syndication. Further, we test the moderating effect of age-based experience diversity by including a variable, which is computed as a top (bottom) quartile age dummy based on the largest absolute values of age difference within dyads. Moreover, we examine the moderating effect of acquisitive experience by using a high-tech dummy which is coded as 1 if the PC is in the technology sector and 0 otherwise.

In addition to examining hypotheses 3, 4 and 5, we extend our analysis by exploring additional contingency factors as reported in the additional analyses and robustness tests

section. We employ a crisis dummy which is based on data from the Federal Reserve Economic Data (FRED) St. Louis, providing approximation periods of expansion and recession for the US market. Finally, we include a time dummy that takes the value of 1 if the repeated syndication happened within two years as well as a cross-border dummy that indicates if the PEVC managers are from different regions.

Control variables

We include various control variables that are reported in previous studies (see Buchner et al., 2018) to influence the performance of venture capital investments. To capture market conditions, we define a post-2008 dummy to account for the global financial crisis and the CBOE VIX, which is a market-based approximation of future volatility.

We also include dyad-specific variables computed as the absolute difference between two PEVC investment managers in a specific syndication dyad. This approach allows us to capture the status inconsistency (experience diversity) across specific syndication dyads. Other control variables include firm age difference, fund age (Meuleman et al., 2017; Sorenson & Stuart, 2001), and absolute difference measures on general and industry-specific experience (Lerner, 1994b; Hochberg et al., 2007; Meuleman & Wright, 2011). Finally, we also control for the difference of each PEVC manager's equity investment in the specific syndication dyad. We control for financing stage, industry and country fixed effects in all our analyses.

4. RESULTS

4.1 Preliminary analysis

As a preliminary analysis we report the mean, median and standard deviation of our variables of interest in Panel A of Table 1. In Panel B, we report the characteristics of the subsample of repeated syndication (1,790) and one-off syndication (2,119) and test whether the difference is statistically significant. One-off syndication means that the specific syndication pair of PEVC managers has only collaborated once, when the tie was formed.

Our sample shows that the average repeated syndication between PEVC pairs is three times after the tie was formed. The average (investment manager) firm age involved in syndication is 10 years with the standard deviation of 11 years. The funds in our sample are young and only two years old on average. The difference in mean and median for general industry experience and equity investment indicate that differences in some values are large in our sample. On average, the syndicated deal return as measured by the IRR is 32%, while the PME is 1.87.

When comparing the differences between the subsamples of repeated syndications and one-off syndication (=syndication formation), we find a significant difference for dyads in experience and equity investment. While Lerner (1994b) finds that venture capitalists with similar levels of experience syndicate, our results on ties that are formed for the first time are different for repeated syndications. Specifically, pairs that repeatedly syndicate tend to be more diverse in terms of industry experience. In another words, highly specialized venture capital managers tend to collaborate with those less specialized. By contrast, when dyads are significantly different in their financial contribution, they do not syndicate frequently. This suggests that while repeated syndication is beneficial when the experience differs (learning opportunity), in terms of financial difference (i.e. contribution) the tie is likely to be formed rather than repeated syndication. We find no statistical difference in the market conditions between repeated and one-off syndicated investments.

Insert Table 1 about here

4.2 Testing the hypotheses

We now explore the possible impacts of our variable of interest on performance. We report the results for IRR and PME in Table 2. Models I–II and V–VI report the results for

syndication formation, while Models III–IV and VII–VIII report the results for repeated syndication.

Insert Table 2 about here

It is evident from the results reported in Table 2 that tie formation has a positive impact on PEVC performance as measured by the IRR (Model I: $\beta=0.0598$, $p\text{-val}=0.000$; Model II: $\beta=0.0537$, $p\text{-val}=0.000$). A one standard deviation (i.e. 0.498) increase in tie formation increases the IRR by 9%, which is economically significant. These findings are robust using PME instead of IRR (Model V: $\beta=0.1074$, $p\text{-val}=0.000$; Model VI: $\beta=0.0963$, $p\text{-val}=0.000$). The larger the difference of the funds' age (Model I: $\beta=0.0937$, $p\text{-val}=0.001$; Model II: $\beta=0.0897$, $p\text{-val}=0.001$) in a specific PEVC syndication, the higher the investment performance as measured by IRR. Similarly, the performance of the investment is enhanced when the level of experience (Model I: $\beta=0.0079$, $p\text{-val}=0.000$; Model II: $\beta=0.0077$, $p\text{-val}=0.000$) between the two PEVC firms that syndicated is different. Put differently, collaboration between experienced and inexperienced PEVC firms improves the performance of investments. By contrast, when the two PEVC firms differ significantly on the contribution invested in the syndicated deal (Model I: $\beta=-0.0014$, $p\text{-val}=0.060$), the investment performance seems to deteriorate. Nevertheless, this effect does not persist for the IRR when we control for market conditions, but tends to hold when using PME as a performance measure (Model VI: $\beta=-0.0021$, $p\text{-val}=0.099$). The post-2008 dummy (Model II: $\beta=-0.1739$, $p\text{-val}=0.0018$) and CBOE VIX measure (Model II: $\beta=-0.0433$, $p\text{-val}=0.000$) are negatively correlated to the performance. This suggests that PEVC performance is adversely affected by the eruption of the global financial crisis and volatile market conditions. The results show that the economic impact of industry experience and contribution are minimal on performance as measured by IRR and PME.

Interestingly, our results show that PEVC repeated syndication has a negative impact on the performance as measured by IRR (Model III: $\beta=-0.1045$, $p\text{-val}=0.000$; Model IV: $\beta=-$

0.0918, p-val=0.000) and PME (Model VII: $\beta=-0.1025$, p-val=0.001; Model VIII: $\beta=-0.0893$, p-val=0.003). It is evident that syndication formation significantly enhances the performance of venture capital investments. Higher divergence in the funds' age (Model III: $\beta=0.0947$, p-val=0.001) and experience (Model III: $\beta=0.0079$, p-val=0.000) increases the performance, while a larger difference in contributions (Model III: $\beta=-0.0016$, p-val=0.027) decreases the performance. The negative performance is robust controlling for market conditions, the post-2008 period (Model IV: $\beta=-0.1658$, p-val=0.024) and during high market volatility (Model IV: $\beta=-0.0416$, p-val=0.001).

These findings suggest that while the initial syndication (=syndication formation) is beneficial and enhances investment performance, repeated syndication between a pair of PEVCs adversely affects investment performance, thereby supporting hypotheses 1 and 2.

To further investigate numerous contingency factors that influence the core relationship between repeated syndication and performance, we use several moderators. First, in Table 3 we examine frequently repeated syndication with a top-quartile and bottom-quartile repeated syndication dummy. We aim to approximate dyads that repeated frequently (top quartile) compared to less frequently repeating dyads (bottom quartile). The results show that infrequent syndication negatively impacts the performance as measured by IRR (Model I: $\beta=-0.0340$, p-val=0.095) and PME (Model III: $\beta=-0.0434$, p-val=0.069). In contrast, when a specific PEVC dyad collaborates repeatedly and frequently, the performance of PEVC investments is enhanced significantly (Model II: $\beta=0.1874$, p-val=0.037; Model IV: $\beta=0.2733$, p-val=0.009). Other variables are qualitatively similar to the baseline results reported in Table 2. Overall, the results seem to suggest that PEVCs do not necessarily commit to the success of their investments when collaboration is less frequent.

Insert Table 3 about here

To examine the moderating effect of experience difference as measured by age (Table 4, Panel A), industry and stage experience (Table 4, Panel B), we interact our experience measure with repeated syndication using the top-quartile experience difference. In Panel A, we use the age of PEVC as a proxy for experience consistent with Gompers (1996). The results are reported in Table, 4 Panel A, and it is clear that the performance is negative when the experience as measured by the age of the two PEVCs is similar (bottom-quartile age) (Model I: $\beta=-0.0935$, $p\text{-val}=0.073$; Model III: $\beta=-0.0646$, $p\text{-val}=0.067$). By contrast, when the difference in age between the two PEVC investment managers is significant (top-quartile age), the performance of the investments is enhanced significantly. Stated differently, the performance of PEVC investments is positive when syndicated managers include old and young PEVCs (Model II: $\beta=0.1333$, $p\text{-val}=0.037$; Model IV: $\beta=0.2346$, $p\text{-val}=0.020$). In Panel B, we use industry and stage experience difference as a proxy for PEVC experience. Models I and II show the results for the IRR, while Models III and IV show the results for the PME. It is evident that repeated collaboration among the PEVCs has a positive impact on the performance when the PEVCs are highly experienced as measured by the top quartile of stage experience (Model I: $\beta=0.1135$, $p\text{-val}=0.023$; Model III: $\beta=0.1246$, $p\text{-val}=0.037$) and industry experience difference (Model II: $\beta=0.1551$, $p\text{-val}=0.021$; Model IV: $\beta=0.2012$, $p\text{-val}=0.031$). These results hold for both IRR and PME performance measures. It is clear from the results in Table 4 (Panels A and B) that highly experienced PEVCs mitigate the negative impact of repeated collaboration on performance. The impact of other variables remains qualitatively similar to our baseline results. Overall, the results are consistent with hypothesis 4, which suggests that diversity in experience among the syndicated members attenuates the negative relationship between repeated syndication and PEVC performance.

Insert Table 4 about here

Next, we examine whether the relationship of repeated syndication on performance is moderated by high-tech portfolio investments. Typically, high-tech portfolios are considered high-risk, high-return investments. Hence, it is likely that PEVCs would invest time and effort to maximize the performance of their investments in high-tech companies to compensate for low expected returns in other industries. Furthermore, information asymmetry and risk are more pronounced in high-tech companies and extra effort is required for its success from collaborating members (Dimov & Milanov, 2010). In the context of repeated syndication, investments in high-tech could be a priority for both PEVC members and therefore the PEVC investments are likely to outperform. In Table 5, Models I and II report the impact of repeated syndication on performance for high-tech companies. It is evident that repeated syndication is positively associated with performance as measured by IRR (Model I: $\beta=0.0681$, $p\text{-val}=0.034$) and PME (Model II: $\beta=0.0145$, $p\text{-val}=0.016$) when the PEVC dyads are syndicating in high-tech investments. The results do not support hypothesis 5; the results suggest that investments in high-tech portfolio companies could attenuate the adverse effects of repeated syndications.

Insert Table 5 about here

In summary, syndication (=syndication formation) has a positive impact on performance. However, when PEVC investment managers repeatedly syndicate, the performance is negative. Together, the results show that frequent syndication and collaboration in high-tech investments enhance the performance of PEVC investments. We can infer from the results that PEVCs do not seem to commit sufficiently for repeated syndications and as a result their investments underperform. We conclude that repeated syndication requires higher commitments from both members and entails different levels of expertise between syndicated PEVC pairs.

4.3 Addressing sample selection and endogeneity concerns

Our measure of performance includes fully and partially realized investments. It is likely that the effect of repeated syndication on performance as measured by IRR and PME is subject to sample selection. We use the two-step Heckman model to correct for possible sample selections. In stage I, we estimate the probability of investments being fully realized using all control variables. Unrealized deals could under- or over-perform, hence might distort the performance measure. In stage II, we focus only on fully realized investments and include an inverse Mills ratio estimated from stage I to control for possible sample selection. Provided that the sample selection is a concern, the inverse Mills ratio would be significant in stage II. Table 6, Panel A, Models I and II show the stage II results of the Heckman model. It is evident from Models I and II that the coefficients of the inverse Mills are not significant at any conventional levels in both models. This indicates that our results are not subject to sample selection bias.

We can identify two major sources of endogeneity that might influence our results. First, our results may be driven by other unobserved characteristics. We use a matched sample approach to address this concern. Second, our measure of repeated syndication is endogenous to past performance, as repeated syndication is more likely to occur when past performance is higher. We address this concern using an instrument variable approach.

As mentioned earlier, we use the entropy balancing matching method. We match repeated and one-off syndication by firm age, fund age, industry experience, contribution and volatility index. The matching results are reported in Table 6, Panel B. It is evident that the differences in the matched variables are not statistically significant at any conventional levels. The results of the matched sample are reported in Models III and IV of Table 6. The coefficients of the repeated syndications are negative and significant, suggesting that repeated syndication has a negative effect on performance even after controlling for possible observable endogeneity.

Overall, the results in Table 6 show that repeated syndications have adverse effects on performance controlling for sample selection and observed endogeneity.

Insert Table 6 about here

Furthermore, we use the IV two-stage least square model. In the first stage, we estimate repeated syndication as a function of various control variables, including our instrument. We use an investment concentration index as our instrument, which is likely to influence the choice of syndication but not necessarily the performance. Following Tian (2012), we construct an investment concentration index for each PEVC firm in each year based on CEPRES industry classification. The index measures by how much a PEVC firm's portfolio deviates in industry composition from a market portfolio consisting of all portfolio companies in which a PEVC firm could have invested. The index is equal to 0 if the PEVC firm's portfolio has the same industry composition as the market portfolio. In other words, the equivalent proportion of companies from each industry as the market portfolio which increases as the PEVC firm's portfolio becomes more concentrated in a few industries. We compute the index as follows:

Suppose that in year t , firm j has $w_{i,t,j}$ portfolio firms in industry i (scaled by the total number of portfolio firms in year t) and there is a total of $\bar{w}_{i,t}$ portfolio firms in industry i (also scaled by the total number of portfolio firms in year t). The *investment concentration index* of firm j in each year is defined as the sum of the squared deviations of $w_{i,t,j}$ from $\bar{w}_{i,t}$, as shown in the equation below:

$$\text{investment concentration index} = \sum_{i=1}^{N-\text{industry}} (w_{i,t,j} - \bar{w}_{i,t})^2$$

Our choice of *investment concentration index* and an instrument is motivated by the fact that the index is likely to reflect the decisions of PEVC firms to syndicate in the investment of the PC, but not necessarily the performance. If PEVC investments are concentrated in a few industries, the index value will be very high, suggesting concentration; as a consequence, PEVC managers would need to diversify. Therefore, the chance for such PEVCs to syndicate is very

high. When the index value is low, it means that PEVC investments are not concentrated and thus do not need to diversify and syndicate.

Table 7 shows the results of our two-stage IV model. Our instrument in stage I is highly significant and increases repeated syndication among the venture capital firms. In stage II, we use a predicted value from stage I instead of repeated syndication. It is evident in stage II that repeated syndication (i.e. predicted value) has a negative impact on performance as measured by IRR or PME. The magnitude of the estimated coefficients is broadly consistent with that reported in the previous tables. Based on the stage II results and the Durbin-Wu-Hausman test, we conclude that our results are not subject to endogeneity and hence our ordinary least squares (OLS) results reported above are robust.

Insert Table 7 about here

4.4 Additional analyses and robustness tests

We examine whether the negative relationship between repeated syndication and performance is moderated by a crisis dummy: time elapsed between the first and subsequent syndication. The results are reported in Table A.3 in Models I–III for IRR and Models IV–VI for PME. It is interesting that the interaction between crisis as measured by the retraction of the size of the US economy (crisis dummy) and repeated syndication positively influences the performance of PEVC investments. This suggests that it is beneficial for PEVC dyads to repeat their syndication during the crisis period and that it enhances performance (Model I: $\beta=0.1771$, $p\text{-val}=0.006$; Model IV: $\beta=0.2702$, $p\text{-val}=0.017$). We investigate the impact of repeated syndication over a two-year period. It is evident from the results that the time between the first and second syndication experience influences the relationship between repeated syndication and performance. In fact, repeated collaboration that occurs soon after the first collaboration has a positive effect and more importantly moderates the negative effect of repeated collaboration. The evidence is robust using IRR (Model II: $\beta=0.0534$, $p\text{-val}=0.036$) or PME

(Model V: $\beta=0.0761$, $p\text{-val}=0.027$) as a measure of performance. In Models III and VI, we explore whether repeated collaboration is different when PEVCs are located in the same versus different regions/countries. We use an indicator, *cross-border*, which takes a value of 1 if any of the PEVCs are based in a different location and 0 otherwise. The results show that the performance is positive when PEVCs are not located in the same region or country. Also, it is evident from the results shown in Table A.3 that the negative effect of repeated collaboration on performance is mitigated when the PEVCs are based in a different location (Model III: $\beta=0.0734$, $p\text{-val}=0.010$; Model VI: $\beta=0.0668$, $p\text{-val}=0.032$). Overall, the results in Table A.3 shed light on the fact that the crisis, time or location of the PEVC moderates the negative effect of repeated collaboration on performance.

Insert Table A.3 about here

We finally examine whether our baseline results are robust controlling for market conditions and year fixed effects. It is likely that the negative effect of repeated collaboration on performance is explained away by market and economic conditions (i.e. Gompers et al., 2008). We use FDI movement, GDP growth, trade openness and stock market liquidity retrieved from the World Bank to measure market and economic conditions (Yoon et al., 2020). Table A.4 shows the results of our baseline analysis. Models I and III show the results for the IRR, while Models II and IV show the PME results. It is evident from the results that our baseline findings using IRR (Model I: $\beta=-0.0958$, $p\text{-val}=0.001$) or PME (Model III: $\beta=-0.0851$, $p\text{-val}=0.006$) are robust controlling for market conditions.

Table A.5 shows the results of using bonding between PEVCs as alternative measures of repeated collaborations. We include two measures: Bonding Measure 1 in Models I and III includes a weight based on the number of syndicators to the accumulated number of previous repeated collaborations (De Clercq & Dimov, 2004). For instance, if there are two syndicated members, the weight equals $\frac{1}{2} = 0.5$; in the case of three syndicator members, the weight is $\frac{1}{3} =$

0.3333. Bonding Measure 2 in Models II and IV follows Seo et al. (2020), focusing on the specific syndicate itself. Hence, we approximate the strength of bond using $K = \frac{n(n-1)}{2}$ where n = the number of syndicators and thus is calculated for each syndication occurrence individually. The results show that our baseline results hold, even after accounting for the number of syndicators. As such, the bonding measures have a negative impact on performance of the PEVC investments. The stronger the accumulated repeated collaboration using bonding measures between the PEVCs, the lower the performance. Both measures of bonding have a negative effect on performance as measured by IRR (Model I: $\beta=-0.0652$, $p\text{-val}=0.00$; Model II: $\beta=-0.0574$, $p\text{-val}=0.004$) or PME (Model III: $\beta=-0.0731$, $p\text{-val}=0.00$; Model IV: $\beta=-0.0631$, $p\text{-val}=0.024$) and are consistent with our baseline analysis. Overall, the results show that market and economic conditions do not explain away the negative effect of repeated collaboration on performance.

Insert Tables A.4 and A.5 about here

5. DISCUSSION AND CONCLUSIONS

PEVC syndication has garnered the interests of many researchers because of its profound implications on risk diversification, inter-organizational relationships and entrepreneurship (Dai & Nahata, 2016; Dimov & Milanov, 2010; Hopp, 2010; Manigart et al., 2006; Sørensen, 2007; Wright & Lockett, 2003). However, relatively limited attention has been paid to explain the role of syndication longevity in influencing investment performance. Hence, the objective of this study has been to examine the heterogeneous effects of one-off syndication formation and repeated syndication on PEVC investment performance.

Our study generates several contributions and implications. We contribute to the entrepreneurial finance and PEVC syndication literature by not only opening the established yet under-examined duality of syndication but also identifying its two distinctive time dimensions: *syndication formation* and *repeated syndication*. Given that syndication formation

enables strangers to collaborate, we have postulated that the allocation of resources and monitoring of the PC will be more efficient to maximize the investment performance. In contrast, we have proposed that repeated syndication incurs structural inertia and free-riding opportunities, and impedes divergent thinking, thereby hampering the investment performance. Thus, our theoretical framework outlining the specific mechanisms enables us to critically examine the relationship between syndication and PEVC performance.

By identifying and examining several boundary conditions, we offer a more granular understanding of PEVC syndications by examining contingency factors. We show that frequently repeated syndications (experience intensity) enable the syndicated members to build a sense of trust and reciprocity that alleviate structural inertia and free-riding problems. Furthermore, we show that differences in age-based experience (experience diversity) between syndicated PEVC members seem to amplify the performance, possibly through better deal selection and management. Thus, frequently repeated syndication and difference in age-based experience attenuate the negative relationship between repeated syndication and PEVC performance. Moreover, high-tech investments (acquisitive experience) weaken the negative performance effect of repeated syndication. In light of exploring these boundary conditions, our study reveals the effect of repeated syndications over time and connects to the varying syndication intensity, experiences and industry background of PEVCs participating in the syndications.

Finally, we provide practical implications. Our findings suggest that it is crucial for managers to pay attention to the evolution and development of syndication networks over time. While it is known that the main motive for PEVC syndication is risk diversification without sacrificing the expected return (Lerner, 1994b; Sorenson & Stuart, 2001; Manigart et al., 2006; Jääskeläinen, 2012), our study shows that inter-organizational learning and collaboration opportunities are relevant to ensure the success of investments.

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Table 1: Descriptive statistics

This table shows the measures for mean, median and standard deviation for the variables of interest across for the entire sample of syndicated VC investments in panel A. Panel B shows these measures across VC syndication pairs that repeatedly syndicate and those that do not repeat the syndication.

Panel A:					
Full sample	Mean	Median	St. Dev.		
Syndication	2.87	0.00	6.68		
Firm Age	10.24	7.83	11.03		
Fund Age	2.23	1.25	2.76		
General Experience	98.83	54.00	112.24		
Industry Experience	27.78	14.00	36.23		
Contribution Difference	60.82	6.42	187.15		
IRR	0.32	0.14	1.46		
PME	1.87	1.08	4.65		
Post 2008	0.22	0.00	0.14		
Crisis Dummy	0.06	0.00	0.24		
Volatility Index	19.96	19.54	6.32		
N	3,909				
	Repeated Syndications		One-off Syndication		
Panel B: Subsample	Mean	Median	Mean	Median	t-test
Firm Age	9.37	6.17	10.89	8.17	1.52
Fund Age	2.24	1.08	2.22	1.33	-0.02
Industry Experience	29.18	16.00	26.60	13.00	-2.58
Contribution	55.46	4.93	65.36	7.93	9.90
IRR	0.31	0.13	0.34	0.15	0.03
PME	1.70	1.06	2.01	1.09	0.31
Post-2008	0.24	0.00	0.20	0.00	-0.02
Crisis Dummy	0.04	0.00	0.08	0.00	0.03
Volatility Index	19.85	19.47	20.06	19.69	0.17
N	1,790		2,119		

Table 2: Multivariate analysis examining the impact of repeated syndication on VC performance

This table considers the impact of the variables of interest on VC performance. The dependent variable for Models I-IV is the IRR, for Models V-VIII is the PME. The coefficients represent the impact of a unit change on the IRR or PME, respectively, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. We include industry, financing stage, and country fixed effects in all settings.

Variables	<i>Dependent Variable: IRR</i>				<i>Dependent Variable: PME</i>			
	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII
Repeated Syndication			-0.1045 (0.000)	-0.0918 (0.000)			-0.1025 (0.001)	-0.0893 (0.003)
Syndication Formation	0.0598 (0.000)	0.0537 (0.000)			0.1074 (0.000)	0.0963 (0.000)		
Crisis Dummy		-0.0409 (0.232)		-0.0459 (0.178)		-0.0242 (0.684)		-0.0163 (0.783)
Post-2008 Dummy		-0.1739 (0.018)		-0.1658 (0.024)		-0.2793 (0.028)		-0.2753 (0.030)
Volatility Index		-0.0433 (0.000)		-0.0416 (0.001)		-0.0547 (0.011)		-0.0573 (0.007)
Ln(1+Firm Age)	-0.0042 (0.543)	-0.0041 (0.555)	-0.0055 (0.418)	-0.0051 (0.452)	-0.0115 (0.330)	-0.0116 (0.327)	-0.0115 (0.330)	-0.0116 (0.324)
Ln(1+Fund Age)	0.0937 (0.001)	0.0897 (0.001)	0.0947 (0.001)	0.0900 (0.001)	0.2091 (0.000)	0.1987 (0.000)	0.2104 (0.000)	0.2002 (0.000)
Industry Experience	0.0079 (0.000)	0.0077 (0.000)	0.0079 (0.000)	0.0077 (0.000)	0.0089 (0.016)	0.0091 (0.014)	0.0081 (0.028)	0.0083 (0.023)
Contribution	-0.0014 (0.060)	-0.0011 (0.131)	-0.0016 (0.027)	-0.0013 (0.071)	-0.0027 (0.035)	-0.0021 (0.099)	-0.0029 (0.025)	-0.0023 (0.076)
Adj. R-sq.	0.234	0.234	0.235	0.237	0.172	0.172	0.171	0.174
N	3,909	3,909	3,909	3,909	3,909	3,909	3,909	3,909

Table 3: Multivariate analysis examining the interaction impact of repeated syndication on VC performance

This table considers the impact of the variables of interest on VC performance. The coefficients represent the impact of a unit change on the dependent variable, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. The interaction terms represent the multiplication of repeated syndication with the dummy of, (i) top quartile experience and (ii) bottom quartile experience. We include industry, financing stage, and country fixed effects in all settings.

Variables	<i>Dependent Variable: IRR</i>		<i>Dependent Variable: PME</i>	
	Model I	Model II	Model III	Model IV
Top Quartile Repeated Syndication		0.0294 (0.553)		0.0443 (0.348)
Repeated Syndication x Top Quartile		0.1871 (0.037)		0.2733 (0.009)
Bottom Quartile Repeated Syndication	0.0172 (0.302)		0.0301 (0.258)	
Repeated Syndication x Bottom Quartile	-0.0340 (0.095)		-0.0434 (0.069)	
Repeated Syndication	-0.0861 (0.000)	-0.6091 (0.008)	-0.0715 (0.020)	-0.6408 (0.003)
Crisis Dummy	-0.0114 (0.736)	-0.1665 (0.008)	-0.0226 (0.674)	-0.0226 (0.705)
Post-2008	-0.1504 (0.039)	-0.0391 (0.773)	-0.2966 (0.010)	-0.2802 (0.028)
Volatility Index	-0.0195 (0.111)	-0.0421 (0.065)	-0.0126 (0.514)	-0.0568 (0.008)
Ln(1+Firm Age)	-0.0037 (0.587)	-0.0037 (0.768)	-0.0023 (0.828)	-0.0127 (0.284)
Ln(1+Fund Age)	0.0733 (0.008)	0.1330 (0.010)	0.2048 (0.000)	0.1976 (0.000)
Industry Experience	0.0067 (0.001)	0.005 (0.203)	0.0087 (0.009)	0.0089 (0.016)
Contribution	-0.0012 (0.094)	-0.0037 (0.006)	-0.0008 (0.475)	-0.0022 (0.086)
Adj. R-sq.	0.227	0.153	0.201	0.173
N	3,909	3,909	3,909	3,909

Table 4: Multivariate analysis examining the interaction impact of repeated syndication on VC performance

This table considers the impact of the variables of interest on VC performance. The coefficients represent the impact of a unit change on the dependent variable, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. The interaction terms in Panel represent the multiplication of repeated syndication with the dummy of, (i) top quartile age and (ii) bottom quartile age. In Panel B we use industry and age as additional experience measures. We include industry, financing stage, and country fixed effects in all settings.

Panel A	<i>Dependent Variable: IRR</i>		<i>Dependent Variable: PME</i>	
	Model I	Model II	Model III	Model IV
Top Quartile Age		0.0312 (0.212)		0.0521 (0.189)
Repeated Syndication x Top Quartile		0.1333 (0.037)		0.2346 (0.020)
Bottom Quartile Age	0.2128 (0.091)		0.1119 (0.083)	
Repeated Syndication x Bottom Quartile	-0.0935 (0.073)		-0.0646 (0.067)	
Repeated Syndication	-0.1008 (0.000)	-0.1635 (0.000)	-0.0991 (0.000)	-0.1173 (0.007)
Crisis Dummy	-0.042 (0.218)	-0.1700 (0.007)	-0.0261 (0.627)	-0.0233 (0.695)
Post-2008	-0.1586 (0.031)	-0.0609 (0.653)	-0.2907 (0.011)	-0.2645 (0.037)
Volatility Index	-0.0424 (0.001)	-0.0391 (0.087)	-0.014 (0.469)	-0.0603 (0.005)
Ln(1+Firm Age)	-0.0179 (0.059)	-0.004 (0.750)	-0.0051 (0.730)	-0.0127 (0.282)
Ln(1+Fund Age)	0.0885 (0.002)	0.1360 (0.008)	0.2041 (0.000)	0.2006 (0.000)
Industry Experience	0.0069 (0.001)	0.0044 (0.447)	0.0075 (0.026)	0.0177 (0.001)
Contribution	-0.0012 (0.090)	-0.0037 (0.006)	-0.0007 (0.526)	-0.0022 (0.088)
Adj. R-sq.	0.236	0.053	0.203	0.171
N	3,909	3,909	3,909	3,909

Table 4 continues

Panel B	<i>Dependent Variable: IRR</i>		<i>Dependent Variable: PME</i>	
	Model I	Model II	Model III	Model IV
Top Quartile Industry experience		0.044 (0.032)		0.0701 (0.026)
Repeated Syndication x Top Quartile Industry experience		0.1551 (0.021)		0.2012 (0.031)
Top Quartile Stage experience	0.034 (0.076)		0.041 (0.068)	
Repeated Syndication x Top Quartile Stage experience	0.1135 (0.023)		0.1246 (0.037)	
Repeated Syndication	-0.1011 (0.000)	-0.1642 (0.000)	-0.0986 (0.000)	-0.1181 (0.000)
Crisis Dummy	-0.043 (0.222)	-0.1705 (0.006)	-0.0255 (0.457)	-0.0236 (0.555)
Post-2008	-0.1572 (0.025)	-0.0624 (0.614)	-0.2906 (0.015)	-0.2633 (0.029)
Volatility Index	-0.0426 (0.001)	-0.0341 (0.077)	-0.016 (0.339)	-0.0606 (0.006)
Ln(1+Firm Age)	-0.0168 (0.072)	-0.005 (0.733)	-0.0054 (0.711)	-0.0132 (0.276)
Ln(1+Fund Age)	0.0878 (0.004)	0.1355 (0.009)	0.2046 (0.000)	0.2008 (0.000)
Industry Experience	0.0064 (0.003)	0.0041 (0.435)	0.0077 (0.028)	0.0171 (0.006)
Contribution	-0.0014 (0.092)	-0.0035 (0.008)	-0.0006 (0.456)	-0.0023 (0.072)
Adj. R-sq.	0.213	0.221	0.211	0.192
N	3,909	3,909	3,909	3,909

Table 5: Multivariate analysis examining the interaction impact of repeated syndication on VC performance

This table considers the impact of the variables of interest on VC performance. The coefficients represent the impact of a unit change on the dependent variable, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. The interaction terms represent the multiplication of repeated syndication with the dummy of high-tech. We include financing stage and country fixed effects.

Variables	<i>Dependent Variable: IRR</i>	<i>Dependent Variable: PME</i>
	Model I	Model II
Repeated Syndication x High-tech	0.0681 (0.034)	0.0145 (0.016)
High-tech	-0.0387 (0.077)	-0.0443 (0.160)
Repeated Syndication	-0.1641 (0.000)	-0.1851 (0.000)
Crisis Dummy	-0.0319 (0.158)	-0.0461 (0.158)
Post-2008	-0.0110 (0.236)	-0.0332 (0.012)
Volatility Index	-0.0522 (0.001)	-0.0512 (0.022)
Ln(1+Firm Age)	-0.0071 (0.425)	-0.0111 (0.426)
Ln (1+Fund Age)	0.1001 (0.005)	0.1773 (0.001)
Industry Experience	0.0014 (0.658)	0.0011 (0.895)
Contribution	-0.0031 (0.086)	-0.0004 (0.475)
Adj. R-sq.	0.126	0.172
N	3,909	3,909

Table 6: Sample selection based on a sample of fully realized and entropy balancing.

This table considers the impact of the variables of interest on VC performance controlling for sample selections and observable endogeneity. The coefficients represent the impact of a unit change on the dependent variable, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. We include industry, financing stage, and country fixed effects in all settings.

Panel A	Sample selection		Entropy balancing	
	Model I: IRR	Model II: PME	Model III: IRR	Model IV: PME
Repeated Syndication	-0.1221 (0.016)	-0.0972 (0.020)	-0.0917 (0.000)	-0.0963 (0.003)
Crisis Dummy	0.0215 (0.721)	0.1966 (0.028)	0.0014 (0.178)	0.0051 (0.283)
Post-2008	0.0202 (0.428)	-0.1313 (0.000)	-0.1201 (0.024)	-0.1331 (0.041)
Volatility Index	-0.0415 (0.018)	-0.0444 (0.082)	-0.0016 (0.211)	-0.0211 (0.241)
Ln(1+Firm Age)	0.0249 (0.322)	-0.1027 (0.006)	-0.0041 (0.204)	-0.0102 (0.241)
Ln(1+Fund Age)	-0.1451 (0.444)	0.9174 (0.001)	0.0401 (0.231)	0.0310 (0.210)
Industry Experience	0.0054 (0.112)	0.0132 (0.009)	0.0014 (0.241)	0.0021 (0.323)
Contribution	0.0022 (0.424)	-0.0137 (0.001)	-0.0011 (0.171)	-0.0013 (0.176)
Inverse Mills	-0.0289 (0.256)	0.0284 (0.204)		
Adj. R-sq.	0.209	0.231	0.063	0.054
N	2,257	2,257	3,909	3,909

Panel B	Repeated Syndications		One-off Syndication	
	Mean	Variance	Mean	Variance
Firm Age	9.371	139.300	9.944	134.602
Fund Age	2.242	6.942	2.244	7.943
Industry Experience	29.221	1567.000	28.552	1433.000
Contribution	55.464	1201.000	54.223	1120.000
Volatility Index	19.853	38.342	19.453	41.222

Table 7: IV model

The dependent variable in stage I is the repeated syndication, while instrument is investment concentration index. The coefficients represent the impact of a unit change on the dependent variable, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. We include industry, financing stage, and country fixed effects in all settings.

	Stage I: Estimation	Stage II: Estimations	
		IRR	PME
Instrument	0.1443 (0.000)	-0.0918 (0.000)	-0.0669 (0.013)
Crisis Dummy	0.0281 (0.198)	0.0459 (0.178)	-0.0318 (0.548)
Post-2008	-0.153 (0.043)	-0.1658 (0.024)	-0.3028 (0.007)
Volatility Index	-0.0816 (0.000)	-0.0416 (0.001)	-0.0321 (0.092)
Ln(1+Firm age)	-0.0041 (0.252)	-0.0051 (0.452)	-0.0042 (0.693)
Ln(1+Fund age)	0.0880 (0.001)	0.0900 (0.001)	0.1210 (0.005)
Industry Experience	0.0055 (0.000)	0.0077 (0.000)	0.0097 (0.003)
Contribution	-0.0014 (0.066)	-0.0013 (0.071)	-0.0026 (0.022)
<i>Durbin-Wu- Hausman Test (p-value)</i>		<i>(0.184)</i>	<i>(0.191)</i>
<i>Overidentification J-test (p-value)</i>		<i>(0.224)</i>	<i>(0.216)</i>
Adj. R-sq.	0.241	0.237	0.281
N	3,909	3,909	3,909

Figure 1: Identification process of syndication formation and repeated syndication

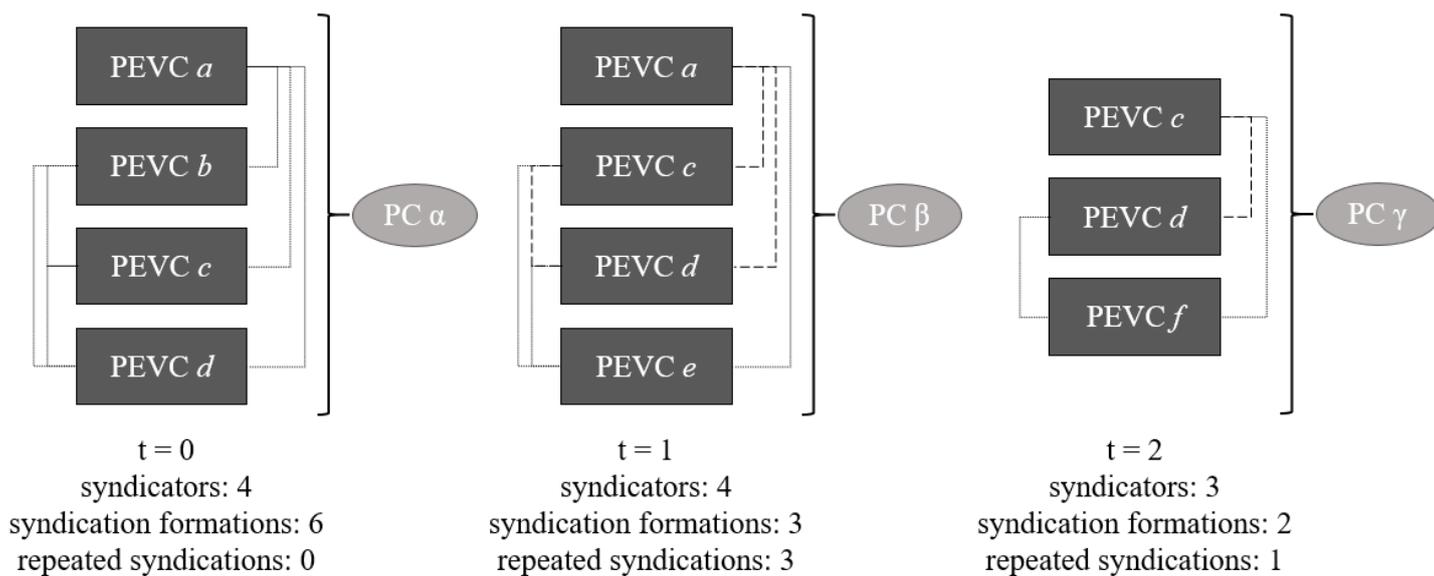


Figure 2: Proportion of number of syndicators per deal in the sample

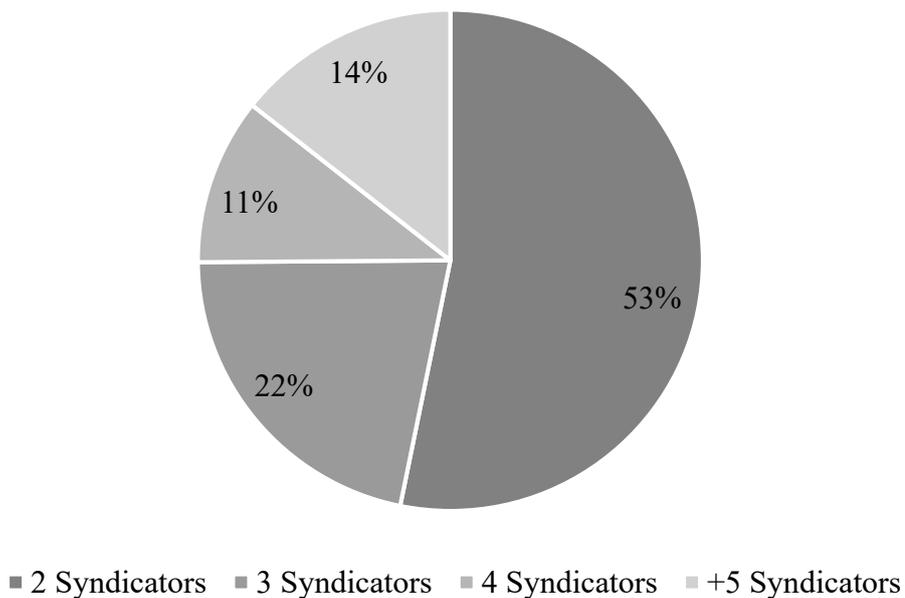
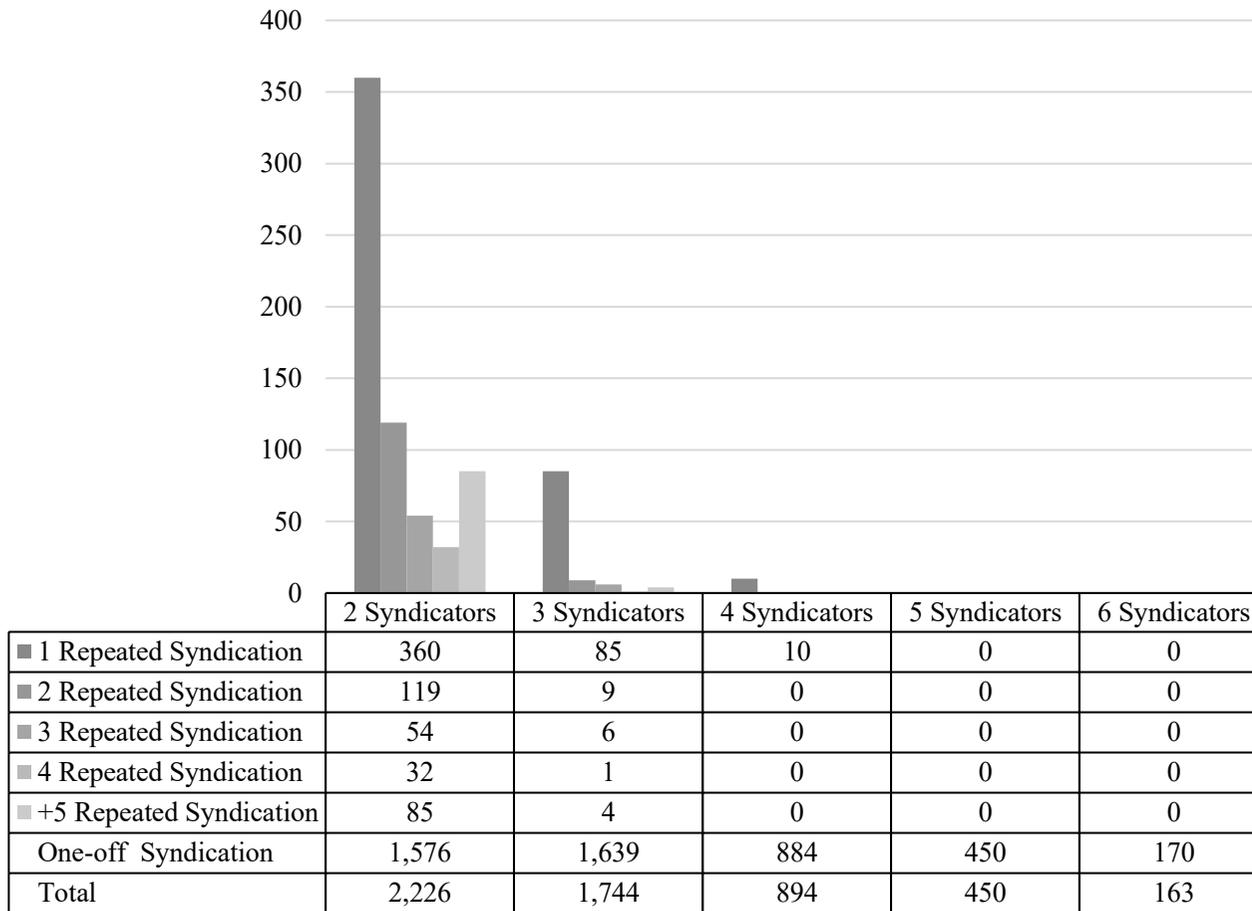


Figure 3: Frequency of repeated syndications across sizes of distinct PEVC syndicates



APPENDIX A

Table A.1: This table describes the variables of interest used in this paper.

Variables	Description
Syndication Formation	1 if two specific PEVC dyad syndicate for the first time (=one-off syndication), and 0 otherwise.
Repeated Syndication	This measures counts the repeated syndications of a specific PEVC syndication dyad after the tie is formed across time.
Top/Bottom Quartile Repeated Syndication	1 if the specific PEVC syndication dyad is in the top (bottom) quartile of the repeated syndications, and 0 otherwise.
Firm Age	Natural logarithm of the age (years in business) of a PEVC firm at the time of an initial investment in a portfolio company.
Top/Bottom Quartile Age	1 if the investment PEVC dyad is on the top (bottom) quartile of absolute difference measure of the PEVC firms' ages, and 0 otherwise.
Fund Age	Natural logarithm of the age (years in business) of a PEVC firm's fund at the time of an initial investment in a portfolio company.
Contribution	The equity invested in the portfolio companies. Investment size.
General Experience	The total number of prior investments.
Industry Experience	The total number of investments in the industry of the portfolio company.
High-tech	1 if the investment is in a high tech industry and zero otherwise.
Post-2008	1 if the investment after 2008, and 0 for investments up to 2008.
Crisis Dummy	1 if the FRED St. Louis indicates a recession, and 0 otherwise.
Volatility Index	CBOE volatility index (VIX) is a market estimate of future volatility.
Time Dummy	1 if the repeated syndication happened within two years.
Cross-border	1 if the PEVC managers are from different regions, and 0 otherwise.

Table A.2: Correlation matrix of variables.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	
Repeated Syndications	(1)	1										
Syndication Formation	(2)	-0.467	1									
Firm Age	(3)	-0.093	0.070	1								
Fund Age	(4)	-0.029	0.033	0.061	1							
Industry Experience	(5)	0.063	-0.085	0.132	-0.039	1						
Equity Investment	(6)	-0.061	0.003	0.003	-0.025	-0.006	1					
Volatility Index	(7)	0.042	-0.004	0.024	-0.008	0.005	-0.067	1				
Crisis Dummy	(8)	-0.012	0.044	0.021	-0.062	-0.012	0.032	0.217	1			
Post-2008 Dummy	(9)	0.017	-0.002	-0.020	-0.022	-0.020	0.172	0.075	0.434	1		
Time dummy	(10)	0.023	0.065	-0.032	-0.011	-0.023	0.054	0.076	0.365	0.223	1	
Cross-border dummy	(11)	0.033	0.056	-0.022	-0.031	-0.011	0.066	0.081	0.435	0.261	0.376	1

Table A.3: Multivariate analysis examining the interaction impact of repeated syndication on VC performance

This table considers the impact of the variables of interest on VC performance. The coefficients represent the impact of a unit change on the dependent variable, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. The interaction terms represent the multiplication of repeated syndication with (i) the crisis dummy, (ii) the time dummy taking a value of 1 if the repeated syndication happened within two years, (iii) the cross-border dummy taking a value of 1 if the PEVC managers are from different regions. We include industry, financing stage, and country fixed effects in all settings.

Variables	<i>Dependent Variable: IRR</i>			<i>Dependent Variable: PME</i>		
	Model I	Model II	Model III	Model IV	Model V	Model VI
Repeated Syndication x Crisis	0.1771 (0.006)			0.2702 (0.017)		
Repeated Syndication x Time Dummy		0.0534 (0.036)			0.0761 (0.027)	
Time Dummy		0.0480 (0.029)			0.0481 (0.021)	
Repeated Syndication x Cross-border			0.0734 (0.017)			0.0668 (0.032)
Cross-border Dummy			0.0409 (0.023)			0.0414 (0.018)
Repeated Syndication	-0.1042 (0.000)	-0.0975 (0.000)	-0.0825 (0.000)	-0.1082 (0.001)	-0.0953 (0.009)	-0.0762 (0.013)
Crisis Dummy	-0.0194 (0.284)	-0.0166 (0.172)	-0.0151 (0.188)	-0.0612 (0.092)	-0.0182 (0.760)	-0.0163 (0.784)
Post-2008	-0.0188 (0.011)	-0.165 (0.025)	-0.165 (0.025)	-0.0291 (0.022)	-0.275 (0.030)	-0.267 (0.035)
Volatility Index	-0.0411 (0.001)	-0.0414 (0.001)	-0.0427 (0.001)	-0.0581 (0.007)	-0.0580 (0.006)	-0.0561 (0.009)
Ln(1+Firm Age)	-0.0064 (0.404)	-0.0053 (0.440)	-0.0053 (0.439)	-0.0132 (0.286)	-0.0012 (0.308)	-0.0013 (0.286)
Ln(1+Fund Age)	0.0922 (0.001)	0.0887 (0.002)	0.0899 (0.001)	0.2022 (0.000)	0.1961 (0.000)	0.1976 (0.000)
Industry Experience	0.0081 (0.000)	0.0076 (0.000)	0.0076 (0.000)	0.0082 (0.025)	0.0081 (0.027)	0.0085 (0.021)
Contribution	-0.0011 (0.091)	-0.0014 (0.067)	-0.0015 (0.050)	-0.0021 (0.078)	-0.0023 (0.074)	-0.0023 (0.075)
Adj. R-sq.	0.236	0.211	0.222	0.173	0.176	0.178
N	3,909	3,909	3,909	3,909	3,909	3,909

Table A.4: Multivariate analysis examining the impact of market conditions on VC performance

This table considers the impact of the variables of interest on VC performance. The coefficients represent the impact of a unit change on the dependent variable, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. We control for various market variables conditions including FDI movement, GDP growth, trade openness and stock market liquidity. We include industry, financing stage, year and country fixed effects in all settings.

Panel A	<i>Dependent Variable: IRR</i>		<i>Dependent Variable: PME</i>	
	Model I	Model II	Model III	Model IV
Repeated Syndication	-0.0958 (0.001)		-0.0851 (0.006)	
Syndication Formation		0.0532 (0.000)		0.1052 (0.000)
Ln(1+Firm Age)	-0.0151 (0.456)	-0.0148 (0.482)	-0.0124 (0.307)	-0.0133 (0.273)
Ln(1+Fund Age)	0.1699 (0.016)	0.1676 (0.020)	0.1902 (0.000)	0.1842 (0.000)
Industry Experience	0.0071 (0.001)	0.0074 (0.001)	0.0093 (0.017)	0.0010 (0.007)
Contribution	-0.0060 (0.086)	-0.0049 (0.083)	-0.0133 (0.079)	-0.0132 (0.062)
Volatility Index	-0.0578 (0.000)	-0.0590 (0.000)	-0.0329 (0.038)	-0.0326 (0.025)
FDI Movement	0.0314 (0.000)	0.0364 (0.000)	0.0421 (0.009)	0.0411 (0.004)
GDP Growth	0.0237 (0.000)	0.0241 (0.000)	0.0401 (0.000)	0.0420 (0.000)
Trade Openness	0.0377 (0.005)	0.0377 (0.006)	0.0328 (0.015)	0.0329 (0.027)
Stock Market Liquidity	0.0115 (0.027)	0.0196 (0.019)	0.0156 (0.033)	0.0165 (0.031)
Adj. R-sq.	0.273	0.273	0.172	0.175
N	3,909	3,909	3,909	3,909

Table A.5: Multivariate analysis using alternative measures of repeated collaboration and market conditions on VC performance

This table shows the results for using bonding as alternative measure of repeated syndication. This table considers the impact of the variables of interest on VC performance. The coefficients represent the impact of a unit change on the dependent variable, given that all other variables are held constant. The p-value for this statistic is reported in parentheses. Bonding measure 1 is the repeated collaboration weighted by the number of syndicators. Bonding measure 2 follows Seo et al. (2020) and uses a combinatory weight. We include industry, financing stage, year and country fixed effects in all settings.

Panel B	<i>Dependent Variable: IRR</i>		<i>Dependent Variable: PME</i>	
	Model I	Model II	Model III	Model IV
Bonding Measure #1	-0.0652 (0.000)		-0.0731 (0.000)	
Bonding Measure #2		-0.0574 (0.004)		-0.0631 (0.024)
Ln(1+Firm Age)	-0.0148 (0.487)	-0.0145 (0.509)	-0.0124 (0.305)	-0.0109 (0.369)
Ln(1+Fund Age)	0.1683 (0.018)	0.1719 (0.013)	0.1872 (0.000)	0.1932 (0.000)
Industry Experience	0.0073 (0.001)	0.0070 (0.001)	0.0010 (0.008)	0.0090 (0.020)
Contribution	-0.0058 (0.082)	-0.0059 (0.074)	-0.0133 (0.016)	-0.0132 (0.022)
Volatility Index	-0.0603 (0.000)	-0.0585 (0.000)	-0.0238 (0.028)	-0.0283 (0.020)
FDI Movement	0.0311 (0.000)	0.0361 (0.000)	0.0410 (0.004)	0.0407 (0.007)
GDP Growth	0.0236 (0.000)	0.0235 (0.000)	0.0401 (0.000)	0.0397 (0.000)
Trade Openness	0.0378 (0.005)	0.0377 (0.005)	0.0330 (0.034)	0.0326 (0.021)
Stock Market Liquidity	0.0114 (0.023)	0.0195 (0.021)	0.0154 (0.032)	0.0162 (0.035)
Adj. R-sq.	0.273	0.272	0.174	0.171
N	3,909	3,909	3,909	3,909