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Tangible and intangible proximities in the access to Venture Capital by Innovative Start-up Companies

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ABSTRACT

We investigate the role of tangible versus intangible forms of proximity in facilitating access to Venture Capital (VC) for Innovative Start-up Companies (ISCs), introducing a novel focus on their relational proximity. Combining insights from entrepreneurship research and economic geography, we develop and test hypotheses on the role of proximities using data on the population of Italian ISCs over the period 2014–2019. Our findings show that tangible (i.e. spatial) proximities influence VC–ISC matching, more in terms of functional rather than geographical proximity. Industrial proximity also plays a role, reducing the binding nature of functional proximity for the matching. While this substitutive effect does not emerge with respect to relational proximity, the latter – captured through a novel measure – appears to exert the strongest influence.

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1. Introduction

Newly established high-tech firms, or innovative start-up companies (ISCs), have long been recognized as a fundamental driver of innovation, industrial dynamics and economic growth (Audretsch and Belitski 2013; Grilli and Murtinu 2014). Given their notable high risk profile, Venture Capital (VC) investments represent the most relevant source of their funding (Alperovych, Groh, and Quas 2020; Caviggioli et al. 2020; Colombelli et al. 2020; Colombo, Mustar, and Wright 2010; Giraudo, Giudici, and Grilli 2019) and the analysis of the factors that enable the encounter of VCs and ISCs has thus become of paramount importance. Indeed, the identification of these factors can support managers and policy makers in the formulation of strategic choices and policy actions, respectively, with which to facilitate the financing of innovative entrepreneurship. Among the identified factors, the location of VCs and ISCs, and their spatial proximity, have received large attention, given their crucial role in mitigating the information asymmetries and the transaction costs that mark their relationship (Van Osnabrugge 2000; Zook 2002).

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However, recent studies have shown that the role of spatial proximity in accounting for a firms' access to local VC is subject to some interesting specifications, if not even contradictions. In some business surveys, for example, investors showed a neutral attitude towards the location of the investee and an increasing engagement in deals that are apparently not local (Carlson and Chakrabarti 2007; Fritsch and Schilder 2008; Martin et al. 2005). This pattern is somehow reflected in our analysis of the Italian case over the period 2014–2019. On average, the geographic distance between VC investors and non-financed potential innovative start-ups is greater than the distance observed in actual investment matches. However, this difference should not be overstated: even in realized deals, the average distance remains substantial – around 285 kilometres. Moreover, nearly 20% of the observed matches involve partners separated by more than two hours of travel time. Further evidence aligned with this pattern is also revealed by Figure 1 (see Section 3.1), reporting the geographical distribution of the VCs and the ISCs in the Italian case of our analysis. A relevant number of VC-backed ISCs are actually not spatially co-located.

Entrepreneurship studies have so far tried to account for this clash by integrating the analysis of physical proximity with that of the social ties that link co-investors (mainly, through their networking), by claiming that the latter could compensate for the lack of the former (Sorenson and Stuart 2001). However, the clash between the VC-enabling role of spatial proximity and the evidence of non-localised VC investments could also be accounted for by other factors, which remain under-investigated and represent a gap in the body of literature, which the present paper aims to fill. More precisely, by drawing on economic geography studies about proximity (Balland, Boschma, and Frenken 2013; Boschma 2005), we claim that an important aspect to retain is represented by the manifold proximity that characterises the relationship between VC investors and start-up companies (Bédu, Brossard, and Montalban 2024).

We contribute to this stream of studies in three ways. First, we argue that the role of spatial proximity in affecting the ISC access to VC, and in turning ISCs into 'VC-backed' – in terms of money and managerial support – should be more accurately disentangled by distinguishing two different kinds of '*tangible proximities*', which builds on the physical meeting between parties: (i) their 'geographical proximity', expressed in metrics of a suitable length; (ii) their 'functional proximity', referring to the effort parties must make (typically for travelling with some transport means) to overcome their geographical distance and make their tangible relationship function.

Second, we maintain that the relationship between VCs and ISCs is also affected by other two forms of '*intangible proximities*', which do not require and/or involve the parties' physical meeting, but rather occur through their connection along other intangible dimensions. A first dimension, which has already been addressed by previous studies on standard VCs, refers to the industrial experience of the partners and could be measured by the similarity (typically, in terms of produced commodities and/or goods) of the industries in which they operate, and have operated over time: in brief, their 'industrial proximity'. A second dimension, on which the literature is instead more scanty, is that of the 'relational proximity' between the focal parties, as accounted by the proximity they show in the network of their business (e.g. in terms of ownership and financial investments) and organisational (e.g. in terms of governance and boarding) relationships.

Third, we posit that intangible proximities could work in alleviating the binding role of tangible proximities for the financial relationship to take place. Indeed, along the

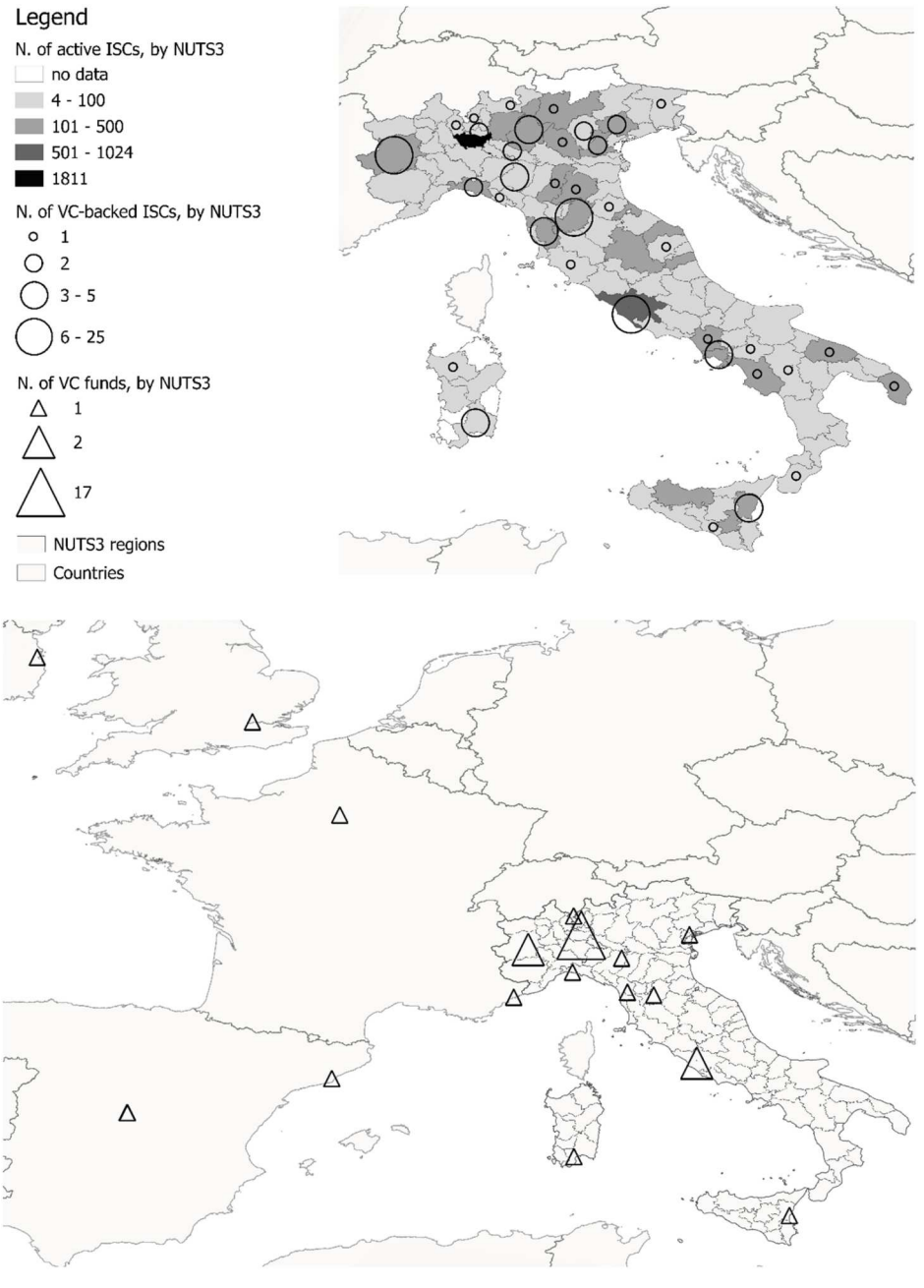

Figure 1. Distribution of Italian ISCs, of VC and of VC-backed ISCs in NUTS3 regions.

intangible dimensions of their relationships, the parties can establish ties through which effectively communicate and operate even at great distances.

To sum up, our paper aims to analyse the extent to which the VC financing of ISCs is facilitated by their (1) tangible proximity, articulated in (1a) geographical proximity (distance in space) and (1b) functional proximity (travel efforts/costs), and by their (2)

intangible proximity, measured by (2a) industrial proximity (similarity of the industries of their activities) and (2b) relational proximity (business and organisational relationships). Furthermore, we aim to investigate whether intangible proximities (as from 2a) and (2b) can lessen the effect of tangible ones (as from 1a) and (1b) on the matching between VCs and ISCs.

We integrate these elements of conceptual novelty with an original empirical application to the population of Italian ISCs and their financing VCs. Indeed, the majority of existing studies about the geography of VC investments mainly refer to the U.S. (Carlson and Chakrabarti 2007; Cumming and Dai 2010; Florida and Mellander 2016; Sorenson and Stuart 2001; Zook 2002), the UK (Harrison and Mason 2002; Lee and Drever 2014; Martin et al. 2005; Mason and Harrison 1992; Mason and Pierrakis 2013), and the German (Bender 2010; Fritsch and Schilder 2008; Lutz et al. 2013; Martin et al. 2005) markets, with few worldwide (Bédu, Brossard, and Montalban 2024; Tykvová and Schertler 2014) and European-wide studies (Martin, Sunley, and Turner 2002). The analyses of the Italian VC market are, instead, scant (Bertoni et al. 2007; Bertoni, Colombo, and Grilli 2011; Grilli 2019; Vacca 2013) and the present study also aims to add new evidence in this regard. The Italian VC market is generally considered immature with respect to other countries sharing different models of capitalism (OECD 2017). However, important advancements have recently occurred, on which this paper focuses. Among the most relevant, in 2012 an important law has been approved (Italian Law 221/2012) that, together with the provision of dedicated tax and financial incentives to ISCSs, has formally instituted and closely monitored the ISC as a novel juridical form, subject to specific innovativeness requirements and to the obligation of producing publicly available data that are yet unexplored.[1]

This important change allows us to observe the entire population of Italian ISCs and to link VCs to them, in such a way to have a general picture of the phenomenon at stake in this specific country. However, the results of our investigation can have general implications for understanding the role of proximity in VC deals with ISCs also in other contexts. This is particularly so where: the financial system is not well developed yet, and the occurrence of a VC-ISC deal is a relatively rare event to observe; the territory is polycentric and marked by geographical barriers across areas and spatially unequal infrastructures, which increase average transport costs and the opportunity costs of potential distant partnerships; the quality of institutions is not high (Adam 2008), and the evaluation of potential risk capital investments is accordingly affected by higher transaction costs, which make monitoring and referrals for risk-capital deals quite important (Dejuan and Mora-Sanguinetti 2019; Fabbri 2010; Giacomelli and Menon 2016; Moro, Maresch, and Ferrando 2018; Schiantarelli, Stacchini, and Strahan 2020).

As we will illustrate in the empirical section, we use our novel dataset to run a set of logistic models, which estimate the conditional probability to observe the occurrence of a specific VC-ISC investment pair, and its dependence on our proximity arguments.

We find that tangible proximities account for this matching, but more in functional than in geographical terms. Industrial proximity between the two actors matters too and makes the role of functional proximity less binding. The greatest correlation emerges with respect to a relational kind of proximity, due to the closeness the partners reveal in the social network they come to constitute through their business (i.e. investments and shareholding) and organisational (i.e. governance and boarding) relationships.

The effect of this proximity on the VC-ISC is remarkable but, unlike industrial proximity, relational proximity does not moderate the impact of functional proximity on the matching.

The rest of this paper is structured as follows. Section 2 positions this study in the extant literature and develops our research hypotheses. Section 3 presents our dataset and the evidence about regional gaps in Italian VC investments; it then illustrates the model, the methodology, and the estimation issues of the empirical analysis. Results are illustrated in Section 4, and Section 5 concludes with a discussion of their implications.

2. Proximities in the relationship between VC and ISCs

The relationship between VCs and ISCs is affected by information asymmetries and transaction costs that the extant literature has widely investigated since long (Van Osnabrugge 2000). To deal with them, VCs carry on monitoring and tutoring activities that benefit from face-to-face interactions with ISCs in different respects. These interactions are more costly and less effective, when the geographical distance between the two parties becomes greater, and even in the presence of digital forms of communication between them (Fritsch and Schilder 2008; Zhao and Jones-Evans 2017). However, as noted in the previous section, VCs have been found to pair with ISCs also at a great geographical distance, and this creates a clash with the theory of the relationship that requires an explanation. In the following we argue that this explanation can be obtained by better disentangling the twofold nature of tangible proximity between the partners, and by retaining the role of their intangible proximities.

2.1. Tangible proximities in VC investments: geographical and functional proximities

In the extant literature, the distance between investors and ventures is generically retained as a factor that affects both the pre-investment activities of the former – that is, the identification and appraisal of investment opportunities – and their post-investment activities – amounting to the monitoring of the identified ventures, and to the supply of value-added services to the latter (Lerner 1995; Sorenson and Stuart 2001). All of these are in fact experiential tasks that involve the acquisition and elaboration of procedural and tacit knowledge, if not even social interactions, which become difficult to implement at a distance. Previous studies have provided wide support to this argument (Gupta and Sapienza 1992; Lerner 1995; Martin et al. 2005; Martin, Sunley, and Turner 2002; Mason 2007), mainly by referring to the inverse of the geographical distance that separates economic actors, or simply as the spatial length between them:[2] in brief, to what can be more specifically defined as their *geographical proximity* (Boschma 2005).

Quite surprisingly, less attention has been paid in this field to another kind of tangible proximity between the focal parties, accounted by 'the effort that it takes to interact' (Moodysson and Jonsson 2007, 118), to overcome the 'functional distance' (Brown and Horton 1970) between them: in brief, their *functional proximity*.

The two tangible proximities are of course related, but not coincident, and the neglect of the latter appears unfortunate. By focusing on the activities undertaken by the agents

to interact, functional proximity accounts for their reciprocal accessibility, as the extent to which they can effectively access and exchange information or resources between them. In turn, this depends on the existence and efficiency of infrastructures and on the travel times between their locations. Like with other kinds of transactions – e.g. in the monitoring of plants' production activities by distant headquarters (Giroud 2013) – these travel factors are pivotal also in the interaction required by a VC to finance ISCs. Since these factors can affect the opportunity costs of acquiring information and monitoring the investee in different ways, two locations that are equally distant in geographical terms from a focal point may still vary significantly in how difficult they are to reach.

Not only are the two tangible proximities conceptually different, but their relevance can also be claimed to be different. Previous studies about other forms of equity investments, like business angel investments (Hermann, Avdeitchikova, and Hjertström 2016), have argued and found that the extra opportunity costs entailed by the functional distance between parties can be more hampering than the direct informative and transaction costs that geographical distance entails. The same argument can be expected to hold also with respect to VC investments, for whose unfolding and innovative effects the role of functional distance (typically, in terms of travel time) has already been ascertained (e.g. Bernstein, Giroud, and Townsend 2016). However, to our knowledge, unlike for other research domains – as in the analysis of travelling time to work (Boussauw, Neutens, and Witlox 2012; Duan et al. 2020) – there has been a limited focus on the comparison between the role of geographical and functional proximity for VC investments (Chen et al. 2010). With the aim of enriching the evidence about that, and as a baseline for the other hypotheses we will put forward, we submit to empirical testing the following first composite hypothesis:

> Hp1: (a) Geographical and functional proximities between VC investors and ISCs increase the likelihood of investment. (b) Functional proximity has a stronger effect than geographical proximity in facilitating VC investments in ISCs.

While important in disentangling the VC-enabling role of tangible proximities, the empirical testing of Hp1 could also help us to explain the seemingly contradictory evidence regarding the limited spatial sensitivity of partners in deal selection.[3] In the current wave of digital transformation, usually associated with the enabling technologies of the so-called Industry 4.0 – like AI, big data, IoT, robots and the like (Martinelli, Mina, and Moggi 2021) – the clash at stake could be accounted by the fact that these technologies enable VC partners to interact in a virtual manner (e.g. through social networks, chats, and digital technologies), by possibly reducing the binding role of their geographical proximity (Fritsch and Schilder 2008). These digital technologies in fact constitute an additional layer, along which the proximity between VC partners – some innovation research has called it as 'virtual proximity' (Coughlan 2014) – could be considered. However, this kind of proximity relies on the availability, access to, and use of the last wave of digital technologies (Sable 2023), which available data make hardly possible to measure in a granular dyadic manner: that is, consistently with the VC-ISC level of analysis of our arguments and empirics. For this reason, while recognising the digital or virtual proximity between ISCs and VCs as relevant, we refrain from encapsulating it in our analysis and rather point to it as an interesting future line of research among the conclusions.

2.2. Intangible proximities in VC investments: industrial and relational proximities

Tangible proximities – both geographical and functional – are not the only dimensions along which VCs and target firms relate. As the seminal paper by Sorenson and Stuart (2001) has shown, VC partners do also relate in networks, which they create by interacting, knowing, and trusting each other. Within these networks, actors can be 'socially' close, compensating the costs of being geographically distant.

Economic actors are embedded in different aspatial contexts, which create different forms of proximities between them, but not along the tangible dimension. As extensively illustrated by Boschma (2005), these *intangible* proximities are of heterogeneous nature and have a diverse economic role, especially in facilitating the knowledge exchange between agents (e.g. firms) for the development of innovative products and processes.

Extending this economic geography argument to the realm of entrepreneurship studies, two intangible proximities appear salient in affecting the financial relationship between VCs and ISCs: industrial proximity and relational proximity.

2.2.1. Industrial proximity

An important proximity between VCs and target firms is determined by the extent to which the former has already invested in the industry in which the latter operates: the greater this extent, the greater their *industrial proximity*. Through its prior investments in the industry of the target company, the VC can in fact gain more knowledge and experience of that industry, and this can be expected to facilitate the next deal via two channels. The first channel passes through its facilitating role in the pre-investment and post-investment activities carried out by the VC (Sorenson and Stuart 2001). Indeed, VC can carry out these activities more confidently by relying on a wider set of contacts in the industry. The second channel is represented by the synergies industrial proximity creates between the prospected and the existing companies in the VC portfolio, providing VCs with coordination economies in its management (Norton and Tenenbaum 1993).

Thinking of the operation of these two channels, we do expect that, as emerged from previous studies (like again Sorenson and Stuart 2001), industrial proximity is positively associated with the probability of observing a VC-ISC match. We thus put forward our second hypothesis:

> Hp2: Industrial proximity between VCs and ISCs facilitates investment by the former in the latter.

As suggested by Sorenson and Stuart (2001), not only do tangible and intangible proximities between the parties of a VC investment matter *per se*, but they also interact between them in conditioning its occurrence. The experience a VC investor accumulates through prior investments in a given industry – i.e. industrial proximity – can enable it to successfully pursue deals with ISCs located at greater tangible distances (geographical and/or functional), thereby compensating for the reduced advantages typically associated with tangible proximity. Putting it differently, a higher industrial proximity between VC and ISC could render the advantages of a higher tangible proximity between them less relevant. Based on this argument, we put forward our third hypothesis:

> Hp3: Industrial proximity between VC and ISC can compensate for low levels of tangible proximity in facilitating VC investments.

2.2.2. Relational proximity

An additional kind of proximity that can affect the matching between VCs and ISCs is the 'belonging' proximity, which derives from them being part of common interpersonal networks or, in brief, their *relational proximity*. In general, interpersonal relationships are an important driver and structuring factor of information/knowledge circuits (Coleman 1990; Friedkin 1998). This is even more so in the VC market, in which public information about investment opportunities and early-stage companies is basically missing, and in which operators often lack sufficiently long histories of business performance upon which to base their evaluations.

Despite their claimable theoretical importance, the evidence about the role of interpersonal ties in the VC market is still scant and reveals important gaps which this paper aims to fill. First, while research about the role of networks and close contacts in the access to finance is already established (Allen and Babus 2009; Fried and Hisrich 1994; Shane and Cable 2002; Uzzi 1999), in the VC realm it has, to date, concentrated on the relationships through which VC investors come to constitute their own communities, rather than on communities of investors and investees. Second, in the thinner stream of research that has considered social ties between VCs and target firms, the focus has mainly been on what could be considered 'potential' rather than 'actual' social ties. This is, for example, the case of education ties, represented by managers of VCs and ISCs that share the same 'alma mater' (Fuchs et al. 2021; Sunesson 2009). This is an aspect, which VC partners can potentially exploit to carry out ownership and control investments between them, and/or to share the boarding of governance structures, in such a way to constitute an actual VC social network. To the best of our knowledge, the role of this latter kind of actual and professional social network, and of the 'relational proximity' that VCs and ISCs reveal in it, has not yet been addressed as a determinant of their financing relationship. Other studies have focused on the 'networking', or 'social' capital, of start-ups only (Bédu, Brossard, and Montalban 2024), usually by looking at the different forms of social capital that entrepreneurs and start-ups display being part of wide networks, which are external to those VC investors could be part of (Shao and Sun 2021).[4] Once more, when both ICSs and VCs have been retained, their relationships have been investigated in potential terms: for example, by considering ISC managers graduating from elite educational institutions and their being part of co-founder teams as signals of attractive quality deals (Nigam, Benett, and Johan 2020). A relational proximity of an 'actual' kind between investor and investee has been investigated by Hermann, Avdeitchikova, and Hjertström (2016). However, they focus on Business Angels, which are more informal investors than VCs and are thus expected to rely more strongly on referrals. By contrast, the role of relational proximity in fostering successful financing relationships between VCs and ISCs has, to date, remained largely unexplored.

Building on the literature that highlights the role of social capital in facilitating business network relationships (Levin et al. 2016), we argue that the interpersonal proximity emerging from the direct or shared network ties between ISCs and VCs is likely more salient than the proximity inferred from their individual connections to third parties – a focus that has characterized much of the existing literature to date (e.g. Shao and Sun 2021). This is particularly so if we consider the network that ISCs and VCs form by interacting between them through their investment (e.g. in terms of ownership and financial

investments) and organisational (e.g. in terms of governance and boarding) relationships. On the one hand, by revealing stronger ties in this kind of network – e.g. by showing a higher sharing of governance positions, co-investment experiences, or participation in joint advisory boards – ISCs and VCs can benefit more symmetrically from the relational resources (such as access to privileged information, reputation spillovers, or strategic endorsements) that the network makes accessible to them. In doing so, they will display a more similar social capital of a 'structural' kind (Tsai 2000), which could facilitate their matching. On the other hand, being more closely connected in the network of their business relationships, ISCs and VCs will be also capable to develop a social capital of a 'relational' kind, becoming more embedded in the network and thus reciprocally more trustworthy (Granovetter 1985). Like in other relational contexts, this proximity will constrain their opportunistic behaviours, facilitate their exchange of resources and information, reduces the costs of concluding a successful VC backing (Uzzi 1999), thus making it more possible. Drawing on this line of argument, we first expect that the relational proximity between VCs and ISCs in the entailed social network could facilitate their matching. Second, extending the argument about the interaction between tangible and intangible proximities which we have made in the previous section, we also expect that a higher relational proximity could make the presence of tangible proximity less binding for the conclusion of a deal. We thus put forward the following two hypotheses:

Hp4: Relational proximity between VC and ISC facilitates the investment of the former in the latter.

Hp5: Relational proximity between VC and ISC can compensate for low levels of tangible proximity in facilitating VC investments.

3. Empirical analysis

3.1. Data and descriptive evidence

Our empirical analysis is based on a new dataset covering the population of Italian ISCs and the investments that VCs have made in them over the period 2014-2019.

In this dataset, ISCs are identified following the definition introduced by the Italian Law 221/2012 (foreseeing different measures of policy support provided to them), which requires two criteria: (i) an age of less than five years; (ii) at least one of the following requisites: (1) employing at least one-third of workers with a PhD, or two-thirds with a Master's, (2) being licensee or depositor of at least one patent or other industrial property rights; (3) investing at least 15% of the value or cost of production in R&D activities. Following this definition, we have collected a dataset, observed over the period 2014-2019, populated by all the 10,213 Italian ISCs that registered as such before 6th June 2019. With respect to this ISC population, we have merged data contained in the Italian business registry (*Registro Italiano delle Imprese*) with AIDA and Orbis Bureau Van Dijk (BvD) data and obtained detailed information about their localisation, ownership structure, investments, and other balance sheet data. Among these data, we have retrieved information about all the investors of the identified Italian ISCs. Out of the 38,425 detected investors, only 37 are VC funds (though, of course, each one has multiple deals); and this information we will carefully retain in the following analysis.

As illustrated in Tables A.1a and A.1b in the Appendix, the majority of these funds' operations are concentrated in *Investment and Related Activities* as well as in the *Management of Companies and Enterprises*. A substantial proportion (82.3%) of the ISCs that received VC backing operate within the service sectors, while 11% are specialized in manufacturing activities.

Looking at the distribution of VCs and ISCs with respect to NUTS3 regions (i.e. Italian provinces), Figure 1 reveals that the clash between the theoretical role of spatial proximity and its empirical evidence that has inspired our paper is also present in the Italian context. ISCs are distributed across the whole Italian territory, while VC actors (with at least one Italian deal) are mainly concentrate in the Northwest and Centre of the country. As a result of this asymmetric geography, even areas with very few or no VC offices, such as the Northeast or the South of the country, host as many as 22% and 18% (as reported in Table 1) of all ISCs, respectively. This evidence suggests that Italian ISCs do not tend to 'mirror' the location of VCs, supporting the inspiring motivation of this paper.

Nonetheless, as revealed by the analysis of the Location Quotient (LQ) with respect to VC-backed ISCs (Section A.1. in the online Appendix), Italy is marked by large regional gaps in this kind of financed innovative investment. As revealed by Table 1, LQ is greater than 1, denoting an over-concentration of VC-backed ISCs, in six of the twenty NUTS2 Italian regions (including Lombardy), while most of the other regions exhibit an under-concentration (LQ < 1), especially in the South and in the Northeast of the

Table 1. Location quotients and geographic distribution (number and share) of ISCs, VC, VC-backed ISCs and VC-ISC investments, at NUTS2 and NUTS1 level.

NUTS2	*LQ*	ISCs		VCs		VC-backed ISCs		VC-ISC investments	
		N.	*Share*	*N.*	*Share*	*N.*	*Share*	*N.*	*Share*
Lombardia	2.64	2587	25.3%	17	45.95%	57	41.9%	69	43.1%
Piemonte	1.12	541	5.3%	2	5.41%	11	8.1%	12	7.5%
Liguria	0.57	191	1.9%	1	2.70%	2	1.5%	3	1.9%
Valle D'Aosta	0.00	21	2.0%	0	0.00%	0	0.0%	0	0.0%
NorthWest, NUTS1 total	*1.93*	*3340*	*32.7%*	*20*	54.05%	*70*	*5.15*	*84*	*52.5%*
Trentino	0.96	265	2.6%	0	0.00%	1	0.7%	1	0.6%
Emilia	0.50	905	8.9%	1	2.70%	5	3.7%	7	4.4%
Veneto	0.49	866	8.5%	1	2.70%	5	3.7%	1	0.6%
Friuli	0.48	220	2.2%	0	0.00%	1	0.7%	7	4.4%
NorthEast, NUTS1 total	*0.36*	*2256*	*22.1%*	*2*	5.41%	*12*	*8.8%*	*16*	*10.0%*
Toscana	1.04	438	4.5%	2	5.41%	10	7.4%	13	8.1%
Lazio	1.44	1139	11.2%	3	8.11%	22	16.2%	25	15.6%
Marche	0.28	370	3.6%	0	0.00%	1	0.7%	1	0.6%
Umbria	0.00	193	1.9%	0	0.00%	0	0.0%	0	0.0%
Center, NUTS1 total	*1.07*	*2140*	*21.0%*	*5*	13.51%	*33*	*24.3%*	*39*	*24.4%*
Sardegna	1.42	149	1.5%	1	2.70%	5	3.7%	5	3.1%
Sicilia	0.59	497	4.9%	1	2.70%	6	4.4%	6	3.8%
Islands, NUTS1 total	*1.00*	*646*	*6.3%*	*2*	5.41%	*11*	*8.1%*	*11*	*6.9%*
Basilicata	0.83	110	1.1%	0	0.00%	1	0.7%	1	0.6%
Campania	0.43	804	7.9%	0	0.00%	6	4.4%	6	3.8%
Puglia	0.22	401	3.9%	0	0.00%	2	1.5%	2	1.3%
Abruzzo	0.00	218	2.1%	0	0.00%	0	0.0%	0	0.0%
Calabria	0.25	224	2.2%	0	0.00%	1	0.7%	1	0.6%
Molise	0.00	74	0.7%	0	0.00%	0	0.0%	0	0.0%
South, NUTS1 total	*0.29*	*1831*	*17.9%*	*0*	0.00%	*10*	*7.4%*	*10*	*6.3%*
Italy, total		*10213*	*100.0%*	29	78.38%	*136*	*100.0%*	*160*	*100.0%*
Foreign VCs				8	21.62%				

country. More importantly for our analysis, there are NUTS3 regions, such as Potenza, that exhibit a greater than one LQ, despite their being located far from any Italian VC office; and other regions, such as Bologna or Genova, which instead host VC offices, but reveal an under-concentration (LQ < 1).

Overall, these findings add to the evidence from which we have started this paper and seem to confirm that geographical proximity could not represent a reliable, or at least, unique predictor of VC investments in Italian ISCs.

3.2. Dependent variable and econometric model

The focal variable of our empirical analysis, *Y*, is the probability of observing a specific VC-ISC investment pair, for which we aim to investigate the determinants and the role of our four proximity variables (defined below). Given the difficulty of finding valid instruments for the multiple proximity regressors of interest, we adopt an alternative identification strategy that leverages a quasi-experimental design. Specifically, we follow an approach widely used in the literature about VC (e.g. Sorenson and Stuart 2001; Tykvová and Schertler 2011), which compares actual investment pairs – i.e. observed VC–ISC deals – with a set of plausible but unrealized alternatives.

To implement this strategy, we first restrict the sample to successfully VC-backed ISCs, thereby reducing heterogeneity in firm quality and financial needs across observed and potential investment pairs. We then generate, for each actual investment, a set of potential alternative VC–ISC pairs. For each investment event, we consider the investing VC funds and construct a counterfactual set of potential matches by pairing them with all ISCs that received funding within a symmetric 8-month windows (i.e. 120 days before or after the focal investment date) reflecting typical deal evaluation periods (Petty and Gruber 2011). Rather than assuming each VC covers all ISCs, this method retains all realistic and time-specific potential matches.

This approach approximates a counterfactual scenario in which each actual deal is evaluated against a set of similarly timed, plausible alternatives. It avoids assumptions about the spatial extent of search and accommodates both local and distant investment behaviors, thus preserving the empirical variation needed to identify the effects of geographical and functional proximity. By isolating the relevant dimensions of comparison and focusing on 'investment-worthy' firms only, our design creates a credible quasi-experimental setting and provides a reliable identification strategy in the absence of valid instruments. This methodology has been widely adopted in the literature to study investment and acquisition behaviors under conditions of partial observability and strategic matching (see, among others, Boschma, Marrocu, and Paci 2016; Chakrabarti and Mitchell 2013).

Given that 136 ISCs were backed once or multiple times by 37 different VC funds, for a total of 160 actual investments, their date-specific interaction gave rise to a sample of 8,480 VC-ISC investment pairs. The proportion of observed pairs represents only 1.89% of the whole sample, lower than the share (i.e. 5%) that is usually retained to have a rare event bias (King and Zeng 2002). Accordingly, after having implemented a set of tests (as detailed in the Section A.2 of the online Appendix, and reported in Table A.5), we implement a Firth's Bias-Reduced Logistic Regression (Firth 1993) to estimate the

following model:

$$P(Y = 1 \mid W_{i,j},\ X_i,\ X_j) = \frac{1}{1 + e^{-(W_{i,j}\beta + X_i\gamma + X_j\delta)}} \quad (1)$$

In Eq (1), Y denotes the occurrence of a specific VC-ISC investment pair, $W_{i,j}$ our set of proximity variables (evaluated at each observed or potential investment date) between j (VC) and i (financed ISC), while X_j and X_i contain investors specific and ISCs control variables, respectively, that will be described in the following Sections.

3.3. Proximity variables

In the following we provide an essential illustration of the proximity measures employed in the analysis. Because of word constraints, details on data sources and the construction of proximity variables are reported in the Appendix (Table A.2).

(i) Tangible proximities

Among the two variables in this category, *geographical proximity* is measured in a standard way, as the inverse of the minimum geodetic distance (in kilometres) between the legal or operational offices of the VC and the ISC.

As for *functional proximity*, drawing on and integrating previous studies (e.g. Brown and Horton 1970; Moodysson and Jonsson 2007), we have explored as many as 7 alternative proxies; (i) the travel time inverse, defined as the inverse of the minimum travel time (in hours) between the locations of VC and ISC, regardless of the mode of transportation; (ii) – (iv) three binary indicators that capture whether the minimum travel time between them is by car, within a two-hour travel time, or within a half-hour travel time, using any mode of transport; (v) – (viii) four mutually exclusive dummies, which indicate if the VC and ISC offices are in the same city (municipality), province (NUTS3), region (NUTS2), or area (NUTS1).

Considering the correlation of these alternatives with other regressors, our baseline specification adopts the dummy variable indicating whether the travel time between partners is below two hours, which we refer to as 'functional proximity.' Conceptually, this choice is supported by prior literature identifying the two-hour threshold as a practical cut-off for same-day travel that allows for in-person interactions and effective post-investment monitoring (e.g. Gompers and Lerner 2001; Mason 2007). We then test the robustness of our results using alternative proxies, as reported in the Appendix (Table A.6).

(ii) Intangible proximities

Turning to the intangible proximity variables, and in line with previous studies, we measure *industrial proximity* between VCs and ISCs as the share of prior investments made by each VC fund in the industries in which the target ISC operates. Referring to the hierarchical structure of industry codes in the NAICS classification, we adopt the three-digit level of disaggregation in our baseline specification. This level offers a balanced trade-off between sectoral detail and comparability across firms, capturing meaningful technological and market similarities without becoming overly narrow or idiosyncratic.

To ensure the robustness of our results, we replicate the analysis using industry codes at the one-digit, two-digit and four-digit levels, as reported in the Appendix.

Our measure of *relational proximity* is based on the network (adjacency matrix) of the professional and investment links that occurred between partners before the VC-backing date. Taking these links as a proxy of the relevant personal relationships between the parties at stake, we build up this matrix in three steps. In the first step, for each ISC and each VC in our sample, we identify their shareholders, holdings, advisors, and managers through their VAT number or BvD identification number. In the second step, we proceed recursively and collect the same pieces of information for each of the firms or individuals identified in the previous step.[5]

In the third step, by collecting the same pieces of information for each of the firms or individuals identified in the second step, and merging it with the one retrieved in the other two steps, we then construct an adjacency matrix that includes all the undirected links between each VC-backed ISC and each VC firm in our sample. Using this matrix, in our baseline estimates, we define 'relational proximity' (for each date-specific potential or observed VC–ISC pair) as the inverse of the shortest path length – that is, the minimum number of steps – required to connect the VC and the ISC within the network. This measure reflects the strength of their direct or indirect interpersonal connection, under the assumption that shorter paths indicate closer relational ties and greater ease of information flow and trust-building. As a robustness check, in the Appendix we alternatively define relational proximity as the total number of distinct paths (i.e. links) connecting the two actors, thereby capturing the breadth rather than the closeness of their network relationship.

(iii) Interactions among proximities

From an econometric perspective, testing Hp3 and Hp5 requires augmenting Model (1) with a set of interaction terms between tangible and intangible proximity variables. In this extended specification, Hp3 (Hp5) would be supported if the interaction term between tangible proximities and industrial (relational) proximity is found to be significantly negative, indicating a substitution effect between these dimensions in facilitating VC–ISC matching.

However, as noted by Ai and Norton (2003, 129), in non-linear models such as our Model (1), the coefficient of an interaction term does not provide a correct estimate of the combined effect of the interacting variables. Moreover, omitting a relevant interaction term can lead to a Type I error, even in inherently interactive models like logit and probit, due to the compression effect (Ai and Norton 2003; Mize 2019; Rainey 2016). Including the product term corrects for this bias at the modest cost of one degree of freedom.

For these reasons, to test Hp3 and Hp5, we extend our baseline specification by incorporating interaction terms between the three main proximity variables and re-estimate the full model accordingly. Following Mize (2019), we analyse these interactions using the delta method to assess whether the Average Marginal Effect (AME) of each proximity variable on the probability of a specific VC investment varies significantly across different levels of the other interacting variable. To complement this, we also provide graphical evidence by plotting predicted probabilities across combinations of values for the interacting variables.

3.4. Control variables

In estimating the role of the previous proximity variables, we should retain that firms' location choices could correlate both with these variables and with relevant unobservables – such as the quality of the managerial team – in turn arguably correlated with the probability that an ISC receives a VC investment.[6]

While this is not sufficient to make causal inference on our results, to attenuate the potential bias entailed by these issues, we control for ISCs-, VCs-, and location-specific factors and lag them by 1 year with respect to the dependent variable.[7] As for ISC −specific controls, we include the age of the firm and the number and characteristics of its managers (see Section 3.1, and Table A.4 in the Appendix). As for the VC, we instead control for their age. All the ISC and VC-specific control variables, unless otherwise indicated, have as source the Orbis and AIDA BvD databases.[8]

In addition to the previous factors, we also control with two dummies for the following circumstances: the fact that ISC had prior VC investments, and that the focal investment was realised in syndication with other VCs.[9]

Finally, we also consider a set of location−specific controls. First, we retrieve the following data from the Eurostat database at NUTS3 level: population, density, firm demography (birth rate) by 2-digit NACE code, and GDP. Second, to proxy for the presence of specific industrial clusters in the area of the focal firms, we consider the share of active high-growth firms by 2-digit NACE code per year. Third, still by 2-digit NACE code and location, we resort to data on patent applications to the European Patent Office, and account for the innovative capacity of the environment which firms operate in. In addition to the previous sets of controls, we include area (NUTS1 macro-region) fixed effects at the ISC's location[10], which are meant to control for the notable Italian North–South development divide. Furthermore, as we show in the Appendix (Table A.3), while co-location at city, province and region is more likely for observed VC-ISC pairs than for potential pairs, this is not true for being located in the same NUTS1 region. This makes NUTS1 an ideal level of aggregation for the control of spatial fixed effects. Indeed, while useful to control for unobservable characteristics at the ISC location, NUTS1 FE are not significantly correlated with any of our main regressors, such as spatial proximity.

4. Results

4.1. Tangible vs. intangible proximities and VC-ISC matching

Table 2 reports the results of different specifications of Eq. (1), in which we progressively insert among the regressors our proxies of geographical (specification 1), functional (specification 2), industrial (specification 3), and relational (specification 4) proximity. Specification 5 further augments the model by inserting the dyadic interaction terms between the same proximity variables. However, as we have illustrated in Section 3, the analysis of this further specification needs to be validated through the integration of further analysis, which we will report in the following Section (Section 4.2).

Before moving to the illustration of the relative results, let us note that Table 2 reveals that the retained controls generally show the expected sign. The fact that the focal ISC has had a prior VC investment increases the probability of its matching with a new VC investment. Consistent with previous studies (e.g. Sorenson and Stuart 2001), syndication

Table 2. Proximities and the likelihood of VC – ISC matching.

Dependent variable: VC-ISC matching						
	(1)	(2)	(3)	(4)	(5)	
Spatial proximity						
	Geographical proximity	0.000***	0.000***	0.000***	0.000***	0.000***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Functional proximity		0.966***	0.991***	1.030***	1.531***
			(0.000)	(0.000)	(0.000)	(0.000)
Industrial proximity						
	Industrial proximity			0.929***	0.578**	1.698***
				(0.000)	(0.022)	(0.001)
Relational proximity				3.033***	4.032***	
	Relational proximity				(0.000)	(0.000)
Interactions						
	Industrial proximity * Functional proximity					−1.147**
						(0.028)
	Relational proximity * Industrial proximity					−0.648
						(0.395)
	Relational proximity * Functional proximity					−0.827
						(0.321)
Controls						
	Syndicated investment	0.752***	0.757***	0.818***	0.859***	0.834***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Dummy: ISC's had prior VC investments	1.071***	1.055***	1.104***	1.158***	1.139***
		(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
	ISC's age at finance	−0.095	−0.110*	−0.115*	−0.126**	−0.121**
		(0.112)	(0.067)	(0.059)	(0.039)	(0.050)
	ISC's share of female managers	0.090	0.077	0.147	0.361	0.325
		(0.800)	(0.827)	(0.681)	(0.303)	(0.357)
	VC's age at finance	−0.000	0.002	0.001	−0.007	−0.005
		(0.987)	(0.857)	(0.935)	(0.596)	(0.700)
	GDP *p.c.* (t-1, at ISC's NUTS3)	−0.000	−0.000	−0.000	−0.000	−0.000
		(0.236)	(0.367)	(0.337)	(0.141)	(0.196)
	Population (t-1, at ISC's NUTS3)	0.000	−0.000	−0.000	−0.000	−0.000
		(0.770)	(0.226)	(0.382)	(0.343)	(0.342)
	N. of patent applications per Mill. Inhabs., (2012, at ISC's NUTS3)	−0.001	−0.004	−0.002	−0.000	0.001
		(0.809)	(0.352)	(0.532)	(0.899)	(0.876)

(*Continued*)

Table 2. Continued.

Dependent variable: VC-ISC matching						
	(1)	(2)	(3)	(4)	(5)	
	NUTS1 FE (at ISC location)	yes	yes	yes	yes	yes
	Constant	−3.244***	−3.559***	−3.538***	−4.053***	−4.757***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Observations	8480	8480	8480	8480	8480
	VIF	1.719	1.790	1.747	1.710	1.710
	Det(correlation matrix)	0.0797	0.0434	0.0405	0.0365	0.0003
Robust pval in parenthesis (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)						
Marginal effects (covariates at median values)						
	Geographical proximity (at 200 km)	3.02e-06***	2.91e-06***	2.40e-06***	1.57e-06**	3.18e-07**
	Functional proximity (at 1)		0.017***	0.015***	0.016***	0.015***
	Industrial proximity (at 0.33)			0.019***	0.011**	0.014**
	Industrial proximity (at 0.5)			0.022***	0.012**	0.016**
	Industrial proximity (at 0.75)			0.027**	0.013*	0.018**
	Relational proximity (at 0.33)				0.077***	0.086***
	Relational proximity (at 0.5)				0.129***	0.152***
	Relational proximity (at 0.75)				0.586***	0.818**

provides VC funds with an additional set of information, which increases the chance of a successful matching with a VC-backed ISC.

Concerning our focal regressors, column (1) of Table 2 shows that, as expected, the probability of a successful match between VC and ISC increases significantly with their geographical proximity. Despite the growing role of digital tools in financial intermediation – including the rise of fintech solutions and online platforms for managing VC–start-up relationships (Klein et al. 2019) – our findings suggest that spatial closeness still plays a key enabling role. In line with the longstanding debate on whether digitalisation diminishes the importance of physical distance (e.g. Fritsch and Schilder 2008), our evidence indicates that, while digital technologies have undoubtedly improved the codification and remote transmission of certain types of information, VC investment decisions continue to depend, in non-negligible part, on tacit knowledge. This includes, for example, subtle evaluations of team dynamics and founder credibility, or informal assessments of local market conditions and stakeholder trustworthiness – elements that are more easily accessed and validated through in-person interactions and local networks than through digital means.

Column (2) of Table 2 shows that our measure of functional proximity is also significantly and positively associated with the likelihood of a successful VC–ISC match, along with that of geographical proximity, thus supporting our Hp1a.[11] In other words, the greater the time and effort required for partners to establish and maintain in-person interactions, the lower the probability that the deal will materialize. This suggests that, as we argued in Section 2, logistical barriers to face-to-face engagement – such as travel time or coordination complexity – can hinder the development of the trust and mutual understanding needed to finalize an investment.

Coming to our Hp1b, the marginal effects at median covariate values (reported at the bottom of Table 2) reveal that the discrete gain in the probability of a successful deal from functional proximity – being within two hours of travel time – is consistently around 1.6 percentage points, ranging from 0.0147 to 0.0165 across all models. In contrast, the marginal effect of geographical proximity – measured as the inverse of a 200 km distance – is five orders of magnitude smaller, and declines as we progressively control for industrial and relational proximity, indicating that its raw contribution may partly reflect unobserved network or sectoral ties. All in all, this supports our Hp1b, namely that tangible proximity plays a more important role in functional rather than geographical terms in enabling successful VC financing of ISCs.

Together, these results imply that ease of access (functional proximity) plays a far more decisive role in securing VC investment than mere spatial closeness, likely because interpersonal trust and ongoing monitoring hinge on the feasibility of repeated in-person engagement rather than on small reductions in straight-line distance.[12]

Our Hp2, concerning the enabling role of industrial proximity in fostering VC–ISC matching, is also supported by the results. In Table 2 (column (3)) the coefficient for industrial proximity is positive and statistically significant, even after controlling for both types of tangible proximity. This suggests that the alignment of sector-specific experience and knowledge between the two parties increases the likelihood of a successful deal, consistently with previous and established evidence (Sorenson and Stuart 2001). Quite interestingly, the marginal effects reported at the bottom of Table 2 indicate a clearly non-linear impact of industrial proximity on the probability of a successful VC-ISC deal. When

industrial proximity is relatively low (having the VC previously invested in 33% of the NAICS sectors of the ISC), its contribution to deal success is modest (about 1.9 percentage points in Model 3), and still lower than that of functional proximity (around 1.6 percentage points). However, as the degree of industrial proximity increases to 0.75, its marginal effect rises sharply.

This suggests that industrial proximity becomes especially valuable when it is strong, amplifying the benefits of prior sector-specific experience. Compared to geographical proximity, whose impact remains negligible across all models, and even to functional proximity, whose effect is relatively stable and linear, industrial proximity appears to have a steep and powerful effect once a certain threshold of similarity is crossed.

With some interesting specifications, that we develop in the Appendix[13], the findings about industrial proximity reinforces the idea that industry-specific know-how, familiarity with market dynamics, and shared cognitive frameworks can facilitate communication and reduce information asymmetries between investors and startups, especially in uncertain and innovation-driven environments.

Postponing the test of Hp3 about the interactive role of industrial proximity to the next Section, column (4) in Table 2 apparently confirms our core hypothesis Hp4, about the importance of what we have defined as relational proximity. In both specification (4) and the fully interacted specification (5), the variable exhibits a highly significant and positive coefficient, with marginal effects that grow steeply across the distribution (bottom panel of Table 2). Specifically, at a moderate level of relational proximity (0.33), the predicted gain in deal probability is already sizable (around 7.7 percentage points), and it increases markedly with network closeness. These results are consistent with the interpretation that the presence of prior direct or indirect ties – proxied by shorter path lengths in the network of shared past affiliations – possibly facilitates mutual trust, reduces due diligence costs, and improves information flow between VC funds and ISCs. Compared to tangible proximities, and even to industrial proximity, relational proximity appears to exert the most powerful influence on deal formation once it reaches a moderate level. This supports the notion that relational embeddedness is arguably the most critical enabler of VC activity, particularly in settings where information asymmetries and uncertainty are high.[14] All in all, these findings validate the added value of our broader conceptualization and network-based measurement approach to relational proximity. By capturing indirect ties and recursive affiliations – rather than limiting the analysis to individual partners' 'simple' social capital – our work uncovers a deeper and more powerful relational structure that had been largely overlooked in previous studies.

4.2. Interaction among proximities

As illustrated in Section 3, testing our final two hypotheses regarding the interactive roles of industrial proximity (Hp3) and relational proximity (Hp5) with tangible proximities cannot rely solely on the full specification of Eq. (1), as reported in the final column (5) of Table 2.

More accurate insights about these interactions can be drawn by assessing whether the Average Marginal Effect (AME) of each proximity variable on the probability of a specific VC investment varies significantly across different levels of the other interacting

variable. Given the prominent role that functional proximity has in comparison with geographical proximity, we limit this interactive analysis to three (functional, industrial, and relational) of the four proximities we have defined.

In this respect, Table 2 shows that the Average Marginal Effect (AME) of each proximity type on the probability of a VC-ISC match is positive. Moreover, in apparent support of both our Hp3 and Hp5, the marginal effects are consistently larger (and statistically significant) when the interacting proximity variable is at a low level. This pattern suggests a substitutive relationship: each proximity type tends to compensate for the lack of another in increasing the likelihood of a successful match between VC and ISC. However, the results from the test of second differences indicate that only the interaction between industrial and functional proximity is statistically significant, while the interaction between relational and functional proximity is not. This lack of significance in the second difference may be due to an asymmetry in how the two proximity dimensions interact.

In our results, the AME of relational proximity does not differ significantly across varying levels of functional proximity. On the other hand, the AME of functional proximity does vary across different levels of relational proximity, as it is significant at low levels of functional proximity, but not at high levels (Table 3).[15] The previous evidence is also reflected in Figure 2, which shows the trend in the marginal effects of one proximity at varying levels of the other proximity variable, considering each of the two directions of their interaction on the left and right side of the relative panel. In line with the interaction patterns shown in Table 3, the plots (both on the left and the right side) clearly illustrate that the marginal effect of each type of proximity tends to decrease as the level of the interacting proximity increases. However, the slope of the marginal effect is statistically significant on both sides (as shown by the confidence bands) only in the case of the interaction between industrial and functional proximity – as proved by the statistical significance of the second-difference test.[16]

Altogether, Figure 2 provides a more nuanced and continuous depiction of the substitution effects among proximities, strengthening the conclusions from Table 3. This evidence supports our Hp3 about a substitution effect between industrial and functional proximities in the enabling of VC-backing of Italian ISCs. Industrial proximity between VC and ISC seems to compensate for low levels of tangible proximity in facilitating VC investments. While the Average Marginal Effects of relational proximity are statistically significant at both levels (low and high) of functional proximity, their difference is not significant. Conversely, the first difference of the AME of functional proximity is only significant for low levels of relational proximity. When relational proximity is high, the AME of functional proximity on VC–ISC matching is not statistically different from zero, indicating that increases in functional proximity do not significantly alter the likelihood of a match in such contexts. These two results are reflected in the lack of significance of the second difference test.

This is interesting and somehow unexpected. The lack of support for Hp5 somewhat contrasts with earlier findings, such as those by Sorenson and Stuart (2001), which emphasized the substitutive role of relational ties in compensating for geographic. In our context, it is the shared industrial experience and knowledge base that appears to more effectively offset the frictions associated with functional distance (e.g. long travel times or coordination hurdles). One possible explanation – consistent with the inconclusive statistical evidence – is that while relational proximity fosters trust and coordination, it may offer a less cognitively structured or evaluative foundation compared to industrial

Table 3. Interactions among proximities and VC-ISC matching.

		First differences		Second difference
		At: Functional proximity low	At: Functional proximity high	
		(Travel Time >2 h)	(Travel Time <2 h)	
1	AME of Industrial proximity	0.794***	0.221	Industrial#Functional
		(0.228)	(0.156)	−0.574**
		At: Industrial proximity low (Industrial proximity 3digits = 0.25)	At: Industrial proximity high (Industrial proximity 3digits = 0.75)	(0.262)
2	AME of Functional proximity	1.105***	0.532	
		(0.269)	(0.359)	
		At: Relational proximity low (Relational proximity =0.25)	At: Relational proximity high (Relational proximity =0.75)	
3	AME of Industrial proximity	0.376***	0.214	Industrial#Relational
		(0.126)	(0.209)	−0,162
		At: Industrial proximity low (Industrial proximity 3digits = 0.25)	At: Industrial proximity high (Industrial proximity 3digits = 0.75)	(0.190)
4	AME of Relational proximity	1.652***	1.490***	
		(0.219)	(0.219)	
		At: Functional proximity low (Travel Time >2 h)	At: Functional proximity high (Travel Time <2 h)	
5	AME of Relational proximity	1.964***	1.550***	Relational#Functional
		(0.320)	(0.297)	−0,414
		At: Relational proximity low (Relational proximity =0.25)	At: Relational proximity high (Relational proximity =0.75)	(0.416)
6	AME of Functional proximity	1.139***	0.726	
		(0.273)	(0.515)	

SE in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Note: Average Marginal Effect of proximity variables and test of the significance of the interaction terms (Model 5 in Table 2).

proximity when compensating for functional distance. Industrial proximity, by contrast, may provide a more robust foundation for mutual understanding, particularly when partners cannot rely on frequent or direct interaction – thanks to shared technological knowledge, sectoral routines, and interpretative schemas that help reduce ambiguity and transaction costs at a distance.

4.3. Additional estimates and robustness checks

The results that we have obtained about the role of proximities in driving the probability a successful VC-ISC pair appear generally confirmed with respect to a set of robustness checks, reported in the Appendix and to which we have referred in presenting them above, which include: (i) alternative proxies for the proximity variables at stake (Table A.6); (ii) the exclusion of VC with offices outside Italy (Table A.8, Model 8).

Results are also robust to four additional checks, which we also report in the Appendix (Section A.4).

(iii) To address the unobserved heterogeneity at the ISC or VC level, which could have escaped from our baseline model, we exploit a Conditional Logit framework with

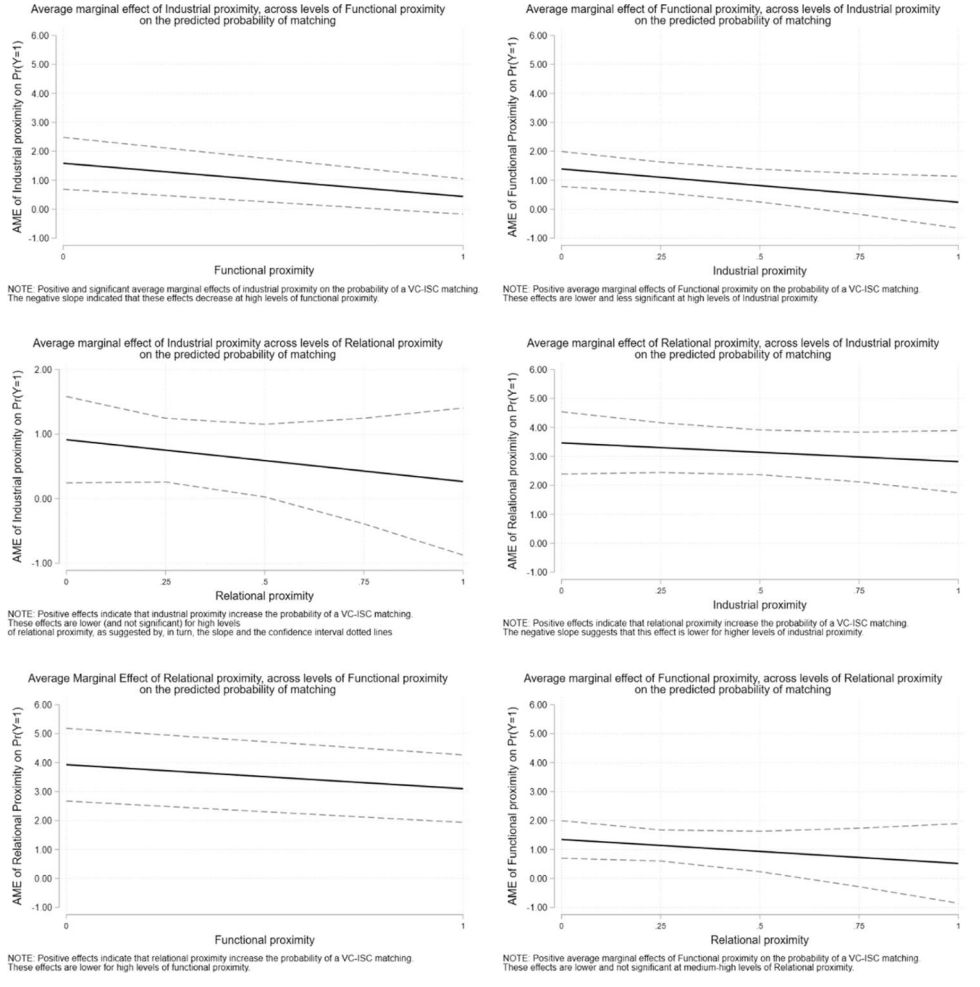

Figure 2. Marginal effects of proximity dimensions at varying levels of the other proximity types. Average marginal effects of each proximity variable (industrial, functional, relational) on the probability of a successful VC–ISC match, conditioned on low-to-high values of the interacting proximity dimensions.

individual fixed effects, first at the ISC and then at the VC level[17] Results (Table A.7, Models (1) – (2)) are robust in term of sign and significance of the coefficients. In the same Table A.7, we further assess robustness by exploring alternative specifications of the fixed-effects structure[18]: Model 3 excludes fixed effects entirely, serving as a benchmark specification and reflecting raw associations between regressors and the outcome. Models 4–9 introduce location fixed effects for the VC's and ISC's location at progressively finer levels of spatial resolution – NUTS1, NUTS2, and NUTS3, respectively, to control for local or institutional time-invariant unobserved differences that may influence the VC-ISC matching. Across all models, the sign and significance of the main regressors remain stable, suggesting that the core relationships identified in our analysis are not driven by unobserved factors at the VC, ISC, or location level.

(iv) A further robustness check concerns the possible presence of spatial autocorrelation in the phenomenon that we are investigating. Indeed, this could be suggested by the spatial inequalities in the distribution of VC-backed ISCs and VC offices we have highlighted in Section 3.1. Quite interestingly, excluding ISCs and VCs located in agglomerated areas (Table A.8, Models 4–7), has the sole effect of increasing the magnitude of the coefficients of the intangible proximity terms. This result provides further evidence about the hypothesis that intangible proximities effectively counteract the barrier of physical distance with respect to VC funds.

(v) We control for the presence of idiosyncratic investments, as results might be affected by second and syndicated VC investments, which the literature has shown to differ from first and solo ones (Berchicci, Block, and Sandner 2011; Bédu, Brossard, and Montalban 2024; Catalini and Hui 2018; Cumming and Dai 2010). The main results of our analysis (Table A.8, Models 1–3) do not change when carrying out this final kind of checks.

(vi) We also estimate two multilevel logistic models with random intercepts at the individual VC level and at the VC's location at NUTS1 level. These specifications allow baseline investment propensities to vary across VCs and locations, capturing unobserved factors such as regional investment cultures or deal flow density. Results from these models (Table A.9, Columns 1-4) remain broadly consistent with our main findings, although the coefficient on industrial proximity shows a reduction in statistical significance.

(vii) Finally, we implement a repeated-choice mixed logit model (Revelt and Train 1998) with random coefficients on the alternative-specific constants for each VC. This approach explicitly models heterogeneous preferences and accounts for correlation across choices by the same VC. As shown in Table A.9 (Columns 5-6), the proximity coefficients mostly retain their sign and significance, except for industrial proximity, whose effect is absorbed by VC-specific characteristics such as sectoral specialization. Despite necessary sample restrictions to satisfy the model's single-choice assumption – due to some instances of multiple investments by the same VC on the same date – the main results remain qualitatively robust, further confirming the stability of our findings.

5. Conclusions

Given their relevance in addressing the idiosyncratic geography of VC investments in ISCs – and motivated by recent, puzzling evidence emerging from direct interviews with firms – we provide a novel investigation into how various dimensions of proximity influence the likelihood of a successful match between VC and ISCs seeking financing.

Our main contribution lies in introducing a new form of intangible proximity – relational proximity – which reflects the closeness between VC funds and ISCs through business (e.g. ownership links, financial ties) and organizational connections (e.g. shared governance, board memberships). Additionally, we clarify a common ambiguity in the literature by clearly distinguishing between geographical and functional proximity – two tangible dimensions often treated as equivalent, but which we argue have distinct roles in shaping VC–ISC interactions.

We have put forward a set of hypotheses on the role of different forms of proximity in shaping VC investments in ISCs, and about their potential substitutability. These hypotheses have been tested using a novel dataset covering the entire population of Italian ISCs and the VC investments they received between 2014 and 2019.

Our analysis has obtained three main results, with important policy implications. First, tangible proximity matters more in functional than in geographic terms. It is the accessibility of partners, rather than simple physical closeness, that facilitates deals – a point that extends previous interview-based insights (Fritsch and Schilder 2008; Martin et al. 2005). Accordingly, policy efforts to strengthen VC financing of innovative startups should focus on improving transport infrastructure and promoting co-location through shared spaces like innovation districts and venture studios, especially in poorly connected regions.

Second, intangible proximities – namely industrial and relational – play a crucial role too. Both sectoral alignment between VC and ISC (industrial proximity) and the existence of professional and investment ties (relational proximity) significantly increase the likelihood of a successful match, with relational proximity emerging as the strongest predictor. This suggests that policymakers should facilitate the development of strong relational networks between VCs and startups by promoting co-investment platforms, encouraging joint participation in governance structures, and fostering programs that enable knowledge exchange and mobility.

Third, we obtain interesting results about the interplay between the different forms of proximity we examined and their impact on the matching between VCs and ISCs. Industrial proximity can compensate for the absence of functional proximity. However, no similar substitution effect emerges between functional and relational proximity. Policymakers aiming to ease access to VC for functionally distant ISCs should focus on strengthening sector-specific knowledge ecosystems – through initiatives such as industry-focused accelerators, knowledge-sharing platforms, and specialized training programs. Conversely, since relational proximity alone does not appear to offer the same compensatory effect, simply encouraging general networking activities is unlikely to be sufficient.

Our empirical analysis is not free from limitations. First, while we mitigate concerns over unobserved heterogeneity by constructing a counterfactual of potential investment pairs, other endogeneity issues may persist. Future research should explore valid instruments to address the potential endogeneity of key regressors, particularly relational and functional proximity. Second, our analysis does not account for digital or virtual proximity – an increasingly relevant factor in remote collaboration and digitally mediated investment. Future studies could extend our framework by building up dyad-level data on the digital engagement of the partners. Finally, our focus on a single country with a relatively underdeveloped VC market, like Italy, limits the external validity of our findings. Cross-country analyses are needed to assess the generalizability of our results.

Notes

1. It is worth noting that a regulatory update concerning innovative start-ups was introduced after the completion of our project and the finalization of this paper, and is therefore not considered in our analysis. Indeed, talian Law No. 193/2024 updated the definition of an innovative start-up, specifying that it must qualify as a micro, small, or medium-sized enterprise under EU Recommendation 2003/361/EC, with an annual turnover below €50 million or a balance sheet total not exceeding €43 million. The law also introduced stricter conditions for remaining in the special section of the Business Register.
2. The geographical, or geodetic, distance between two points is generally measured with the length of the shortest path between them calculated along the surface of the Earth.

3. In business surveys, questions about functional distance, usually posed to managers by using relevant thresholds (e.g., within-two-hours travel distance) are possibly easier to be evaluated than more general questions about geographical distance (e.g., importance of deal location). This framework effect could also concur to explain the perceived irrelevance of the latter detected by Carlson and Chakrabarti (2007) and Fritsch and Schilder (2006).
4. In the study by Shao and Sun (2021), for example, the authors refer to the social capital of entrepreneurs only, and disregard the possible role of VC investors in its construction. Indeed, the *structural* dimension of entrepreneurs' social capital is measured by the network ties of entrepreneurs' work experiences, while the *relational* dimension by looking at their involvement in political and financial organisations.
5. More specifically, as illustrated in a simplified manner by Figure A.1 in the Appendix, for shareholding or outward-holding firms, we identify the references of advisors, managers, holdings, and shareholders (either individuals or corporate shareholders). For individuals, such as managers, advisors and individual investors, we detect all previous and contemporaneous professional positions and individual investments.
6. As we will explaine in Section 4.3, in a robustness check of our results we also control for unobserved heterogeneity through the inclusion of individual fixed effects at the ISC and VC level.
7. We use one-year lagged controls to mitigate endogeneity concerns, particularly reverse causality. This timing also reflects the information typically available to VC investors, as deal processes often span several months.
8. We also consider among the controls for ISC the one-year lagged measurement of a number of productivity-related variables (production costs, costs of research and advertising, per capita value added, value of production, patents rights, labour cost, and labour productivity) and of profitability-related variables (revenues, debt/equity ratio, return on investments, return on equity; earnings before interest, taxes, depreciation, and amortisation). However, given the presence of large number of missing values for all of these balance-sheet variables, the relative estimates are not that informative and are thus available from the authors upon request. Results turn out to be generally consistent.
9. We use this dummy to account for the diminished salience of distance in syndicated deals, guaranteed by risk, information, and costs sharing between VC investors (Sorenson and Stuart 2001). However, as this was already investigated in the literature (Tykvová and Schertler 2014; Catalini and Hui 2018), and our focus is on proximity between VC-investors and target firms, we do not measure the relational proximity between different VCs participating in the investments. Notwithstanding, syndicated investments represent only 14% of the observed operations and, when they are excluded from the sample as a robustness check (Appendix A.4), general results in terms of significance of the coefficients hold.
10. In the Appendix, we conduct robustness checks using alternative specifications of fixed effects, including those at the NUTS1 regional level for VCs, the more granular NUTS2 level, and individual-level fixed effects. These alternative specifications yield consistent results, reinforcing the robustness of our findings.
11. To assess and control for potential multicollinearity, we report both the mean Variance Inflation Factor (VIF) and the determinant of the correlation matrix for each regression model. Although individual VIFs are not shown in the tables, none exceed a value of 4 – except in Model 5 of Table 2, which includes interaction terms. In that model, the VIF for the interaction between functional proximity (travel time < 2 h) and relational proximity reaches 7.21. Nonetheless, the determinant of the correlation matrix remains at 0.0004, which is comfortably above the commonly accepted threshold of 0.0001, indicating that multicollinearity does not pose a serious issue.
12. As Table A.6 in the Appendix shows, this important result appears robust to other measurements of functional proximity we have investigated.
13. Table A.6 in the Appendix reveals that industrial proximity is significantly positive also at the similarly aggregated level of 2 digits of the NAICS classification, while this is not so at the most aggregated 1 digit level, and the most disaggregated 4 digits level. This is interesting and

suggests that, in line with the benefits of an 'unrelated', rather than 'related' kind of variety in sharing knowledge (Castaldi, Frenken, and Los 2015), when the industry-group environment that the partners share is very specific – i.e., at the level of 4 digits (in Model 3), as with an ISC in Basic Chemical Manufacturing targeted by a VC with previous experience of it – the entailed learning return for the VC is possibly too narrow. Conversely, at the intermediate level of sectors (2 digits) and subsectors (3 digits), the enabling mechanisms of the VC-ISC matching we have envisaged in Section 2 seem to work.

14. Table A.6 in the Appendix shows that the relevance of relational proximity gets confirmed when its intensity, in terms of the number of social ties that link the partners between them, is considered.
15. However, this asymmetry should be interpreted with caution, as it might be specific to our data and to differences in how each proximity variable is generated and measured.
16. This is also true for the interaction between industrial and relational proximity, which we just retain for the sake of completeness.
17. These results are presented as a control, rather than baseline, and are not included in the main text given that in logistic models a large number of individual fixed effects pose the incidental parameter problem (Neyman and Scott 1948) and diminishes the consistency of Maximum Likelihood estimators. The data structure of our analysis prevents us from exploiting panel data corrections for this problem (e.g. Hahn and Newey 2004; Fernández-Val and Weidner 2016), since at each investment date there are multiple observed, and thus alternative, investments.
18. More precisely, Model 3 excludes fixed effects entirely, serving as a baseline and reflecting raw associations between regressors and the outcome. Models 4–9 introduce location fixed effects for the VC's and ISC's location at progressively finer levels of spatial resolution – NUTS1, NUTS2, and NUTS3, respectively, to control for local or institutional time-invariant unobserved differences that may influence the VC-ISC matching.

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