Heterogeneity and Geographical Location in Italian Business Networks

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1 Introduction

Business networks play a crucial role in modern economic systems, because they generates network externalities and enable firms to achieve goals they would not be able to reach alone (Economides, 1996). Importantly, this organizational business model enables Small and Medium-sized Enterprises (SMEs) to overcome their structural limitations, helping to increase internationalization, brand and product innovation, cost reduction, bargaining power, and R&D investments (Pescatore et al., 2020).
In Italy, the Law n° 33/2009 introduced the very innovative policy instrument of Business Network Agreements (BNAs or *Network Contract*). It is a new way of fostering cooperation between enterprises with the aim of overcoming the typical limitations of the Italian production system, which is based mainly on small and medium-sized enterprises. The BNA should not be confused with industrial districts that mainly involve enterprises characterized by territorial proximity and operating in the same or related sectors. Relationships within an industrial district are often informal in nature and based on mutual trust and reputation (Becattini, 1991); differently, a network contract is a formal and legally binding agreements which may involve firms operating in both very distant and different markets. However, the enterprises, while cooperating with each other, maintain their full legal independence, without altering the degree of competition with other enterprises, including those participating in the agreement. In other words, network firms cooperate and compete at the same time, thus producing a double positive effect; on the one hand cooperation allows firms to share knowledge (Bullinger, 2004), promote innovation (Teirlinck and Spithoven, 2013), increase reputation and bargaining power (Lechner et al., 2006) and gain access to international markets (Ojala, 2009), on the other hand maintaining competition leads to lower prices and greater incentive to innovate. Another type of cooperation that should not be confused with network contracts is the technology consortium (Baumol, 2001). This form of association is better suited to a reality composed of numerous production entities of limited size (such as the Italian one) since it not only allows individual companies to have access to the technologies developed by the other members by giving their own in exchange, but also provides them with a valuable incentive to conduct their own R&D activities. However, unlike network contracts, such agreements are concluded separately with each (or even some) of the other members of the consortium and can therefore take very different forms and contents (Correani et al., 2009).

Over the years, BNAs among Italian firms have gained relevance, as shown in figure 1, growing

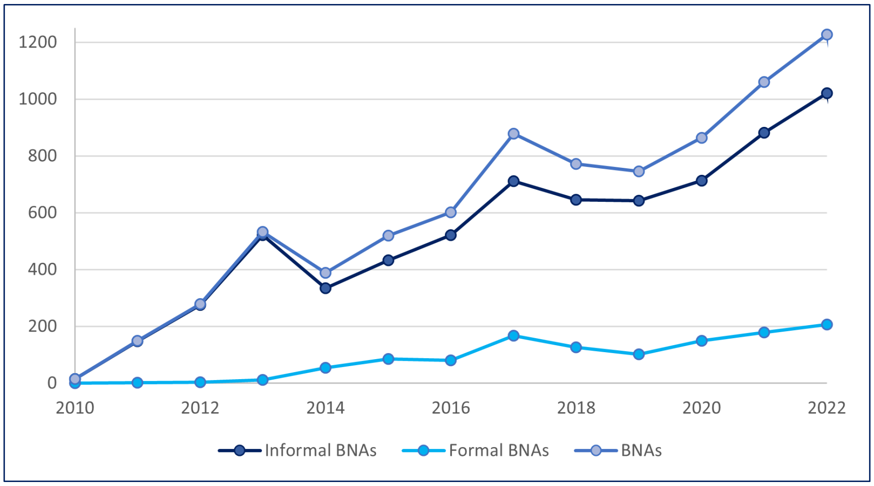

Figure 1: Annual trend of BNAs - Our Elaboration on Infocamere Data

from a few dozen network contracts in the early years to more than 1,200 BNAs in 2022. In the figure 1 we distinguish between formal and informal BNAs, according the Italian legislation. Formal BNAs have legal subjectivity and own autonomy; collaboration is regulated by a specific contract and managed by a joint body with independent legal personality and registered in the ordinary section of the Register of Companies. Differently, informal BNA is more like an actual contract between firms, without acquiring legal subjectivity.
Table 1 shows that informal networks prevail over formal ones in all regions of Italy, and are found to be more concentrated in the regions of higher industrialization (Lombardy, Veneto, Emilia Romagna, Lazio).

Italian networks have been the focus of many empirical studies, especially in an attempt to assess their impact on the performances of the firms involved. Four years after the introduction of network contracts, Colombo et al (2014) showed significant improvements in the EBIT indicator for all Italian companies belonging to a network. Subsequently, Confindustria (2017) highlighted the positive effects of the network on turnover, employment and productivity. These early results were confirmed by Burlina (2019) who, being able to rely on 9 years of observations, used a *difference in differences* approach to investigate the effect of inter-firm networks on Italian SMEs turnover growth. The analysis reveals that collaboration among firms increases their turnover by 66% although this effect does not appear to be long-lasting. Positive effects are also found on export propensity, especially for firms forming networks in more traditional sectors (Cisi et al., 2020). Interestingly, networks agreements appear to be very beneficial for the Italian family firms (Aiello et al., 2020) since they can rely on a well-established endowment of social (relational) capital that ensures the long-term survival of the network (Ghinoi et al., 2023). A particular form of network is represented by eco-networks; these are agreements that have the specific objective of reducing the polluting emissions of participating companies by promoting green innovation. As Fabrizi et al (2022) pointed out, Italian eco-networks have a higher positive impact on employment than other networks, because of their greater propensity for innovation.
Along these lines of research, we propose a new empirical analysis of the Italian networks, investi-

Table 1: Regional Distribution of BNAs

Region	**Inf. BNAs**	**%**	**Form. BNAs**	**%**	**Tot BNAs**	**%**
Piemonte	386	5.52%	48	4.06%	434	5.31%
Valle d'Aosta	28	0.40%	2	0.17%	30	0.37%
Lombardia	848	12.13%	103	8.71%	951	11.64%
Trentino-Alto Adige	128	1.83%	21	1.78%	149	1.82%
Veneto	705	10.09%	66	5.58%	771	9.43%
Friuli-Venezia Giulia	346	4.95%	26	2.20%	372	4.55%
Liguria	130	1.86%	59	4.99%	189	2.31%
Emilia Romagna	516	7.38%	47	3.98%	563	6.89%
Toscana	452	6.47%	105	8.88%	557	6.82%
Umbria	124	1.77%	50	4.23%	174	2.13%
Marche	217	3.10%	14	1.18%	231	2.83%
Lazio	854	12.22%	220	18.61%	1074	13.14%
Abruzzo	275	3.93%	31	2.62%	306	3.74%
Molise	14	0.20%	4	0.34%	18	0.22%
Campania	458	6.55%	84	7.11%	542	6.63%
Puglia	390	5.58%	85	7.19%	475	5.81%
Basilicata	51	0.73%	7	0.59%	58	0.71%
Calabria	114	1.63%	26	2.20%	140	1.71%
Sicilia	226	3.23%	49	4.15%	275	3.37&
Sardegna	133	1.90%	22	1.86%	155	1.90%
Multi-region	595	8.51%	113	9.56%	708	8.66%
Total	**6990**	**100.00%**	**1182**	**100.00%**	**8172**	**100.00%**

Source: our Elaboration on Infocamere Data. Note that in Nuts 1 level classification: Trentino-Alto Adige is divided in two parts: The autonomous province of Trento and the autonomouns province of Bolzano, with respectively 65 Inf. BNAs and 14 Form. BNAs; 63 Inf. BNAs and 7 Form. BNAs

gating the relationship between the nature of the activity of Italian firms that have signed a network agreement and their geographical location (spatial dispersion). This aspect was first studied by Correani et al. (2022) through a theoretical model combining Cournot-like strategic interaction with cooperation in cost reducing activity (network agreement) and strategic spatial location. Given the complexity of the model, their analysis is limited to two-firms networks and the main result suggests that the distance between the cooperating firms tends to be greater when they operate in related fields, whereas agglomeration is observed when firms operate in complementary or very different business sectors. The intuition behind this result is that two cooperating firms operating in the same industry (e.g., producing substitute goods) will tend to distance themselves from each other to reduce competition; in contrast, this behaviour is attenuated, and firms agglomerate, if the two firms engage in complementary or totally different activities. In the latter case, in fact, they can enjoy the benefits of cooperation without running the risk of benefiting direct competitors operating in the same geographical area.

In this paper we provide an empirical test of the results proposed by Correani et al. (2022) but

extending the analysis to networks with more than two firms. Based on the database of network contracts in Italy provided by Infocamere, we calculate the average geographic distance between firms belonging to the same network, and relate it to an entropy index that measures the level of heterogeneity among the activities carried out by the network firms. If the theory proposed by Correani et al. (2022) is correct, we should observe a negative and significant correlation between the entropy index and the average distance between enterprises in the same network.
However, our regressions (OLS) show the opposite. The geographical distance between firms in a network increases as the degree of entropy increases. The positive relationship remains highly significant even when considering additional control variables such as the number of firms in the network, network type, and industry dummy variables. When firms forming a network carry out similar activities they tend to minimize the geographical distance between them so as to maximize positive externalities (spillovers) even if this leads to increased competition. This phenomenon seems to replicate that of industrial districts, which are characterized by very similar competing firms operating in a well-defined geographical area.
A second regression model is proposed to investigate the effect of network-firm heterogeneity on the dimension of network, measured with the number of firm that signed the agreement. Our results are significant and show a positive relationship between network size and the degree of heterogeneity among the firms involved. In other words, when firms belong to the same industry, tend on average to form small network to minimise positive externalities in favour of direct competitors.
The rest of the paper is organised as follows: Section 2 describes the data and entropy index; Section 3 introduces the econometric model and Section 4 discusses the main results. Section 5 concludes.

2 Data description

This Section describes the data gathered from InfoCamere [1], employed in our empirical analysis.
The dataset provides the list of 8172 Italian BNAs, distinguishing between 6990 informal (network contract) and 1182 formal networks (*reti soggetto*). For each network, the dataset reports the number of participating firms and the aim of the contract, whereas for each firm into a network are reported its location (region and city) and sector of business (Ateco-code). We use these informations to compute our variables and implement the econometric model. The dependent variable is the average distance among the firms belonging to the same network. In a second regression we consider the number of firm belonging to the same network as the dependent variable. The key independent variable is the index of entropy measuring the degree of heterogeneity among the activities of network firms; moreover, we also consider a set of other regressors to take into account the geographical location of firms (according to NUTS 1 Level Classification by Eurostat)[2], the production sector in which a network firm primarily operates (agriculture, trade, industry, service, tourism, multi-sector and other sector), the type of network (formal or informal) and the effects of subsequent amendments to the legislation governing network contracts. The last amendment to Law No. 33/2009 was made in 2016 and we assume this year as a benchmark to investigate whether changes in the law affected the average distance among network firms.
Descriptive statistics are given in Table 2 whereas we discuss the variables in more detail in the next sections.

[1] https://contrattidirete.registroimprese.it/reti/; Time of downloading: 03/03/2023
[2] https://ec.europa.eu/eurostat/web/nuts/background

Table 2: Summary statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Average distance	8172	75,71	133,523	0	1081,123
Number of firms	8172	6,38	11,336	2	260
Entropy	8172	0,63	0,515	0	3,095

2.1 Average distance

To calculate the average distance among firms in the same network, we consider the *Comune* attribute indicating the cities where firms are located, and the latitude and longitude of the locations, obtained by a different datatset [3].
We use the geographical coordinates and sf R-package (Edzer, 2018) to compute the Euclidean distance between pair of firms [4]; thus, for each network formed by n firms, we obtain the following square matrix

$$\begin{bmatrix} x_{11} & x_{12} & ... & x_{1n} \\ x_{21} & x_{22} & ... & x_{2n} \\ ... & ... & ... & ... \\ x_{n1} & x_{n2} & ... & x_{nn} \end{bmatrix}$$

where x_{ij} indicates the geographical distance (in Kilometres) between firms i and j of the same network. Obviously, $x_{ii} = 0$ for any $i \in [1, n]$. Finally, the average distance is computed according to the formula $\bar{x} = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} x_{ij}}{n(n-1)}$. The total average distance is 75,71 km with a large variance (17828.4); the maximum average distance is 1081,12 Km and the minimum is 0, corresponding to networks formed by firms located in the same city.

2.2 Entropy

The main objective of this paper is to test whether there is a significant relationship between the degree of spatial concentration of a network and the specific activity carried out by the participating firms. This is precisely why we need some measure of the degree of heterogeneity among the activities that distinguish network member firms. Therefore, we compute the entropy index for both informal and formal BNAs, using the attribute *Attività* reported in the dataset to classify firms involved in informal networks and the first two numbers of the five-digit version of Ateco code for the formal ones. The entropy index is a statistical indicator that measures how one qualitative character (the type of firms activity) is distributed among the individual (network firms) of a population. Formally, the entropy index for a single network is calculated according to the Shannon's rule (Masisi et al., 2008; Borra, Di Ciaccio, 2014; Von Mises, 2014;)

$$H(X) = -\sum_{i=1}^{k} P(x_i) log P(x_i) \tag{1}$$

[3] https://github.com/MatteoHenryChinaski/Comuni-Italiani-2018-Sql-Json-excel
[4] For applications of Euclidean distance in Spatial Econometric Models see Buczkowska et al., 2019

where k is the number of activities we observe into the network, and $P(x_i)$ is the probability that a specific activity x_i occurs into the network. The entropy index ranges from 0, in the case of maximum homogeneity among enterprises belonging to the same network, to $log k$ when all network enterprises carry out different activities, that is $P(x_i) = \frac{1}{k}$ for any activity x_i.

2.3 Number of firms

Table 3 reports a classification of Italian networks by sector and dimension, showing that 4155

Table 3: BNAs by Sector, Size and Geographical Area.

	NW	NE	CN	SOUTH	INS	MULTI	TOTAL
Network by sector							
AGRICOLTURE/FISHERY (1)	224	353	375	244	85	23	1304
OTHER SECTOR (2)	1	1	13	4	3	2	24
TRADE (3)	108	105	215	120	36	28	612
INDUSTRY/HANDCRAFT (4)	511	603	501	345	84	179	2223
SERVICES (5)	548	542	686	546	130	295	2747
TOURISM (6)	33	64	59	49	23	10	238
MULTISECTOR (7)	179	183	185	230	69	170	1016
TOTAL	1604	1851	2034	1538	430	707	8164
Size by firm per Network							
2-3	805	938	909	741	194	568	4155
4-5	366	416	425	362	76	70	1715
6-9	248	282	304	227	71	46	1178
≥ 10	185	219	398	209	89	24	1124
Total	1604	1855	2036	1539	430	708	8172

Source: Our elaboration on Infocamere Data. Groups of Region (NUTS 1 Level): NW = Liguria, Lombardia, Piemonte, Valle d'Aosta/ Vall/ee d' Aoste; NE = Emilia-Romagna; Friuli- Venezia Giulia, Trentino-Alto Adige/ Sudtirol, Veneto; CN = Toscana, Umbria, Lazio, Marche; SOUTH= Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia; INS = Sardegna, Sicilia

business network agreements (50,8%) involve only 2-3 companies. Only 1124 network contracts (13,7%) involve more than 10 firms. It is important to note that a firm can take part in more than one business network agreement, but 91.1% of the total belongs to only one network.

2.4 Geographical location and business sector

We considered the codes of region and the description of business sector for each network firm, and counted the frequency of such codes-attributes for each networks; then, the code-attribute that occurs with the maximum frequency will characterise the network. In case that two or more codes-attributes appear the same number of times, the BNAs was assigned respectively to a multi-region

and multi-sector variable. As reported in Table 3, we distinguish 7 different sectors (agriculture, trade, industry, service, tourism, multi-sector and other sector) and 5 geographical macro-areas, namely north-west (NW), north-east (NE), centre-north (CN), south, islands (INS) and finally multi-region (MULTI) for all networks involving firms located in different regions. Figure 2 reports the geographical distribution of networks; Lazio and Lombardia regions have the highest concentration of both formal and informal networks.
Finally, we create a dummy variable for sectors and geographical areas, taking the value 1 if the network is in the corresponding area or sector, and 0 otherwise. In both cases, multi-sector and multi-region have been assumed as reference categories.

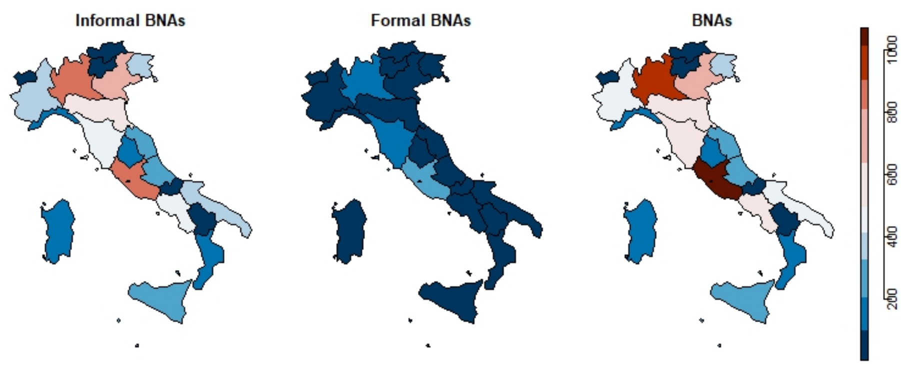

Figure 2: Geographical Distribution of Informal and Formal BNAs.

3 Econometric specification

We employ a cross-section econometric exercise aimed at investigating the relationships between the degree of activity differentiation among network firms and i) the average spatial distance among collaborating firms on the one hand, and ii) the dimension of the network (number of participating firms) on the other hand. We adopt cross-section regression because data provided by InfoCamere only report information at the time of network's founding year. For instance, no information is provided regarding any increases or decreases in the number of participating firms in subsequent years. Usually, the adoption of more sophisticated models such as time series and panel analysis is performed by merging the InfoCamere dataset with the AIDA Bureau Van Dijk dataset, which provides detailed information on the annual balance sheet data of Italian companies (see among the others Burlina, 2019; Cisi et al., 2020; Fabrizi et al., 2022).
Here follows the first regression equation:

$$avg\_dist_i = \alpha + \beta_1 H_i + \beta_2 type_i + \beta_3 area_i + \beta_4 sector_i + \beta_5 post\_2016 + \varepsilon_i \tag{2}$$

where avg_dist_i is the dependent variable measuring the normalised average distance among firms belonging to network i. H_i is the index of entropy measuring the degree of heterogeneity among firms' activities: in case $H = 0$ the firms carry out the same activity whereas increasing H indicates different and independent activities. In this regard, the theoretical literature has pointed out the presence of two possible effects. On the one hand, the strong competition among firms in the same sector could induce them to enter into agreements only with firms operating in more distant areas (Correani et al., 2022;); on the other hand, proximity would allow them to maximize the positive externalities arising from spillovers (Goyal and Joshi, 2003; Di Dio and Correani, 2017, 2020). In the first case we should observe a negative value of the β_1 parameter because greater heterogeneity among network firms would correspond to less geographical distance between them. Conversely, in the second case the β_1 parameter would take on a positive value, indicating the tendency of network firms to agglomerate (low average distance) the more similar the activities they perform (low H).

All other regressors are dummies. $type_i$ is a dummy variable taking value 1 for informal network. $sector_i$ is a set of seven dummy variables indicating the production sector in which network i operates (agriculture/fishing, industry, trade, services, tourism, other sector and multi-sector; this last variable has been assumed as the reference category). $area_i$ is a set of dummy variables to control for network location according to the NUTS1 level classification by Eurostat [5] (north-west, north-east, middle, south, islands and multi-region, the latter one has been adopted as the reference category). $post\_2016$ is a dummy variable taking value 1 if the network was founded in or after 2016, that is the year of the latest amendment to law about Italian BNAs. ε represents the error term.
The second regression equation considers the number of network firms (in logarithmic terms) as dependent variable:

$$LN_i = \alpha + \beta_1 H_i + \beta_2 type_i + \beta_3 area_i + \beta_4 sector_i + \beta_5 post\_2016 + \varepsilon_i \quad (3)$$

where LN_i indicates the natural logarithm of the number of firms forming network i. We use this model to test the relationship between network size and the degree of activity differentiation among network firms. From a theoretical point of view (Di Dio et al. 2017) we would expect a positive β_1 because greater activity differentiation is associated to a lower competition, thereby inducing more firms to join the network.

4 Results

Table 4 reports estimates of the relationship between the normalised average distance and the entropy index. It emerges that the H index is positively linked to the average distance and statistically significant at the 1% level in every regression model, implying that an increase of one unit of the entropy increases the average distance among firms in a network from almost 27 to 53 kilometres (we compute these values multiplying β_1 by the maximum distance reported in table 2).

Therefore, the larger the diversity among the activities conducted by the firms belonging to a network, the greater the average distance among them. The rationale behind this outcome is that when firms of network work in the same, or similar, sector of production, thus showing a low value of the entropy index, they may tend to agglomerate in a closest distance in order to benefit of positive

[5] The NUTS1 level classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU and the UK for socio-economic analyses of the regions at major socio-economic regions https://ec.europa.eu/eurostat/web/nuts/background

Table 4: Average distance and entropy.

	Dependent variable: Average Distance (normalised)					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0,0562***	0,0689***	0,0842***	0,2101***	0,2017***	0,1998***
	(0,002)	(0,004)	(0,005)	(0,004)	(0,005)	(0,006)
H	0,0461***	0,0429***	0,0253***	0,0496***	0,0407***	0,0411***
	(0,005)	(0,005)	(0,005)	(0,005)	(0,005)	(0,005)
Type of BNAs dummy	No	-0,0137***	-0,0169***	-0,0095**	-0,0113**	-0,0111***
	No	(0,003)	(0,003)	(0,003)	(0,003)	(0,003)
Regional dummies	No	No	No	Yes	Yes	Yes
Sectorial dummies	No	No	Yes	No	Yes	Yes
Post 2016 dummy	No	No	No	No	No	Yes
Observations	8,172	8,172	8,164	8,164	8,164	8,164
R^2	0.008	0.01	0.034	0.24	0.25	0,25

Results for regional, sectorial, and post-2016 dummies are not reported for brevity but available upon request. *, **, and *** denotes, respectively, statistical significance at the 10%, 5%, and 1% levels.

spillovers as it occurs in industrial districts. Such spillovers stem from a kind of strategic compatibility of the activities conducted by these firms, that enjoy benefits in terms of shared knowledge and marketing strategies, product and process innovation (Marshall, 2009). On the opposite, this propensity for agglomeration decreases as the degree of heterogeneity among the firms involved in the network increases; in other words, firms working on different sector of production do not exhibit the need of being located very close.

This result contradicts the findings of the recent model of Correani et al. (2022), in which firms producing the same good tend to locate far apart to reduce competition. This outcome can be motivated by the number of firms considered, since Correani et al. (2022) study networks with only two firms, whereas our analysis places no limit on the number of firms in the network. However, we show that our results do not change even considering only networks between two firms (Table 4).

Table 5: Average distance and entropy for two-firm networks.

	Dependent variable: Average Distance (normalised)					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0,0527***	0,1024***	0,1072***	0,1299***	0,1270***	0,1181***
	(0,004)	(0,011)	(0,014)	(0,010)	(0,014)	(0,016)
H	0,1256***	0,1188***	0,0757**	0,0986***	0,0752**	0,0756**
	(0,021)	(0,020)	(0,027)	(0,020)	(0,026)	(0,026)
Type of BNAs dummy	No	-0.0535***	-0,0502***	-0.0396***	-0.0374***	-0.0368***
	No	(0.010)	(0.011)	(0.010)	(0.010)	(0.010)
Regional dummies	No	No	No	Yes	Yes	Yes
Sectoral dummies	No	No	Yes	No	Yes	Yes
Post 2016 dummy	No	No	No	No	No	Yes
Observations	2.332	2.332	2.328	2.328	2.328	2.328
R^2	0.015	0.025	0.042	0.12	0.13	0.13

Results for regional, sectorial, and post-2016 dummies are not reported for brevity but available upon request. *, **, and *** denotes, respectively, statistical significance at the 10%, 5%, and 1% levels.

Informal networks are more geographically concentrated respect to formal ones. On average, for the same entropy index, the distance among firms in an informal network is reduced by 57 to 39 km compared to formal networks. A second regression is run to test the relationship between the degree of heterogeneity among network firms and the network size, measured in logarithmic terms. Results are reported in Table 4. Network size is positively related with entropy and statistically significant at 1% level in all regressions, confirming that firms tend to increase collaborative arrangements only if this does not result in a clear advantage for their direct competitors. If entropy increases by $0,1$, then the percentage change in number of network firms ranges from $100[exp(0,1 * 1,4123) - 1] \approx 15\%$ in regression (1) to $100[exp(0,1 * 1,6213) - 1] \approx 18\%$ in regression (3). Informal networks are, on average, smaller than the formal ones. Arguably, centralized management of the formal network combined with greater contractual constraints are likely to reduce the risks of opportunistic behaviour, thereby incentivizing more firms to enter the network.

Table 6: Number of firms and entropy

	Dependent variable: Number of firms (in log)					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1,0131***	1,3235***	0,6039***	0,9295***	0,3956***	0,3275***
	(0,011)	(0,022)	(0,028)	(0,031)	(0,033)	(0,037)
H	1,4123***	1,33448***	1,6213**	1,2933***	1,5766**	1,5909**
	(0,030)	(0,030)	(0,028)	(0,029)	(0,028)	(0,028)
Type of BNAs dummy	No	-0.3357***	-0,2611***	-0.3330***	-0.2601***	-0.2510***
	No	(0.010)	(0.011)	(0.010)	(0.010)	(0.010)
Regional dummies	No	No	No	Yes	Yes	Yes
Sectoral dummies	No	No	Yes	No	Yes	Yes
Post 2016 dummy	No	No	No	No	No	Yes
Observations	2.332	2.332	2.328	2.328	2.328	2.328
R^2	0.21	0.23	0.38	0.27	0.39	0.39

Results for regional, sectorial, and post-2016 dummies are not reported for brevity but available upon request. *, **, and *** denotes, respectively, statistical significance at the 10%, 5%, and 1% levels.

The positive relationship between average distance and Shannon entropy emerges to be robust when including other control variables as sectorial and regional dummies, BNAs dummies, and post-2016 dummies (Models 2 to 6). Results for dummy variables are not reported for brevity.

5 Conclusion

The network contract, introduced in Italy with the Law n° 33/2009, is the most innovative form of business-to-business cooperation regulation. Since its establishment, many scholars have studied its effect on the performance of the enterprises involved, showing an undoubted positive effect on innovative capacity, employment and profits. Unlike industrial districts or technological consortia, the network can involve enterprises that carry out very different activities and operate in distant geographical areas. However, it is still unclear how much the differences between enterprises may affect some specific aspects of the network, such as the average distance among network firms and the size of the network. To this end, we use data on Italian networks provided by InfoCamere to construct an entropy index that measures the degree of heterogeneity among the firms that make up a single network. According to our empirical analysis, both the average distance between network firms and the size of the network are positively and significantly related to the entropy index. In other words, firms tend to form small networks in limited geographical areas if they engage in similar activities. By concentrating in a limited area, firms are able to make the most of the positive externalities arising from cooperation and the fact that they carry out similar activities; at the same time, however, by limiting the number of partners with whom they share their efforts, it allows them to reduce the negative effects of competition. On the contrary, we observe more dispersed and big networks among heterogeneous firms.

Conflict of interest statement
On behalf of all authors, the corresponding author states that there is no conflict of interest.

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