



JENA ECONOMIC RESEARCH PAPERS



2010 – 069

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www.jenecon.de

ISSN 1864-7057

The JENA ECONOMIC RESEARCH PAPERS is a joint publication of the Friedrich Schiller University and the Max Planck Institute of Economics, Jena, Germany. For editorial correspondence please contact markus.pasche@uni-jena.de.

Impressum:

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The Regional Supply of Venture Capital – Can Syndication overcome Bottlenecks?

Michael Fritsch[‡] and Dirk Schilder⁺

September 2010

Abstract

We investigate whether the supply of venture capital (VC) is driven by spatial proximity between a VC company and the portfolio firm. Our analysis is based on information about VC investments in Germany between 2004 and 2009. We find that possible problems caused by the geographic distance to a portfolio firm seem to be overcome by syndication of investments with one of the VC firms located close to the investment. Our analysis does, however, suggest that short geographic distance between an investor and the investment has an increasing effect on the probability for syndication as well as on the number of firms that join the syndicate. Hence, local VC suppliers may assume a role of an 'anchor' connecting the regional economy to more distant parts of the industry.

JEL-classification: G24, O16, D21, M13, R12

Keywords: Venture Capital, syndication, geographic proximity, start-up financing, equity gap

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1 Introduction¹

A sufficient supply of capital is a crucial precondition for entrepreneurial activity, and equity capital, particularly venture capital (VC), is especially important. VC can be essential for the emergence and survival of young and innovative start-ups, which usually have severe problems accessing other means of financing. Consequently, there is widespread concern that regional disparities exist in the supply of VC, which may lead to an “equity gap” in certain regions (see, e.g. Martin et al., 2005; Mason and Harrison, 1992). This concern is based on two assumptions. First, in some countries such as the US and the UK, suppliers of VC are clustered in just a few locations and are largely absent in other regions. Second, it is assumed that the emergence and successful maintenance of a VC partnership requires certain spatial proximity between the VC investor and the investment. If this assumption is realistic, start-ups may suffer from a shortage of equity in those regions where no or only a few VC companies are located. It is the combination of regional clustering of VC firms and the need for spatial proximity for VC investment that may cause a regional equity gap, which then creates a barrier for innovative start-ups in the respective regions.

This paper investigates the role of spatial proximity between VC suppliers and their portfolio firms in Germany. We particularly focus on the ability of German VC companies to overcome problems of geographic distance by means of syndication; i.e. sharing an investment with other investors (Wright and Lockett, 2003). Our main argument is that if investors can find syndication partners that are located geographically close to an investment, the investment’s distance as well as the distance

¹ We gratefully acknowledge comments of three anonymous referees on an earlier version which have been very helpful in improving this paper.

between the syndication partners will be of only very minor concern. If our argument holds, then the importance of geography for VC investment rests on two pillars: first, the importance of having a VC firm located close to the investment for the formation of a syndicate, and second, the demand-side of the VC market, that is, the number of innovative start-ups that emerge in a region. This does, however, not imply that geography is completely unimportant. As far as spatial proximity of one of the syndication partners to an investment is conducive to syndication, regional VC suppliers may assume a role of an 'anchor,' connecting the regional economy to more distant parts of the industry. The results of our empirical analysis will reveal whether VC firms do enlarge their spatial range of operation by syndicating investments and whether there are, indeed, regional equity gaps for innovative start-ups in Germany. From a policy perspective, this is an important point regarding questions such as "Is a lack of VC firms in a region an impediment for entrepreneurship and innovation there?" and "Can special problems of accessing VC in certain regions be regarded as a justification for policy makers to support regional VC development?"

Earlier research has analyzed the role of geographic distance between VC firms and their investment targets for the US and the UK.² These studies have shown that VC companies and their portfolio firms tend to be located in close proximity to each other, suggesting that geographic distance plays a crucial role for VC investment. This finding, however, may at least partly result from the relatively high geographic concentration of innovation activities and VC firms in these countries (Powell et al., 2002; Martin et al., 2005). If most of the innovative firms are clustered in one or in some few regions, it should not be surprising also to

find most if the VC companies in the same regions investing mainly in ventures which are located nearby. Hence, the role of geographic distance for VC investments can hardly be investigated if investments in companies which are located far away only rather seldom occur. Therefore, countries with a considerably more decentralized spatial structure in terms of innovative entrepreneurship such as Germany may be much better suited to investigate the role of geographic proximity for VC investment.

The remainder of the paper is organized as follows. We first give a brief overview of the German VC market, particularly the spatial distribution of VC firms and potential investments (Section 2). Section 3 provides a literature review of the main arguments suggesting that spatial proximity may play an important role for VC investment. After introducing the data (Section 4), we discuss possible reasons for geographic proximity in VC investments (Section 5). The results of the empirical analyses of the importance of spatial proximity for VC investments and for syndication of these investments are presented in Section 6. We conclude by summarizing our results and discussing their implications (Section 7).

2 The spatial distribution of VC companies and their potential targets in Germany

The German VC market is considered to be less mature than for example the VC markets in the US or in the UK. The first German VC company, the *Deutsche Wagnisfinanzierungsgesellschaft*, was founded in 1975 (Becker and Hellmann, 2002) and until the mid-1990s only a handful of further firms existed. For comparison, the first US and UK VC firms were set up in the 1940s – the *American Research and Development Corporation*

² For the US, see Sorensen and Stuart (2001), Powell et al. (2002), Florida et al. (1991), and Leinbach and Amrhein (1987). Main studies for the UK are Mason and Harrison (1999, 2002), Martin (1989), and Martin et al. (2005).

(Gompers and Lerner, 2005, 8) and the *Industrial and Commercial Finance Corporation* which later became *3i* (Frommann and Dahmann, 2003). Since the mid-1990s, however, the German VC market developed from a very immature sub-segment to a more and more important part of the financial service industry. Today, according to the European Venture Capital Association, it is the third largest European market in terms of capital invested – closely following France and considerably behind the UK. The German market is regarded as still having large upside potential which can be seen in a relatively low share of investments in total GDP (EVCA, 2008). The share of start-ups which received early stage VC in Germany is, however, quite comparable to the UK and the US.³

Compared to the UK and the US (Martin et al., 2002; Powell et al., 2002), German VC firms are much more geographically dispersed. Figure 1 shows the regional distribution of members of the German Private Equity and Venture Capital Association, which comprises nearly all German VC suppliers, private and public, i.e. under governmental influence. The circles indicate the number of VC companies. The larger the circle is, the

³ In Germany less than 400 start-ups appeared to be sufficiently promising to Venture Capital investors to receive first-round financing in 2007 (BVK, 2008, 9; European Venture Capital Association, 2008, 144). Taking the total number of start-ups in Germany as recorded in the ZEW Founder Panels to be about 266,000, this is only three out of every 2,000 new businesses. For the USA and the UK, the two nations with the most advanced VC industries, these shares are even lower. According to the 2009 Yearbook of the US National Venture Capital Association (2009, 11, 31), the number of new-businesses receiving first-round VC financing in 2008 amounted to 1,179. Compared to the more than 2,000,000 new companies set up in the United States each year (Shane, 2009), this makes one out of every 2,000 new businesses. The British Venture Capital Association (BVCA, 2009, 12) reports 269 early stage investments in the UK during 2008. Assuming the UK had about 250,000 start-ups that year, then the share of VC-backed new businesses is about one in a 1,000. A problem in calculating such ratios is that the information on the overall number of start-ups may not be comparable between countries. In particular, there are considerable differences between countries with respect to the inclusion of small-scale start-ups, such as firms with no employees or part-time entrepreneurship, which may make a considerable share of the overall number of new businesses.

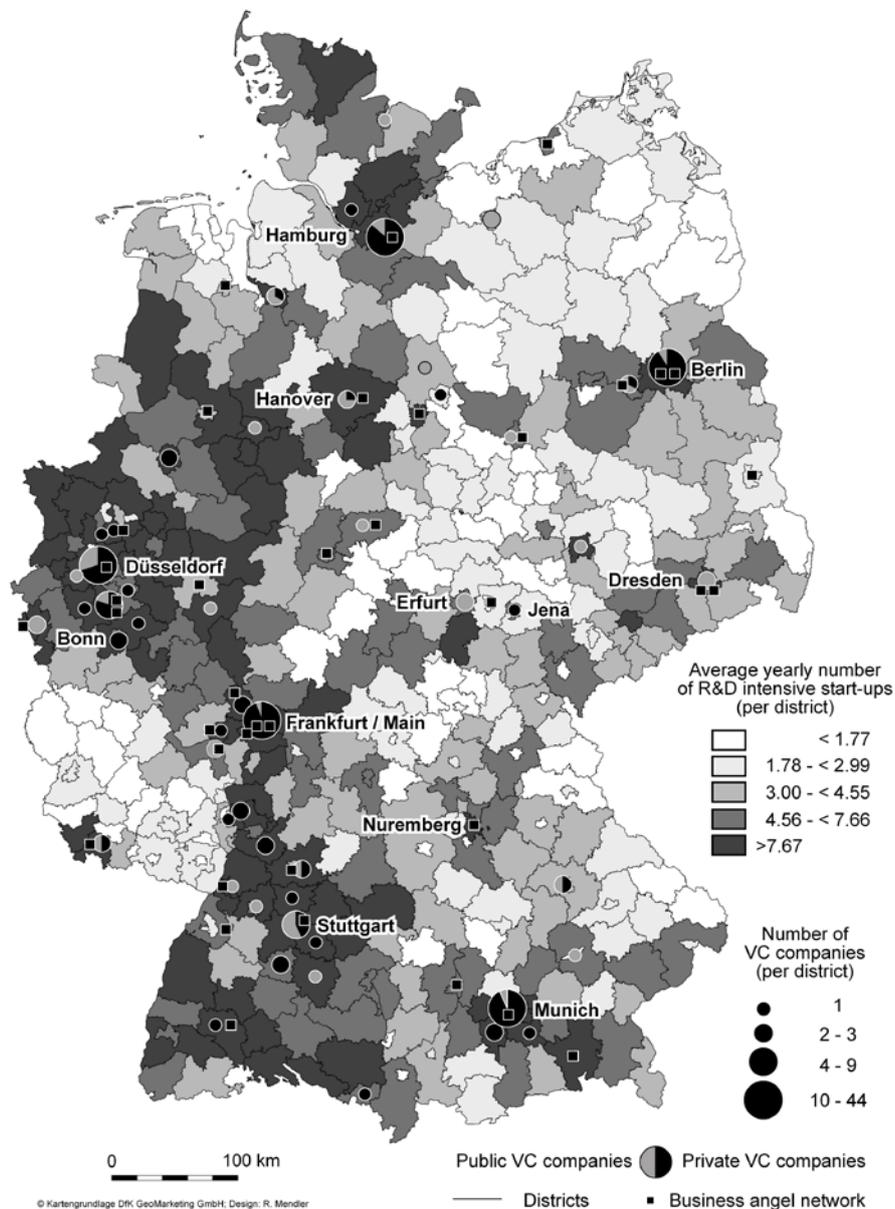


Figure 1: The spatial distribution of VC firms and R&D intensive start-ups in Germany

greater the number of VC companies located in that district is. Business angel networks are represented by black quadrats. The greatest numbers of German VC suppliers are located in some larger cities that can be regarded as commercial centers: Berlin, Frankfurt, Hamburg, Dusseldorf, Frankfurt, Munich, and Stuttgart. VC firms can, however, also be found in

smaller cities such as Bonn, Dresden, Erfurt, Jena, and many more. Although there are no VC suppliers in a number of regions, there is always at least one VC supplier located up to 200 kilometers (km) away, which is below the critical distance of a lead investor to an investment assumed for the US (e.g., Florida and Kenney, 1988; Sapienza et al., 1996).

The regional distribution of the average yearly number of R&D intensive manufacturing start-ups which can be considered potential VC investments, the demand-side of the VC market, deviates quite considerably from the distribution of the VC suppliers (figure 1).⁴ The innovative start-ups show a geographically rather dispersed structure with no obvious clustering and occur even in areas where no or only few VC firms are located.

3 VC syndication — General rationale and spatial aspects

Many, if not most VC investments, include more than one financier (Lerner, 1994; Brander et al., 2002), i.e. the VC providers form a so-called syndicate. The partners of such a syndicate all have a stake in the portfolio company but may perform different tasks (Wright and Lockett, 2003). These tasks range from being an active lead investor responsible for monitoring of and consulting with the financed firm, to that of a passive co-investor whose main contribution is the money invested. Possible motives for syndication are risk-sharing (Lockett and Wright, 2001), mobilizing larger amounts of capital (DeClercq and Dimov, 2004), and

⁴ The figures pertain to the average number of start-ups in innovative manufacturing industries per year in the 2000-2008 period. The classification of innovative industries follows Grupp and Legler (2000). The data are based on the Foundation Panels of the Centre for European Economic Research (ZEW) in Mannheim. We are greatly indebted to the ZEW for making the data available.

gaining additional expertise for the evaluation of possible target firms⁵ as well as for the necessary monitoring and consulting services (Manigart et al., 2006). By means of syndication, different VC firms can combine their resources; namely, their specific knowledge and capabilities (DeClercq and Dimov, 2004). Syndication may also help to reduce the costs of these activities. If, for example, the syndication partners are located at different geographic distances from the investment, the VC company which is based closest to the portfolio firm can take responsibility for those monitoring and consulting tasks that need to be performed on-site. In this way, the more distantly located syndication partners may benefit from the cooperation in terms of lower overall travel costs for supervising the investment (Sorensen and Stuart, 2001; Fritsch and Schilder, 2008).

Research has shown that VC investment in innovative new firms typically takes place in several successive rounds which may be spread over a number of years (Gompers and Lerner, 2001; Sahlman, 1990). The reasons for syndication of VC investments as well as the challenges for the investor may vary considerably depending on the stage of the investment process (Sorensen and Stuart, 2001). In the early stages of an investment such as the evaluation of potential investments, investors might be less reliant on syndication partners as compared to later stages because capital requirements at the beginning of an investment process tend to be relatively low (DeClercq and Dimov, 2004). Furthermore, the older a portfolio firm becomes, the more additional and specific knowledge it might need from the investors. Finally, the VC firms that join an investment at later stages can benefit from the insights of the earlier investors what may help to reduce their risk (Lockett and Wright, 1999,

⁵ In this regard, having an independent evaluation of the portfolio firm by another VC company may be an important motive for syndication.

2001). Therefore, the more mature an investment is, the more VC firms might participate in a syndicate.

The role of regional proximity in the supply of equity for young and innovative start-ups has been the subject of intense discussion in the literature.⁶ The geographic distance between a VC company and a possible target firm can influence the financier's investment decision in two ways. First, it may affect the search and identification of potential investment targets due to distant-related constraints in the spatial diffusion of information about these targets (Green, 1991, 23; Zook, 2002). Second, geographic distance may shape the amount of transaction costs that is expected to be necessary for monitoring and supervising the financed firm, activities that can be time consuming and even, at times, require face-to-face interaction (Gompers, 1995; Lerner, 1995; Sapienza and Gupta, 1994; Petersen and Rajan, 2002). Hence, the cost of this interaction should increase with the geographic distance between the VC firm and the investment (Mason and Harrison, 2002; Sorensen and Stuart, 2001).

Empirical studies have found that in many countries VC companies are densely clustered in space (see Section 2). In the United States, for example, VC suppliers are heavily concentrated in certain areas on the east and west coasts (Sorensen and Stuart, 2001; Powell et al., 2002; Florida et al., 1991; Leinbach and Amrhein, 1987). In the United Kingdom, home of the largest VC market in Europe, VC suppliers are highly concentrated around London and in the southern part of the country (Mason and Harrison, 1999, 2002; Martin, 1989; Martin et al., 2005). Martin et al. (2002) also found a certain degree of spatial clustering of VC

⁶ See, e.g. Florida et al. (1991), Fritsch and Schilder (2008), Gupta and Sapienza (1992), Martin et al. (2002, 2005), Mason (2007), Mason and Harrison (2002), Powell et al. (2002), and Sorensen and Stuart (2001).

suppliers in France and Germany. However, this concentration was not as pronounced as it is in the United States and the United Kingdom.

In addition to the geographic distribution of VC suppliers, some studies have investigated the role of spatial distance between VC suppliers and their investments, which may be an important determinant of the regional availability of finance for young and innovative companies (for an overview, see Fritsch and Schilder, 2008, and Mason, 2007). If proximity between the investor and the financed firm is important or even necessary to ensure sufficient management support and control so as to make the investment profitable, the geographic scope of a VC company's activities will be limited. In an attempt to determine the most efficient geographic range of activity for VC investors, Zook (2002) arrives at a critical distance of a one-hour trip for VC companies in the Silicon Valley while Florida and Kenney (1988) believe 150-250 miles as critical distance for lead investors in the US. Sapienza et al. (1996) result in an average travel time of about 1.5 hours for VC investments in the UK and more than 2 hours for the US. However, these results relate to the extremely geographically concentrated VC markets in the UK and the US and may not apply for countries with a less pronounced clustering of innovative start-ups such as Germany. If spatial proximity is important for a profitable relationship between an investor and the financed firm, and if VC suppliers are more or less geographically clustered, there might be a regional undersupply of VC in those areas where no or only few VC companies are located.

One way VC companies can overcome the problem of large geographic distance from an investment is through syndication (Sorensen and Stuart, 2001). Based on an interview survey of German VC providers, Fritsch and Schilder (2008) found strong evidence that syndication can, at least partially, be used as a substitute for regional proximity. If one of the

syndication partners is located close to the investment, it can perform the required monitoring and consulting at less expense than a more distantly located company. The co-investors then can assume more of a passive role (Gupta and Sapienza, 1992; Wright and Lockett, 2003). If this hypothesis is correct, syndicated investments can be located at a greater geographic distance from the VC companies than non-syndicated investments can if at least one of the syndication partners is located relatively close to the portfolio firm. Therefore, we may expect that investors that are located far away from an investment will search for syndication partners located close to the portfolio firm to perform the monitoring and consulting activity, not neglecting other aspects of finding suitable co-investors such as its available capital, its track record, or its industry expertise. Hence, the geographic distance between at least one of the syndicate's VC companies and the financed firm should be relatively small.

Since the advantage of syndication will depend on the difference of geographic distances to the investment between two potential syndication partners, the probability for syndication can be expected to be the higher the larger this difference is. This reasoning implies that the geographic distance among syndication partners should be largely unimportant. It is, however, important for the regional availability of VC to have at least one supplier located not too far away who could act as an 'anchor,' thereby connecting the regional economy to more distant parts of the industry by means of syndication. Thus, geography may, indeed, matter for regional VC investment, but mainly for one of the investors who is forming a syndicate.

4 The database

Our analysis is based on a data set of German VC investments at the micro level. The data are provided by *VC facts*, a company that collects information on German VC activity (VC facts, 2004-2009). We use data for the years 2004 to 2009, which include information on VC investments, ranging from 133 to 257 investments per year. This number is about 40 to 60 percent of the aggregate annual number of early-stage investments recorded by the German Private Equity and Venture Capital Association (2009).⁷ There is a clear concentration of investment in certain industries quite similar to the sectoral pattern of the investments recorded by the German Private Equity and Venture Capital Association (2004-2009): more than one-third of the investments are in the life sciences, a bit more than 10 percent are in software-related businesses as well as in the communication industries and in medical technologies. Investments by foreign VC companies which have an office in Germany are also included.⁸ We have no indication for any misrepresentation of overall VC investment activity in our sample.

For the purposes of this paper, we focus on detailed information about the location of an investment as well as that of the investors, the number of investors involved, the total amount of money invested, and the age of the financed company. Based on the information about the location of the VC firms and of their investments, we are able to calculate the traveling distances between an investor and a portfolio company by car using the Internet-based route planner *map24.de*.

⁷ The market data from the German Private Equity and Venture Capital Association are not available at a company level.

⁸ Foreign investment of German VC companies is not contained in the data.

Of the 1,240 VC investments in the sample, 911 (73.5 percent) are syndicated, i.e. there is more than one investor involved. The number of links between investors and the investment in a syndicate equals the number of syndication partners. For example, in a syndicate with two investors, there are two links, one between each investor and the portfolio company. We can identify 3,016 such pairs in the data. Due to several missing values, most of our analysis is based on a minimum of 819 and 826 of such pairs. The missing data mainly concerns addresses of informal VC investors and of foreign VC firms that do not have an office in Germany; hence, these investors are not included in the analysis. Furthermore, certain governmental investors that merely act as passive co-investors or only give guarantees have been excluded.

Table 1: Descriptive statistics

	Mean	Median	Minimum	Maximum	Standard deviation
Age of portfolio company (years)	3.8	3.0	0.0	36.0	3.6
Number of employees in portfolio company	28.8	20.0	1.0	481.0	31.6
Total amount of capital invested (million €)	8.4	4.0	0.2	85.0	12.8
Number of investors per investment	4.4	4.0	1.0	17.0	3.2
Geographic distance to VC company (km)	232.4	148.0	0.0	868.6	230.2

Table 1 sets out descriptive statistics for the sample. All figures refer to the point in time when the investment was made. On average, the financed companies were slightly younger than four years old and had

about 30 employees. The average amount invested per financed company was about 8.4 million Euros. On average, the number of investors in a syndicate is 4.4.

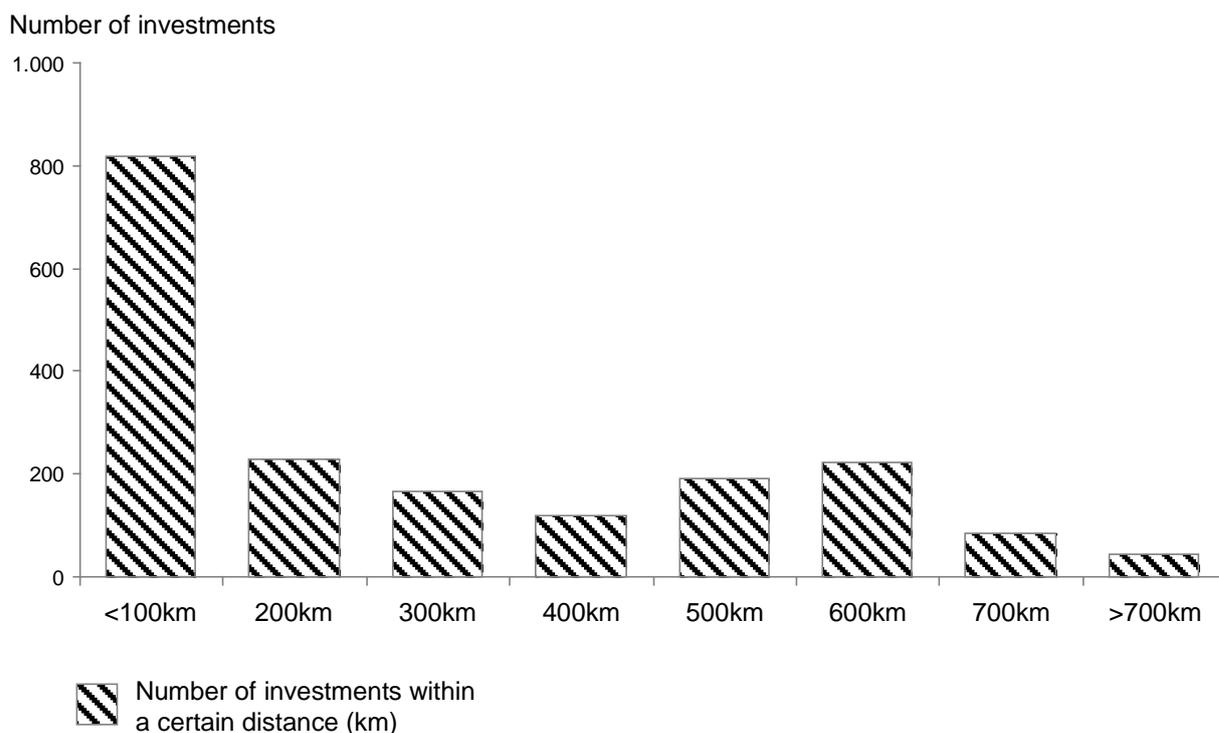


Figure 2: Spatial distances and travel times between VC companies and portfolio firms

Since our main interest is to analyze the role of spatial proximity between VC investors and portfolio firms, we focus on the distance between these two parties. Figure 2 shows the distribution of the spatial distance between the VC companies and their portfolio firms in kilometers. We find that around 44 percent of the investments are located within a distance of 100 kilometers to their investors and less than 56 percent are within 200 kilometers. This means that almost half the VC investments are located more than 200 kilometers away from the investing VC firm. Given a dense network of roads and railway connections in Germany, the travel

times between two locations are highly correlated with the distance in kilometers (see Achleitner et al., 2009).

These findings give first indication that regional proximity to an investment is not as important for VC firms and portfolio companies in Germany as is widely believed. Furthermore, these figures suggest that regions located far away from clusters of VC suppliers might not be at a severe regional disadvantage in obtaining equity for young and innovative companies.

5 What influences the distance between VC firms and their investments?

There are two main characteristics of an investment in our sample that may influence the distance between a VC company and its portfolio firm: the age of the portfolio firm and the amount of capital invested. A young company in the early stages of its technical and organizational development that does not generate much turnover or profit is likely to require more guidance and supervision by the VC firm than a company in a later stage of its lifecycle (Gupta and Sapienza, 1992). This hypothesis is based on the assumption that a lack of business and management skills may be a particular problem in young innovative companies which are often run by engineers or natural scientists, many of them not having much business experience (Gupta and Sapienza, 1992). Furthermore, young and innovative companies face a relatively high degree of uncertainty in regard to the technical and economic success of their projects (Sapienza et al., 1996). Therefore, the monitoring and supervision required from the VC supplier may be more time consuming and considerably more expensive during earlier developmental stages of the portfolio firm than at later stages. Thus, spatial proximity between the VC company and the portfolio firm is expected to be more important for early-stage investments (Sorensen and Stuart, 2001).

The size of the investment in terms of overall capital invested may also influence the degree of consulting and monitoring provided and, therefore, the importance of regional proximity in two possibly contradictory ways. First, the larger the investment, the higher the expected profit is (Martin et al., 2005). Hence, VC companies will be willing to invest more effort and resources to ensure the success of a project involving a large investment as compared to a smaller one. Because of a higher expected return of a large investment, the investor can also more easily afford the higher transaction costs incurred in monitoring and advising a portfolio firm that is located far away. Therefore, regional proximity between VC suppliers and financed firms may be less important for larger investments. Second, larger investments pose a greater risk for VC companies (Robinson, 1987; Robbie et al., 1997). The danger of incurring a relatively high loss if a large investment fails may motivate VC investors to undertake greater efforts of monitoring and advising in order to reduce such a risk of failure. This might have implications for the importance of spatial proximity because monitoring and advising is easier when the investment is located nearby. Given these different lines of argument, it is not entirely clear how the size of an investment affects the importance of proximity. Taking a first look at our data, we find that the correlation coefficient for the relationship between the size of the investment measured by the total amount of capital invested and the distance to the investment is rather small and statistically insignificant (Table 2).

The correlation coefficient between the age of a financed firm at the time of investment and geographic distance between the VC company and the portfolio firm is also very small and not statistically significant (Table 2). This result may partly be explained by the age composition of the sample. More than 83 percent of the portfolio firms in our data set were less than six years old at the time of investment. Since nearly all the

investments are at an early stage of development and not in bridge or turnaround stages, they may be characterized by similar requirements for consulting and supervision.⁹ Not surprisingly, the amount of an investment is positively correlated with the age of the investment (Table 2).

To reveal the distance-related benefits of syndication in one variable, we calculate the difference between the geographic distance of a VC firm to an investment and the distance of the syndication partner located closest to the portfolio firm. The larger this difference is, the more advantageous the syndication is: at least if the partner located closest to the investment provides the monitoring and consulting. This is confirmed by the significantly positive correlation of the “distance to investment / minimal distance to investment” variable with the number of investors per investment (Table 2; last row). A VC firm with a low value of this indicator is located close to the investment and has only a weak distance-related incentive to syndicate. The negative correlation of this difference within a syndicate and the minimal distance (Table 2) indicates that the search for a syndication partner located close to the investment is more important for those investors that are located farther away. The more distant a VC firm is from an investment, the longer the distance to the syndication partner located closest to the investment is. This clearly shows that it is not of crucial importance for syndication partners to be located close to each other. What is important, however, is that a least *one* of the investors is in close spatial proximity to the portfolio firm.

⁹ We do not have reliable information about the stage of an investment but have to use the age of the portfolio company as a proxy assuming that there is a strong correlation between a company's age and the stage of an investment.

Table 2: Correlation coefficients of variables regarding syndication and the distance between VC company and portfolio firm

	1	2	3	4	5
1 Number of investors	1.00				
2 Age of portfolio company (years)	0.25**	1.00			
3 Total amount of capital invested (million €)	0.62**	0.21**	1.00		
4 Distance to specific investment (km)	0.03	0.01	0.05	1.00	
5 Minimal distance to investment (km) ^a	-0.26**	-0.06**	-0.08*	0.56**	1.00
6 $\frac{1}{\sqrt{}}$ minimal distance to investment ^a	0.27**	0.06*	0.13**	0.67**	-0.24**

Notes: ^a Syndicated investments only. ** Statistically significant at the 1%-level; * Statistically significant at the 5%-level; Number of observations: 826.

The greater the number of investors, the closer at least one of the investors will be to the investment. Furthermore, there is a pronounced positive correlation between the minimal distance within a syndicated investment and the distance between an individual VC company and the portfolio firm. This indicates that the farther away the investment is located, the greater the distance of the closest investor to the portfolio firm is. However, this positive correlation is a statistical artifact arising from the method used to calculate the minimal distance and has no meaningful interpretation.¹⁰ There is no statistically significant relationship between

¹⁰ Since the distance of a VC firm to the investment cannot be smaller than the minimum distance of the investor that is located closest to the investment, the observations all lie either in the upper-right part or in the lower-left part of a scatter plot of these two variables

the geographic distance to a portfolio company and the number of investors.

A positive correlation between the age of the investment, which indicates its stage, and the number of investors (Table 2) suggests that investors in later stages tend to syndicate more often than at an earlier stage. The slightly negative statistical relationship between a portfolio company's age and the minimal distance to a member of a syndicate can be regarded as an indication that older investments are more likely to have a member of a syndicate located close to the portfolio firm. This might be due to higher needs for on-site involvement for investors during later developmental stages of a venture.

6 The role of syndication in regional VC supply

6.1 Syndicated versus non-syndicated investments

Comparing the mean values of a number of variables between the sub-samples of syndicated and non-syndicated investments (Table 3) leads to further insights. We find that syndicated investments are, on average, nearly three times larger in terms of the total amount of capital invested. The age of a syndicated investment which indicates its stage is on average slightly and significantly higher than the average age of a portfolio company with a single investor. This suggests a greater probability of later stage investments to be syndicated. Closer inspection shows that the share of portfolio firms with only a single investor is about 28 percent

(distance to specific investment and minimal distance to investment). Because of this type of distribution, a simple correlation coefficient must assume a positive value.

among the young firms (between 0-4 year old) but only 20 percent among the firms which are older than 4 years.

Table 3: Independent samples t-test for comparing investments with a single investor and syndicated investments

		Mean	t for $H_0: \text{mean}(0) \neq \text{mean}(1)$	Number of observations
Age of portfolio company (years)	Single investor	3.19	-3.00**	237
	Syndicated investments	3.93		1,624
Total amount of capital invested (million €)	Single investor	2.97	-3.77**	72
	Syndicated investments	8.85		765
Distance to a specific investment (km)	Single investor	217.43	-1.10	247
	Syndicated investments	234.65		1,628
Minimal distance to investment (km) ^a	Single investor	217.43	10.45**	247
	Syndicated investments	95.40		1,641

Notes: ^a Company level ** Statistically significant at the 1 percent-level; * Statistically significant at the 5 percent-level.

The average distance of a VC company from a syndicated investment is not significantly greater than that of a single investment, whereas the minimal distance of one of the firms in a syndicate is on average shorter than the distance of a single investor. For syndicates, the average minimal distance between the syndication partner located closest to the investment and the portfolio firm is less than 100 kilometers (Table

3) while single investors are on average located 217 kilometers away from the portfolio firm. These results suggest that VC companies located far away from the portfolio firm tend to syndicate their investments with at least one of the syndication partners that is located relatively close to the target firm.

Table 4: The effect of spatial proximity on the probability of syndication (logit estimations)

	Probability of syndication	
	I	II
Age of portfolio company (years)	0.0166 (0.43)	0.0122 (0.32)
Total amount of capital invested (million €)	0.1397** (3.64)	0.1306** (3.49)
Geographic distance to investment (km)	0.0001 (0.05)	–
Minimal distance to investment (km) ^a	–	-0.0031* (5.32)
Constant	1.6831** (6.56)	2.3223** (8.95)
Log likelihood	-219.00	-206.55
Pseudo R-squared	0.065	0.121

Notes: Asymptotic *t*-values in parentheses; ^a Company level ** Statistically significant at the 1 percent-level; * Statistically significant at the 5 percent-level; Number of observations: 819 and 826

These interpretations of the correlation analysis and the *t*-tests are confirmed by multivariate logistic and negative binomial regressions (Tables 4 and 5). The two models in Table 4 show the results of the logit estimations regarding the influence of the distance between a VC company and the portfolio firm on the probability of syndication. The dependent variable is the syndication dummy, which assumes the value of

1 if an investment is syndicated and a value of 0 otherwise. According to the estimates, the age of the portfolio company has no statistically significant effect on the probability of syndication, whereas the probability of syndication rises with the amount of capital that is invested. This indicates that it is more the capital requirements and the desire for risk sharing than the stage of an investment that determines syndication.

The results for Model I in Table 4 clearly show that the distance between a VC company and a portfolio firm has no significant effect on the decision to syndicate. However, when substituting the distance variable by the minimal distance between one of the syndication partners and the investment (Model II), this minimal distance has a significantly negative influence on the probability of syndication. Although this effect is of low magnitude – a ten kilometers increase of the minimal distance lowers the odds ratio by three percentage points – , it shows that the probability of syndication increases with the spatial proximity of one of the syndication partners to the investment. To include the distance and the minimal distance into one model does not lead to meaningful results because the pronounced correlation between the two variables causes severe multicollinearity problems. Furthermore, it is not possible to include the spread between the distance of the VC firm to the portfolio firm and the minimal distance of the syndication partner located closest to the investment into the model because this predicts the outcome perfectly. This result is due to the fact that this spread is zero for all solo investments and positive for all syndicates; therefore, a spread of zero has a syndication probability of zero, whereas a positive spread has a probability of syndication of 1.

Table 5: The effect of spatial proximity on the number of syndication partners (negative binomial regressions)

	Number of co-investors		
	I	II	III
Age of portfolio company (years)	0.0445** (6.18)	0.0334** (4.97)	0.0403** (5.80)
Total amount of capital invested (million €)	0.0265** (13.36)	0.0254** (14.07)	0.0249** (13.45)
Geographic distance to investment (km)	0.0001 (0.02)	–	–
Minimal distance to investment (km) ^a	–	-0.0015** (9.08)	–
Distance to investment / minimal distance to investment ^a	–	–	0.0008** (6.55)
Constant	0.9850** (19.11)	1.1747** (25.50)	0.9009** (19.79)
Log-likelihood	-1,949.9	-1,921.76	-1,929.0
Pseudo R-squared	0.066	0.086	0.076

Notes: Asymptotic *t*-values in parentheses; ^a Company level ** Statistically significant at the 1 percent-level; * Statistically significant at the 5 percent-level; Number of observations: 819 and 826.

Similar results are achieved when the number of co-investors involved in a syndicate is taken as the dependent variable (Table 5). We employed negative binomial regression as the estimation method due to the integer character of this variable. The relationship between the size of the syndicate and spatial variables is a further indicator that syndication is often used to overcome problems of geographic distance to an investment. Like the probability of syndication, the number of co-investors rises with the overall size of the investment and is only slightly affected by the age of the portfolio company. Furthermore, there is no effect of the geographic distance of an investor to the location of the investment on the

size of a syndicate in terms of the number of VC firms involved (Model I). However, the minimal distance between one of the investors and the financed company has a statistically significant impact on the number of co-investors (Model II). If one of the investors is located close to the investment, the other VC companies can exploit this regional proximity to reduce possible problems of geographic distance.

We may further our argument by assuming that the geographic distance between a VC company and a portfolio firm could have a special influence on the decision to syndicate if it is possible to have one of the syndication partners located fairly close to the investment. The spread between the geographic distance to an investment and the minimal distance of one syndication partner can be regarded as an indicator of such an advantage of syndication. The significantly positive coefficient for this measure (Model III in Table 5) confirms this hypothesis. According to the estimation results, the number of co-investors increases with the spread between the distance of a VC company to a portfolio firm and the minimal distance in a syndicated investment. This supports the hypothesis that proximity between the investors is of minor importance compared to spatial distance to the portfolio firm.

6.2 Are follow-up investors different from initial investors?

Our data do not contain information that allows us to identify the lead investor of a syndicate. Such information could be important because the role of regional proximity and the use of syndication for overcoming the problem of distantly located investments may be different for an actively involved lead investor as compared to passive co-investors. Furthermore, our data do not allow us to determine which investor in a syndicate has initialized the investment. However, our sample covers six years, and we

can identify several rounds of investment for 247 out of the 3,016 pairs of investors and portfolio firms in this period. We performed additional analyses of these investments that include several investment rounds, i.e. the VC firms invest in the portfolio firm in different years, attempting to reveal possible differences between VC firms that have been involved at earlier investment stages and those investors which joined an investment later on. If syndication is a means to overcome problems of geographic distance to a portfolio company, follow-up investors may benefit from spatial proximity of VC firms which are already involved in the investment. Hence, syndicates that have one investor already located close to the respective investment might be particularly attractive to join.

Table 6: Follow-up investors versus initial investors

	Type of investor	Mean	t for $H_0: \text{mean}(0) \neq \text{mean}(1)$	Number of observations
Age of portfolio company (years)	Early investor(s)	3.66	-5.28**	1,614
	Follow-up round	4.94		247
Total amount of capital invested (million €)	Early investor(s)	7.25	-5.88**	706
	Follow-up round	14.26		131
Distance to a specific investment (km)	Early investor(s)	225.32	-3.44**	1,630
	Follow-up round	279.36		245
Minimal distance to investment (km) ^a	Early investor(s)	115.04	2.35*	1,641
	Follow-up round	86.92		247

Notes:^a Company level; ** statistically significant at the 1 percent-level; * statistically significant at the 5 percent-level.

A *t-test* that compares follow-up investors with initial investors reveals considerable differences between both groups. Unsurprisingly, the target companies tend to be older at the time follow-up investors join the syndicate. Moreover, the amount of money invested in a follow-up round is larger (Table 6), which is probably due to higher capital requirements of older portfolio companies. The significantly larger average distance of follow-up investors to a specific investment clearly shows that these follow-up investors tend to be located farther away from the investment target than the initial investors. In detail, affiliating an additional investor to an existing syndicate leads to a decrease in the minimal distance in 76 out of 247 cases. This is consistent with the conclusion drawn from our analysis in the previous section (section 6.1) that syndication is used to overcome the problems of distantly located portfolio firms, i.e. follow-up investors tend to join syndicates that already have an investor that is located close to the portfolio firm. Accordingly, the distribution of spatial distances between follow-up investors and portfolio firms differs from the distribution in the overall sample (see Figure 1). For example, only 34 percent of the follow-up investors are located up to 100 kilometers away from the investment while this share amounts to 44 percent in the entire sample. This finding is supported by a considerably smaller minimal distance that we find for investments with additional follow-up investors as compared to initial investors.

Overall, the results of our analyses strongly suggest that syndication is used as a measure to overcome the problems involved with geographic distance between a VC company and the investment; although, other reasons for syndication such as the capital requirements and the desire for risk-sharing may still play an important role. The probability of syndication does not increase solely due to large geographic distances between the VC company and the portfolio firm. Location has an impact on syndication, particularly, if one of the syndication partners is located relatively close to

the investment. This effect is even more pronounced for follow-up investors that prefer to join syndicates with one investor already located close to the investment.

These findings indicate that the supply of VC in a region can be multiplied by way of syndication even if there are only few VC companies located in that region. Thus, a dense regional cluster of VC firms might not be necessary in order to make capital available for young and innovative companies. However, in a syndicated investment, one of the investors should be located fairly close to the portfolio company. Therefore, it could be possible that there exists some kind of a 'follow-up round' equity gap in regions with no VC suppliers at all. However, given the average minimum distance of 94 kilometers to the closest VC investor in a syndicate, and 217 kilometers for investments with a single investor (see Table 4), the actual occurrence of such an equity gap in Germany appears quite unlikely given the spatial distribution of VC suppliers (Figure 1). Accordingly, interviewed managers of German VC firms nearly unanimously stated that geographic distance does not shape their investment decision (Fritsch and Schilder, 2008).

7 Conclusions and policy implications

We have investigated the role of geographic distance between VC firms and investments on the regional supply of VC in Germany. The German context may be particularly well suited for such an analysis because of the country's rather decentralized spatial structure. Innovative start-ups and VC firms are not as highly clustered in space in Germany as is the case in the US and in the UK. If such a high spatial concentration of innovative start-ups induces co-location of VC firms, then investments into distantly located companies may hardly exist or arise only in special cases, for example, with portfolio firms that require specific knowledge of VC

investors that is not available in the region or if a portfolio firm requires extraordinarily large amounts of capital. Our analysis in the German context shows that geographic distance between a VC company and a potential investment plays only a minor role and that syndication can be a means to overcome distance-related problems. Hence, the high levels of spatial proximity between VC companies and their investments that have been found for the US and the UK cannot necessarily be considered proof that spatial proximity is of crucial importance for VC investment, but rather may mainly result from the spatial structure in these countries.

We confirm the results of an earlier interview-study (Fritsch and Schilder, 2008) by showing that regional proximity between a VC company and a portfolio firm is fairly unimportant for VC investments in Germany. Based on our data (about 1,240 VC investments in Germany between 2004 and 2009), we find evidence that the regional supply of VC is largely independent of the location of an investment. The average distance between investor and investment is more than 232 kilometers, and 44 percent of the investments are made in locations that are more than 200 kilometers away from the financier.

We have shown that syndication is frequently used by VC firms to overcome the problems inherent in investments located far away. The more closely one of the syndication partners is located to the portfolio firm, the more likely it is that several VC firms will share the investment. We also find a positive relationship between spatial proximity of a VC firm to an investment and the number of co-investors involved in a syndicate. This suggests that an investment of a VC firm located in close proximity will be able to attract more syndication partners than an investment where the minimal distance to a member of the syndicate is relatively large. This effect is even more pronounced for follow-up investors that prefer to join syndicates in which one of the early-movers is already located close to the

investment. Furthermore, the probability of syndication rises with the amount of capital invested. The age of the portfolio firm, which can be regarded as an indicator of the investment stage, does not have significant effects on the probability of syndication.

According to our results, the question if a regional equity gap for young and innovative start-ups exists in Germany has to be answered with a “no” and a “yes.” “No” because geographic distance of an investment to a VC company does not seem to be an important impediment for VC investment as such. VC firms *do* invest in distantly located firms, and they may use syndication with other VC suppliers which are located closer to the investment as a means of overcoming the spatial proximity. “Yes” because if a VC firm located close by is conducive for the formation of a syndication, then regions with no supplier within a certain distance may, indeed, have problems attracting the financial resources they need. According to our results, the absence of VC suppliers in a region may particularly lead to some disadvantages with regard to the financing of larger investments that require the involvement of several financiers. In practice, even the most remote German regions have a VC supplier located not farther than 200 kilometers away, which lies within the critical distance for a lead investment as identified in studies for the US. Even if it may be slightly more difficult to attract VC investments in some regions, this can hardly be regarded as a severe obstacle to entrepreneurial and innovative activity.

These results fall in line with previous work on regional VC supply that has hypothesized that possible geographic disparities of VC might be due to demand-side effects such as differences in the number of potential investments, entrepreneurs’ limited awareness of VC or even their aversion towards participation of external investors (for an overview, see Christensen, 2007). Therefore, from a policy point of view, promoting the

establishment of regional VC markets will not solve the problem of undesirably low levels of innovative entrepreneurship. Hence, other avenues for effectively stimulating the emergence of innovative, new businesses in a region need to be chosen.

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