The impact of mixed syndication between government and private venture capital on investees in Estonia

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Received 5 January 2022
Revised 1 March 2022
15 March 2022
Accepted 15 March 2022

Abstract

Purpose – The study compares the impacts of mixed syndication venture capital (VC) investment and private VC (PVC) investment on the transitional performance indicators of intangible assets, fixed assets, liabilities and number of employees in Estonia. It also examines the impact of mixed syndication on investees' sales and profit.
Design/methodology/approach – This study conducted panel data regression analyses based on the dataset consists of yearly data from 2006 to 2015 for more than 187,000 unlisted firms in Estonia.
Findings – Results showed that mixed syndication had a significant positive effect on the number of employees of investees but not on investees' sales and profit. PVC investment had a significant positive effect on investee sales but not on the transitional performance indicators of investees.
Originality/value – The study has two unique research contributions. First, it investigates the impact of syndicated investment on investees' transitional performance indicators in addition to performance indicators. Second, it focuses on Estonia, an emerging country that has somewhat achieved success in fostering information and communications technology startups and is one of the earliest emerging countries to implement a mixed syndication VC investment policy.

Keywords Mixed syndication between government and private venture capital, Private venture capital, Investment, Investee performance, Estonia, Emerging countries

Paper type Research paper

1. Introduction

Syndication refers to investments by two or more investors, which is a common phenomenon in the venture capital (VC) industry [1]. VCs can share their investment risk with syndication partners and leverage the broader range of knowledge and experience brought by the various partners (Gompers and Lerner, 2004; De Clercq and Dimov, 2004). Conversely, differences among syndication partners entail higher communication costs and longer coordination times (Lockett and Wright, 2001), leading to prolonged decision-making periods (Wright and Lockett, 2003).

Mixed syndication VC investment between government and private VC is a type of syndication investment jointly conducted by government VC (GVC) and private VC (PVC).

JEL Classification — E22, O16, P45

The work was supported by JSPS KAKENHI (Grant number JP18K01779). The author expresses gratitude to Dr. Meelis Kitsing, the Rector and Professor of Political Economy at the Estonian Business School, for providing valuable information and suggestions.

Disclosure statement: The author has no competing interests to declare.

Journal of Asian Business and Economic Studies
Vol. 30 No. 1, 2023
pp. 49-66
Emerald Publishing Limited
2515-964X
DOI 10.1108/JABES-01-2022-0003

This type of syndication can be challenging because there are larger differences between the government and private sector compared to syndication among private sector firms (Zhang, 2018). Moreover, while GVCs and PVCs can complement each other by drawing on their different strengths, the communication and management costs required to overcome the differences are high for both parties (Zhang, 2018).

Although the topic of mixed syndication investment by GVCs and PVCs has been studied, sufficient research is lacking on the pathways by which the two types of VC can affect the performance of mixed syndication-backed investees (Engberg *et al.*, 2021). Moreover, most prior research on the impact of mixed syndication on the performance of investees has focused on developed countries, not on emerging ones. To address these gaps, this study analyzes the impacts of mixed syndication between GVCs and PVCs on the performance of their investees and compares it to that of PVCs in the context of Estonia. The study investigates the impact of syndicated investment on investees' transitional performance indicators (intangible assets, fixed assets, number of employees and liabilities) in addition to performance indicators (sales and profit). We focus on Estonia, an emerging country that has achieved a certain level of success in fostering information and communication technology (ICT) startups and is one of the earliest emerging countries to implement a mixed syndication VC investment policy.

Estonia transitioned from a communist economy to a capitalist one in the early 1990s. With this shift, the government implemented various measures to promote entrepreneurship, such as e-government, a strategy of using ICT to provide public services and support the ICT industry (Nauwelaers *et al.*, 2013; Kirihata, 2016a; Kitsing, 2019). This strategy has led to the rapid growth of ICT startups (Kirihata, 2016b; Kitsing, 2019; Owen and Mason, 2019). The Estonian Development Fund, which was established in 2006 and is fully funded by the Estonian government, is an important entrepreneurship policy (Kirihata, 2016a). According to the Estonian Development Fund Act, its purpose is to support the transformation of the Estonian economy from a communist economy to a capitalist economy and promote employment, exports, entrepreneurship and innovation (Kirihata, 2016a) [2]. Smart Cap, the first and only GVC in Estonia during the study period (2006–2015), was established under the Estonian Development Fund Scheme and is mandated to conduct all its investments in syndication with PVCs [3]. The purpose of this is to crowd-in PVCs and to encourage the expansion of the VC industry in Estonia [4]. Smart Cap established GVC funds (Early Fund I and II) and conducted mixed syndication investment in 18 seed and startup firms. Among these, 13 were first-round investments in their investees (Kirihata, 2016a).

This study focuses on the mixed syndication VC investment by Smart Cap, which was established relatively early compared to other emerging countries. This study focuses on Estonia because Smart Cap was mandated to conduct all its investments in syndication with PVCs, and it made no sole investment in GVCs. During the study period, the Estonian VC industry saw only PVC investments (both sole PVC investments and syndication investments among PVCs) and mixed syndication investments by GVCs and PVCs. Therefore, this study did not need to consider the factor of sole investment by GVCs, which is necessary in studies of other emerging economies. By choosing the case of Estonia, it is possible to analyze the characteristics of mixed syndication investments by GVCs and PVCs more clearly when compared to pure PVC investments.

The research questions of this study are as follows: first, what is the impact of Estonian mixed syndication VC investment on the transitional indicators (i.e. intangible assets, fixed assets, liabilities and number of employees) of investees compared to PVC investment alone? Second, does mixed syndication VC investment contribute to performance indicators, such as the sales and profit of their investees? By exploring these questions, this study aims to reveal the unique characteristics of mixed syndication in an emerging country.

While mixed syndication has been promoted in developed countries such as Europe, Japan, Singapore and New Zealand, only a few emerging countries—mainly in Eastern and Central Europe, including Estonia—have introduced mixed syndication (Kirihata, 2018; Karsai, 2018; Owen and Mason, 2019). As such, this study has useful implications for emerging countries, especially emerging Asian countries that have undergone economic development in recent years and aim to implement such policies.

2. Theoretical background

The American Research and Development Corporation (ARDC), the world's first organized VC established in 1946, aimed to generate new industries by supplying capital to entrepreneurs to commercialize innovative technology created by Boston area universities (Jacobs, 1969; Bygrave and Timmons, 1992), the purpose of which was similar to that of many existing GVCs. In the earliest days of the VC industry, VCs such as the ARDC invested in and became actively involved in startups (Gorman and Sahlman, 1989; Manigart *et al.*, 2002).

VCs have had a positive impact on the performance, employment and innovation of their investees (Jain and Kini, 1995; Tang and Yi, 2008; Bertoni *et al.*, 2011; Chemmanur *et al.*, 2011; Arvanitis and Stucki, 2014; Colombo *et al.*, 2016; Kelly and Kim, 2018) [5]. Improving the performance of VC investees means improving the return on investment for VCs. Based on this positive cycle, VCs developed a unique investment style – one in which investors consider themselves to be on "the same boat" with their investees (Bygrave and Timmons, 1992).

This unique style of VC investment contributes not only at the micro-level, as mentioned above, but also at the macro-level. According to Chan (1983), when all investors have higher search costs, entrepreneurs are induced to offer inferior projects. Therefore, investors will avoid entering the VC market and instead put their funds into safer investment sectors, leading to an undesirable allocation of resources in society. VCs, as financial intermediators, alleviate the problem of information asymmetry between investors and entrepreneurs by getting on the same boat with their investees, resulting in greater overall social and economic welfare (Gompers and Lerner, 2001; Baum and Silverman, 2004).

Because VCs function at both the micro- and macro-levels, governments have fostered the VC industry as a policy measure to support innovative startups. One such policy measure is the establishment of GVCs. As VCs have expanded and shifted their investment to later-stage firms, the financial gap for early-stage firms has become more serious. This has led to an increase in the number of GVCs investing in startups. In recent years, GVCs' share of total VC investment in Europe has increased to 20% (Invest Europe, 2020).

The most distinctive feature of GVCs is that their investment objective is not only to maximize their investment returns but also to promote the economy, employment and innovation at the national and regional levels (Lerner, 2009). These objectives have shaped the unique characteristics of GVC investments. Because of their distinctive preinvestment activities, GVCs invest in a restricted geographical area, as well as in early stage and high-tech firms, typically university spin-offs (Murray, 1998; Pintado *et al.*, 2007; Cumming, 2007; Cumming and Johan, 2009; Mason and Pierrakis, 2013; Lim and Kim, 2015) [6]. Regarding postinvestment activities, GVCs tend to hold their shares and maintain a consistent investment stance over a long period (Buzzacchi *et al.*, 2013; Leleux and Surlemont, 2003; Bertoni *et al.*, 2015) [7]. Further, GVCs do not hastily require their investees to achieve an IPO (initial public offering) (Jeng and Wells, 2000), [8] and they tend to involve themselves less with their investees than PVCs (Knockaert *et al.*, 2006; Bottazzi *et al.*, 2008; Luukkonen *et al.*, 2013) [9].

Many prior studies comparing the contributions of GVCs against PVCs have shown relatively negative results. Thus, the purpose of establishing a mixed syndication between GVCs and PVCs is to compensate for the limitations of GVCs in terms of contributing to the

performance of their investees by including the business-oriented investment style of PVCs (Lerner, 2009; Bertoni and Tykvová, 2015) [10]. Prior studies indicate that GVC involvement in investees has a negative impact, or at least no positive impact, on investee exits (Tykvová and Walz, 2007; Cumming and Johan, 2009, 2010; Munari and Toschi, 2015; Munari *et al.*, 2015), employment (Standaert and Manigart, 2018), productivity (Alperovych *et al.*, 2015) and patents (Pierrakis and Saridakis, 2017). Conversely, some studies report that GVC involvement positively impacts the employment, reputation, long-term debt financing, innovation and patents of their investees (Lerner, 2000; Cumming, 2007; Toole and Czarnitzki, 2007; Link and Scott, 2010; Meuleman and De Maeseneire, 2012; Guerini and Quas, 2016; Colombo *et al.*, 2016).

While academic research on the impact of mixed syndication between GVCs and PVCs on their investees is limited, recent research has shown the positive effects of PVC-led mixed syndication with the complimentary involvement of GVCs. As for the impact of mixed syndication investment on the performance of investees, there was a positive relationship between mixed syndication and the exit and financing of their investees (Brander *et al.*, 2015). Mixed syndication had a positive impact on the sales of their investees, although GVCs alone had no significant positive impact on them (Grilli and Murtinu, 2015). The exit rate of mixed syndication-backed firms seemed to be higher than that of PVC-backed firms, but not at a significant level (Cumming *et al.*, 2017). Regarding the role of GVCs and PVCs in mixed syndication, PVC-led mixed syndication had a significant positive impact on the sales of their investees (Grilli and Murtinu, 2014). GVCs played a complementary role to PVCs in mixed syndication schemes to promote invention and innovation by their investees, although they alone had no impact (Bertoni and Tykvová, 2015).

However, as discussed in the Introduction, most prior research on the impact of mixed syndication on the performance of investees has focused on developed countries rather than emerging ones. Additionally, there is a lack of research on transitional performance indicators that lead to investee performance (Engberg *et al.*, 2021). To address these gaps, this study compares the impact of mixed syndication on intangible assets, fixed assets, liabilities and number of employees to that of PVC investment in Estonia. It also examines the impact of mixed syndication on investee performance indicators.

3. Data and variables

3.1 Data

The dataset used in this study contains information on the performance of all unlisted firms and PVC and GVC funding in Estonia. All performance data on unlisted firms in Estonia were obtained from the business registry of the Estonian Ministry of Economic Affairs and Communications. The dataset consists of yearly data from 2006 to 2015 for more than 187,000 unlisted firms registered in the Estonian business registry. Data on PVC and GVC funding were obtained from multiple sources: the Estonian Private Equity (PE) and Estonian VC Associations; the Estonian Business Angels Network and a database made by Startup Estonia, an affiliate organization of the Estonian Ministry of Economic Affairs and Communications. Individual PVCs, GVCs and their investees were contacted by phone and e-mail to verify the exact year of PVC investments and their investee's acceptance, after consolidating all the gathered data on PVC and GVC financing from these organizations.

The study focus is restricted to first-round PVC and GVC investments, and investments in the second or later fundraising rounds were excluded. Firms that have received PVC or GVC funding in their second or later rounds are more influenced by investors from earlier rounds as they hold a higher percentage of shares. By focusing only on first-round PVC and GVC funding, this study can fairly evaluate the effects of VCs and GVCs' involvement in their investee's performance.

3.2 Variables

The definitions of all the variables are explained in Table 1. The dependent variables in this study include sales, profit, intangible assets, fixed assets, number of employees and liabilities. Among these, this study defines sales and profit as performance indicators and intangible assets, fixed assets, number of employees and liabilities as transitional performance indicators.

The independent variables are dummy variables that indicate whether firms are the investees of mixed syndication or just PVCs. As already noted in Section 1, Smart Cap is mandated to conduct all its investments in syndication with PVCs, and there is no sole investment by Smart Cap in GVCs. Therefore, there is no need to consider the factor of sole investment by GVCs, which is necessary in studies of other emerging economies. In this study, PVC investment can be defined as all remaining PVC investments in Estonia that are not mixed syndication investments by GVCs and PVCs.

The control variables are age, assets, headquarters location and firm industrial dummies. Industry dummies are based on the Estonian Classification of Economic Activities, the Estonian equivalent to the Nomenclature of Economic Activities codes in the European Union (EU). The real gross domestic product (GDP) growth rate and the total amount of domestic PE investment in Estonia are also used in this study as control variables. The total amount of PE investment and real GDP growth rate are based on data from the Estonian Ministry of Economic Affairs and Communications.

Regarding the control variables, age, assets, headquarters location, industrial dummies and the real GDP growth rate are considered to be factors that influence the dependent variables of sales, profits, intangible assets, fixed assets, number of employees and liabilities, while the total amount of PE investment is considered to be a factor that influences the independent variable of PVC investment and mixed syndication investment dummy. These factors were considered in the selection of the control variables.

In this study, the natural logarithms are taken for all continuous variables, including sales, profit, intangible assets, fixed assets, number of employees, liabilities, age, assets and the total amount of domestic PE investment after considerable adjustment in inflation [11]. This is due to the skewed distribution of the valuation numbers and the appropriateness of this technique for dealing with nonlinearities in the relationship between the dependent and independent variables. It also reduces the impact of outliers (Armstrong *et al.*, 2006; Colleweart and Manigart, 2016).

Table 2 shows the yearly distribution of PVC and GVC investments over the 2006–2015 period. The number of mixed syndications, shown in Table 2, has remained zero since 2011. Mixed syndication investments have been conducted since 2011; however, all of them are excluded from this research because they are not first-round investments for their investees. Among the PVCs, the highest was 8 in 2012. Tables 3–5 show the distribution of the PVC-backed firms and mixed syndication-backed firms and all the other unlisted firms by industry (Table 3), headquarters location (Table 4) and year of establishment (Table 5). As illustrated in Table 3, both mixed syndication-backed firms and PVC-backed firms are concentrated in the ICT industry. Regarding the location of the headquarters, 75% or more of both mixed syndication-backed firms and PVC-backed firms are concentrated in the northern capital city area in Estonia, which is higher than all the other unlisted firms (Table 4). The year of establishment of the mixed syndication-backed firms are concentrated in the latter half of the 2000s, while those of PVC-backed firms are distributed from the first half of the 2000s to the first half of the 2010s (Table 5).

4. Materials and methods

This study first conducts a panel data regression analysis on the impact of mixed syndication and PVC investment on the sales and profit as performance indicators of their investees.

Dependent variables	
ln_sales	Natural logarithm of sales in a firm in a year after adjusting for inflation
ln_profit	Natural logarithm of profit before taxation in a firm in a year after adjusting for inflation
ln_intangible_assets	Natural logarithm of intangible assets in a firm in a year after adjusting for inflation
ln_fixed_assets	Natural logarithm of fixed assets in a firm in a year after adjusting for inflation
ln_employees	Natural logarithm of number of employees in a firm in a year
ln_liabilities	Natural logarithm of liabilities in a firm in a year after adjusting for inflation
Independent variables	
Mixed syndication	Dummy variable set to 1 when firms accept the mixed syndication between GVCs and PVCs investment in the first round (and zero otherwise)
PVC	Dummy variable set to 1 when firms accept all remaining PVC investments that are not mixed syndication investments in the first round (and zero otherwise)
Control variables	
ln_age	Natural logarithm of age of a firm in a year
ln_asset	Natural logarithm of number of assets in a firm in a year after adjusting for inflation
North	A dummy variable equal to 1 if a firm's headquarters is in the northern capital city area in Estonia in a year (and zero otherwise)
ln_real GDP growth rate	Natural logarithm of real GDP growth rate in a year
ln_total domestic PE investment	Natural total domestic PE investment in a year after adjusting for inflation (base year 2015)
Agriculture, forestry and mining	A dummy variable equal to 1 if a firm's industry is agriculture, forestry, mining in a year (and zero otherwise)
Arts, entertainment	A dummy variable equal to 1 if a firm's industry is arts, entertainment in a year (and zero otherwise)
Construction	A dummy variable equal to 1 if a firm's industry is construction in a year (and zero otherwise)
Education	A dummy variable equal to 1 if a firm's industry is education in a year (and zero otherwise)
Electricity, gas and water supply	A dummy variable equal to 1 if a firm's industry is electricity, gas, water supply in a year (and zero otherwise)
Finance and insurance	A dummy variable equal to 1 if a firm's industry is finance and insurance in a year (and zero otherwise)
Health and social work	A dummy variable equal to 1 if a firm's industry is health and social work in a year (and zero otherwise)
Hotels and restaurants	A dummy variable equal to 1 if a firm's industry is hotels, restaurants in a year (and zero otherwise)
ICT	A dummy variable equal to 1 if a firm's industry is ICT in a year (and zero otherwise)
Liberal professions	A dummy variable equal to 1 if a firm's industry is liberal professions in a year (and zero otherwise)
Manufacturing	A dummy variable equal to 1 if a firm's industry is manufacturing in a year (and zero otherwise)
Other services	A dummy variable equal to 1 if a firm's industry is other services in a year (and zero otherwise)
Public administration	A dummy variable equal to 1 if a firm's industry is public administration in a year (and zero otherwise)
Real estate	A dummy variable equal to 1 if a firm's industry is real estate in a year (and zero otherwise)
Transportation	A dummy variable equal to 1 if a firm's industry is transportation in a year (and zero otherwise)
Wholesale	A dummy variable equal to 1 if a firm's industry is wholesale in a year (and zero otherwise)

Table 1.
Variable definitions

	Mixed syndication investments	%	PVC investments	%
2006	0	0.00	2	4.17
2007	1	7.69	2	6.25
2008	4	30.77	1	10.42
2009	3	23.08	4	14.58
2010	4	30.77	2	12.50
2011	1	7.69	6	14.58
2012	0	0.00	8	16.67
2013	0	0.00	2	4.17
2014	0	0.00	3	6.25
2015	0	0.00	5	10.42
Total	13	100.00	35	100.00

Table 2. Yearly distribution of mixed syndication and PVC investments

	Mixed syndication-backed firms		PVC-backed firms		All the other unlisted firms	
	No	%	No	%	No	%
Agriculture, forestry and mining	0	0.00	0	0.00	13,003	6.98
Arts and entertainment	0	0.00	0	0.00	8,569	4.60
Construction	0	0.00	0	0.00	18,815	10.09
Education	0	0.00	0	0.00	3,190	1.71
Electricity, gas and water supply	0	0.00	0	0.00	1,002	0.54
Finance and insurance	0	0.00	2	5.71	6,273	3.37
Health and social work	0	0.00	0	0.00	2,981	1.60
Hotels and restaurants	0	0.00	0	0.00	4,451	2.39
ICT	6	46.15	23	65.71	7,947	4.26
Liberal professions	4	30.77	3	8.57	21,800	11.70
Manufacturing	3	23.08	5	14.29	10,557	5.66
Other services	0	0.00	1	2.86	23,318	12.51
Public administration	0	0.00	0	0.00	126	0.07
Real estate	0	0.00	0	0.00	24,536	13.16
Transportation	0	0.00	0	0.00	7,941	4.26
Wholesale	0	0.00	1	2.86	31,877	17.10
Total	13	100	35	100	186,386	100.00

Table 3. Industry comparison

	Mixed syndication-backed firms		PVC-backed firms		All the other unlisted firms	
	No	%	No	%	No	%
Northern capital city area (north)	10	76.92	26	75.29	71,495	38.23
Other	3	23.08	9	25.71	115,483	61.77
Total	13	100.00	35	100.00	186,978	100.00

Table 4. Distribution of Estonian unlisted firms by headquarter location

In this analysis, the independent variables are the mixed syndication and PVC dummies. The dependent variables are sales and profit. The control variables are age, assets, the headquarters location dummy (north), industry dummies (finance and insurance, ICT, liberal professions, manufacturing, other services and wholesale), real GDP growth rate and total domestic PE investment.

To address the endogeneity issues associated with the simultaneity of the dependent variables with the independent and control variables, the independent variable and control variables are lagged by one year. The total domestic PE investment is lagged by two years to deal with the endogeneity issues between the mixed syndication and PVC dummies. The performance indicator model in this study is based on Equation (1):

$$\begin{aligned}\text{ln\_sales}(\text{ln\_profit})_{i,t} &= \beta_0 + \beta_1 \text{Msynd}(\text{PVC})_{i,t-1} + \beta_2 \text{ln\_age}_{i,t-1} + \beta_3 \text{ln\_assets}_{i,t-1} \\ &+ \beta_4 \text{ln\_rgdp}_{i,t-1} + \beta_5 \text{ln\_pe}_{i,t-2} + \beta_6 \text{North}_{i,t-1} + \beta_7 \text{Fin}_{i,t-1} + \beta_8 \text{ICT}_{i,t-1} + \beta_9 \text{Pro}_{i,t-1} \\ &+ \beta_{10} \text{Man}_{i,t-1} + + \beta_{11} \text{O\_S}_{i,t-1} + \beta_{12} \text{Who}_{i,t-1} + U_{i,t}\end{aligned} \quad (1)$$

where ln_sales is the logarithm of sales. ln_profit is the logarithm of profit. Msynd is a mixed syndication dummy. PVC is a PVC dummy. ln_age is the logarithm of age. ln_assets is the logarithm of assets. ln_rgdp is the logarithm of real GDP growth rate. ln_pe is the logarithm of the total domestic PE investments. North is the dummy for the northern capital city area. Fin is a financial and insurance dummy. ICT is the ICT dummy. Pro is a liberal professions dummy variable. Man is a manufacturing dummy variable. O_S is a dummy variable for other services. Who is the wholesale dummy. U is the error term.

Second, in this study, panel data regression analysis is conducted with mixed syndication and PVC investment as independent variables and intangible assets, fixed assets, the number of employees and liabilities as dependent variables. The transitional performance indicator model in this study is based on estimation Equation (2): the only difference from the performance indicator model (1) is the dependent variables (intangible assets, fixed assets, number of employees and liabilities of the investees). The independent and control variables remain unchanged. Table 6 presents the descriptive statistics of all dependent variables, independent variables and control variables used in the panel data regression analysis.

$$\begin{aligned}&\text{ln\_intangible}(\text{ln\_fassets}, \text{ln\_}\textit{employees}, \text{ln\_liabilities})_{i,t} \\ &= \beta_0 + \beta_1 \text{Msynd}(\text{PVC})_{i,t-1} + \beta_2 \text{ln\_age}_{i,t-1} + \beta_3 \text{ln\_assets}_{i,t-1} + \beta_4 \text{ln\_rgdp}_{i,t-1} \\ &\quad + \beta_5 \text{ln\_pe}_{i,t-2} + \beta_6 \text{North}_{i,t-1} + \beta_7 \text{Fin}_{i,t-1} + \beta_8 \text{ICT}_{i,t-1} + \beta_9 \text{Pro}_{i,t-1} + \beta_{10} \text{Man}_{i,t-1} \\ &\quad + + \beta_{11} \text{O\_S}_{i,t-1} + \beta_{12} \text{Who}_{i,t-1} + U_{i,t}\end{aligned} \quad (2)$$

where ln_intangible denotes the logarithm of intangible assets. ln_fassets is the logarithm of fixed assets. ln_employees is the logarithm of the number of employees. ln_liabilities is the logarithm of liabilities.

Table 5. Distribution of Estonian unlisted firms by year of establishment

	Mixed syndication-backed firms		PVC-backed firms		All the other unlisted firms	
	No	%	No	%	No	%
Before 1990	0	0.00	0	0.00	1,476	0.79
1991–1995	0	0.00	0	0.00	17,931	9.59
1996–2000	0	0.00	1	2.08	27,322	14.61
2001–2005	1	7.69	6	14.58	39,976	21.38
2006–2010	12	92.31	10	45.83	63,061	33.73
2011–2015	0	0.00	18	37.50	37,212	19.90
Total	13	100.00	35	100.00	186,971	100.00

	Mean	SD	Min	Max
ln_sales	8.793	4.518	0.000	23.154
ln_profit	2.704	8.004	−18.283	20.668
ln_intangible assets	8.818	3.608	0.000	22.663
ln_fixed assets	9.014	3.706	0.000	21.810
ln_number of employees	0.539	0.980	0.000	11.472
ln_liabilities	6.823	3.949	0.000	18.504
Mix syndication	0.000	0.009	0.000	1.000
PVC	0.000	0.012	0.000	1.000
ln_age	1.625	0.964	0.000	3.584
ln_assets	10.243	2.527	0.000	22.875
North	0.455	0.498	0.000	1.000
Finance and insurance	0.031	0.172	0.000	1.000
ICT	0.044	0.204	0.000	1.000
Liberal professions	0.129	0.335	0.000	1.000
Manufacturing	0.061	0.240	0.000	1.000
Other services	0.106	0.308	0.000	1.000
Wholesale	0.171	0.377	0.000	1.000

Table 6.
Descriptive statistics

Since the panel data in this study span 10 years, it is assumed that both the effects of firm-specific factors that do not change with time and the effects of factors that change with time are included. To examine the extent to which these effects are included in the models, this study first conducted panel data analysis using the pooled regression model, fixed effects model and random effects model and then tested these results using the *F*-test and the Hausmann test. Both the performance indicator Model (1) and transitional performance indicator Model (2) rejected the pooled regression analysis and random effects models. Both adopted the fixed effects model. In this study, both the performance indicator Model (1) and transitional performance indicator Model (2) were analyzed using the fixed effects model.

5. Results

Tables 7 and 8 illustrate the results of the panel data regression analysis using the fixed effects model. Regarding the performance indicator Model (1), this study confirmed PVC investment had a significant positive effect ($p < 0.1$) on the sales of their investees. PVC investment had a slightly negative effect on investee profits, but the effect was not significant. The mixed syndication investment had a negative, but not significant, effect on both the sales and profits of their investees (Table 7).

Regarding the transitional performance indicator Model (2), this study confirmed the mixed syndication investment had a significant positive effect ($p < 0.01$) on the number of employees of their investees. The mixed syndication had a slightly positive, but not significant, effect on intangible assets, fixed assets and liabilities. The PVC investment had a somewhat positive, but not significant, effect on intangible assets, fixed assets, number of employees and liabilities (Table 8).

PVC investment in Estonia had a positive impact on sales, a performance indicator of investees, and mixed syndication investment had a positive impact on the number of employees. These results were significant even when considering the age ($t-1$), assets ($t-1$) and real GDP growth rate ($t-1$) of control variables, which are expected to affect the dependent variables of sales, profit, intangible assets, fixed assets, number of employees and liabilities, and the total domestic PE investment ($t-2$) of a control variable, which is expected to affect the independent variables of PVC and mixed syndication investment (Tables 7 and 8).

Table 7.
Effects of mixed syndication and PVC investment on the sales and profit of their investees

	Sales						Profit and loss					
	Coeff	SE	*t*	Coeff	SE	*t*	Coeff	SE	*t*	Coeff	SE	*t*
Mixed syndication (*t*−1)	−0.028	1.142	0.02	–	–	–	−4.789	3.498	1.37	–	–	–
PVC (*t*−1)	–	–	–	1.122	0.683	1.64*	–	–	–	−0.893	2.232	0.40
ln_age (*t*−1)	−0.320	0.007	43.48***	−0.320	0.007	43.49***	0.536	0.025	21.50***	0.536	0.025	21.49***
ln_asset (*t*−1)	0.665	0.004	169.94***	0.664	0.004	169.94***	−0.863	0.013	65.50***	−0.863	0.013	65.51***
ln_real GDP growth rate (*t*−1)	0.009	0.002	4.18***	0.008	0.002	4.18***	0.250	0.007	36.73***	0.250	0.007	36.74***
ln_total domestic PE investment (*t*−2)	−0.016	0.006	25.77***	−0.015	0.006	25.77***	−0.115	0.002	55.40***	−0.115	0.002	55.40***
Constant	2.867	0.042	67.83***	2.868	0.042	67.84***	12.769	0.144	88.37***	12.770	0.145	88.38***
North dummy and industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		612,468			612,468			588,913			588,913	
F-test (*p*-value)		0.00			0.00			0.00			0.00	
Houseman test (*p*-value)		0.00			0.00			0.00			0.00	

Note(s): 1: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Fixed effects models were selected using the *F*-test and Hausmann test
Independent variables lagged by one or two years in consideration of simultaneity

Table 8. Effects of mixed syndication and PVC investment on the investees' intangible assets, fixed assets, liabilities and number of employees

	Intangible assets						Fixed asset					
	Coeff	SE	*t*	Coeff	SE	*t*	Coeff	SE	*t*	Coeff	SE	*t*
Mixed syndication ($t-1$)	0.816	1.437	0.57	–	–	–	1.075	0.921	1.17	–	–	–
PVC ($t-1$)	–	–	–	0.782	1.379	0.57	–	–	–	0.190	0.633	0.30
ln_age ($t-1$)	−1.566	0.038	41.48***	−1.577	0.038	41.48***	−0.642	0.007	83.51***	−0.642	0.008	83.51***
ln_asset ($t-1$)	0.330	0.020	16.88***	0.333	0.020	16.88***	0.741	0.004	172.46***	0.741	0.004	172.48***
ln_real GDP growth rate ($t-1$)	−0.196	0.009	22.35***	−0.196	0.008	22.35***	−0.015	0.002	7.41***	−0.015	0.002	7.41***
ln_total domestic PE investment ($t-2$)	−0.016	0.003	5.40***	−0.016	0.003	5.41***	−0.016	0.001	26.54***	−0.016	0.006	26.54***
Constant	6.133	0.225	27.23***	6.132	0.225	27.23***	2.353	0.048	48.67***	2.352	0.048	48.66***
North dummy and industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		92,015			92,015			481,062			481,062	
F- test (*p*-value)		0.00			0.00			0.00			0.00	
Houseman test (*p*-value)		0.00			0.00			0.00			0.00	

	Number of employees						Liabilities					
	Coeff	SE	*t*	Coeff	SE	*t*	Coeff	SE	*t*	Coeff	SE	*t*
Mixed syndication ($t-1$)	0.791	0.203	3.89***	–	–	–	0.112	0.814	0.14	–	–	–
PVC ($t-1$)	–	–	–	0.070	0.121	0.58	–	–	–	0.410	0.531	0.77
ln_age ($t-1$)	−0.017	0.001	12.83***	−0.017	0.001	12.82***	−0.317	0.006	49.16***	−0.317	0.006	49.16***
ln_asset ($t-1$)	0.090	0.007	130.23***	0.090	0.001	130.25***	0.549	0.003	164.77***	0.549	0.003	164.77***
ln_real GDP growth rate ($t-1$)	0.006	0.004	16.64***	0.006	0.000	16.64***	−0.011	0.002	6.86***	−0.011	0.002	6.86***
ln_total domestic PE investment ($t-2$)	−0.007	0.000	59.75***	−0.007	0.000	59.76***	−0.015	0.005	29.74***	−0.015	0.001	29.74***
Constant	−0.197	0.008	26.26***	−0.198	0.008	26.28***	3.888	0.037	105.03***	3.888	0.037	105.03***
Industries and North dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		598,112			598,112			525,365			525,365	
F- test (*p*-value)		0.00			0.00			0.00			0.00	
Houseman test (*p*-value)		0.00			0.00			0.00			0.00	

Note(s): 1: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$
2: Fixed effects models were selected using the *F*-test and Hausmann test
3: Independent variables lagged by one or two years in consideration of simultaneity

6. Conclusion

6.1 Conclusions and implications

This study compared the impact of mixed syndication on transitional performance indicators—intangible assets, fixed assets, number of employees and liabilities—with that of PVC investment in Estonia. It also examined the impact of mixed syndication on performance indicators—sales and profits—of their investees.

Mixed syndication had a significant positive effect on the investee's number of employees, a transitional performance indicator; however, it did not have a significant effect on sales and profit, the performance indicators of their investees. The results also showed that PVC investment had a positive effect on sales, a performance indicator of their investees, but did not have a significant effect on intangible assets, fixed assets, number of employees and liabilities.

These results in the context of Estonia imply that the difference between mixed syndication and PVC investment, in terms of the sales growth performance indicators, presents a challenge to mixed syndication schemes from the perspective of private investment businesses. The difference between mixed syndication and PVC investment in terms of the employment growth transitional performance indicator might be a result of the influence of government on mixed syndication investment.

The Estonian Development Fund Act states that the Estonian Development Fund aims to support the transformation of the Estonian economy, from a communist to a capitalist economy, and to promote employment, exports, entrepreneurship and innovation. These findings imply that the difficulty of mixed syndication schemes is in determining how to ensure that GVCs, which have political purposes such as employment, export growth and promotion of innovation, can work harmoniously with investees to build cooperation and realize sales and profit growth, which is a positive cycle that satisfies not only investees but also syndication partners.

6.2 Limitations and future research

This study revealed that mixed syndication had a positive effect only on one transitional performance indicator, the number of employees and not on either of the performance indicators (sales or profit). From the comparison, it is inferred that this is caused by the government's influence on mixed syndication investment. However, why did the employment growth of mixed syndication-backed firms not contribute to the growth of sales and profits? The reasons for this discrepancy and the processes behind it have not been completely clarified in this study. Is it from the communication cost that comes from the different characteristics of GVCs and PVCs? Is this because of conflict between GVCs and PVCs, or is it because of both costs and conflicts that they could not make appropriate decisions (Zhang, 2018)? This study could not entirely answer these questions. Empirical research on decision-making and management processes in mixed syndication is difficult because of the sensitive nature of the issues involved; however, it is a promising research theme for the future.

Second, this study focused only on first-round investments by mixed syndication and PVCs to discuss the impact of mixed syndication on their investee's performance in the context of Estonia. Consequently, the sample number of mixed syndication investments in the first round decreased to 13 and that of the PVCs decreased to 35. In previous studies focusing on GVCs in emerging countries with relatively small economies, case studies are the dominant research methods. Even in the few existing empirical studies, the sample size issue is one of the main impediments. It would be recommended to build better research methods, such as crossing national boundaries, to examine investments in several emerging countries to gain a larger sample size.

The third issue is statistical analysis. Variables between VC investments and the performance of their investees, such as sales and profit, are likely to be linked simultaneously.

This study deliberated on the issue of endogeneity as much as possible by adopting multiple methods. The fixed effects model is used in this study considering that endogeneity can occur as a result of time-invariant firm-specific factors. This study also dealt with the endogeneity issues caused by time-variable factors by taking one- or two-year lags between the dependent and independent variables. However, this study could not adopt the instrumental variables method because it could not find appropriate instrumental variables. This remains a challenge for the future.

Finally, this study focused on mixed syndication investment; however, in recent years, governments around the world have introduced new GVC schemes. The first is the "hybrid fund" scheme funded by both the government and private sector. Another is a "fund of funds" scheme, which consists of both government and private sector funds that invests in PVC funds and does not directly invest in entrepreneurial firms (Colombo *et al.*, 2016; Kirihata, 2017). Research on these types of GVC investment has just begun (Standeart and Manigart, 2018; Zhang, 2018; Owen *et al.*, 2019). The impact of GVC schemes on economies in emerging countries, especially emerging Asian countries that have undergone economic development in recent years, is significant. Thus, further research is necessary in the context of emerging Asian countries.

Notes

1. Through a syndication scheme, investees can raise more money than they would be able to on their own (De Maeseneire and Van Halder, 2010).
2. The preparation for the establishment of the Estonian Development Fund started in 2002 (Kirihata, 2016a). Since the IT bubble burst in the early 2000s, investors have preferred more risk-free investments, thus increasing the financial gap for start-ups in Europe (Mason and Harrison, 1995; Block and Sandner, 2009). The Estonian Parliament discussed the possibility of expanding research and development grants and loans, but concluded that it would be difficult to close the financial gap through an increase in such measures. This resulted in the establishment of the Estonian Development Fund (Lange *et al.*,2004; Kelder and Viimsalu, 2009).
3. There are three main categories of GVC schemes: (1) direct government funds that are fully funded by the government and managed by a government entity, (2) hybrid funds that are funded by both government and the private sector and (3) a "fund of funds" that invests in PVC funds and not directly in entrepreneurial firms. In the third scheme, the role of GVCs is limited to the provision of funds (Colombo *et al.*, 2016; Kirihata, 2017).
4. Prior research found that GVC schemes have crowded-in PVCs (Cumming and Li, 2013; Brander *et al.*, 2015); however, other studies have shown the opposite or different results (Karsai, 2018; Leleux and Surlemont, 2003; Cumming and MacIntosh, 2006; Cumming and Johan, 2009; Cumming, 2014; Karsai, 2018). Among the positive findings, prior research has shown that the establishment of GVCs has led to the development of the VC industry (Avnimelech and Teubal, 2004; Avnimelech and Teubal, 2006; del-Palacio *et al.*, 2012; Wonglimpiyarat, 2016) or partially contributed to it (Avots *et al.*, 2013; Lim and Kim, 2015; Baldock, 2016; Owen and Mason, 2017).
5. Not all prior research has confirmed the positive relationship between VC investment and the performance of their investees (Engel and Keilbach, 2007; Puri and Zarutskie, 2012; Hoenen *et al.*, 2014; Lahr and Mina, 2016).
6. Some GVCs have invested in low-tech firms in mature industries (Dahlstrand and Cetindamar, 2000).
7. In the case of Canadian GVCs, the abolishment of government tax incentives significantly changed their investment stance (Johan *et al.*, 2014).
8. Some GVCs have focused on investment in firms that were about to exit (Cumming and Johan, 2010).
9. Some GVCs in Australia have been closely involved in their investees (Cumming and Johan, 2009; Cumming, 2007).

10. For investees, GVC investments have the effect of being endorsed by the government (Guerini and Quas, 2016; Minola *et al.*, 2017).

11. The inflation adjustment in this study is based on the GDP deflator in Estonia using 2015 as the base year.

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