La domanda di Venture Capital in Europa: il ruolo dell'offerta e della distanza

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Abstract

Lo studio analizza sotto quali condizioni le giovani imprese ad alta tecnologia ricercano attivamente un finanziamento di VC, prestando particolare attenzione all'effetto della localizzazione. Utilizziamo un campione di 535 imprese operanti in settori ad alta tecnologia, localizzate in 7 paesi europei e osservate nel periodo 1984-2009. I risultati supportano l'ipotesi che la localizzazione sia un fattore chiave nel determinare la probabilità di ricercare un finanziamento di Venture Capital. In particolare la disponibilità di investitori nella regione in cui l'impresa è localizzata è la principale determinante. Anche la disponibilità non locale ha un impatto, che però decresce velocemente con la distanza. Esistono inoltre delle barriere nazionali, nel senso che l'impatto di disponibilità non locale al di fuori del paese è trascurabile. I risultati forniscono quindi spunti di riflessione particolarmente rilevanti a livello di politiche di supporto alle imprese.

In this paper we analyze how the location of European high-tech entrepreneurial ventures affects their propensity to seek external equity. We analyze a sample of 524 ventures located in seven European countries and observed in the period 1984-2009. We find that companies located in proximity to regions where the venture capital (VC) market is more developed are more likely to search for external equity, while the concentration of the local VC market plays a negligible role. An abundant supply of VC has a positive stimulating effect of large economic magnitude on the demand for external equity. However, this effect rapidly decreases with distance and vanishes at around 250 km. It also vanishes when crossing national borders. Our results suggest that overcoming the national fragmentation of the European VC market may stimulate entrepreneurial ventures demand for external equity, and is a key priority for European policy makers.

Keywords: high-tech entrepreneurial ventures, venture capital, demand for external equity, geographic distance

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1 Introduction

In the early stages of their life, high-tech entrepreneurial ventures face huge difficulties in collecting the outside capital they need to develop their businesses. The information asymmetries associated with the highly technical content of their investment projects, the low value and the intangible nature of (most of) their assets which cannot be pledged as collateral and the lack of a track record discourage traditional investors such as banks to lend capital to these companies (Berger and Udell, 1990; Carpenter and Petersen, 2002; Denis, 2004).

Venture Capital (VC) represents an appealing source of external equity capital for high-tech entrepreneurial ventures (Gompers et al., 2001). VC investors provide long-term equity finance and business skills to high growth-potential companies. Thanks to their superior screening capabilities and the use of monitoring and staging mechanisms (Kaplan and Strömberg, 2001), VC investors address information asymmetries more effectively than traditional financial intermediaries.

However, only a tiny number of companies successfully access the VC market. In 2014, 3,200 European and 3,700 US-based companies received VC (source: Invest Europe's and NVCA's yearbooks 2015). Moreover, the geographical distribution of VC investments is not even, with most investments concentrated in selected regions like Silicon Valley, the Boston and New York metropolitan areas in the US (e.g., Florida and King, 2016) and the London and Paris metropolitan areas in Europe. VC investors are spatially concentrated in financial centers and high-tech regions and their investments exhibit a local bias, i.e. they are very likely to invest nearby (Chen et al., 2010; Cumming and Dai, 2010; Sorenson and Stuart, 2001; Harrison et al., 2010; Lindgaard Christensen, 2007). This investment behavior is the result of both the location of their networks of informants and the need for spatial proximity to monitor investee companies (Cumming and Dai, 2010).

While most of the literature on the "geography of VC" focuses on the supply side of the market, a handful of studies have suggested that the uneven distribution of VC investments may also be a reflection of demand-side factors, as companies in peripheral regions are less likely to seek VC (Bertoni et al., 2015b; Mason and Harrison, 2002). However, this nascent literature does not provide a comprehensive understanding of the role of local VC markets – i.e., their size and structure – in making companies more (or less) prone to look for VC, nor it assesses the barriers represented by geographic distance, within and across national boundaries. These issues are especially important for European firms. On the one hand, the European VC market still appears to be fragmented at the national level (e.g., Bertoni et al., 2015a) offering an ideal test-bed to assess the role of national borders on the demand for external equity, an issue which is clearly highly relevant for European policy makers[1]. On the other hand, contrary to

[1]Since well before the Lisbon Agenda (e.g., European Commission, 1998), European policymakers have been trying to create an EU-wide VC market for high-potential entrepreneurial ventures. More recently, the European Commission has adopted several acts (most notably the Small Business Act and the Single Market Act), with the aim of promoting cross-border VC investments. These acts have established new rules to ensure that VC funds located in any member state can be freely invested throughout the EU (the so-called pan-European passport for VC investors).

the evidence on the U.S. VC market (e.g., Sørensen, 2007; Chemmanur et al., 2011), previous studies have failed to detect a positive "selection effect" in the European VC market (e.g., Croce et al., 2013), with VC investors failing to "pick winners" (i.e. investing in ventures with superior business opportunities). A better understanding of the demand side of the European VC market will help in clarifying the source of these anomalies. In this paper, we aim at filling this gap by studying how the demand side of the European VC market is affected by the size, structure and geography of the supply side of the market.

Proximity to an abundant supply of VC should positively influence companies' propensity to look for external equity. First, as the number of VC investors looking for potential targets increases, companies have greater chances of obtaining VC and need to exert less effort to find suitable VC investors (Bertoni et al., 2015b). Therefore, (expected) search costs are lower for companies that are located near well developed VC markets. Second, these companies become more easily aware of the potential benefits of VC financing, because of word of mouth among them (Martin et al., 2005). They can also more easily access information about the VC seeking process, including how to write a business plan or prepare an effective "elevator pitch" to prospective VC investors. Therefore, the costs of getting "investment ready" are lower. (Mason and Harrison, 2004). Third, bigger VC markets are more likely to be "thick", i.e. characterized by a sufficiently high number of buyers (i.e., VC investors) and sellers (i.e., companies actively seeking VC). A high number of VC investors translates also into a greater heterogeneity in investors' characteristics and in a higher probability to find a suitable match for entrepreneurs (Gans and Stern, 2010). Fourth, geographical distance amplifies information asymmetries for VC investors, who typically rely on local informational networks to screen business proposals (Cumming and Dai, 2010; Sorenson and Stuart, 2001). Moreover, distant investments bring about more uncertainty for VC investors, because these latter may not be familiar with the institutional characteristics in which the company is embedded. Research shows that information asymmetries and uncertainty are critically associated with the costs of obtaining financing for entrepreneurial ventures, as VC demand a higher premium (Carpentier and Suret, 2006). Lastly, distance also increases the monitoring costs for VC investors, which in turn may negatively affect the extent to which VC are able to add value to their ventures (Bernstein et al., 2015).

The structure of the VC market (i.e. the level of competition) should also have an impact on companies' propensity to seek external equity. In more competitive VC markets, VC investors are forced to offer better conditions to ventures' entrepreneurs in order to secure promising investment opportunities. In fact, Gompers and Lerner find that pre-money valuations are higher in more competitive VC markets. Rational entrepreneurs whose companies are located in an area where there is a highly competitive VC market will be more likely to look for external equity as they expect to incur lower dilution costs.

Above, we argued that proximity to a large (and competitive) VC market encourages entrepreneurs to look for external equity. Long distance from prospective VC investors is not the only geographical factor discouraging companies from seeking external financing: national

barriers may also play a strong negative role. Cross-border investments entail additional uncertainty in terms of regulations, tax policies, and cultural norms, and greater due diligence costs for VC investors (Cumming and Macintosh, 2003; Wright et al., 2005). This in turn increases the search costs that entrepreneurs incur while looking for VC abroad and reduces the likelihood of their search being successful.

In this paper we analyze how the location of European high-tech entrepreneurial ventures affects their propensity to seek external equity. We expect companies located in regions where the VC market is more developed and more competitive to be more likely to search for external equity(Carpentier and Suret, 2006). Moreover, we investigate how companies' propensity to look for external equity is influenced by the availability of VC outside of their regions or even their countries. We expect the geographic distance from large VC markets to discourage companies in their search for external equity. We also expect the size of foreign VC markets to have more limited influence on entrepreneurs' inclination to seek external equity compared to national markets.

Our empirical investigation is based on a sample of 524 high-tech entrepreneurial located in seven European countries – Belgium, Finland, France, Germany, Italy, Spain and the United Kingdom. For these companies we know whether and when they looked for external equity in the first 15 years of their existence. These companies answered to a survey administered in 2010 regarding their equity financing seeking history. Sample companies were extracted from the VICO database, created as a part of a research project funded by the European Commission within the 7th Framework Program (see www.vicoproject.org). The VICO database comprehends information on VC-backed and non VC-backed young high-tech companies located in Europe. It is particularly appropriate for our analysis because it includes companies located in different European countries and follows their development over time. The international dimension of the VICO database allows us to study VC markets with heterogeneous levels of development, as measured by the ratio of national VC investments to GDP (OECD, 2013; Bertoni et al., 2015b) and to assess the impact of national borders on companies' demand for external equity. Moreover, the geographical distribution of VC within each of the seven national markets is also heterogeneous. Martin et al. (2005), for instance, show that the UK presents one main hub of VC activity (the London metropolitan area), while in Germany the industry is more evenly spread across six centers. The panel dimension of the VICO database is also interesting for our purposes. Our dataset includes observations between 1984 and 2009, giving us the opportunity to observe the development of the different VC markets over 25 years. We complemented company-level information from the VICO database with VC market-level data on the size, structure and geographical distribution of the VC markets over time. These latter information were extracted from Thomson One.

Results support the view that location is a key driver of companies' propensity to look for external equity. The availability of an abundant supply of VC in the regions where companies are located plays a major positive role, while the concentration of the local VC market does not significantly influence companies' propensity to look for external equity. As we expected, the

positive impact on demand of the size of the VC market rapidly declines with an increase of its geographical distance from companies' location, vanishing at a distance greater than 250 km. In addition, we find that the availability of VC outside national borders does not affect companies' propensity to look for external equity, independently of geographic distance. This evidence is in line with the view that national borders represent a crucial barrier for entrepreneurs seeking external equity.

The paper proceeds as follows. In section 2, we present the data used in this paper. In section 3, we describe the econometric model. Results are presented in section 4. In section 5, we conclude the paper with a summary of our main results, a discussion of the contribution of the paper to the VC literature, indications on limitations and directions for future research, and managerial and policy implications.

2 Data

2.1 Sample

We analyze a sample composed of 524 European high-tech entrepreneurial ventures that replied to an on-line survey we administered in 2010. The sample is extracted from the VICO database[2], which includes detailed information for a large sample of high-tech entrepreneurial companies operating in seven European countries: Belgium, Finland, France, Germany, Italy, Spain and the United Kingdom. All companies included in the sample are founded after 1984, are independent at foundation (i.e., not controlled by other business organizations), and operate in the following high-tech manufacturing and services industries: nanotechnology, biotechnology, pharmaceuticals, computers, electronic components, telecommunications equipment, precision, optical and medical instruments, robotics, aerospace, software, telecommunications services, internet and multimedia services, web publishing, renewable energies, R&D and engineering services. The VICO dataset includes two strata of companies: a sample of 759 VC-backed companies and a control group of 7,611 non-VC-backed companies that are potential investee (Bertoni and Martì Pellon, 2011: p. 5). Companies (both VC-backed and non-VC-backed) in the VICO dataset are observed from the foundation date up to 2010 (or to the time they ceased operations or were acquired). VC-backed companies received equity (or equity-like) financing in the early stages of their life in the years from 1994 to 2004, and were less than ten years old at the time of the first VC investment. As is common in the VC literature, the VICO dataset does not include leverage buy-outs (LBOs), real estate, distressed debt funds and other private equity investments. Data related to VC-backed firms were collected via random extraction from commercial databases (i.e., Thomson One, VC-PRO, and Zephyr) and country-specific proprietary datasets, including the yearbooks of the Belgium Venture Capital Association and

[2]The VICO dataset was built thanks to the joint effort of nine universities across Europe with the support of the 7th European Framework Program. For more details on the procedures used in the data-gathering process and on all of the variables included in the dataset, see Bertoni and Martì Pellon (2011). For more information on the VICO project, please visit the dedicated website www.vicoproject.org.

the Finnish Venture Capital Association, the ZEW Foundation Panel (Germany), the Research on Entrepreneurship in Advanced Technologies (RITA) directory and Private Equity Monitor (Italy), the Webriesgo Database (Spain), and the Library House, which is now called Venture Source (the UK). Moreover, the data were cross-checked with those available from public sources (e.g., websites and annual reports of VC investors, press releases and press clippings, and initial public offering prospectuses). A central data collection unit ensured that the information was consistent across countries. This data collection process ensures that the VICO dataset offers a more accurate coverage of VC investments in European countries than the one provided by available commercial databases. The non-VC-backed firms were included in the VICO dataset following the same criteria (country, age, independence, industry, and legal status) used for the inclusion of the VC-backed firms and were randomly extracted (conditional on these criteria) from all available vintage years of Bureau van Dijk's Amadeus database. Also in this case, other sources were used to improve the coverage of the dataset, such as industry associations and Chambers of Commerce directories, commercial firm directories, Zephyr, Creditreform, the ZEW Foundation Panel, and the RITA directory.

In February 2010, an online survey was administered to VICO companies in order to collect information on the demand for VC. The survey was sent to 730 VC-backed and 4704 non VC-backed companies for which we had an email address. Respondents had to ask "*Yes*" or "*No*" to the question "*Has your company ever sought equity financing from sources other than founders, their family members and friends?*". For companies that answered "*Yes*", we also asked when they actually sought. The possible non-exclusive answers were: "*before or at the time of foundation; in the first 2 years after foundation; between the 2nd and the 5th year from foundation; between the 5th and the 10th year from foundation; after the 10th year from foundation.*".[3] We sent reminders between February and April 2010. In order to increase the response rate of VC-backed companies (who arguably were more likely to seek VC) we complemented the online survey with phone interviews. Eventually, we received 284 answers from VC-backed companies (response rate of 38.9%) and 536 answers from control group companies (response rate of 11.4%). In this paper we use the questionnaires of 524 companies (175 VC-backed and 349 control group) for which we have a full set of information.

2.2 Sample descriptive statistics

Out of 524 sample high-tech entrepreneurial ventures, 248 (47.3%) actively sought equity financing in their life. Table 1 provides a cross tabulation of the frequencies of companies that looked for external equity and those that eventually closed a deal and received VC. The two groups of companies are closely related. In our sample, the vast majority of VC-backed companies did actively seek equity capital (84.6%) while 15.4% obtained VC without looking actively

[3]In order to reduce retrospective bias and to increase response rates, we decided not to inquire about companies' seeking behavior on a year by year basis. That option would have meant to administer a much longer survey, with a much higher level of detail, and it would have led to less complete and reliable answers. Instead, we collected information on companies' seeking history in 5 periods of their early life, relatively easy to identify and remember.

for external equity. Moreover, 28.7% of companies that never closed a deal looked for external equity, while the remaining 71.4% never did.

[Insert Table 1 around here]

Table 2 provides a breakdown of seeking and non-seeking companies by industry, country and foundation year in our sample. Companies in Biotech & Pharmaceutical and in Telecommunications are more likely to look for equity capital with respect to companies operating in other sectors. For what concerns the country distribution, companies located in Belgium, UK and France are characterized by above average probability of seeking external equity. Finally, relatively younger companies (especially those born between 1997 and 2000) in our sample have higher seeking rates. χ^2 tests prove that differences between seeking and non seeking companies are significant by country and foundation year classes and almost significant by industry.

[Insert Table 2 around here]

In Figure 1 we show the age at which our sample companies looked for external equity. Entrepreneurial ventures may have looked for capital in more than one period in their lives, however most of them sought between the 3^{rd} and the 5^{th} year after foundation, while few of them did it after the 10^{th} year.

[Insert Figure 1 around here]

2.3 The geographical distrubution of VC investments in Europe

We retrieved information about the geographical distribution of VC investments in Europe from Thomson One database. On the 26^{th} of February 2016, we downloaded from Thomson One the full list of VC investments carried out between 1980 and 2010 by European VC investors (44,126 investments in total). Figure 2a shows the evolution of the total number of investment rounds and of first investment rounds made by European investors between 1990 and 2010 (the number of investment rounds before 1990 is very close to 0). The number of investments increased steeply since the 90s, spiking in year 2000 (around 2500 investments) and falling in 2002 (to around 1000 investments) as a result of the dot-com bubble. Interestingly, another jump is evident in 2003-2004 and is constituted largely by follow-up rounds (as shown by the difference between the curves of total rounds and first rounds).

In Figure 2b we show the number of active investors per year. We consider an investor to be active if it has made at least one investment in the focal year. The graph shows again a peak of active investors (close to 800) in 2000, and a following shake-out, although this latter seems to be relatively small when compared to the figure about investments. The number of investors active in first rounds is (quite constantly from 2002) nearly half of the total number of active investors.

[Insert Figure 2 around here]

For each investment, Thomson One records information about the address at which the headquarters of both the VC investor and the target company are located, which we used to identify the geographical regions. In particular, we defined geographical regions based on the Nomenclature of Territorial Units for Statistics (NUTS) created by the European Commission. The NUTS classification is a single, coherent system for dividing the European Union's territory in order to produce regional statistics for the community. The NUTS classification is based on three hierarchical levels: NUTS1 (major socio-economic regions), NUTS2 (basic regions used by the European Commission for the application of regional policies) and NUTS3 (small regions for specific diagnoses). Eurostat set up the NUTS classification at the beginning of the 1970s, and it has updated the classification several times since then, according to changes in the regional breakdown of a country. In this paper, we use the NUTS 2010 classification, introduced on 7 February 2011 (Commission Regulation (EU) No 31/2011) at the NUTS2 level. The European Union's territory is subdivided in 270 NUTS2 regions. On average, a NUTS2 region has an area of 16,310 km^2, equivalent to a radius of 40.67 km (Eurostat, 2011).

In order to attribute a NUTS2 regions to each VC investor and target company, we first translated the textual information on their ZIP code, city and country provided by Thomson One into numerical information on the latitude and longitude coordinates. This process, called geocoding, was automated using Google Maps Geocoding API and the R command "geocode". We then used geographical data on the administrative boundaries of each NUTS, retrieved from Eurostat's website, to link each pair of coordinates with a NUTS2 (2010) identifier.

Figures 3 and 4 show the number of investments by location (at the NUTS2 level) of investors and of invested companies cumulated over the period 1980-2010, respectively. Interestingly, we find extremely similar representation of regions in the ranking. The Inner London and the Île de France (Paris) regions stand out quite sharply: the former ranks first in the number of investors while the latter ranks first in the number of invested companies.

Figure 5 presents further evidence about the co-location of investors and invested companies in Europe. In the figure, we plot the percentage of investments with at least one investor located in the same country and NUTS2 region where the invested company resides. In the 1990, at least one of the investors was located in the same NUTS2 region of the portfolio company in 18.8% of the investments, and in the same country in 70.8% of cases. The tendency to co-locate increased in time. In 2010, the percentages of investments in which one of the investors is located in the same location of the portfolio company are 44.3% at NUTS2 level and 89.8% at country level. This trend may be a result of several factors. First, as the number of VC investors has increased in time, more VC hubs have emerged and the average distance from the portfolio companies has decreased. Second, VC investors often use syndication with a partner located close to the target company to access distant investment opportunities (Tykvová and Schertler, 2011). As the tendency of VC investors to syndicate also increased over time, this practice has become more and more common[4]. Third, VC investors types with a strong local focus (such as governmental and bank-affiliated VC, see Bertoni et al., 2015a) have also become

[4]According to our elaboration of Thomson One data, the average number of investors in a single deal went from 1.1 in the 90s to 1.5 in 2010.

more widespread over time.

[Insert Figures 3 , 4 and 5 around here]

3 Econometric model

In this section we study the effect of location on the demand for external equity by high-tech entrepreneurial ventures. Our dependent variable measures whether sample entrepreneurial ventures looked for external equity in a particular year or not. To build the variable, we combined the answers that our 524 sample companies gave to the survey questions on whether and when they ever sought equity financing from sources other than founders, their family members and friends. We constructed a time-varying variable that takes value of 1 in all years t in which a company i looked for external equity, and 0 otherwise. The variable $seeking_{i,t}$ is defined from one year before foundation to the 15^{th} year after foundation[5]. For VC-backed companies, we exclude from the sample all years after the actual receipt of the first VC round, since we are not interested in companies that seek follow-up financing rounds. Our observation period goes from 1984 (one year before the foundation of our youngest sample company) to 2009 (one year before the survey was administered). In figure 6 we plot the sum of $seeking_{i,t}$ by year. Most companies sought external equity in year 2000, an evidence that is pretty consistent with figures about total investments around the bubble period (Figure 2a).

[Insert Figure 6 around here]

Our aim is to investigate the effects of proximity to an abundant supply of VC on entrepreneurs' inclination to look for external equity (i.e. the demand side of the VC market). However, we cannot directly observe the actual supply of VC (i.e. the amount of money that European VC investors are willing / have at disposal to invest in new firms). Therefore, we used the number of VC investments that actually took place and the amount of VC invested as proxies for the supply of VC financing. Note that this is also what companies can actually observe. Thus, they take their decision whether or not to seek external equity based on the same information reflected in our measures.

Our main independent variables originates from the data extracted from Thomson One. To measure the local availability of VC, we construct a variable counting the number of new investments made by investors whose headquarters were located in each European region (NUTS2)[6]. We consider an investment to be *new* when the investor entered in a company for the first time. Our aim is to capture the availability of investors willing to enter in a venture that is new for them. In order to have more stability in time, for each region we summed the number investments in the last 3 consecutive years. The variable $availability\_local_{i,t}$ is the logarithm

[5]We decided to limit our analysis to companies younger than 15 years because of our focus on VC financing in an early stage of entrepreneurial ventures' life.

[6]Please note that, since the investments were assigned to a region on the basis of the investor location, a single round of investment can be counted more than once according to the number of syndicating investors.

of this number and represents the availability of VC in the region in which the company i is located in the 3 years before t[7].

We measure the level of competition in the local VC market with a classical C4 index[8]. More precisely, the variable $concentration\_local_{i,t}$ represents the percentage of new investments made by the top 4 investors in the region of company i in the last 3 years.

In order to assess the effect of geographical distance between companies' location and prospective VC investors on the demand for external equity, we built a distance-weighted index of the availability of VC outside the region where the focal company is located. Instead of considering all the 270 NUTS2 regions in Europe, we consider only the ones that ranked among the top 50 in terms of number of VC investments in a particular year. We call these 50 regions "VC hubs". We only consider the 50 VC hubs because they are likely to be the main drivers of companies decision to seek external equity. Investments in those 50 hubs represent 87.2% of the total number of investments. The additional advantage is that the computation burden is reduced. Our measure of the distance-weighted (non-local) availability of VC is defined as follows:

$$availability\_far_{i,t} = \log \sum_{l \in L_t, l \neq k_i} (distance_{i,l,t}^{-\alpha} * availability\_local_{i,t})$$

where L_t is the group comprising the 50 VC hubs, l denotes each of those hubs, $distance_{i,l,t}$ is the distance (in 10km) between company i and the centroid of the hub l (excluding the region where the company is located -k_i-, if it is a hub) and α is a decay factor for distance.

We also "split" the previous variable in order to disentangle the effect of the availability within national borders ($availability\_national_{i,t}$) and outside of the country $availability\_abroad_{i,t}$. Both measures are distance-weighted indexes of availability of investments analogous to $availability\_far_{i,t}$. They are defined as follows:

$$availability\_national_{i,t} = \log \sum_{l \in C_{i,t}, l \neq k_i} (distance_{i,l,t}^{-\alpha} * availability\_local_{i,t})$$

$$availability\_abroad_{i,t} = \log \sum_{l \in \overline{C_{i,t}}, l \neq k_i} (distance_{i,l,t}^{-\alpha} * availability\_local_{i,t})$$

where $C_{i,t}$ is the group of VC hubs within the country where the company i resides and $\overline{C_{i,t}}$ is the group of cross-border VC hubs ($C_{i,t} \cup \overline{C_{i,t}} = L$).

We set α to the value that maximizes the log-likelihood function of our econometric model (for a similar approach see Bonaccorsi et al., 2014). A detailed description of the procedure we used to estimate decay parameter values is given in the Appendix A. According to this procedure, the optimal decay parameter values are 0.4 for $availability\_far_{i,t}$, 1 for $availability\_national_{i,t}$ and 0.3 for $availability\_abroad_{i,t}$. Calibrated parameters higher than 0 suggest that distance from VC hubs matters for companies tendency to look for external equity.

[7] As robustness checks, we performed similar analyses using in alternative the new investments made in the last 5 years or in the last year only. We also repeated the analysis considering, instead of new investments, all investment rounds and first investment rounds only. In all cases, we obtained similar results, which are available from the authors upon request.

[8] We alternatively use a Herfindahl-Hirschman index, obtaining similar results

Moreover, the high parameter for $availability\_national_{i,t}$ indicates that importance of VC availability decays faster with distance within national borders than across borders. Henceforth, for sake of simplicity we omit the index i, t that we used to better explain our variables.[9]

The econometric model also includes a set of industry, country and year dummies and a continuous variable measuring the age of the company.

For a subset of companies, we also have information about the human capital of the founding team, the internal availability/composition of capital and the innovativeness of the venture, all of which have been identified by previous literature as important drivers of companies' tendency to seek external finance (Eckhardt et al., 2006; Cosh et al., 2009; Mina et al., 2013). Our sample companies were inquired about the human capital of founders in the survey administered in 2010. In particular, we asked whether "*among the founders of the company there were individuals who, before the foundation of the company: i) had previous managerial experience, ii) had founded one or more firms, iii) had obtained an MBA or a master in Economics and iv) had obtained a PhD in technical or scientific disciplines*". We code the answers to these questions in 4 dummy variables: *manager*, *serial*, MBA and $PHD\_science$. We measure the availability of capital by the variables $cashflow/sales$, equal to the ratio between cash flow and sales, and $debt/totalassets$, equal to the ratio between total debt and total assets. Both of these variables are lagged by 1 year and winsorized at the 1% level to reduce the impact of outliers. The accounting data necessary to compute these ratios is available in the VICO dataset and was originally retrieved from Bureau Van Dijk's Amadeus dataset. We proxy companies' innovativeness by the variable *patentstock*, equal to the cumulative number of patents granted to each company, depreciated over time (with a 0.15 knolwedge depreciation rate, as is usual in the patent literature, see e.g. Hall et al., 2005). All these variables are inserted in the model specification as controls. We also control for two variables measured at NUTS2 level in each year: the logarithm of the GDP per capita ($local\_GDP\_percapita$) and the logarithm of the number of patents granted ($local\_patents$), both of which were retrieved from Eurostat. A summary of all variables used in our analysis is provided by table 3, while table 4 shows summary statistics and the correlation matrix.

[Insert Tables 3 and 4 around here]

4 Results

The econometric model is estimated using a panel random effects specification, which estimates the linear probability of looking for external equity for company i in year t. The results of the econometric estimates are reported in Table 5. The different columns represent different model's specifications. Every model includes as regressor company age and three sets of dummies capturing industry, country and year effects. In columns 1, we include the main independent variables: the local VC availability, the level of competition in the local VC market and the non-local VC availability. In column 2 we substitute the non-local VC availability with

[9] Please note that in all models all variables were lagged 1 year in order to reduce concerns about endogeneity.

two components: the national VC availability and the VC availability abroad. All the non-local variables are distance-weighted using the optimal decay parameter values for distance, as described in detail in Appendix A. In columns 3 and 4, we include additional control variables in order to account for company-specific and region-specific effects. The number of observations when we consider these additional controls decreases to 421 companies, because of missing values.

The local VC availability has a positive effect on companies' propensity to look for external equity, as shown by the positive and significant coefficient (at least at 10% level) of *availability_local*. On the contrary, entrepreneurial ventures' propensity to seek external equity seems not to be significantly affected by the level of competition in the local VC market. The variable *concentration_local* though negative, is never significant in all our models. The distance weighted non-local availability $availability\_far$ has a positive coefficient (in columns 1 and 3), significant at the 1% level, indicating that companies' propensity to look for external equity is positively influenced by proximity to large VC markets outside of their regions. However, this effect is driven by the national VC market. In fact, columns 2 and 4 of table 5 show that *availability_national* has a positive and significant (at the 1% level) effect on the companies' propensity to look for external equity, while *availability_abroad* is non-significant at standard significance levels.

[Insert Table 5 around here]

It is important to investigate the economic magnitude of the effects illustrated above, and how rapidly the magnitude decreases with geographic distance. For this purpose, let us consider Figure 7. The figure shows the magnitude of the effects of local and national VC availabilities, estimated using the model specification presented in column 4. The graph shows the effects of an increment in the number of investments in a given region on the probability that a company actively seeks external equity financing if it is located in the same region (effect of the local availability) or in a different region of the same country, as a function of the distance from that region (effect of the national availability).

We consider an increment of 22 investments, equal to a change from the 25^{th} (1) to the 75^{th} (23) percentile of the number of new investments in the last 3 years over all NUTS2 region. For sake of example, this hypothetical shock would correspond to a move from Alsace to Karlsruhe region in 2002. The effect of the shock in local availability leads to an increase in the likelihood of a focal company looking for external equity in a given year equal to 4.7%, computed as 0.019 (i.e. the coefficient of *availability_local* in column 6 of table 5) multiplied by the shock in the local availability (log(23+1)-log(1+1)). In other terms, in 2002 companies located in Karlsruhe had a probability to look for external equity 4.7 percentage points higher than those located in Alsace, only because of location effects. Since the unconditioned probability of looking for equity financing in our sample is equal to 18.3% (see Table 4), this difference is sizable and represents an increase of around one fourth. The effect of the shock in the availability of VC in the region where a company is located is always greater than that of a similar shock in another region. The shock in the size of the VC market considered above (+22 investments) leads to

a 3.5% increase of the probability that a company located at 100 km from this market looks for external equity. The increase is 1.93%, 1.06% and 0.06% for companies located 250 km, 500 km and 1000 km away from the focal market, respectively. In other words, in our example companies located 250 km away from Karlsruhe area are ceteris paribus only 1.93 percentage points more likely to search than companies located 250 km away from Alsace region, and so on.

[Insert Figure 7 around here]

Let us turn our attention to control variables. Companies' age does not seem to have an influence on the probability to look for external equity, once we add to the model specification firm- and region-specific controls. The estimates in columns 3 and 4 of table 5 support the view that the human capital of the founders positively affect companies' propensity to look for external sources of finance (Eckhardt et al., 2006). In fact, our measures of founders' previous managerial experience, MBA and PhD, have a positive and significant (at the 10% level) effect on the dependent variable. Companies with more cash flow are significantly (at the 1% level) less likely to look for external equity. This result is in line with the pecking order theory, according to which companies prefer to finance new projects with internal cash flows with respect to relatively more costly external capital (Cosh et al., 2009; Myers and Majluf, 1984). Debt on total assets exerts a positive effect (significant at the 10% level) on companies propensity to look for external capital, in line with to prior studies (Cosh et al., 2009; Mina et al., 2013). The same holds true for companies with a greater patent stock (significant at the 5% level), possibly because these firms can use their IPR as collateral. The positive and significant (at the 1% level) coefficient of regional GDP per capita indicates that companies located in more developed regions are more inclined to look for external equity. The opposite applies to companies located in regions where more patents are filed, as indicated by the negative and significant (at the 1% level) coefficient of the logarithm of patents in the region. This effect may be due to the fact that more innovative regions have in place more comprehensive support systems for high-tech entrepreneurial ventures, partially compensating for the need for external equity.

4.1 Robustness checks

We performed several robustness checks. First of all, we are concerned about the presence in our sample of companies that did not look for external equity simply because they were extremely unlikely to receive it, irrespectively of their location. However, detecting ex-ante whether a company is a candidate to receive VC is not an easy job. In order to overcome this issue, we exploit the information about the actual receipt of VC financing. In particular, we build a sample composed of VC-backed companies and non-VC-backed twins with the rationale that the companies included in this sample have similar probability of receiving VC, thus making the sample more homogeneous. This is in line with the suggestion by Ho et al. (2007) to use matching as a pre-processing technique so that the potential for confounding bias is significantly reduced compared to the parametric analysis based on raw data. We computed the probability

that a company is actually financed by VC, i.e. the propensity score, using all company-year observations for non-VC backed companies and the company-year observations in the year when VC-backed companies actually receives the first financing round. In particular, we estimate a probit model with age, industry and year dummy variables (whose values are non-missing for all company-year observations) and predict the estimated probability of receiving VC. Then, we performed a 1 to 2 matching, in other words we associated to each VC-backed company two non VC-backed companies having a similar probability (i.e. within a caliper) of obtaining VC. This was done without replacement, i.e. a non VC-backed company was not eligible to be matched more than once. We decided to adopt a 1 to 2 matching in order not to reduce too much the number of observations while effectively reduce uncontrolled heterogeneity in our sample and consequently the potential confounding bias. We restrict the matched sample imposing the company-year observations to be in the common support, in other words we dropped observations whose estimated propensity score is higher than the maximum or lower than the minimum propensity score of VC-backed companies. We obtained that an observation referred to a VC-backed company in the year when it received VC (e.g. company x_1 year t_1) was matched with an observation referred to a non VC-backed company in certain year (e.g. company x_0 year t_0) by minimizing the distance in terms of propensity score. Then, for company x_1 and x_0, we keep in the "matched sample" all company-year observations until year t_1 and t_0 respectively. We then checked that our matched sample have acceptable balancing properties, e.g. by graphing the pre- and post-matching propensity scores distribution. The results of the models estimated using the "matched sample" are reported in table 6. The results relating to the effects of proximity to an abundant supply of VC are very similar to those illustrated above. Note that in these estimates the concentration of the local VC market has a (weakly) significant negative effect on the probability to seek external equity.

[Insert Table 6 around here]

Second, we are also concerned about potential reverse causality. A company actively seeking external equity may decide to locate in a place with high (local) availability of VC, in other words companies' localization choice may be endogenous. We cannot directly rule out reverse causality. The best we can do is to assess its alleged effect on our estimates. One can assume that companies that did not look for external equity at the time of foundation or before are unlikely to have selected their location according to the local availability of VC.[10] Therefore, we decided to estimate the model excluding companies that indicated in the questionnaire that they were looking for external equity at foundation or before. The results are reported in table 7. While the coefficient of *availability_local* is smaller and less significant, the remaining results are unchanged. Therefore, it is unlikely that our results are driven by reverse causality.

[10] In accordance with this assumption, we find a positive and significant correlation (controlling for country, industry and year dummies and age in a cross-sectional probit model) between the fact that a company looks for external equity at foundation or before and its location in one of the 50 VC hubs. Conversely, we do not find a significant correlation (same specification as before) between the fact that a company looks for external equity in other period of its life except at foundation or before and its location in one of the 50 VC hubs. This empirical evidence suggests that only companies seeking external equity at foundation or before may have decided where to locate according to the availability of VC across regions.

[Insert Table 7 around here]

Third, we decided to further validate the robustness of our results by changing the specification of the model, i.e. using different key independent variables as proxies of the "spatial" availability of VC. In particular, we build variables indicating the availability of VC within a certain radius: for example $availability\_d_0 - d_1\_km$ is computed as the log of the number of new investments made by investors located at a distance between d_0 and d_1 kilometers from the focal company. We decided to use 0, 50, 250, 1000 and 5000 kilometers as threshold in order to balance the need for a sufficiently fine-grained measure of distance and the risk of collinearity between those variables. We also checked for the sensitivity of our results to the chosen thresholds (for the sake of synthesis, these additional estimates are not reported in the paper and are available from the authors upon request). Moreover, we differentiated between the "radius" availability inside the same country where the focal company is located, $availability\_national\_d_0 - d_1\_km$, and the availability abroad, $availability\_abroad\_d_0 - d_1\_km$. The results of the models with this "radius" specification are reported in table 8. In line with the evidence illustrated earlier, they indicate that companies are more inclined to look for external equity if they are located nearby a large VC market (i.e. at less than 250 km). However, the effect of demand of the availability of an abundant supply of VC vanishes across national borders, independently of geographical distance[11].

[Insert Table 8 around here]

5 Discussion and conclusion

The aim of this paper was to assess how the geographic distribution of the supply of VC affects entrepreneurs' propensity to look for external equity (i.e. the demand side of the VC market). For this purpose, we have examined the search for external equity by a sample of 524 European high-tech entrepreneurial ventures observed over 25 years. Our results indicate that the location of high-tech entrepreneurial ventures deeply affects their propensity to look for external equity. Companies located in proximity of a VC hub, where there is abundant supply of VC, are considerably more likely to look for external equity. However, the positive influence of a large VC market rapidly decreases with greater geographical distance and becomes negligible at a distance higher than 250 km. The same applies when crossing national borders: companies' propensity to seek external equity is not influenced by VC hubs located beyond national borders, independently of distance.

These results contribute to the literature on VC in several ways. In recent years, considerable attention has been devoted to the study of the "geography of VC", i.e. the study of how VC investments are spatially distributed. The uneven distribution of VC investments is typically

[11]We further checked the robustness of our results by repeating the "radius" model estimation using the matched sample and on the sample obtained by excluding firms seeking external capital at foundation or before. Results of these estimates (available from the authors) confirm that the positive effects on demand of an abundant supply of VC are very localized, and vanish across borders.

attributed to supply-side factors, such as the strong geographic concentration of VC investors and their preference to invest locally (Chen et al., 2010; Lindgaard Christensen, 2007; Mason and Harrison, 2002). The handful of studies that focus on demand-side factors suggest that companies located outside of VC hubs self-select out of the VC market (Bertoni et al., 2015b; Mason and Harrison, 2002). We add to this literature by showing that a large supply of VC stimulates the demand for external equity by companies located within a radius of 250 km. These results confirm that geographical distance between entrepreneurial ventures and prospective investors is a source of considerable costs for entrepreneurs, thereby reducing their inclination to seek external equity. In addition, we show that lack of competition in the local market does not discourage entrepreneurs from looking for external equity. Second, we add to the literature on cross-border VC investments. This literature focuses on the potential benefits for entrepreneurial ventures of partnering up with international VC investors, as these latter may offer access to their local market and better exit opportunities (Mäkelä and Maula, 2005; Bertoni and Groh, 2014). However, international investments also bring about substantial costs, associated for example to differences in regulations and culture (Cumming and Macintosh, 2003; Wright et al., 2005). The evidence that companies' propensity to look for external equity is not affected by the availability of VC beyond their national borders indicates that, in the eyes of entrepreneurs, the expected costs of cross-border VC are often not compensated by the expected benefits.

We also contribute to the literature on the search for external finance of entrepreneurial ventures. So far, very few studies have analyzed the decision made by entrepreneurial ventures to look for external equity financing (Cosh et al., 2009; Eckhardt et al., 2006; Mina et al., 2013). To the best of our knowledge, Bertoni et al. (2015b) were the only to consider how the local supply of VC affects the demand. Based on data on Italian ventures, they find that when the local VC market is thin, only a small fraction of companies is willing to incur the entry cost required to be in the VC market. We extend this work to an international setting, which allows us to assess the role of national borders, and provide an in-depth analysis of the influence on the demand for external equity exerted by geographical distance between entrepreneurs and prospective investors, located both within and across national borders.

As any study, this work has some limitations which opens up new directions for future research. First, in this paper we consider the stimulating effect on the demand for external equity generated by proximity to a large supply of VC. However, in addition to size, other characteristics of the VC supply may influence entrepreneurs' propensity to look for external equity. In particular, VC markets may differ depending on the investment experience of investors, and their ownership and governance (e.g. private versus governmental VC, independent versus captive VC, etc.). As the objectives and competencies of different investors clearly differ, the expected benefits and costs for entrepreneurs of seeking VC may also differ. For example, we expect that an abundant supply of governmental or bank-affiliated VC, which generally invest locally, will not stimulate demand at distance, while the opposite holds true for VC markets populated by corporate VC investors, which tend to invest on a global scale. Second, following

a consolidated tradition in the Industrial Organization literature, we have inversely proxied the level of competition in local VC markets with concentration indexes. In so doing, we have neglected syndication, which may clearly influence competition. Third, while in this paper we focus on the geographical distance between entrepreneurial ventures and prospective VC investors, we have not considered the impact of other types of distance, such as cultural or institutional distance (Nahata et al., 2015). These factors may clearly influence the costs incurred by entrepreneurs in searching for VC and their expectations relating to the likelihood of success of their search. Fourth, while this study considers a 25 years period, we have assumed the effect of geographical distance on the demand for external equity to be stable over time. Indeed, the fast development of ICT and of the transportation system, especially on international scale, may have led to a reduction of the importance of physical proximity between prospective investors and entrepreneurs in inducing these latter to search for external equity. More generally, it would be interesting to assess how the regional endowment of physical transportation infrastructure (i.e. proximity to a hub airport) and advanced telecommunications infrastructure moderates the effect of geographical distance on entrepreneurs' demand for external equity.

In spite of the above limitations, our study provides novel results which have important policy implications. Our results clearly highlight the role of geographical distance in discouraging entrepreneurs' search for external equity. This evidence brings to the fore the issue of how promising ventures located in peripheral areas (i.e. areas that are far from VC hubs) can be helped to get in touch with prospective VC investors. Moreover, the result that the demand for external equity is not influenced by VC hubs located beyond national borders, in spite of the unique benefits entrepreneurial ventures can reap from foreign VC investors, further documents the national fragmentation of the European VC market and its detrimental effects. In recent years the European Commission has made several steps to overcome national barriers to cross-border VC flows, most notably with the introduction of the VC passport (European Parliament, 2013). A replication of our analysis in some years from now would be extremely useful to asses the effectiveness of this move for the creation of a unified European VC market.

Tables & figures

Table 1: Number of sample companies seeking external equity and closing a deal with a VC investor

Sought equity financing	**Closed a deal**								
	Never closed			**Deal closed**			**Total**		
	No.	Col %	Row %	No.	Col %	Row %	No.	Col %	Row %
Non seeking	249	71.35	90.22	27	15.43	9.78	276	52.67	100.00
Seeking	100	28.65	40.32	148	84.57	59.68	248	47.33	100.00
Total	349	100.00	66.60	175	100.00	33.40	524	100.00	100.00
Pearson chi2(1) =	146.1973	Pr =	0.000						

Table 2: Number of sample companies seeking external equity: break down by industry, country and foundation year

	Sought equity financing								
	Non seeking			Seeking			Total		
	No.	Col %	Row %	No.	Col %	Row %	No.	Col %	Row %
Industry									
Biotech, Pharma, Other R&D	48	17.39	44.44	60	24.19	55.56	108	20.61	100.00
ICT manufacturing	60	21.74	56.60	46	18.55	43.40	106	20.23	100.00
Internet & Multimedia	15	5.43	53.57	13	5.24	46.43	28	5.34	100.00
Other Manufacturing	23	8.33	67.65	11	4.44	32.35	34	6.49	100.00
Software	123	44.57	53.71	106	42.74	46.29	229	43.70	100.00
Telecommunications	7	2.54	36.84	12	4.84	63.16	19	3.63	100.00
Total	276	100.00	52.67	248	100.00	47.33	524	100.00	100.00
Pearson chi2(5) =	8.6669	Pr =	0.123						
Country									
Belgium	20	7.25	38.46	32	12.90	61.54	52	9.92	100.00
Finland	38	13.77	51.35	36	14.52	48.65	74	14.12	100.00
France	38	13.77	43.68	49	19.76	56.32	87	16.60	100.00
Germany	17	6.16	58.62	12	4.84	41.38	29	5.53	100.00
Italy	66	23.91	69.47	29	11.69	30.53	95	18.13	100.00
Spain	72	26.09	59.50	49	19.76	40.50	121	23.09	100.00
United Kingdom	25	9.06	37.88	41	16.53	62.12	66	12.60	100.00
Total	276	100.00	52.67	248	100.00	47.33	524	100.00	100.00
Pearson chi2(6) =	26.3163	Pr =	0.000						
Foundation year classes									
1984-1988	36	13.04	65.45	19	7.66	34.55	55	10.50	100.00
1989-1992	39	14.13	65.00	21	8.47	35.00	60	11.45	100.00
1993-1996	41	14.86	49.40	42	16.94	50.60	83	15.84	100.00
1997-2000	78	28.26	45.35	94	37.90	54.65	172	32.82	100.00
2001-2004	82	29.71	53.25	72	29.03	46.75	154	29.39	100.00
Total	276	100.00	52.67	248	100.00	47.33	524	100.00	100.00
Pearson chi2(4) =	11.3405	Pr =	0.023						

Table 3: Variables description

	Variable	Description	Data source(s)
1	$seeking_{i,t}$	Dummy equal to 1 in the year when the company look for outside equity financing. In order to build this variable we combined the questions *Has your company ever sought equity financing from sources other than founders, their family members and friends?* and the closed question about when they seek.	VICO survey
2	$availability\_local_{i,t}$	(Logarithm of the) sum of the number of investments made by each investor located (headquarters) in the region of company i in the time period $(t-2)$ to t. Please note that we consider only the "new" investments by an investor, i.e. when an investor finances a firm for the first time.	Thomson One
3	$concentration\_local_{i,t}$	Concentration of investments made by investors located (headquarter) in the region of company i in the time period $(t-2)$ up to t. Classical C4 measure, computed as the percentage of investments made by the top 4 investors in the time period $(t-2)$ to t.	Thomson One
4	$availability\_far_{i,t}$	A distance-weighted index of availability of investments outside the region where the company i is located. Formula: $\log \sum_{l \in L_t, l \neq k_i} (distance_{i,l,t}^{-\alpha} * availability\_local_{i,t})$ where L_t is the group comprising the 50 VC hubs, l denotes each of those hubs, $distance_{i,l,t}$ is the distance (in 10km) between company i and the centroid of the hub l (excluding the region where the company is located -k_i-, if it is a hub) and α is a decay factor for distance.	Thomson One and GoogleMaps
5	$availability\_national_{i,t}$	A distance-weighted index of availability of investments outside the region where the company i is located but in the same country. Formula: $\log \sum_{l \in C_{i,t}, l \neq k_i} (distance_{i,l,t}^{-\alpha} * availability\_local_{i,t})$ $C_{i,t}$ is the group of VC hubs of the country where the company resides, l denotes each of those hubs, $distance_{i,l,t}$ is the distance (in 10km) between company i and the centroid of the hub l (excluding the region where the company is located -k_i-, if it is a hub) and α is a decay factor for distance.	Thomson One and GoogleMaps
6	$availability\_abroad_{i,t}$	A distance-weighted index of availability of investments outside the country where the company i is located. Formula: $\log \sum_{l \in \overline{C_{i,t}}, l \neq k_i} (distance_{i,l,t}^{-\alpha} * availability\_local_{i,t})$ $\overline{C_{i,t}}$ is the group of VC hubs outside of the country where the company resides, l denotes each of those hubs, $distance_{i,l,t}$ is the distance (in 10km) between company i and the centroid of the hub l and α is a decay factor for distance.	Thomson One and GoogleMaps
7	$manager$	Dummy equal to 1 if among the group of founders of the company there were one or more individuals who had previous managerial experience (before the foundation of the company)	VICO survey
8	$serial$	Dummy equal to 1 if among the group of founders of the company there were one or more individuals who had founded one or more firms (before the foundation of the company), i.e. serial entrepreneur(s)	VICO survey
9	MBA	Dummy equal to 1 if among the group of founders of the company there were one or more individuals who had obtained an MBA or a master in Economics (before the foundation of the company)	VICO survey
10	$PhD\_science$	Dummy equal to 1 if among the group of founders of the company there were one or more individuals who had obtained a PhD in technical or scientific disciplines (before the foundation of the company)	VICO survey
11	$cashflow/sales$	Ratio between cash flow and sales, computed in the year $t-1$	VICO dataset
12	$debt/totalassets$	Ratio between total debt and total assets, computed in the year $t-1$	VICO dataset
13	$patentstock$	Depreciated number of granted patents for firms in manufacturing sector	VICO dataset
14	$local\_GDP\_percapita$	logarithm of the GDP per capita at the local (NUTS2) level in the year $t-1$	Eurostat
15	$local\_patents$	logarithm of the number of patents at the local (NUTS2) level in the year $t-1$	Eurostat

Table 4: Variables descriptive statistics and correlation matrix

	Variable	Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1)	seeking	0.183	0.387	0.000	1.000	1.000															
(2)	availability local	2.181	1.943	0.000	7.226	0.078	1.000														
(3)	concentration local	0.581	0.427	0.000	1.000	0.064	0.373	1.000													
(4)	availability far (α=0.4)	1.953	0.951	0.352	3.763	0.085	0.531	0.361	1.000												
(5)	availability national (α=1)	0.931	0.924	0.000	5.065	0.109	0.117	0.338	0.653	1.000											
(6)	availability abroad (α=0.3)	2.244	1.023	0.200	3.685	0.070	0.563	0.348	0.982	0.537	1.000										
(7)	age	5.610	4.237	-1.000	15.000	-0.049	0.195	0.117	0.256	0.119	0.271	1.000									
(8)	manager	0.641	0.480	0.000	1.000	0.110	0.042	-0.010	0.003	0.014	-0.006	-0.009	1.000								
(9)	serial	0.425	0.494	0.000	1.000	0.036	-0.029	-0.024	0.054	0.054	0.040	-0.027	0.366	1.000							
(10)	MBA	0.160	0.366	0.000	1.000	0.081	-0.001	0.020	0.033	0.041	0.034	-0.053	0.158	0.069	1.000						
(11)	PhD science	0.195	0.396	0.000	1.000	0.057	0.101	0.068	0.171	0.197	0.131	-0.143	-0.107	-0.012	0.152	1.000					
(12)	cash flow / sales	0.017	0.264	-1.392	0.991	-0.147	0.000	-0.015	0.003	-0.023	0.012	0.107	-0.091	-0.083	0.008	-0.069	1.000				
(13)	debt / total assets	0.084	0.215	0.000	2.833	0.076	0.129	0.116	0.207	0.130	0.215	0.127	0.003	0.005	-0.002	0.000	-0.070	1.000			
(14)	patent stock	0.035	0.225	0.000	7.214	0.112	0.035	0.044	0.069	0.124	0.041	0.005	0.062	0.077	0.029	0.113	-0.093	0.008	1.000		
(15)	local GDP percapita	25.062	9.825	8.000	98.400	0.120	0.716	0.156	0.460	0.274	0.464	0.151	0.063	-0.034	0.014	0.117	0.007	0.094	0.037	1.000	
(16)	local patents	5.424	1.256	0.513	8.114	0.033	0.632	0.236	0.319	0.140	0.313	0.106	0.035	-0.067	0.062	0.134	-0.027	0.035	0.061	0.553	1.000

Table 5: Seeking external equity: a panel random effect model

	(1)	(2)	(3)	(4)
availability local	0.011**	0.014**	0.016**	0.019**
	(0.005)	(0.006)	(0.008)	(0.008)
concentration local	-0.013	-0.017	-0.003	-0.007
	(0.014)	(0.014)	(0.017)	(0.018)
availability far (α=0.4)	0.480***		0.519***	
	(0.086)		(0.098)	
availability national (α=1)		0.053***		0.053***
		(0.013)		(0.015)
availability abroad (α=0.3)		0.089		0.028
		(0.094)		(0.109)
manager			0.061*	0.064**
			(0.033)	(0.032)
serial			-0.031	-0.030
			(0.031)	(0.030)
MBA			0.069*	0.070*
			(0.037)	(0.037)
PhD science			0.067*	0.064*
			(0.039)	(0.038)
cash flow / sales			-0.113***	-0.115***
			(0.022)	(0.022)
debt / total assets			0.053*	0.052*
			(0.029)	(0.029)
patent stock			0.071**	0.076**
			(0.030)	(0.030)
local GDP percapita			0.008***	0.007***
			(0.002)	(0.002)
local patents			-0.058***	-0.047***
			(0.014)	(0.014)
age	-0.005*	-0.004*	-0.003	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
N Obs.	5009	5009	3933	3933
N groups	524	524	421	421
pseudo-R2	0.065	0.060	0.095	0.089

Legend: The table reports coefficients and standard errors (in brackets) of panel random effects models whose dependent variable is *seeking*. Significance levels: * $p < 0.10$;** $p < 0.05$;*** $p < 0.01$.

Table 6: Seeking external equity: a panel random effect model on the matched sample

	(1)	(2)
availability local	0.017*	0.021**
	(0.009)	(0.010)
concentration local	-0.040*	-0.045*
	(0.024)	(0.025)
availability far (α=0.4)	0.237***	
	(0.066)	
availability national (α=1)		0.048**
		(0.024)
availability abroad (α=0.3)		0.148
		(0.168)
age	0.008**	0.008**
	(0.004)	(0.004)
Country dummies	Yes	Yes
Industry dummies	Yes	Yes
Year dummies	Yes	Yes
N Obs.	2059	2059
N groups	464	464
pseudo-R2	0.110	0.106

Legend: The table reports coefficients and standard errors (in brackets) of panel random effects models whose dependent variable is *seeking*. Significance levels: * $p < 0.10$;** $p < 0.05$;*** $p < 0.01$.

Table 7: Seeking external equity: a panel random effect model excluding companies seeking at foundation or before

	(1)	(2)
availability local	0.006	0.009*
	(0.005)	(0.005)
concentration local	-0.006	-0.009
	(0.013)	(0.014)
availability far (α=0.4)	0.402***	
	(0.082)	
availability national (α=1)		0.053***
		(0.013)
availability abroad (α=0.3)		-0.147
		(0.091)
age	0.004*	0.005**
	(0.002)	(0.002)
Country dummies	Yes	Yes
Industry dummies	Yes	Yes
Year dummies	Yes	Yes
N Obs.	4603	4603
N groups	438	438
pseudo-R2	0.095	0.091

Legend: The table reports coefficients and standard errors (in brackets) of panel random effects models whose dependent variable is *seeking*. Significance levels: * $p < 0.10$;** $p < 0.05$;*** $p < 0.01$.

Table 8: Seeking external equity: a panel random effect model with "radius" specification

	(1)	(2)	(3)	(4)
availability 0-50 km	0.013**	0.015**		
	(0.005)	(0.007)		
availability 50-250 km	0.017***	0.016**		
	(0.006)	(0.007)		
availability 250-1000 km	0.015	0.010		
	(0.014)	(0.017)		
availability 1000-5000 km	-0.001	-0.003		
	(0.028)	(0.034)		
availability national 0-50 km			0.014***	0.016**
			(0.005)	(0.007)
availability national 50-250 km			0.015**	0.014*
			(0.006)	(0.007)
availability national 250-1000 km			0.002	0.007
			(0.006)	(0.008)
availability national 1000-5000 km			0.018	0.042
			(0.036)	(0.064)
availability abroad 0-50 km			-0.009	-0.000
			(0.029)	(0.032)
availability abroad 50-250 km			0.005	0.006
			(0.006)	(0.007)
availability abroad 250-1000 km			0.016	0.014
			(0.011)	(0.014)
availability abroad 1000-5000 km			-0.004	-0.003
			(0.027)	(0.033)
manager		0.065**		0.064**
		(0.029)		(0.029)
serial		-0.027		-0.028
		(0.028)		(0.028)
MBA		0.071**		0.069**
		(0.034)		(0.034)
PhD science		0.056		0.058
		(0.035)		(0.035)
cash flow / sales		-0.120***		-0.121***
		(0.022)		(0.022)
debt / total assets		0.057**		0.058**
		(0.029)		(0.029)
patent stock (manufacturing)		0.082***		0.082***
		(0.030)		(0.030)
local GDP percapita		0.007***		0.006***
		(0.002)		(0.002)
local patents		-0.046***		-0.045***
		(0.013)		(0.013)
age	-0.004*	-0.003	-0.004*	-0.003
	(0.002)	(0.003)	(0.002)	(0.003)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
N Obs.	5009	3933	5009	3933
N groups	524	421	524	421
pseudo-R2				

Legend: The table reports coefficients and standard errors (in brackets) of panel random effects models whose dependent variable is *seeking*. Significance levels: * $p < 0.10$;** $p < 0.05$;*** $p < 0.01$.

Figure 1: Percentage of sample companies seeking external equity by age classes

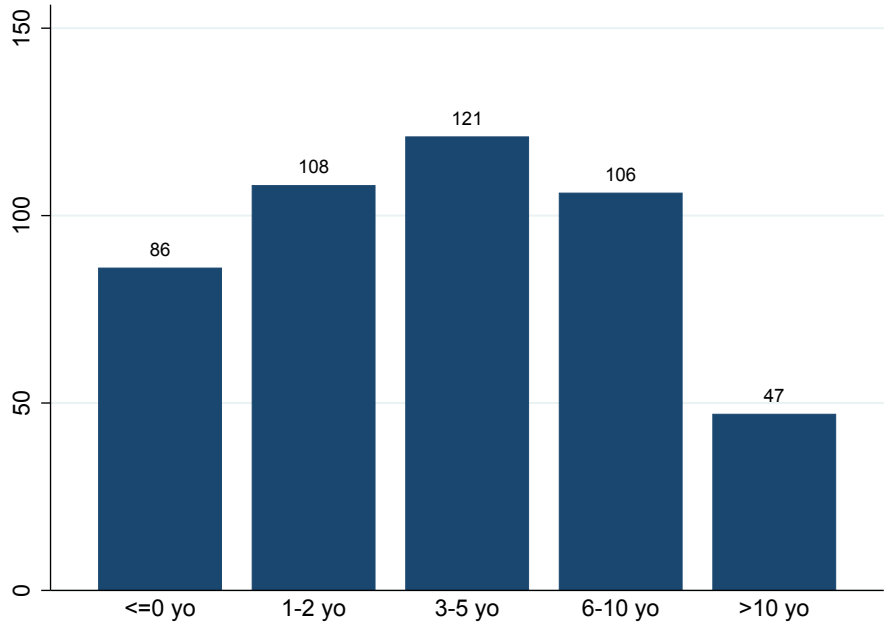
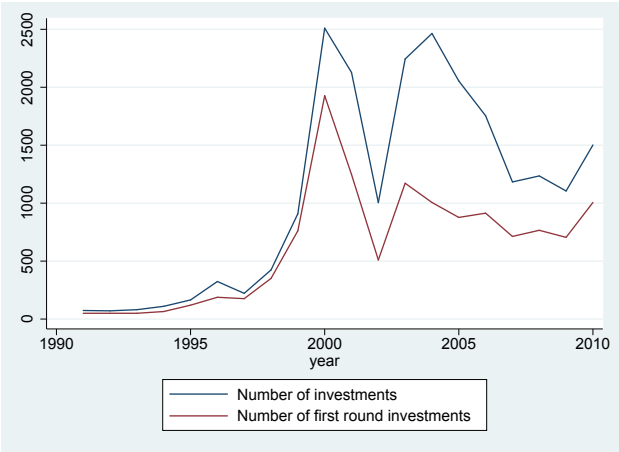
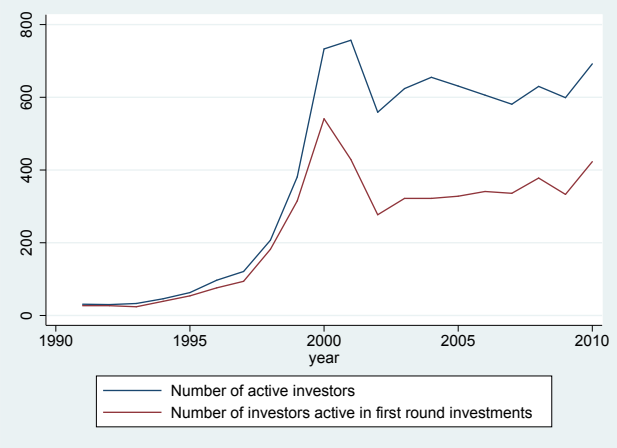


Figure 2: Total number of investments made by European investors and total number of active European investors



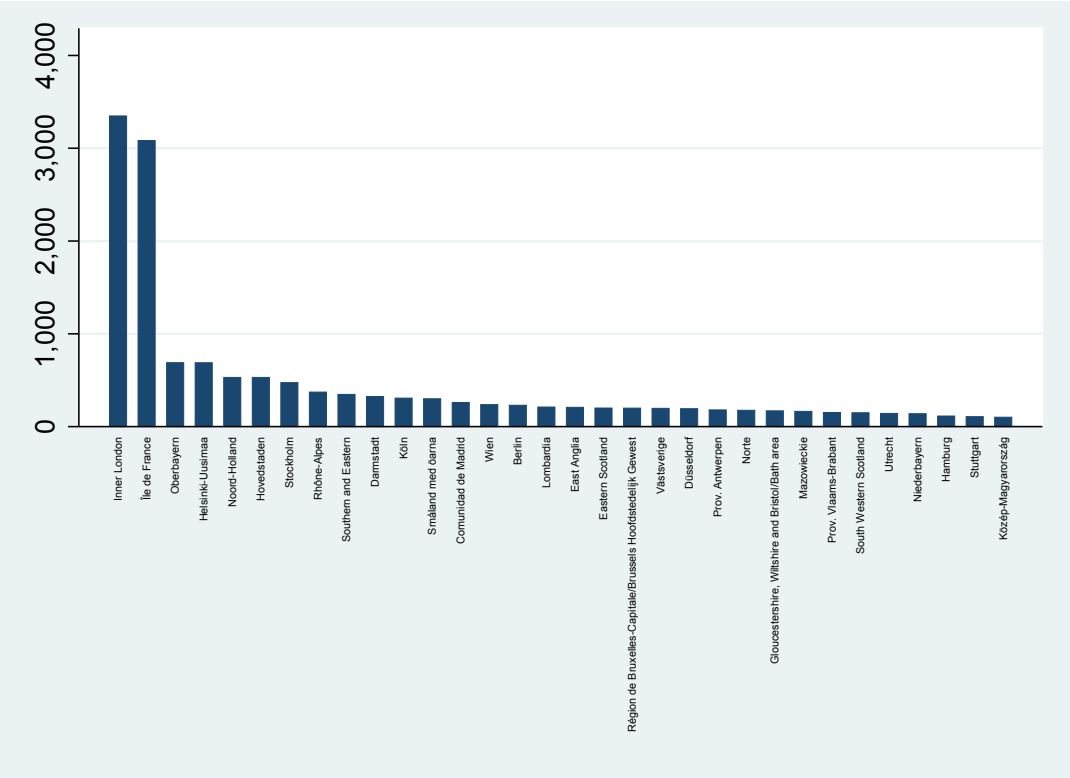
(a) Total number of investments



(b) Total number of European investors

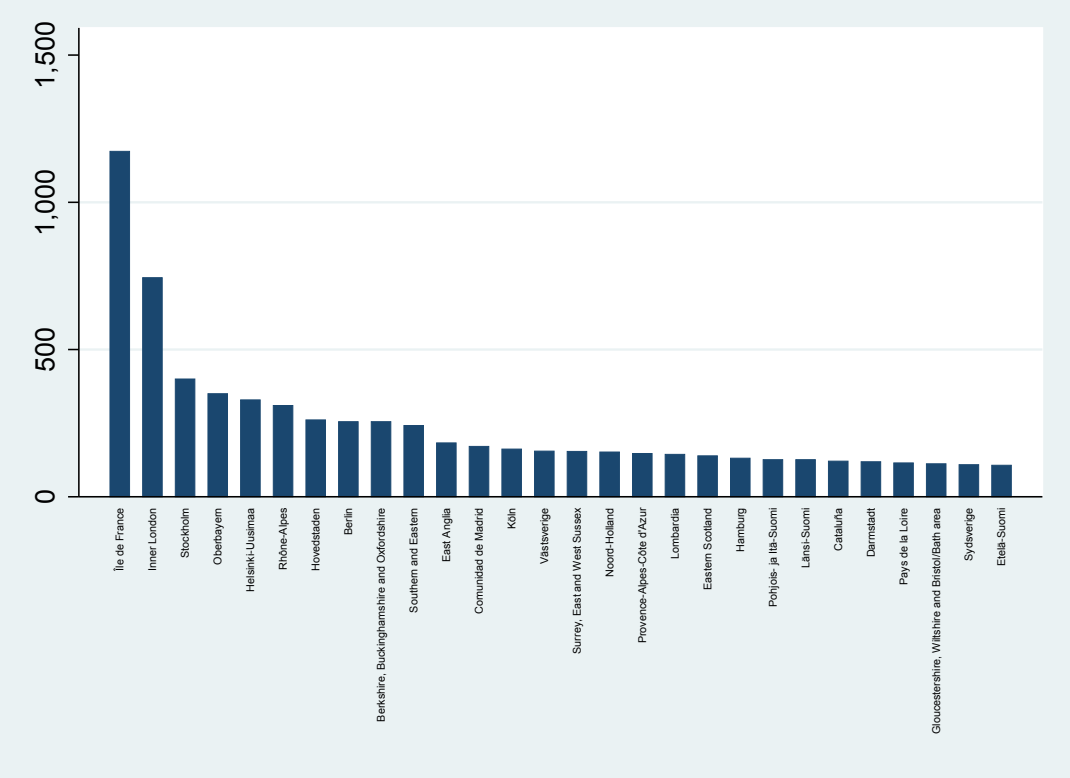
Source: own elaboration based on Thomson One data

Figure 3: Total number of new investments by investor location (1980-2010)



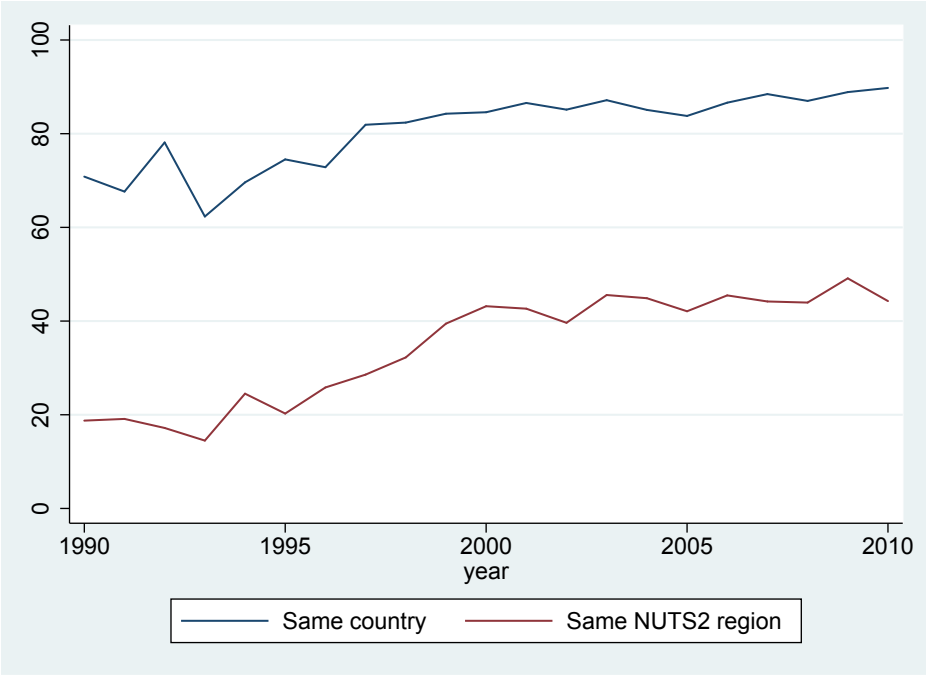
Source: own elaboration based on Thomson One data. Please note that each investment is counted more than once when it is syndicated, i.e. an investment made by 3 investors is counted as one for each NUTS2 region where the investors are located.

Figure 4: Total number of investments by invested company location (1980-2010)



Source: own elaboration based on Thomson One data

Figure 5: Percentage of investments with at least one investor located in the same country and NUTS2 region where the company resides (1990-2010)



Source: own elaboration based on Thomson One data

Figure 6: Number of sample companies seeking external equity by year

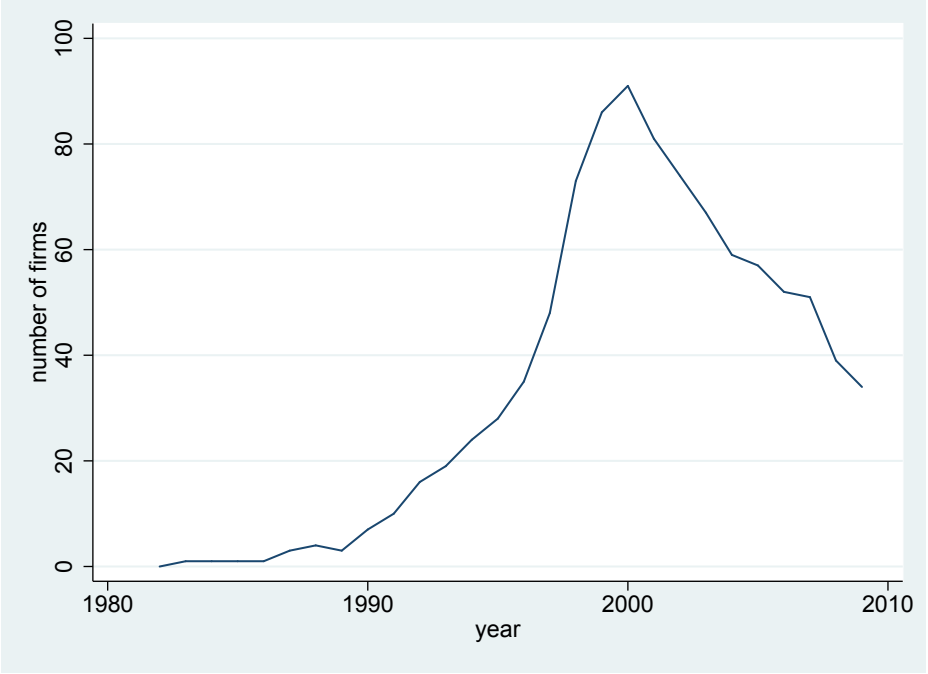
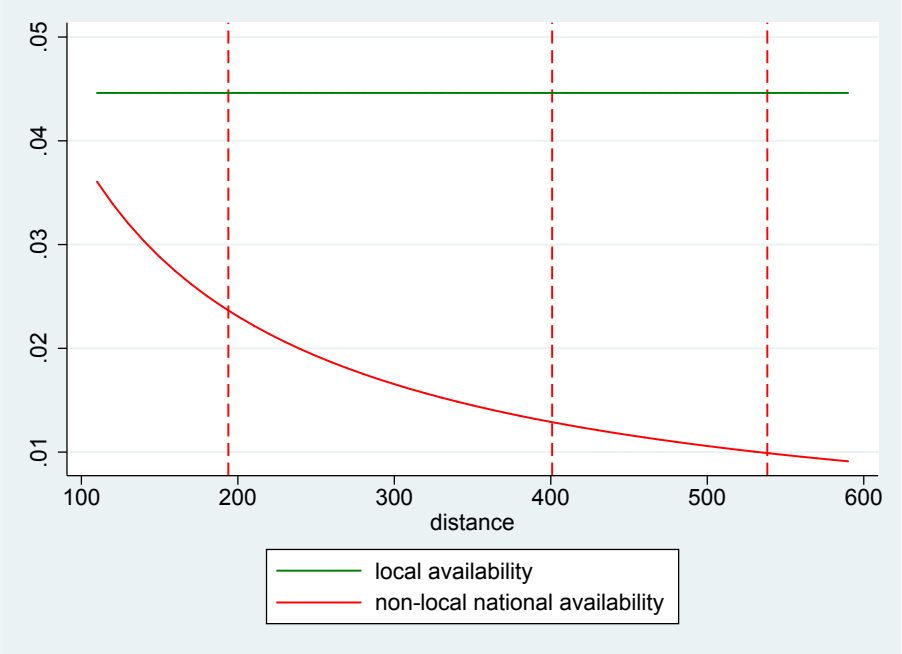


Figure 7: The estimated effects of VC availability and distance on companies propensity to search external equity

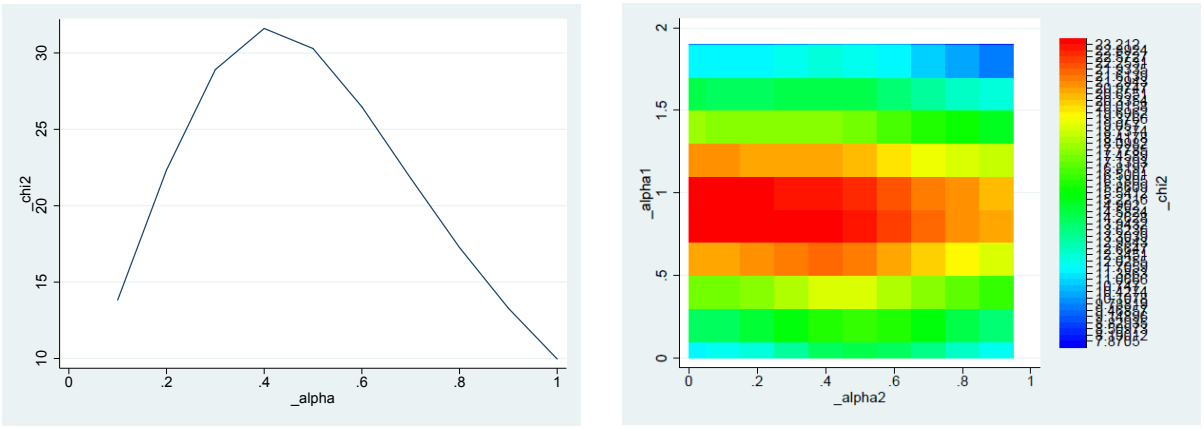


Legend: The figure shows the change in a company's propensity to seek external equity for a change in the number of new investments in a NUTS2 region from 1 to 23, respectively equal to the 25^{th} and the 75^{th} percentiles of the distribution. The local availability line shows the effect on companies in the same NUTS2 region, while the non-local national availability line shows the effect on companies outside that NUTS2 region but in the same country. We do not plot the effect of a shock in the availability abroad because its coefficient is not significant. The vertical dotted lines represent the 25^{th}, 50^{th} ans 75^{th} percentile of the distribution of the distance from the 50 VC hubs.

A Appendix: calibration of the distance decay parameter

In order to set the distance decay parameter α for each type of availability of VC not located in the same region of the company (i.e. non-local, non-local national, non-local international), we evaluated the value that maximizes the log-likelihood function of the econometric model in table 5 columns 3 and 4. We tested increasing values of α in increments of 0.1. For non-local availability ($availability\_far$) we performed a likelihood ratio test LR = -2[log-likelihood(unrestricted model) - log-likelihood(restricted model)], where the unrestricted model corresponds to the model in column 3 but without the non-local availability variable as regressor. More specifically, depending on the value of the decay parameter we maximize the $\chi^2(1)$ value related to the LR test (figure 8a). Analogously, for what concern the calibration of the non-local availability in the same country ($availability\_national$) and the non-local availability abroad ($availability\_abroad$), we perform a "joint" maximization of the LR test (i.e. of the corresponding $\chi^2(2)$) making the two parameters $alpha_1$ and $alpha_2$ respectively (figure 8b).

Figure 8: The estimated effects of distance and number of investments



(a) (b)

Figure 8 shows that the values that maximize the LR test are 0.4, 1, and 0.3 for $availability\_far$, $availability\_national$, and $availability\_abroad$, respectively. Accordingly, these values are used as the decay parameters in evaluating the effect of non-local availability of VC on the probability to seek external equity finance. It is worth noting that we can reject the null hypothesis that non-local availability is zero (at the 1% significance level, please note that $\chi^2(1)$ is greater than 6.64 in figure 8a for $\alpha = 0.4$) and the null hypothesis that non-local availability in the country and abroad are jointly equal to zero (at the 1% significance level, please note that $\chi^2(2)$ is greater than 9.21 in figure 8b for $\alpha_1 = 1$ and $\alpha_2 = 0.3$).

References

A. N. Berger and G. F. Udell. Collateral, loan quality and bank risk. *Journal of Monetary Economics*, 25(1):21–42, jan 1990. ISSN 03043932. doi: 10.1016/0304-3932(90)90042-3. URL http://www.sciencedirect.com/science/article/pii/0304393290900423.

S. Bernstein, X. Giroud, and R. Townsend. The Impact of Venture Capital Monitoring. *The Journal of Finance*, page In press, oct 2015. ISSN 1540-6261. doi: 10.1111/jofi.12370. URL http://dx.doi.org/10.1111/jofi.12370.

F. Bertoni and A. P. Groh. Cross-Border Investments and Venture Capital Exits in Europe. *Corporate Governance: An International Review*, 22(2):84–99, mar 2014. ISSN 09648410. doi: 10.1111/corg.12056. URL http://doi.wiley.com/10.1111/corg.12056.

F. Bertoni and J. Martì Pellon. Financing Entrepreneurial Ventures in Europe: The Vico Dataset. aug 2011. URL http://papers.ssrn.com/abstract=1904297.

F. Bertoni, M. G. Colombo, and A. Quas. The patterns of venture capital investment in Europe. *Small Business Economics*, 45(3):543–560, 2015a. ISSN 0921-898X. doi: 10.1007/s11187-015-9662-0. URL http://link.springer.com/10.1007/s11187-015-9662-0.

F. Bertoni, D. D'Adda, and L. Grilli. Cherry-picking or frog-kissing? A theoretical analysis of how investors select entrepreneurial ventures in thin venture capital markets. *Small Business Economics*, 2015b. ISSN 0921-898X. doi: 10.1007/s11187-015-9690-9. URL http://link.springer.com/10.1007/s11187-015-9690-9.

A. Bonaccorsi, M. G. Colombo, M. Guerini, and C. Rossi-Lamastra. The impact of local and external university knowledge on the creation of knowledge-intensive firms: Evidence from the Italian case. *Small Business Economics*, 43(2):261–287, 2014. ISSN 15730913. doi: 10.1007/s11187-013-9536-2.

R. E. Carpenter and B. C. Petersen. Capital Market Imperfections, High-Tech Investment, and New Equity Financing. *the Economic Journal*, 112(477):F54–F72, feb 2002. ISSN 00130133. doi: 10.1111/1468-0297.00683. URL http://doi.wiley.com/10.1111/1468-0297.00683.

C. Carpentier and J.-M. Suret. Some evidence of the external financing costs of new technology-based firms in Canada. *Venture Capital*, 8(3):227–252, jul 2006. ISSN 1369-1066. doi: 10.1080/13691060600748421. URL http://www.tandfonline.com/doi/abs/10.1080/13691060600748421.

T. J. Chemmanur, K. Krishnan, and D. Nandy. How does Venture Capital Financing Improve Efficiency in Private Firms? A Look Beneath the Surface. *Review of Financial Studies*, 24 (12), aug 2011. doi: 10.2139/ssrn.1025322. URL http://papers.ssrn.com/sol3/papers.cfm?abstract{_}id=1025322http://papers.ssrn.com/abstract=1025322.

H. Chen, P. A. Gompers, A. Kovner, and J. Lerner. Buy local? The geography of venture capital. *Journal of Urban Economics*, 67(1):90–102, jan 2010. ISSN 00941190. doi: 10.1016/j.jue.2009.09.013. URL http://linkinghub.elsevier.com/retrieve/pii/S0094119009000801.

A. Cosh, D. J. Cumming, and A. Hughes. Outside Entrepreneurial Capital. *Economic Journal*, 119(1):494–533, 2009. ISSN 00130133. doi: 10.1111/j.1468-0297.2009.02270.x.

A. Croce, J. Martí, and S. Murtinu. The Impact of Venture Capital on the Productivity Growth of European Entrepreneurial Firms: 'Screening' or 'Value Added' Effect? *Journal of Business Venturing*, 28(4):489–510, 2013. doi: 10.1016/j.jbusvent.2012.06.001.

D. J. Cumming and N. Dai. Local bias in venture capital investments. *Journal of Empirical Finance*, 17(3):362–380, jun 2010. ISSN 09275398. doi: 10.1016/j.jempfin.2009.11.001. URL http://dx.doi.org/10.1016/j.jempfin.2009.11.001.

D. J. Cumming and J. G. Macintosh. A cross-country comparison of full and partial venture capital exits. *Journal of Banking & Finance*, 27:511–548, 2003. doi: 10.1016/S0378-4266(02)00389-8.

D. J. Denis. Entrepreneurial finance: an overview of the issues and evidence. *Journal of Corporate Finance*, 10(2):301 – 326, 2004. doi: 10.1016/S0929-1199(03)00059-2.

J. T. Eckhardt, F. Delmar, and S. Shane. Multistage Selection and the Financing of New Ventures. *Management Science*, 52(2):220–232, 2006. doi: 10.1287/mnsc.1050.0478.

European Commission. Fostering Entrepreneurship in Europe: priorities for the future. Technical Report 98, European commission, Brussels, 1998.

European Parliament. Regulation (EU) No 345/2013 of the European Parliament and of the Council of 17 April 2013 on European Venture Capital Funds. Technical report, 2013. URL http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0345{&}from=EN.

Eurostat. Regions in the European Union: Nomenclature of territorial units for statistics - NUTS 2010/EU-27, 2011 edition. 2011. URL http://ec.europa.eu/eurostat/documents/3859598/5916917/KS-RA-11-011-EN.PDF.

R. Florida and K. M. King. Spiky venture capital: the geohrapgy of venture capital investment by metro and ZIP code. page 30, 2016. URL http://martinprosperity.org/media/Startup-US-2016_Spiky-Venture-Capital_Revised.pdf.

J. S. Gans and S. Stern. Is there a market for ideas? *Industrial and Corporate Change*, 19(3):805–837, apr 2010. ISSN 0960-6491. doi: 10.1093/icc/dtq023. URL http://icc.oxfordjournals.org/content/early/2010/04/11/icc.dtq023.short.

P. A. Gompers and J. Lerner. Money chasing deals? The impact of fund inflows on private equity valuation. *Journal of Financial Economics*, (2):281–325, feb . ISSN 0304405X. doi: 10.1016/S0304-405X(99)00052-5.

P. A. Gompers, D. Z. Levin, and J. Lerner. The Venture Capital Revolution. *Journal of Economic Perspectives*, 15(2):145–168, may 2001. ISSN 0895-3309. doi: 10.1257/jep.15.2.145. URL http://www.jstor.org/stable/2696596.

B. H. Hall, A. Jaffe, and M. Trajtenberg. Market Value and Patent Citations. *The RAND Journal of Economics*, 36(1):16–38, 2005. URL http://www.jstor.org/stable/1593752.

R. T. Harrison, C. M. Mason, and P. Robson. Determinants of long-distance investing by business angels in the UK. *Entrepreneurship & Regional Development*, 22(2):113–137, mar 2010. ISSN 0898-5626. doi: 10.1080/08985620802545928. URL http://www.tandfonline.com/doi/abs/10.1080/08985620802545928.

D. E. Ho, K. Imai, G. King, and E. A. Stuart. Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis*, 15(3):199–236, 2007. ISSN 10471987. doi: 10.1093/pan/mpl013.

S. N. N. Kaplan and P. Strömberg. Venture Capitalists As Principals: Contracting, Screening, and Monitoring. *American Economic Review*, 91(2):426–430, apr 2001. doi: 10.3386/w8202. URL http://ideas.repec.org/p/nbr/nberwo/8202.html.

J. Lindgaard Christensen. The Development of Geographical Specialization of Venture Capital. *European Planning Studies*, 15(6):817–833, jul 2007. ISSN 0965-4313. doi: 10.1080/09654310701232137. URL http://www.tandfonline.com/doi/abs/10.1080/09654310701232137.

M. M. Mäkelä and M. V. J. Maula. Cross-border venture capital and new venture internationalization: An isomorphism perspective. *Venture Capital*, 7(3):227–257, jul 2005. ISSN 1369-1066. doi: 10.1080/13691060500258877. URL http://www.tandfonline.com/doi/abs/10.1080/13691060500258877.

R. Martin, C. Berndt, B. Klagge, and P. Sunley. Spatial Proximity Effects and Regional Equity Gaps in the Venture Capital Market: Evidence from Germany and the United Kingdom. *Environment and Planning A*, 37(7):1207–1231, jul 2005. ISSN 0308-518X. doi: 10.1068/a3714. URL http://epn.sagepub.com/content/37/7/1207.abstract.

C. M. Mason and R. T. Harrison. The geography of venture capital investments in the UK. *Transactions of the Institute of British Geographers*, 27(4):427–451, dec 2002. ISSN 0020-2754. doi: 10.1111/1475-5661.00064. URL http://doi.wiley.com/10.1111/1475-5661.00064http://www.blackwell-synergy.com/links/doi/10.1111/1475-5661.00064.

C. M. Mason and R. T. Harrison. Improving access to early stage venture capital in regional economies: A new approach to investment readiness. *Local Economy*, 19(2):159–173, aug 2004. ISSN 0269-0942. doi: 10.1080/0269094042000203090. URL http://lec.sagepub.com/lookup/doi/10.1080/0269094042000203090.

A. Mina, H. Lahr, and A. Hughesy. The demand and supply of external finance for innovative firms. *Industrial and Corporate Change*, 22(4):869–901, 2013. ISSN 09606491. doi: 10.1093/icc/dtt020.

S. C. Myers and N. S. Majluf. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13(2):187–221, 1984. ISSN 0304405X. doi: 10.1016/0304-405X(84)90023-0. URL http://ideas.repec.org/a/eee/jfinec/v13y1984i2p187-221.html.

R. Nahata, S. Hazarika, and K. Tandon. Success in Global Venture Capital Investing: Do Institutional and Cultural Differences Matter? *Journal of Financial and Quantitative Analysis*, 49(04):1039–1070, jan 2015. ISSN 0022-1090. doi: 10.1017/S0022109014000568. URL http://journals.cambridge.org/abstract_S0022109014000568.

OECD. Entrepreneurship at a glance 2013. OECD annual report. Technical report, OECD, 2013.

M. Sørensen. How Smart Is Smart Money? A Two-Sided Matching Model of Venture Capital. *The Journal of Finance*, 62(6):2725–2762, nov 2007. ISSN 00221082. doi: 10.1111/j.1540-6261.2007.01291.x. URL http://doi.wiley.com/10.1111/j.1540-6261.2007.01291.x.

O. Sorenson and T. E. Stuart. Syndication Networks and the Spatial Distribution of Venture Capital Investments. *The American Journal of Sociology*, 106(6):1546–1588, may 2001. ISSN 0002-9602. doi: 10.1086/321301. URL http://www.jstor.org/stable/10http://www.jstor.org/stable/10.1086/321301.

T. Tykvová and A. Schertler. Cross-border venture capital flows and local ties: Evidence from developed countries. *The Quarterly Review of Economics and Finance*, 51(1):36–48, feb 2011. ISSN 10629769. doi: 10.1016/j.qref.2010.09.005. URL http://www.sciencedirect.com/science/article/pii/S1062976910000682.

M. Wright, S. Pruthi, and A. Lockett. International venture capital research: From cross-country comparisons to crossing borders. *International Journal of Management Reviews*, 7 (3):135–165, sep 2005. ISSN 1460-8545. doi: 10.1111/j.1468-2370.2005.00113.x. URL http://doi.wiley.com/10.1111/j.1468-2370.2005.00113.x.