Does geographic distance to the premises of the venture capitalist affect the performance of investee firms?

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ABSTRACT

There is consensus in the literature about the positive impact of venture capital (VC) on the performance of VC-backed firms, across different dimensions. Many papers also highlight that at least part of it is explained by the non-financial value-adding services VC managers provide to portfolio companies. In this paper, we argue that geographic distance is a key aspect that affects the impact of these value-adding services on the performance of investee firms. We analyze the impact of geographic distance on performance on a large sample of Spanish VC-backed firms. We find that total assets growth is significantly greater in the case of portfolio firms backed by private venture capitalists that are closer to the investor's premises.

1. INTRODUCTION

There is ample empirical evidence of the positive impact of venture capital (VC, hereafter) involvement on the performance of their portfolio companies across different dimensions, such as innovation (Bertoni and Tykvová, 2015; Kortum and Lerner, 2000), dependency between investments and internal cash flow generation (Bertoni et al., 2013, 2010), employment and sales growth (e.g., Bertoni et al., 2011; Paglia and Harjoto, 2014), or productivity (Chemmanur et al., 2011; Croce et al., 2013). This positive effect derives from the joint effect of three different aspects of VC participation: screening, funding and post-investment value added (Quas et al., 2020).

Venture capitalists (VCs, hereafter) conduct a meticulous selection process before the investment decision, mostly focusing on the characteristics of the entrepreneur, first, and then on the attractiveness of the business plan (Macmillan et al., 1985). In this process, experienced VCs are able to select the most promising companies (Sørensen, 2007), which should naturally perform better than non-funded firms. In addition, VCs invest in SMEs highly affected by information asymmetries that significantly limit the access to external finance and constrain their growth (Carpenter and Petersen, 2002). The provision of funding to these firms reduces the dependency between their investment activity and internal cash flow (Bertoni et al., 2013), thus allowing them to grow. Finally, VCs provide a wide range of non-financial value-adding services to portfolio companies (Large and Muegge, 2008).

There is already literature highlighting the significant effect of non-financial value added on portfolio firm performance. Croce et al. (2013) focus on total factor productivity (TFP) to control for financial value added (i.e., funding). They argue that by resorting to TFP it is possible to control for the effect of funding because it computes the quotient between output (related to growth) and inputs (which considers investments carried out with the cash injection). Quas et al. (2020) go a step beyond by isolating the effect of non-financial from that of financial value added. They prove a significant effect of the former on the performance of portfolio firms.

Since non-financial value-adding services are crucial to enhance the performance of portfolio firms, we argue that geographical distance is an important variable for VCs. Sapienza (1992) suggests that the more frequent the interaction between investors and

investees, the greater the value added provided by VCs. In the same vein, Sorenson and Stuart (2001) affirm that spatial proximity between the VCs and invested firms facilitates the interchange of information, as well as monitoring and value-adding activities. Hence, a high distance between VCs and their portfolio companies may have a negative impact on performance.

The purpose of this work is to investigate whether geographical distance, measured in both kilometers and travel time between portfolio companies and their lead VCs, affects the performance of portfolio firms.

We focus on a large sample of Spanish venture-backed firms, composed of 1,035 companies, which received the first round between 2005 and 2013, tracing their evolution until 2018, whenever possible. We compared firm performance in the closest versus the most distant firms using a difference-in-differences (DD) methodology.

The rest of the manuscript is structured as follows. In section 2, we outline the theoretical background. In section 3, we describe the data and the methodology. In section 4, we show the empirical results. In section 5, we include the discussion and highlight our conclusions.

2. THEORETICAL BACKGROUND

2.1. Information asymmetries and venture capital

According to Akerlof (1970), the existence of imperfect, asymmetric information in financial markets gives raise to transaction costs and, ultimately, agency costs, which derive in the presence of adverse selection (hidden information) and moral hazard (hidden action) problems. Firm managers, who naturally have an inside perspective of the business, may have incentives not to share full information with others (e.g., potential investors). They may try to transmit a better picture of the firm as an artifice to mislead the decisions of potential investors, which should face the cost of verifying the information (Myers and Majluf, 1984; Stein, 2003).

Small and medium size enterprises (SMEs, hereafter) are highly affected by information asymmetries, giving rise to extreme adverse selection and moral hazard problems. According to OECD, they represent more than 95% of firms and 60-70% of the jobs, and stand as the biggest contributors to the gross domestic product (Robu, 2013). Due

to their flexibility, disruptiveness, innovativeness, and competitiveness, SMEs are considered as the backbone of any economy. But SMEs have difficult access to external finance because bank officials are not prepared to analyze their investment projects. This situation may undermine their growth prospects and future performance (Carpenter and Petersen, 2002). As a result, growth in most SMEs, especially younger and smaller ones, is basically supported by their internally generated cash flows (Berger and Udell, 1998).

VCs are better prepared than other financial intermediaries to cope with agency costs and asymmetrical information. VCs reduce information asymmetries by performing a detailed screening process, followed by tailor-made contracts and strict monitoring procedures (Amit et al., 1998; Weiss, 1991). Moreover, VCs do not condition their investment to the possession of collateral, which is not available in most new entrepreneurial businesses. The main goal of VCs is to build a portfolio of promising innovative companies, normally at initial stages of development. In addition to funding, they also provide valuable non-financial services to portfolio companies (Croce et al., 2013; Quas et al., 2020; Sapienza, 1992).

2.2. The impact of venture capital on portfolio firm performance

The existence of investors specialized in supporting innovative SMEs has a positive effect on the economy. There is a significant positive causal relationship between the presence of VC and employment growth (Belke et al., 2006). Hence, Belke et al. (2006) conclude that governments should facilitate the establishment of an institutional environment friendly to the flourishing of a healthy VC industry so that it can spur a virtuous cycle of entrepreneurial dynamism, innovation, and job creation. Croce et al. (2019) support this view. They compare the impact of both private and government-owned VCs on job creation during a period of economic crisis and under normal economic conditions. They find that private VC-backed firms do better during periods of crisis than those backed by government-backed entities. In periods under normal economic conditions, however, they find that the investments of government-backed VCs have a higher impact on employment growth, probably due to their tendency to focus on labor-intensive industries. Anyhow, VC activity has an overall positive effect on employment growth.

The existing evidence also supports the positive impact on sales growth (Bertoni et al., 2011; Paglia and Harjoto, 2014). Cooper et al. (1994) show that the amount of initial

capital is related to higher probabilities of survival and growth in new ventures having access to financial resources at early stages of development. Sales and employment growth implicitly support the view that VC helps relax the dependency of investments to internal cash flow generation in portfolio firms (Bertoni et al., 2013; Engel and Stiebale, 2014). In addition, VCs achieve the professionalization of the firm (Hellmann and Puri, 2002), enhance innovation (Bertoni and Tykvová, 2015; Kortum and Lerner, 2000) and, as a result, improve efficiency and productivity growth in investee firms (Chemmanur et al., 2011; Croce et al., 2013). Finally, Shane and Stuart (2002) find that start-ups receiving VC funding have more chances of undergoing an IPO. They also conclude that social capital endowments facilitate external funding and have long-term positive effects on the performance of new companies.

What explains this positive impact of VC involvement on the performance of investee firms? Since venture managers are specialized agents that look for promising entrepreneurial companies to invest in, they could be credited for being able to pick the winners. Consequently, the better performance of invested firms could be explained by this assumption. However, Croce et al. (2013) studied the impact of screening and post-investment value added on the better performance of VC-backed firms in Europe. They separate the impact of screening and value added by analyzing productivity growth of VC-backed firms before and after the initial VC round. They find that the value added provided by VCs has a positive impact on performance, beyond that of screening. In the same vein, Quas et al. (2020) isolate the effect of post-investment non-financial value added from that of funding, finding a significant effect of the former on the performance of VC-backed firms.

2.3. The non-financial value added and geographic distance

VCs take not only a fundamental role in the financing of SMEs but they also provide value-adding services in the form of experience, management advice, access to the network of contacts, coaching, and mentoring (Large and Muegge, 2008; Sørensen, 2007). Normally, value added comes in the form of periodic visits of investors to invested firms, reducing agency costs through monitoring; VCs managers help in defining strategic planning, management recruitment, and provide investee firms with an important network of financial and operational contacts (Sørensen, 2007).

In addition to screening, the provision of non-financial value-adding services has a significant impact on the performance of portfolio companies (Quas et al., 2020). There is a broad variety of studies about the effect of value added on performance. Macmillan et al. (1989) applied a questionnaire in which 350 VCs highlighted the important role played as board members in portfolio firms. Hellmann and Puri (2002) find that investors have an impact on the internal process of professionalization of the invested firms. VC-backed firms make greater use of business and professional contacts when recruiting personnel and are more likely to appoint an external CEO (Hellmann and Puri, 2002).

Furthermore, the mentoring and coaching of invested firms by VCs during the holding period may leave a long-lasting effect on the organization and operations of invested firms called the "imprinting" effect. In this way, the effect of the value-adding services provided persists over time, even after the exit of VC investors (Croce et al., 2013). In addition, Davila et al. (2003) mention a "reputation effect" that comes along with the funding event. VCs transmit a positive signal about the quality of a new venture, reducing the uncertainty of being associated with it. This aspect may be important when raising additional external financing. This good reputation may also play an important role in other aspects, such as attracting skilled managers and workers.

Some factors may affect the extent to which the VCs can provide value added to the invested firms. It does not depend only on VCs' willingness to provide value, but also on the desire of invested firm's managers to receive it. According to Sapienza et al. (1996), value added is greater in contexts of high uncertainty. The logic behind this stands in that the greater the uncertainty, the more willing the managers of invested firms will be to improve their decision-making process. Thereby, this implies that early-stage companies facing high levels of uncertainty are the ones that benefit more from value-adding services. Another factor that may affect VCs value added is the experience of venture managers. The invested firms would be more open to accepting advice coming from more experienced managers who have a better understanding of VC or its focal industry dynamics (Sapienza et al., 1996). Berglund et al. (2007) show that VCs general and industry-specific expertise is crucial in the experimentation and learning processes of new ventures.

The importance of the provision of diverse non-financial value-adding services highlights the need for a close contact between VC and investee firm managers. Then, an

additional factor that may affect VCs value added may be the geographic distance between the investor and the invested firm. According to Sorenson and Stuart (2001), spatial proximity between the VCs and invested firms facilitates the exchange of information, and thus the execution of the post-investment roles of the first, i.e., monitoring and other value-adding activities. Higher distances might decrease the value added provided by VCs, bringing negative effects to investees and resulting in worse performance. Sapienza (1992) finds that the more frequent the interaction between VCs and the managers of the invested firm, the greater the value of VC manager's involvement. In addition, the time spent traveling reduces the number of companies that an individual can monitor (Sorenson and Stuart, 2001). In this regard, Bernstein et al., (2016) report that new airplane connections reduce travel time to the VC-backed firm premises, leading to an increase in the number of patents and in the likelihood of an IPO or acquisition.

In sum, the value-adding services provided by VC managers have a major impact on the performance of invested firms. This non-financial support contributes to productivity growth, innovation, and the success of portfolio companies. Since geographical distance may reduce the VCs' ability to conduct a proper monitoring process and to provide other value-adding services, we argue that distant investee firms should show lower performance compared to that of VC-backed firms that are closer to the premises of the VC firm.

Furthermore, due to the broader independence when performing their activities, private VCs seem to have the capacity to better monitor their portfolio companies, providing higher value-adding services, especially in periods of economic recession (Croce et al., 2019). Private VCs also differ in the contractual organization, facing higher restrictions and pressure by their funders (limited partners), who require minimal financial returns (Alperovych et al., 2014). Bottazzi et al. (2008) show that private VCs show higher levels of activism when compared to government-owned VCs (i.e., private VCs are more involved in their portfolio companies), thus adding more value. Conversely, the impact of government-managed VCs on their investee firms is negligible (Grilli and Murtinu, 2014). As a result, geographical distance is especially relevant for privately-funded VCs.

3. DATA AND METHODOLOGY

3.1. Sample and data collection

According to the Spanish Venture Capital and Private Equity Association (ASCRI), 1,330 firms received the initial VC round in Spain between 2005 and 2013. We were able to find accounting data and the location for a large sample of 1,035 firms in ORBIS, which represents 77.8% of the population. Data on the VCs involved was obtained from Webcapitalriesgo, official provider of information to ASCRI. Regarding the current situation of our sample firms, 687 (66%) are active, whilst the rest are inactive due to several reasons, such as acquisition, dissolution, extinction, or liquidation.

The distance between invested companies and their respective (leading) VCs is computed in two ways: in kilometers and in time using the most effective transportation systems (car, bus, train or airplane) available. The distance and travel time were calculated using Google Maps. The process was carried out taking into account possible abnormalities that could affect the consistency of data collection, with the main one being the day of the week and the hour in which the travel time is calculated. Special care was taken to focus only on working days and to avoid rush hours in the data collection process. The time of displacement to airports was also considered. We always take the fastest route selected by Google Maps. Regarding means of public transportation, we prioritize train and underground, whenever available. For longer distances with access to an airport in the surroundings, we compute flight time considering direct connections, whenever available, also adding the travel time (by car or public transportation) spent from the airport to the premises of the portfolio firm. For longer distances, we also compare travel time between airplane and fast-train connections.

The sample consists of firms funded by both government-supported and privately-funded VCs. The sample was grouped into four categories, according to the distance and travel time between the investee firms and their respective (leading) VCs: 1) companies that are located within the first quartile of distance of the sample and the ones that belong to the fourth; 2) companies that are located within the first quartile of travel time of the sample and the ones that belong to the fourth; 3) companies that are located within the first and the second quartiles of distance of the sample and the ones that belong to the fourth; 4)

companies that are located within the first and the second quartiles of travel time of the sample and the ones that belong to the fourth. The idea behind this choice is to compare the closer and the more distant ones to verify the effects of distance and travel time on performance.

Table 1 shows the distribution by region and investor type. Panel A presents data related to first versus fourth quartile investee firms whereas Panel B shows the distribution of first plus second versus fourth quartile portfolio firms. In general, companies invested by government-sponsored VCs prevail in most regions, except for Madrid, Catalonia, and Valencian Community, where private VCs seem to lead most VC investments.

Table 1. Distribution of sample investee firms by region and type of investor

Panel A: First versus fourth quartile VC-backed firms

	Firms first vs. fourth quartile (kilometers)					Firms first vs. fourth quartile (minutes)				
Region	Public VCs	%	Private VCs	%	**Total sample**	Public VCs	%	Private VCs	%	**Total sample**
Andalucia	90	89.1%	11	10.9%	**101**	134	94.4%	8	5.6%	**142**
Aragon	19	79.2%	5	20.8%	**24**	16	76.2%	5	23.8%	**21**
Asturias	19	95.0%	1	5.0%	**20**	23	95.8%	1	4.2%	**24**
Baleares		0.0%	7	100.0%	**7**					**0**
Canarias		0.0%	2	100.0%	**2**		0.0%	2	100.0%	**2**
Cantabria	2	66.7%	1	33.3%	**3**	2	50.0%	2	50.0%	**4**
Castilla La Mancha	5	62.5%	3	37.5%	**8**	9	75.0%	3	25.0%	**12**
Castilla Leon		0.0%	4	100.0%	**4**	7	46.7%	8	53.3%	**15**
Cataluña	30	19.9%	121	80.1%	**151**	21	20.0%	84	80.0%	**105**
Comunidad Valenciana	4	11.8%	30	88.2%	**34**	3	14.3%	18	85.7%	**21**
Extremadura	13	92.9%	1	7.1%	**14**	14	93.3%	1	6.7%	**15**
Galicia	8	80.0%	2	20.0%	**10**	7	77.8%	2	22.2%	**9**
La Rioja	2	100.0%		0.0%	**2**	2	100.0%		0.0%	**2**
Madrid	18	18.8%	78	81.3%	**96**	14	16.1%	73	83.9%	**87**
Murcia	1	50.0%	1	50.0%	**2**	3	75.0%	1	25.0%	**4**
Navarra	21	72.4%	8	27.6%	**29**	25	80.6%	6	19.4%	**31**
Pais Vasco	18	69.2%	8	30.8%	**26**	22	84.6%	4	15.4%	**26**
Total	**250**	**46.9%**	**283**	**53.1%**	**533**	**302**	**58.1%**	**218**	**41.9%**	**520**

Panel B: First and second versus fourth quartile VC-backed firms

	Firms first and second vs. fourth quartile (kilometers)					Firms first and second vs. fourth quartile (minutes)				
Region	Public investors	%	Private investors	%	**Total sample**	Public investors	%	Private investors	%	**Total sample**
Andalucia	134	91.8%	12	8.2%	**146**	167	94.9%	9	5.1%	**176**
Aragon	29	82.9%	6	17.1%	**35**	31	83.8%	6	16.2%	**37**
Asturias	45	97.8%	1	2.2%	**46**	45	97.8%	1	2.2%	**46**
Baleares		0.0%	7	100.0%	**7**					**0**
Canarias		0.0%	2	100.0%	**2**		0.0%	2	100.0%	**2**
Cantabria	2	50.0%	2	50.0%	**4**	2	50.0%	2	50.0%	**4**
Castilla La Mancha	5	62.5%	3	37.5%	**8**	9	75.0%	3	25.0%	**12**
Castilla Leon	5	55.6%	4	44.4%	**9**	11	57.9%	8	42.1%	**19**
Cataluña	42	19.6%	172	80.4%	**214**	38	19.2%	160	80.8%	**198**
Comunidad Valenciana	4	9.8%	37	90.2%	**41**	3	10.7%	25	89.3%	**28**
Extremadura	15	93.8%	1	6.3%	**16**	17	94.4%	1	5.6%	**18**
Galicia	10	83.3%	2	16.7%	**12**	11	84.6%	2	15.4%	**13**
La Rioja	2	100.0%		0.0%	**2**	2	100.0%		0.0%	**2**
Madrid	33	25.2%	98	74.8%	**131**	27	22.1%	95	77.9%	**122**
Murcia	3	75.0%	1	25.0%	**4**	3	75.0%	1	25.0%	**4**
Navarra	29	76.3%	9	23.7%	**38**	29	80.6%	7	19.4%	**36**
Pais Vasco	54	87.1%	8	12.9%	**62**	56	93.3%	4	6.7%	**60**
Total	**412**	**53.0%**	**365**	**47.0%**	**777**	**451**	**58.0%**	**326**	**42.0%**	**777**

The numerical disparity between the total sample of first vs. fourth quartile in kilometers and distance is due to a methodological decision: the differentiation between quartiles was arranged based on rounded cut off points.

3.2. Empirical strategy and methodology

Our empirical approach aims to compare the performance of distant versus close investee firms using a difference-in-differences (DD, hereafter) methodology. The sample was divided into four groups to analyze the average effect of distance and travel time on the dependent variables. The main model is as follows:

$$Y_{i,t} = \alpha_0 + \alpha_1 VCinv_{i,t} + \alpha_2 Quartile_i + \alpha_3 VCinv_{i,t} Quartile_i + \eta_i + \varepsilon_{i,t}$$

The dependent variables are the logarithm plus 1 of gross revenues (*lnGrossRevenues*) and total assets (*lnAssets*) of investee firms. The independent variables are: (1) $VCinv_{i,t}$ is a dummy variable equal to 0 in the pre-investment period and 1 from the year of the initial VC round on, for each VC-backed firm i. (2) $Quartile_i$ is an unchanging dummy variable defining the distance or time quartile that corresponds to each investee firm *i*, according to the distance and travel time to its respective VCs.

In addition, the model also includes several control variables (η_i). *RegionVC* is a dummy variable equal to 1 if the firm is located in Madrid or Cataluña (i.e., VC cluster regions), or zero otherwise. *AgeComp* is the age of the company at the time of each observation. *LnKm* and *LnMin* represent the logarithm of the distance in kilometers and the travel time in minutes, respectively, from the lead VC's headquarters to the investee's premises. Sector and year dummies are also considered.

The sample was divided into four groups. Henceforth, the variable *Quartile* has a different value in each specification. In specifications 1 and 2, this variable is equal to 1 if the firm belongs to the first quartile (i.e., closer companies) of distance or travel time, and is equal to 0 if it belongs to the fourth (i.e., distant companies). In specifications 3 and 4, this variable is equal to 1 if the firm belongs to the first and second quartiles of distance or travel time and is equal to 0 if it belongs to the fourth.

The results of a Hausman test indicates that fixed effects is the best estimation procedure. Therefore, as the variable *Quartile* is unchangeable for each individual over time, its coefficient is not estimated in all specifications.

The coefficient of the interaction term *VCinvQuartile* is the DD estimator in our model. It measures the average effect of the distance or travel time of a firm to the premises of the respective (leading) VCs on the dependent variables.

We estimate four specifications for each dependent variable to test our hypotheses. *Model 1* compares firms located within the first quartile of distance from the VCs with the ones that belong to the fourth. *Model 2* compares firms located within the first quartile of travel time taken to reach the premises of the VCs with the ones that belong to the fourth. In addition, the short distance/time of first quartile investee firms justifies the consideration of the second quartile also as "close" firms. *Model 3* compares firms located within the first and the second quartiles of distance from the location of the VCs with the ones that belong to the fourth. *Model 4* compares firms located within the first and the second quartiles of travel time with the ones that belong to the fourth.

3.3.Descriptive statistics

In Table 2, we show the average values for our dependent variables for the whole sample (including firms that received funding from government-supported VCs) and only for firms that received funding from private VCs, respectively. The average values are calculated, for comparative purposes, for the year before the VC funding event (-1) and two years after this event (2). In each table, we show the results for each subcategory, according to the quartile they belong to, and the change between those two periods for the investees that are more distant and for those that are closer to the lead VCs. In all cases, the average values show significant growth after the funding event, both for gross revenues and assets. However, it is interesting to observe that, for firms funded by private VCs, growth was significantly higher for those that were closer to the VCs' premises when compared to the distant ones (Panel B), contrary to the overall results for the whole sample. This might suggest that private VCs are capable of providing higher value-adding services (Croce et al., 2019), as discussed in section 2.

Table 2. Average values and growth from one year before and two years after the VC investment

Panel A: All sample firms

	Average lnGrossRevenues					Average lnAssets				
Year since VC inv.	Fourth quartile	Avg. Growth	Closer quartiles	Avg. Growth	Sig.	Fourth quartile	Avg. Growth	Closer quartiles	Avg. Growth	Sig
	Fourth vs. first quartile (min)									
-1	5.126		4.565			7.032		6.380		
2	11.618	6.491	10.925	6.359		13.846	6.814	13.310	6.930	
	Fourth vs. first quartile (km)									
-1	5.586		5.267			7.556		6.841		
2	11.874	6.289	11.117	5.851		13.964	6.408	13.459	6.618	
	Fourth vs. first & second quartile (min)									
-1	4.912		5.504			7.032		7.154		
2	11.618	6.706	11.679	6.175		13.846	6.814	13.721	6.567	**
	Fourth vs. first & second quartile (km)									
-1	5.586		5.523			7.556		7.174		
2	11.874	6.289	11.656	6.133	**	13.964	6.408	13.708	6.534	***

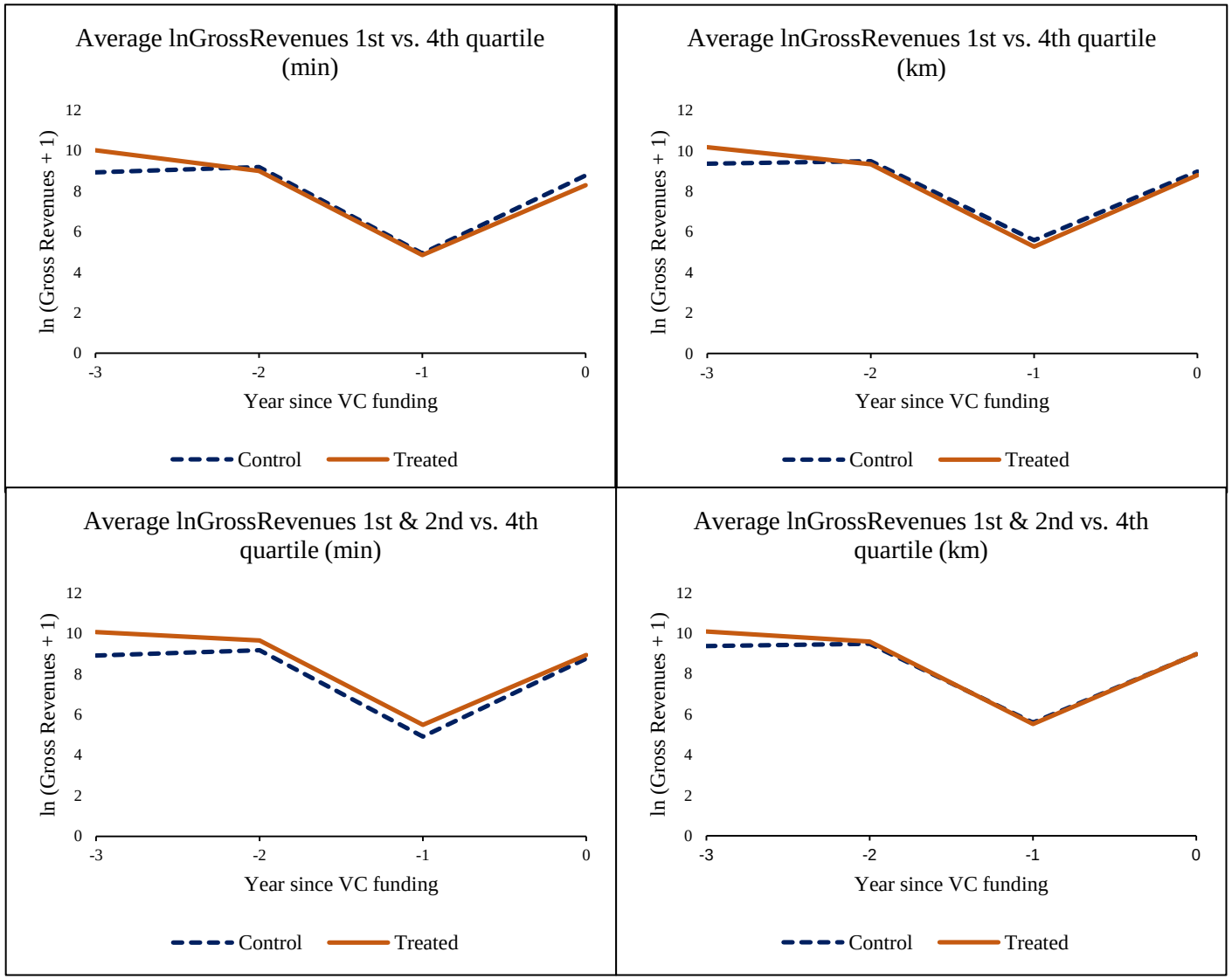
Panel B: Firms backed by private VC firms

	Average lnGrossRevenues					Average lnAssets				
Year since VC inv.	Fourth quartile	Avg. Growth	Closer quartiles	Avg. Growth	Sig.	Fourth quartile	Avg. Growth	Closer quartiles	Avg. Growth	Sig
	Fourth vs. first quartile (min)									
-1	6.529		4.575			8.540		6.582		
2	12.074	5.545	10.735	6.161	**	14.317	5.777	13.595	7.014	**
	Fourth vs. first quartile (km)									
-1	6.601		5.286			8.459		7.190		
2	12.281	5.680	11.091	5.805	**	14.339	5.881	13.692	6.502	*
	Fourth vs. first & second quartile (min)									
-1	6.529		5.389			8.540		7.114		
2	12.074	5.545	11.549	6.160		14.317	5.777	13.851	6.737	*
	Fourth vs. first & second quartile (km)									
-1	6.601		5.411			8.459		7.129		
2	12.281	5.680	11.545	6.134	*	14.339	5.881	13.845	6.716	*

Average values and growth for *lnGrossRevenues* and *lnAssets* in invested firms between years -1 and 2 since the VC funding event. The results are clustered by quartiles.
Significance: * p-value<10%, ** p-value<5%, *** p-value<1%.

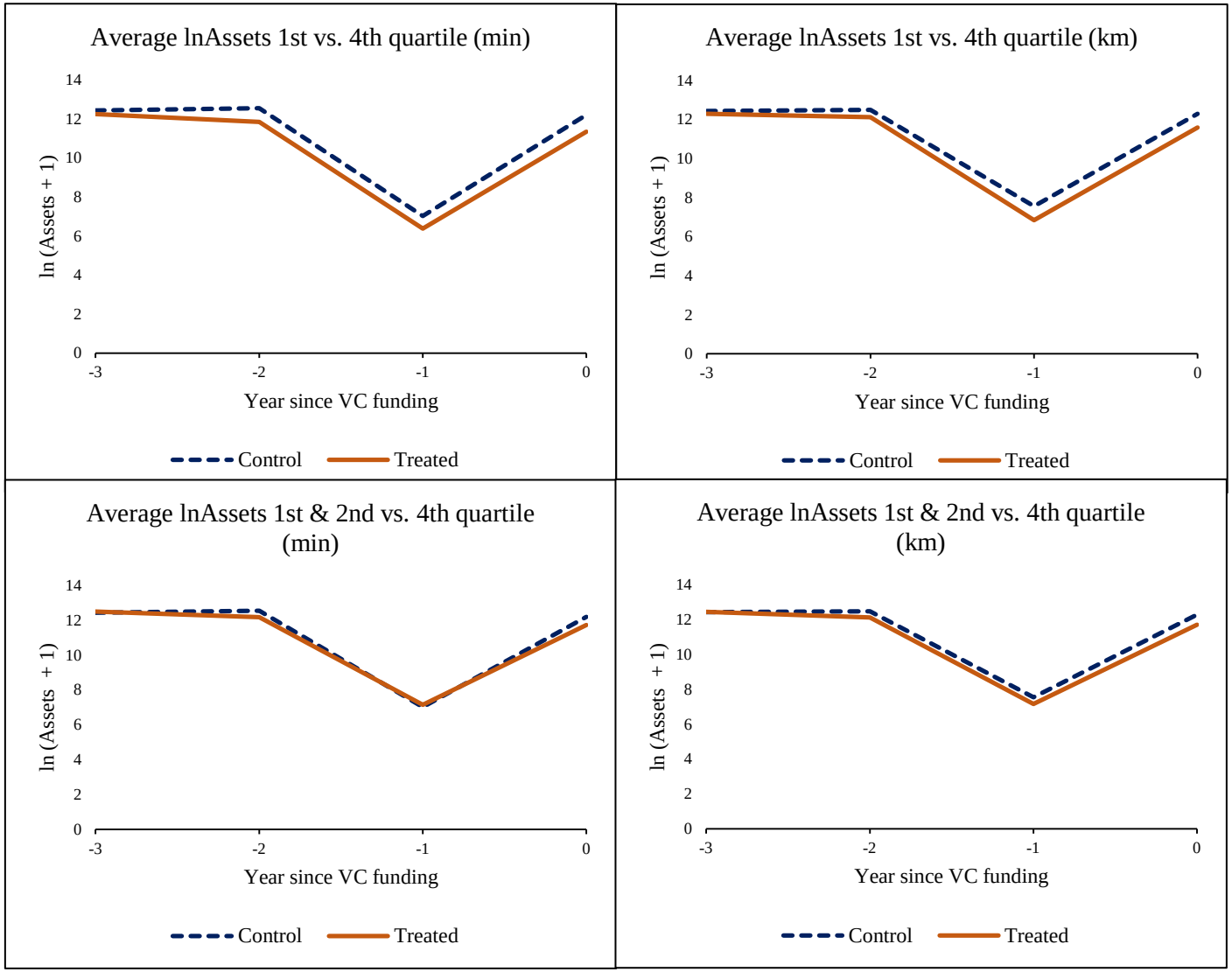
A crucial aspect of the DD methodology is the parallel trends assumption (Roberts and Whited, 2013; Wing et al., 2018). According to this assumption, the distant and closer firms (to the lead VCs) should show, on average, a similar trend before the VC funding event. The treated group consists of the closer firms receiving VC funding, while the control group consists of the distant firms receiving VC funding. Our main problem is that many of our sample firms were funded in the year of establishment or one year earlier (28.6%). Hence, the figures checking this parallel trends assumption are based on a subsample of firms for which the average values of the dependent variables are available for the 3 years before the VC funding event. Figures 1 and 2 show the differences for closer and distant firms, according to the four categories described earlier. With the limitation described, as both the control and treated groups show a similar trend before the VC funding, the parallel trends assumption is fulfilled.

Figure 1. Evolution of the average values for *lnGrossRevenues* before VC funding



Graphs show a parallel trend of *lnGrossRevenues* between control (most distant firms) and treated group (closest firms). On the vertical axis, we have the average value for *lnGrossRevenues*. On the horizontal axis, we report the years referring to the VC funding event; year 0 represents the moment when the VC investment occurred.

Figure 2. Evolution of the average values for *lnAssets* before VC funding



Graphs show a parallel trend of *lnAssets* between control (most distant firms) and treated group (closest firms). On the vertical axis, we have the average value for *lnAssets*. On the horizontal axis, we report the years referring to the VC funding event; year 0 represents the moment when the VC investment occurred.

4. RESULTS

In Table 3, we show the results of the regressions on the dependent variables for all firms, displayed across two panels: first versus fourth quartile in kilometers and in minutes (Panel A), and first plus second versus fourth quartile in kilometers and minutes (Panel B). In Table 4, we present the same structure in Panels A and B, respectively, but only for firms invested by private VCs.

For all specifications and dependent variables, the coefficient of *VCinv* is positive and significant (p-value<1%), thus confirming that VC involvement has a significant impact on the performance of investee firms.

Regarding the effect on gross revenues, the distance in kilometers is not significant in any specification. As regards the effect on assets, also the results of the interaction variable shown in columns two and four of Panels A and B of Table 3 (*lnAssets*) does not show any significant coefficient. However, the results in column three of Table 3 (*lnGrossRevenues*) report significant, but negative, coefficients, indicating that the most distant firms show better performance than the ones that are closer to the premises of the focal VCs. Therefore, for the whole sample (including both government-supported and private VC-backed firms), our results do not support the negative relationship between geographic distance and investee firm performance.

Nevertheless, since the quality and quantity of value added provided by government-backed VCs is challenged in the literature (Alperovych et al., 2015; Bottazzi et al., 2008; Croce et al., 2019; Grilli and Murtinu, 2014), we considered that the weight of invested firms backed by government-supported VCs in the sample (632 out of 1035) might be influencing our results.

Hence, in Table 4, we report the results solely for the firms invested by private VCs. For the dependent variable *lnGrossRevenues*, we do not find significant results. However, we show positive and significant coefficients for *lnAssets* (columns two and four), both for the distance in kilometers and the travel time in minutes, providing partial support for our view on the negative relationship between geographic distance and firm performance for companies invested by private VCs. For the first versus fourth quartile in minutes (Panel A,

column four, coefficient 1.1782), we have that, for companies that received funds from private VCEs, the assets growth of the closest ones is 224,85% higher when compared to the most distant ones (p-value<5%). When comparing the second quartile with the fourth, both in kilometers and minutes (Panel B, columns two and four, coefficients 0.8279 and 0.8523), the closest exceeded the most distant ones in around 130% in terms of assets growth (p-value<5%).

Table 3. Regression results for all firms

Panel A

Independent variables	First vs. fourth quartile (km) *lnGrossRevenues*		First vs. fourth quartile (km) *lnAssets*		First vs. fourth quartile (min) *lnGrossRevenues*		First vs. fourth quartile (min) *lnAssets*	
VCinv	3.9562 (0.2902)	***	3.9922 (0.2723)	***	4.2881 (0.3062)	***	4.2050 (0.2957)	***
VCinvQuartile	-0.3767 (0.3405)		0.3147 (0.3261)		-0.6170 (0.3635)	*	0.3360 (0.3523)	
RegionVC	-2.2585 (0.9984)	**	-0.8516 (0.4209)	**	-1.0444 (1.1555)		-0.7970 (0.5415)	
AgeComp	-0.0089 (0.0062)		-0.0108 (0.0082)		-0.0095 (0.0062)		-0.01219 (0.0086)	
Sector dummies	Yes		Yes		Yes		Yes	
Time dummies	Yes		Yes		Yes		Yes	
const	11.2481 (1.1915)	***	12.4382 (0.9469)	***	10.3118 (1.8474)	***	11.1991 (1.0146)	***
Obs.	4563		4563		4308		4304	
Firms	533		533		520		520	
R^2	0.6081		0.5969		0.598		0.5939	

Panel B

Independent variables	First & second vs. fourth quartile (km) *lnGrossRevenues*		First & second vs. fourth quartile (km) *lnAssets*		First & second vs. fourth quartile (min) *lnGrossRevenues*		First & second vs. fourth quartile (min) *lnAssets*	
VCinv	3.9908 (0.2781)	***	4.0802 (0.2605)	***	4.3793 (0.2920)	***	4.3868 (0.2812)	***
VCinvQuartile	-0.3750 (0.3062)		0.0770 (0.2894)		-0.7466 (0.3196)	**	-0.2146 (0.3079)	
RegionVC	-2.2132 (0.9962)	**	-0.8105 (0.4177)	*	-0.7708 (1.0625)		-0.4666 (0.5412)	
AgeComp	0.0132 (0.0118)		0.0026 (0.0082)		0.0136 (0.0118)		0.0029 (0.0082)	
Sector dummies	Yes		Yes		Yes		Yes	
Time dummies	Yes		Yes		Yes		Yes	
const	11.7692 (2.1790)	***	11.3371 (1.0845)	***	10.5925 (1.9182)	***	10.8267 (0.9696)	***
Obs.	6764		6764		6655		6651	
Firms	777		777		777		777	
R^2	0.5921		0.5888		0.598		0.5872	

The table shows the fixed effects estimation results for the dependents variables *lnGrossRevenues* and *lnAssets* for all firms. The independent variables are: (1) VCinv: Dummy variable that takes value 1 from the year of the initial VC investment on, and zero otherwise. (2) Quartile: Dummy variable that takes value 1 for firms belonging to the 1, or 1 & 2, quartile of distance, depending on the specification, or zero otherwise. The model also includes control variables: Age, Cluster VC regions, plus sector and year dummies. In Panel A, we show the results for the sample comparing first versus fourth quartile in kilometers and minutes, whereas in Panel B we show the results for the sample comparing first plus second versus fourth quartile firms in kilometers and minutes. The first column shows the independent variables of the model; in each respective line we have the coefficients and, in parenthesis, the standard errors for each variable. Industry and Time dummies are included.

Level of significance: * p-value<10%, ** p-value<5%, *** p-value<1%.

Table 4. Regressions results for *firms invested by private VCs*

Panel A

Independent variables	First vs. fourth quartile (km) *lnGrossRevenues*		First vs. fourth quartile (km) *lnAssets*		First vs. fourth quartile (min) *lnGrossRevenues*		First vs. fourth quartile (min) *lnAssets*	
VCinv	3.7243 (0.3617)	***	3.6418 (0.3437)	***	3.7208 (0.4363)	***	3.5326 (0.4212)	***
VCinvQuartile	-0.1096 (0.4307)		0.5936 (0.4092)		0.3079 (0.5299)		1.1782 (0.5092)	**
RegionVC	0.3147 (0.6467)		-0.1049 (0.6198)		-1.5597 (0.5785)	***	-1.4308 (0.5085)	***
AgeComp	-0.0083 (0.0079)		-0.0026 (0.0056)		-0.01227 (0.0085)		-0.0041 (0.0066)	
Sector dummies	Yes		Yes		Yes		Yes	
Time dummies	Yes		Yes		Yes		Yes	
Const	14.7968 (2.7554)	***	15.8402 (2.4964)	***	11.0508 (0.7310)	***	12.3044 (0.5332)	***
Obs.	2498		2498		1818		1818	
Firms	283		283		218		218	
R^2	0.639		0.5945		0.6308		0.5883	

Panel B

Independent variables	First & second vs. fourth quartile (km) *lnGrossRevenues*		First & second vs. fourth quartile (km) *lnAssets*		First & second vs. fourth quartile (min) *lnGrossRevenues*		First & second vs. fourth quartile (min) *lnAssets*	
VCinv	3.6981 (0.3476)	***	3.6367 (0.3320)	***	3.8746 (0.4082)	***	3.5815 (0.3967)	***
VCinvQuartile	0.2458 (0.3929)		0.8279 (0.3733)	**	0.0897 (0.4489)		0.8523 (0.4327)	**
RegionVC	-0.3023 (0.6614)		-0.0781 (0.6357)		-0.8645 (0.7818)		-0.5846 (0.8169)	
AgeComp	-0.009 (0.008)		-0.0028 (0.0058)		-0.0105 (0.0081)		-0.0029 (0.0060)	
Sector dummies	Yes		Yes		Yes		Yes	
Time dummies	Yes		Yes		Yes		Yes	
const	14.8363 (2.7793)	***	15.7480 (2.5097)	***	10.8447 (0.7842)	***	11.6890 (0.7342)	***
Obs.	3156		3156		2741		2741	
Firms	365		365		326		326	
R^2	0.6434		0.5983		0.6483		0.5925	

The table shows the fixed effects estimation results for the dependents variables *lnGrossRevenues* and *lnAssets* for firms invested by private VCs.. The independent variables are: (1) VCinv: Dummy variable that takes value 1 from the year of the initial VC investment on, and zero otherwise. (2) Quartile: Dummy variable that takes value 1 for firms belonging to the 1, or 1 & 2, quartile of distance, depending on the specification, or zero otherwise. The model also includes control variables: Age, Cluster VC regions, plus sector and year dummies. In Panel A, we show the results for the sample comparing first versus fourth quartile in kilometers and minutes, whereas in Panel B we show the results for the sample comparing first plus second versus fourth quartile firms in kilometers and minutes. The first column shows the independent variables of the model; in each respective line we have the coefficients and, in parenthesis, the standard errors for each variable. Sector and Time dummies are included.
Level of significance: * p-value<10%, ** p-value<5%, *** p-value<1%.

5. DISCUSSION AND CONCLUSION

VCs play an important role in enhancing the success prospects and performance of SMEs. They offer both financial aid, in the form of capital provision, and qualitative aid, in the form of value-adding services. Considering that qualitative aid depends on face-to-face interaction, geographical distance between investees and their lead VCs might significantly affect the provision of these services. The purpose of this work is to verify whether the geographic distance, measured both in kilometers and in minutes (travel time), has a significant impact on the performance of the invested firms.

In all regressions, our results support the positive effect of VC funding on the performance of SMEs. Regarding our research question, however, the results do not corroborate the negative relationship between geographic distance and the performance of investee firms when we consider our full sample, which includes firms backed by both private and government-supported VCs. Since the quality and quantity of value added provided by government-supported VCs are challenged in the literature, our results could be certainly affected by the significant weight of firms backed by government-managed VCs in our sample (61%). When we focus only on ventures funded by private VCs, we do find significant differences in total assets growth. In particular, when comparing the first plus second quartile with the fourth, both in kilometers and minutes of travel distance, the closest firms showed a superior growth in total assets of around 130% than the most distant ones (significant at the 5% level).

As main contributions of this paper, we should first highlight that it confirms the overall positive effect of VC involvement on performance in all specifications. Second, we introduce a new tool to address the effect of geographic distance on performance (i.e., Google Maps). Third, we provide initial evidence that geographic distance has a significant impact on the growth in total assets for firms backed by private VCs.

Nevertheless, as limitations, we should mention that there are additional variables that could help in understanding the effect of geographic distance on performance, such as the stage of development of the investee firm, the experience of the venture managers or the role of syndication. We do not explicitly consider them in our analysis, only focusing on the distance to the premises of the lead VCs.

As future extensions, we should take into account that, when investing in more distant firms, VCs may target mature firms more often than early-stage ones. As they are more consolidated companies, these ventures normally possess a longer track record and require less intensive monitoring. In addition, it is important also to control for the experience of VC managers. It may well be that the most experienced VCs are the ones that invest in more distant ventures because they can provide more qualified value-adding services at a lower cost (Sapienza et al., 1996; Sorenson and Stuart, 2001). Another possible explanation is syndication, which is a way of overcoming the difficulties and problems related to geographic distance (Fritsch and Schilder, 2012). It could be the case that the monitoring and value-adding initiatives are shared by several syndicate members. Hence, focusing the measurement of the distance to the lead investor could bias the results. Further investigation should be carried out to analyze the influence of all of these issues. Finally, it would be an interesting addition to investigate whether the screening process was more meticulous for distant firms than for firms that are closer to the premises of the VCs.

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