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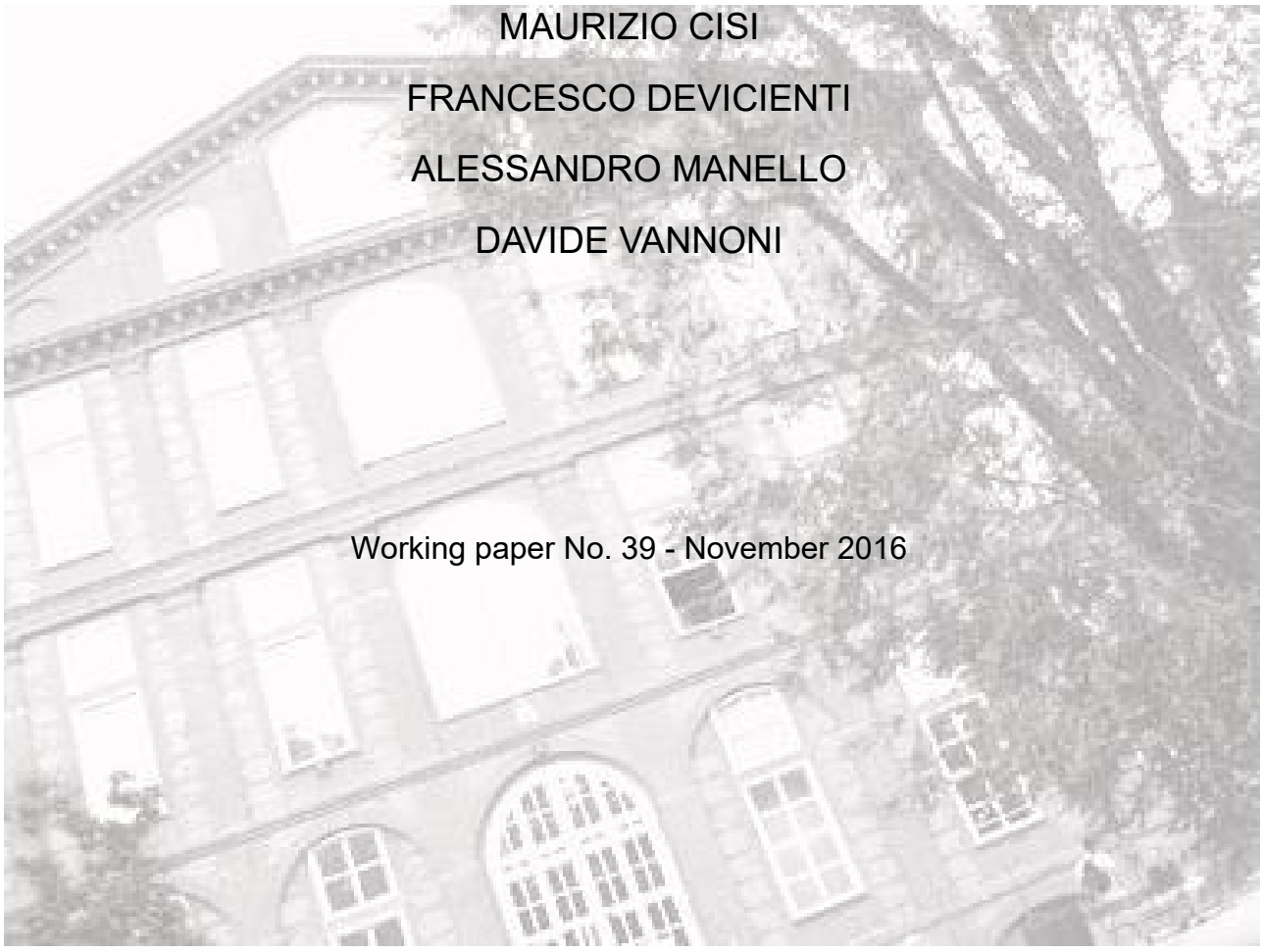
THE IMPACT OF FORMAL NETWORKING ON THE PERFORMANCE OF SMEs



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The impact of formal networking on the performance of SMEs

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Abstract

Using a large sample of Italian small and medium enterprises (SMEs), we investigate the effect of membership in a formal business network ("*contratto di rete"*) on firms' economic performance. We find that network participation has a positive effect on value added and exports, but not on profitability. The advantages of networking are stronger in the case of: smaller SMEs, firms operating in traditional and in more turbulent markets, firms located in less developed areas and firms not already exploiting the weaker ties offered by industrial districts. Network characteristics, such as size, geographical dispersion and diversity, are also found to influence performance.

Keywords: formal business network, small and medium firms, economic performance
JEL codes: D22, L24, L25, M21

1. Introduction

Firms, as social and economic actors, are members of numerous networks, which can be formal or informal, structured or de-structured, managed or not managed. The economic and managerial literature substantially agrees on the presence of positive economic returns from those interactions, arguing that isolated firms show, systematically, a worse performance with respect to firms that interact with each other. Networking activities of firms have been extensively investigated in the entrepreneurial and managerial fields, from both a theoretical

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and empirical perspective. Two main fields of investigation have emerged within network research, as Hoang and Antoncic (2003) highlight: the first analyzes the impact of networking on firms' performances, while the second considers the main factors influencing networks formation and functioning. Several surveys and quantitative analyses have been accompanied by a parallel and extensive qualitative research aimed at explaining the contents and nature of the relationships (Jack, 2010). Being a member of a network can be an important source of competitive advantage (Dyer and Singh, 1998), may allow one to gain access to knowledge and resources at lower costs (Gulati and Higgins, 2003; Zaheer and Bell, 2005) and to benefit from scale economies without the disadvantages of the big dimension (Watson, 2007). However, despite the wide theoretical and empirical research on the positive effects of networking on performance, large-scale empirical analyses are still scarce and the results are often poorly comparable, as highlighted by Oliver and Ebers (1998). The definition of firms' network is one of the most problematic aspects that emerge by analyzing the literature. Networking is often a self-reported activity that may refer to a continuum of interactions and collaboration levels. When networks are clearly defined and properly observable, their effects on firm performance are often contaminated by other non-network aspects, and hence difficult to isolate. The recent contribution by Schoonjans *et al*. (2013), for instance, analyzes the effect of formal networks identified through the participation to a Flemish government program based on managers' training and structured contacts among managers of small firms and large corporations, in a context where the effect of networking *per se* is mixed with the training effect.

Our paper contributes to this debate in several ways. First, we adopt a clear-cut definition of business-to-business formal network, which is more stringent than the classical definition given by Parker (2008), according to which a business network is a group of entrepreneurs that voluntary share knowledge and experiences. In our case, the relationships among firms in the network are closer, have clear objectives and respect a specific contractual scheme, named "*reti d'impresa*", recently introduced in Italy. Firms enter this type of legal contract voluntarily with the explicit aim of co-producing, co-marketing, co-purchasing or co-operating in product or market development, echoing the strong definition of formal network introduced by Huggins (2001). Such a contractual instrument has been introduced to favor the formalization of cooperation and collaboration among firms with the goals of partially overcoming the limits of small businesses and increasing the potential economic gains for network members, which are organized in formal groups with specific objectives (e.g.,

Huggins, 2000). Second, we consider a *pure* network effect because firms explicitly decide to sign the network contract agreements without receiving any other kind of relevant support, training or facilities from the government. Therefore, the identified effect is only related to organizational, technical and competitive advantages from firms' cooperation in production or marketing, and is not mixed with the effect of other policy measures (e.g., sponsored training). Third, our analysis is one of the few that relies on longitudinal data and firm fixed-effect methods. In doing so, we aim at eliminating the potential bias in estimates arising from self-selection of specific firm types into networking due to *unobservable* firm characteristics, such as a firm's specific culture, the management style or the owners' preferences. Finally, we provide new empirical evidence on the effects of network membership and its interactions with the external context, based on a large-scale econometric analysis. While doing so, we also shed light on some hitherto under-explored interactions between formal networking and the external context. Specifically, we test whether the advantages of networking are stronger for firms not already exploiting the weaker ties offered by industrial districts, and whether a differentiated effect of networking emerges when this unfolds in economic environments characterized by higher uncertainty and volatility, where the information-sharing channel of networking ought to be particularly valuable. To the best of our knowledge, this latter dimension of heterogeneity has never been explored before in the literature.

We obtain our data by merging economic and financial information for a large representative sample of Italian incorporated businesses with information on their membership status in a formal network, covering the years from 2010 to 2014 and forming a longitudinal firm sample. We then investigate the effects of network participation on different measure of performances in the short and medium term, with the idea that networking can create benefits even in the short run. We focus on small and medium enterprises (SMEs) for the relevance of small business in Italy in comparison to other European countries, for their lower personalization of business as compared to micro firms (for which the importance of personal social ties is instead high) and for their simpler functioning as compared to inter-firm relationships among large companies.[1] Our findings show that network agreements increase the value added per unit of sales, a proxy for the capacity of the firm to manufacture goods and provide services and sell them to the market, as well as the export propensity of participating firms, while the effects on profits are found to be negligible. After splitting our sample according to specific external factors, interesting differences emerge: the network

[1] Such kinds of sophisticated cooperation often materialize as joint ventures or complex technological alliances.

effect is stronger for small SMEs, and for firms located in underdeveloped areas or operating into more traditional sectors. Moreover, we find that formal networking acts as an effective tool for enhancing the performance of firms operating outside traditional industrial clusters and in more turbulent markets (measured by a strong industry-wide volatility of sales), where collecting or sharing information is expected to be particularly important.

The remainder of the paper is organized as follows. The next section reviews the literature on networking and economic performance and describes the specific Italian context. Section 3 presents our hypotheses and the main methodological concerns, while Section 4 describes our database. Section 5 presents and discusses our main results, and Section 6 concludes.

2. Literature review

2.1 *A definition of formal business networks*

How to define a network of firms, as well as the content of the network relationship itself, are controversial points in the literature. Often, business networks have been defined as general entities, where information is shared without any kind of specific interactions or relationship. Clusters of firms, for example, represent probably the weaker definition of a formal network, where mild ties among entrepreneurs and general inter-firms linkages within the industrial clusters are the instruments for supporting cooperation, innovation and sharing information flows (Li et al., 2015; Villa, 2007). In that definition of formal business networks, the interactions among firms are secondary and only rarely based on a direct relationship in the operational activities. Similarly, formal business networks based on weak operational interactions are identified by other authors like Birley (1985), Chell and Baines (2000) or Robson and Bennet (2000). In such cases, entrepreneurs interact with each other indirectly, through the mediation of institutions like chambers of commerce, governments, specialized agencies or trade organizations, which act as useful instruments to promote information sharing or exchange of experiences. However, one of the most important aspects of networking is an explicit voluntary adhesion and a direct interaction, as highlighted by Parker (2008), who defines formal business networks as organizations that bring together entrepreneurs with the aim of sharing information and experiences for mutual advantage. Other authors adopt a more restrictive view of formal business networks, by defining them as "initiatives to bring together firms to co-produce, co-market, co-purchase or co-operate in

product or market development trough contractual agreements" (Huggins, 2001).[2] Such a narrower definition guarantees the effective willingness of members to cooperate and represents one of the main differences between the objectives of our study, focused on formal networks of firms aimed at operating together, and those of studies focusing on other types of networks.

2.2 Networks and members' performances

The long-standing idea that belonging to a network is beneficial for firms has been the focus of a large literature in the managerial, entrepreneurial and economic fields. There are several channels through which networking can sustain performance. Networking reduces transaction costs (Lin and Lin, 2016), can supply firms with resources in a flexible manner and at a reduced cost (Li et al., 2015), can facilitate knowledge flows and technological improvements (Vanhaverbeke et al., 2009), as well as help to stimulate product or process innovation (Schott and Jensen, 2016; Mazzola et al., 2016). However, despite a strong convergence on the general positive effects of networking on performances, the empirical results are still strongly dependent on the specific definition of network, on the kind of firms analyzed and on the economic context. The general consensus on the positive effect of networks is mainly driven by the results for SMEs, as recently argued by Schoonjans et al., (2013), but is mixed for weak formal (Park et al., 2010; Watson, 2011) and informal networks (Kingsley and Malecki, 2004), as well as for cooperations among larger firms (Koka and Prescott, 2008).

In the case of formal business networks created on strong voluntary basis, firms truly decide to cooperate in production or marketing and their relationship configures itself as a strong tie in the relational-structural embeddedness framework (Granovetter, 1985; Gulati, 1998). Frequent interactions, common or explicit objectives and closeness among firms increase reciprocal trust, reduce opportunistic behavior and facilitate operational advantages of networking, especially for small and medium firms (Julien, 1995). Schoonjans et al., (2013) present the larger panel analysis on the networking effect available in the literatures and adopt the fixed-effect estimator to reduce endogeneity concerns. Focusing on the whole population of East-Flander SMEs (less than 250 employees) during the period 1992-2008, they analyze the effect of a government program, named PLATO, aimed at favoring contacts among SMEs

[2] The literature identifies other kinds of formal business networks, using different labels, according to the prevailing characteristics of the participant firms or to the main goals pursued. For instance, inter-firms/inter-organizational networks (Huggins and Thompson, 2015) or alliances (Mazzola and Perrone 2013; Mitsuhashi and Greve, 2009) are mainly referred to large firms that cooperate through complex technical, technological or market relationships.

managers also by organizing training sessions and discussions with large firms' managers. They find a positive and significant effect of networking on net assets growth and on value added growth (+2% and +3%, respectively), but the networking and managers' training effects are likely to mix with one another. Using survey data on Australian SMEs in the period 1994-1997, Watson (2011) considers firms linked to weak formal networks (industry associations, business consultants or banks) and to strong informal networks (other firms in the industry, family and friends) and find that only some specific types of formal networks (i.e. business consultants) have significant effects on firms' survival and growth. Park et al., (2010), analyzing a large sample of manufacturing firms in Korea (mainly SMEs) in the period 1994-2003, find evidence that networking (i.e. industrial clustering) has a positive effect on sales growth and survival, while other types of interactions (i.e. subcontracting) have a negligible effect. Watson (2007) proposes one of the largest cross-sectional studies, using data on Australian SMEs with less than 200 employees. Formal networks are defined as relationships with external accountants or industrial associations. He finds that firms involved in weak formal networks have higher survival probabilities and higher economic performances (in terms of the probability of being over the 25th percentile of ROA and sales growth). Lechner et al., (2006) use data from a survey study on CEOs and founders of venture capital firms (small firms by definition), and find a general positive effect of networking on firm development and sale levels. Their data on networks, which are self-reported by respondents, include both formal networks (technological alliances, marketing information networks) and informal networks (friends, other firms). Havnes and Senneseth (2001), analyzing a sample of more than 1700 SMEs operating in eight different European countries, find no benefits from networking[3] in the short run in terms of employment or sales growth. However, in the long term, firms involved in alliances and networks show an increasing geographical extension of their market.

The evidence for large firms is less clear-cut, probably because of the complex objects of the relationships, often focused on complex technological cooperation rather than on simpler synergies in production, commercialization or market development. Positive effects on profits (measured by a scale variable condensing market performances) are found by Ritala (2012) for collaboration among competing firms in Sweden, but the evidence is only based on firms employing more than 100 workers. Mixed results are instead reported by Koka and Prescott

[3] The data are self-reported by firms who are asked if they cooperate with other firms in areas such as expanding product spectrum, sales, financing opportunities, etc.

(2008), who analyze formal alliances among medium and large firms in the steel industry in 40 different countries, using sales per employees as a performance measure. By applying a random-effect panel estimation[4], they find that firms benefit from alliances in relatively stable environments, while in periods of radical changes, networks are negatively related with performance.

The empirical evidence for Italian firms, mainly drawn from institutional-level studies, is scarce and often inconclusive. Bentivogli et al. (2013) propose an analysis of the determinants of networking, using a sample of 1,000 firms involved in formal network agreements. They estimate a Probit model for the probability of entering such contracts, and find that firms located in Southern or North-Eastern regions of the country, as well as firms characterized by larger size and larger revenue growth have a higher probability of entering network agreements. Colombo et al. (2014) propose the first investigation on the effects of formal network agreement ("*reti d'impresa*") on performance. Using a sample of 6,000 network firms and 70,000 non-network firms, they show that the probability of having EBIT improvements is positively (even if marginally significant) related to networking, while no effect emerges on sales growth. More recently, Confindustria (2016), by applying a propensity score matching to control for observable characteristics influencing networking decisions, argued that firms entering formal network agreements are more productive (in terms of Value added per worker) as well as more oriented to foreign markets. Notice, however, that these existing studies for Italy rely on cross-sectional data and have been unable to employ methods (e.g., instrumental variable or fixed-effect estimation) to control for self-selection into networking due to unobservable characteristics.

2.3 Network characteristics and economic outcomes

According to the structural embeddedness approach, the characteristics of the network itself as well as the different prevailing kinds of ties can be important determinants of networking, with also strong interactions with the economic context (Gulati and Higgins, 2003). The number and type of prevailing ties (strong versus weak), as well as the content of relationships can influence the specific advantage of firms occupying certain positions of the network, and therefore their performances. Goerzen and Beamish (2005), investigating the relationship between network size and members' performances, find a clearly positive relation

[4] Notice that random-effect panel estimators assume that the firm effects included in the regression are uncorrelated with the main variable of interest, i.e. networking membership. Hence, unlike models based on firm fixed-effects, random-effect models are unable to eliminate endogeneity concerns arising from firm unobservable characteristics that influence both performance and networking propensity.

between the number of members and performance. However, Lechner et al., (2006), after confirming a positive relationship between network size (measured by the number of members) and performance (measured by sales level or by the time-to-break-even) in the years after foundation, argue that the explanatory power of network size is limited and can only partially explain the final economic outcomes. Conversely, they highlight the importance of network type in explaining the link between performance and networking, with differentiated results according to the different nature (in terms of reputation, cooperation, marketing or technology) of the network alliance. Similarly, Das and Teng (2002) suggest that the main characteristics of the network deeply influence the potential benefits for each single member from participation, with consequences also on the potential economic return. A general result from the theory is that the strength of network ties, sometimes proxied by the geographical proximity, matters and increases economic return. Consistent to this view, Rowley et al., (2000) find a ROA greater than the industry mean for members of networks characterized by high geographical density. On the contrary, Goerzen and Beamish (2005) find a negative effect of geographical dispersion on profitability of network members. Analyzing survey data from subsidiaries of 580 Japanese MNEs in 1999, they propose a conceptual model for identifying the main channels through which network diversity influences performance. In particular, they define network diversity according to the number of different industries (i.e. members which operate in different sectors) involved in the network agreement, finding a negative effect of diversity on ROA, ROI and ROS. The negative impact of diversity (measured by heterogeneity in partners' sizes) on performance (measured by sales growth) is also confirmed recently by Parida et al. (2016), who analyze survey data from 134 Swedish firms.

2.3 *The Italian network contract*

In an attempt to stimulate technological innovations and improve the competitiveness of SMEs, Italy adopted in 2009 a regulation for "Enterprises network". Article 3, paragraph 4-ter, and following of Decree 5/2009 (converted into Law 33 of 2009)[5] defines the "*contratto di rete*" as a contract allowing two or more enterprises to pursue the goal of individually and collectively increase their innovative capacity and market competitiveness. On the basis of a shared framework program, enterprises mutually undertake to collaborate, to exchange

[5] The law of April 9, 2009, n. 33, enacting, with amendments, the Law Decree 10 February 2009, n. 5 concerning urgent measures to support industrial sectors in crisis. The law was amended by Art. 42 of Decree 78/2010 translated into Law 122/2010 and subsequent amendments.

industrial, commercial, technical or technological information or services, or to jointly perform one or more activities. As such, the network agreement features a model of legal cooperation inspired by the logic of auto-regulation between contracting parties: the regulation does not prescribe any particular right or obligation for members, who are free to choose the details and specifications of the agreement.

The flexible normative background is intentionally weak in terms of binding constraints, in order to support any kind of collaboration: it allows companies to specify in detail "the common program and cooperation procedures between joining enterprises". The fact that the legislator does not state prescriptive rules promotes the creation of heterogeneous kinds of network, from horizontal models, where members are similar small and medium enterprises, to the more popular vertical model, in which a leading company strengthens the link with its suppliers.

The basic requirements of the network contract include the statement of the strategic goal and common scopes in order to reach improvements in terms of innovative capacity and competitiveness, the identification of a network program that specifies the activities and investments required to implement the strategic goal, as well as the rights and duties of each participant (Scagnelli and Cisi, 2015). The establishment of a common budget is not mandatory, as well as the definition of a common representative body. The firms can also foresee entry and exit rules, and ending conditions for the network.

3. Hypotheses development and methodology

According to the literature, entering formal networks stimulates resources and information sharing, increases cooperation and coordination along the supply chain, with an expected positive effect on performance. Of course, previous contributions use different definitions of performance: value added or asset growth (Schoonjans et al., 2013), sales growth (Park et al., 2010), ROA (Watson, 2007), ROA and ROS (Goerzen and Beamish, 2005), employment and sales (Havnes and Senneseth, 2001), with choices mainly suggested by data availability and by the focus of the study. We decide, according to data availability, to investigate three main aspects, on which the interest, at least in Italy, is stronger: efficiency, profitability and capacity of selling abroad. Our first hypothesis on the positive network effects can be split in three sub-hypotheses, one for each performance measure:

H1: entering formal networks has a positive effect on performance, measured by the value added / sales ratio, an indirect measure of efficiency (H1a), profitability (H1b) and penetration in foreign markets (H1c).

The last aspect has been rarely investigated in the literature, partly owing to limited data availability. However, the interactions among network partners can help firms characterized by low exports to accumulate experience and information, which can be used to increase foreign sales. This can be favored also by directly sharing resources, transaction costs and risks relative to making business abroad (Lu and Beamish, 2001). Recent contributions, reviewed by Fernhaber and Li (2013), are mainly focused on the participation to international network agreements, rather than to networking in general. Yu et al. (2011) is one of the rare cases focusing on how networking (technological and marketing alliances) can enhance international sales by stimulating entrepreneurs or managers to recognize and exploit international opportunities.

According to the structural approach, the context in which firms operate, together with their intrinsic characteristics and position in the network, can deeply influence the potential outcome, as highlighted by Gulati (1998), Gulati and Higgins (2003), Huggins (2000) and Szarka (1990). These aspects have been implicitly investigated in different papers, but rigorous empirical tests on the effects of the socio-economic environment and on different network characteristics on members' economic performances are still lacking.

We propose different hypotheses on different structural aspects that can influence the economic outcome of networking. Firstly, we think that structural differences among firms can influence both the motivation and the economic impact of networking. We test such idea empirically by dividing small and medium SMEs. In fact, larger SMEs (i.e. with more than 50 employees) can already exploit some benefits from scale economies, while smaller SMEs can benefit more from sharing resources in operational activities so as to overcome inefficiencies due to small size. On the contrary, larger SMEs may be more interested in sharing experiences or resources for making business abroad and opening new opportunities. This motivates our second hypothesis.

H2: Small firms enter networks to reduce costs, while medium firms enter networks mainly to open new opportunities in foreign markets.

It is well known that the Italian socio-economic environment is very different across regions, with a strong economic and historical divide between the North and the South. The lack of

resources or infrastructures of southern regions can stimulate the decision of entering networks for preventing isolation, and the potential benefits from being a network member may be stronger in underdeveloped areas due to the lower possibility of undertaking informal networking. We also identify the turbulence of firms' relevant markets by computing the volatility of sales at a very fine-grained industry level. We expect that firms operating in more uncertain environments obtain higher returns from formal networking, as these are the settings where access to additional information and resources is particularly valuable. This motivates our third hypothesis that, as far as we know, has never been tested before.

H3: Firms which operate in less favorable environments (i.e. underdeveloped areas or turbulent sectors) are expected to obtain higher returns from networking.

Other aspects related to the external operating and technological environment can strongly influence the benefits from networking. According to previous works, networks facilitate knowledge flows, (Vanhaverbeke et al., 2009), product or process innovation (Schott and Jensen, 2016) and new product development (Mazzola et al., 2016). Therefore, networking in more innovative industries may be more beneficial for firms. Using the well known Pavitt's taxonomy, we are able to classify industries according to their technological/innovative content and test empirically if firms operating in more innovative context show systematically higher returns from networking.

H4: Firms operating in more innovative industries show systematic higher returns from networking.

As highlighted in the literature review, previous works often find a positive outcome also from weaker forms of firm-level cooperation, like in the case of industrial clusters (Li et al., 2015). However, the presence of different networks has been rarely considered. Probably, Watson (2011) is one of the first contributions that jointly considers different kind of networks (i.e. banks, solicitors, industry associations and business consultants), confirming that most of the effects on firms' growth come from formal networking. The formal agreement we analyze (*reti d'impresa)* may overlap with other kinds of weaker formal networks (or even with informal networks). In such cases, as the firms involved may already be able to access valuable information and resource through the weaker form of networking, we expect the effect of contractual network agreement to be smaller. In fact, the Italian production system, characterized by some specific geographical areas with strong industrial specialization (i.e. industrial districts or clusters) may offer a unique opportunity for investigating the interaction between strong formal ties and weak formal or informal ties.

H5: Firms located within industrial districts are benefiting less from contractual network agreements.

Finally, the structure of the network is expected to deeply influence the economic outcome for members (Das and Teng, 2002). On the basis of previous works, we decide to focus on three aspects: network size, network geographical dispersion and network diversity (measured by the prevailing activities of network members). According to the literature, we expect a positive effect for large networks (Goerzen and Beamish, 2005; Lechner et al, 2006) because of the growing number of ties and of potential information/resources to be shared. A negative effect is expected for geographical dispersion (Goerzen and Beamish, 2005), due to the weakening of ties as far as the distance increases. Finally, a large network diversity (Goerzen and Beamish, 2005; Parida et al., 2016) is expected to increase coordination costs, which impacts negatively on performance. Therefore, our last three hypotheses are the following:

H6: Network size has a positive effect on performance (H6a), while network dispersion, in geographical terms, and network diversity, in terms of the different activities of members, are negatively related to performance (H6b and H6c, respectively).

3.1 The empirical model

To empirically test our hypotheses, we consider the following regression model, applied on a very large and representative sample of Italian SMEs, for which we have complete financial statement data:

$$\pi_{it} = \alpha + \beta NET_{it} + \delta Z_{it} + \eta D_t + \omega_{it} + \varepsilon_{it} \qquad (1)$$

where π_{it} represents the selected measure of performance (value added ratio, profits or export propensity) and NET_{it} is a dummy variable identifying the networking status that changes over time, and becomes active the year after the firm enters a network agreement. Z_{it} is a vector of firm-level time-variant controls, including standard indicators able to explain performance such as firm size, age, capital intensity and degree of vertical integration. D_t is a vector of year fixed effects (i.e. dummies for the specific year of analysis) aimed at catching macroeconomic determinants of performance. The last part of the equation, $\omega_{it} + \varepsilon_{it}$, indicates the error term: the first component ω_{it} is correlated with the presence of network alliances, while the second component ε_{it} is a purely white noise error term**.**

The most recent economic literature on networks starts highlighting potential endogeneity problems regarding the relationship between signing network contracts and unobservable firms' characteristics, aspects which were substantially ignored in previous studies trying to estimate the economic outcomes of networking. Bodnaruk et al. (2013) argue that the probability of engaging in business alliances, and then to participate to network agreements, is strongly influenced by the quality of corporate governance. The latter strictly depends on the quality and ability of managers (or of owners in case of small firms without managers), so that the identification of the causal effect crucially depends on the possibility to separate these unobservable factors, as well as other observable factors, from the presence of network alliances.

As observable controls, equation 1 includes some indicators reflecting differences among firms in relation to financial/economic aspects (i.e. size, age, vertical disintegration and physical capital intensity). Moreover, we include dummies able to capture structural differences in performance, due to regional, time and sectoral specificities. It is more difficult to deal with unobservable factors, which enter the error term ω_{it}, creating potential endogeneity problems. Such aspects can be seen as specific features such as the firm tradition and culture, or firm "quality", which substantially coincides with the ability or quality of the main decision maker within the firm. Since such unobservable factors undoubtedly influence the probability of being involved in network agreements, ignoring them can lead to an over-estimate of the real causal effect of networking on performance. If we are willing to assume that the firm culture or the ability/quality/capacity of the managers are stable over time, any potential endogeneity problem can be solved through the inclusion of firm fixed effects in equation (1). The model is then estimated through the so called fixed effect estimator based on the within group transformation of equation (1), i.e. by demeaning all variables included in our econometric models. In this case, the estimated coefficient on the dummy NET_{it} represents the effect on performance due to formal network participation.

Our empirical strategy is based on the estimation of equation (1) for the whole sample (H1) and for different subsamples (H2, H3, H4, H5), following different models specification in order to test the robustness of the results. The main aspect of interest is the coefficient for the dummy variable NET_{it}, in the full sample and for each subsample. All the estimates keep into account the panel structure of the database and include firm fixed effects as well as year-specific fixed effects.

For the last hypothesis (H6), we modify our econometric approach. In particular, we run separate OLS regressions on the subsample of firms entering a network agreement during the period considered. In this case, firms are pre-selected among those firms entering a network, and then the potential endogeneity problems are partially mitigated. Since time invariant controls (i.e. network characteristics) are not changing over time, we cannot use the fixed effect estimator. However, in order to reduce heterogeneity, we saturate our OLS specification with controls, using the same variables in the aforementioned Z_{it} vector, as well as numerous industry-year (i.e. two-digit NACE dummies interacted with years) and region-year interactions (i.e. regional dummies interacted with years).

4. Data

Our main source of information is the INFOCAMERE database on Italian formal network agreements, which collects data on all the agreements signed since the introduction of the network contract until 31/12/2015. The total number of firms involved in such contracts is 11,927, while the total number of networks is 2,282. For each contract, we are able to identify each member and classify it as self-employer, micro-firm, SME or large firm. We have information on the network name, number and identity of partners, main objects of the agreement, month and year of the network creation. In order to evaluate the effects of the network agreement on performance, we need to recover economic information for each member. We decided to focus on SMEs, as highlighted in the introduction, in order to reduce heterogeneity and because of the relevance of networking for them. We considered the whole population of Italian firms that are compelled to register the balance sheet, i.e. limited companies and corporations, and we selected only firms with a number of employees between 10 and 250. Using the tax code as a firm identifier, we matched the INFOCAMERE data with the AIDA dataset (provided by Bureau Van Dijk) which contains the balance sheets of all Italian firms. Notice that, for each firm in the AIDA database that enters a network agreement, we have information on the whole network, even if for some members we do not have financial data. Finally, we completed the economic information by merging data on international sales included in the ISTAT-COEWEB dataset at individual level, using again the tax code as a firm identifier.

We were able to collect financial statement information for the period 2008-2014 for a sample of 167,622 firms. We structured our database as an unbalanced panel, using all available information on Italian SMEs. All the monetary values are deflated according to the Italian

Consumer Price Index. Table 1 shows some statistics on the adoption of network agreements for the whole population of SMEs that are included in the AIDA database. As it is clear from the figures, the most consistent participation to the network agreement is very recent. There has been has a jump in 2012, and the small number of firms participating to the networks is one of the main drawbacks of our analysis.

Table1: Number of SMEs participating to the Italian network agreement

Year	Networking SMEs	Networking incidence	N. of New networks	Networks at the end of the year
2010	28	0.02%	13	13
2011	311	0.2%	120	133
2012	979	0.6%	274	407
2013	1,921	1.4%	452	859
2014	2,558	1.9%	316	1,175
Total	5,797	0.6%	1,175	

Even if the network agreement is immediately effective, it is reasonable to assume that its economic effects take some time to emerge: it is very difficult that a formal network officially born during the year can materialize its effect before the end of the year. Therefore, we consider the year of the contract as a sort of "transition period", where the network has been formed, but its effects cannot influence the balance sheets, irrespective of the month in which the contract has been signed. The financial variables relative to such year have been classified as "pre-network" observations, but the results are substantially stable if we treat such observations as missing values.

Given the large dimension of the database and the presence of unreliable or incomplete balance sheet data, a careful process of data cleaning has been applied. First, firms that became inactive during the period, as well as firms involved in liquidation processes, have been excluded from the sample for the entire period of investigation. Moreover, we devoted particular attention to outliers reporting unreliable or out-of-scale balance sheet data: we exclude all firm-year observations reporting negative value added as well as value added too large in comparison to the other balance sheet dimensions (for instance over the 99^{th} percentile in term of value added per unit of revenues and value added per unit of labor cost). Finally, only geographical areas (Italian provinces) and industries (at two-digit NACE disaggregation) where at least one network agreement has been signed (i.e. when a firm in such province/industry enters a formal network) have been considered. We use complete information on each network, even if only corporations and limited companies can be used for evaluating the effects of networking on performance. In this vein, we create specific

indicators considering all network members, including micro-firms, self-employees as well as large corporations. First, we count the total number of network members to create an indicator of network size. Secondly, we compute an index representing the geographical dispersion in terms of number of provinces, given by the ratio of the number of provinces over the total number of network members. Thirdly, we generate another indicator representing the network dispersion along the value chain that has been computed using information on the activity code (NACE) for each member. As in the previous case, we use the ratio of the number of two-digit sectors characterizing network members over the number of network members. Those indicators, relative to the network itself, have been reported in the last part of table 2, with reference to the situation at the end of 2014. In terms of size, 50% of networks show less than 6 members, while in terms of geographical dispersion the median network has 18% of members located outside the province. Finally, the median network shows at least one member operating in a different two-digit NACE code, while very heterogeneous networks are less common.

Table 2: Networking phenomena: incidence by size class, area, sectors and network indicators

	N. Networking firm	Network participation rate	
Size Class			
More than 50 employees	346	3.3%	
Less than 250 employees	2,212	1.8%	
Geographical area			
North West	792	1.7%	
North East	782	2.2%	
Centre	538	1.9%	
South	446	1.8%	
Pavitt Taxonomy			
Science Based	235	3.7%	
Specialized Suppliers	529	2.9%	
Information Intensive	234	1.9%	
Supplier Dominated	1,096	1.6%	
Others	464	1.7%	
Total sample	2,558	1.9%	
Network indicators	Median	10th percentile	90th percentile
Network size	6	3	24
Network dispersion	0.187	0	0.555
Network diversity	0.373	0	0.666

4.1 Variables used in the analysis

As dependent variables, we use three different measures of performance at the firm level, computed according to financial statements and export information. First, we consider an indirect measure of efficiency, the value added per unit of revenues, which reflects the capacity of the firm to manufacture goods (and provide services) and sell them to the market. Secondly, we analyze profitability using the Return of Assets indicator (ROA), computed as EBIT margin over Total Assets. ROA is one of the most commonly used measures of profitability, and has been already aopted in the networking literature by Goerzen and Beamish (2005)[6].

Finally, the export share, defined by the ratio of foreign sales over revenues measures the capacity to enter foreign markets. Additional control variables are used to partially explain the observed heterogeneity of economic performances, and are drawn from the managerial literature as well as from empirical studies on the determinants of performance (Nickell et al., 1997). The aforementioned controls enter gradually in our model specification, in order to test the stability of results. Table 3 presents the descriptive statistics for the explanatory variables.

Table 3: Descriptive statistics

Variable	Description	2014		2010	
		mean	sd	mean	sd
VA ratio (VA/S)	Value added / Sales ratio	0.35	0.19	0.33	0.19
ROA	EBIT over total assets	0.04	0.62	0.05	0.25
Export share (Exp)	Export / sales ratio	0.06	0.17	0.06	0.16
Export share squared		0.03	0.12	0.03	0.11
Size	Ln Sales	14.65	1.28	14.57	1.36
Size squared		216.26	38.12	214.04	40.32
Age	Years after foundation	21.30	17.51	17.45	18.66
Vertical disintegration	Costs of materials and services over Total costs	0.65	0.20	0.68	0.21
Physical capital intensity	Physical Assets over Sales	0.43	1.71	0.42	1.59
Dummies					
Networking	Probability of entering networks	1.90%		0.02%	
Exporting	Probability of exporting	25.81%		23.60%	

[6] We also compute ROS (EBIT margin over total sales) as well as ROE (EBIT margin over equity), the most popular measures of profitability, and we obtain similar results for all the regressions reported, which are available upon request.

5. Results

5.1 Empirical findings on the whole sample of Italian SMEs

We begin by addressing the first hypothesis on the general effect of networking on performance, measured in terms of value added, profitability and export propensity. The effects can be mainly considered as short term impacts, given the recent introduction of the specific network agreement in the Italian legislation. Unless otherwise stated, the reported estimates are based on specifications that include firm fixed-effect, to account for time-invariant unobserved heterogeneity in firms' divers of performance.

Table 4, columns 3 through 5, reports the estimates for three specifications which use value added per unit of sales as the dependent variable. Firms involved in formal network agreements show a higher capacity of producing VA per unit of revenues, as suggested by the positive and significant coefficient estimated for the dummy *Networking*. After a SME signs a network contract agreement for cooperating and sharing resources with other peers, its value added per unit of revenues increases. The result is robust to different model specifications, which always control for firm fixed effects, year specific effects, as well as different time-variant firm characteristics, among which vertical disintegration, physical capital intensity and export propensity. The effect is limited in terms of magnitude, but positive and always statistically significant: after networking, the value added per unit of revenues increases by 0.005 (half percentage point) in absolute term, with an increase of near 2% in relative terms. H1a is, therefore, supported. Size, as expected, shows a positive impact on the value added, mainly through efficiency gains due to economies of scale. However, the negative sign estimated for size squared suggests that, up to a certain threshold, internal coordination costs limit additional gains in value added creation. A firm's past experience, proxied by the firm's age, represents an important aspect fostering performance, as expected. The negative signs recorded for vertical disintegration[7] and physical capital intensity are also to be expected, given the nature of the variables. Vertical disintegration increases when external costs increase, with an expected negative effect on value added. The inclusion of that control variable is very important because it excludes that the effect on value added is due to different vertical structures among firms. Similarly, a higher weight of physical assets implies higher amortization and depreciation, which enter negatively in the determination of value added. The last two controls, export share and its squared term, show an unexpected pattern. In

[7] The share of external costs (costs for the purchase of components, materials and services) over total costs is a well known measure of vertical integration. A higher share reflects the fact that the firm, instead of organizing in house most of the activities, relies on contracts with third parties for the supply of inputs and components.

general, we expect a positive effect of international sales on competiveness, because only the best firms are able to export. Our estimates show a negative sign for the linear term and a positive sign for its square, highlighting a U-shaped relation. In the case of low export levels, firm are marginal exporters and, probably, selling abroad implies to bear additional costs that overcome the positive returns. On the contrary, strong exporters (i.e. when the square term is high) are by definition highly competitive and this reflects in higher value added.

If we move our attention to profitability, the results of networking are substantially inconclusive. The sign of estimated coefficients is positive but it is poorly significant and suggests that the effect of networking on ROA is negligible. This evidence is substantially stable across all different model specifications and is probably motivated by a different objective, at least in the short run, of networking and by the presence of some initial costs. Profits appear to be higher for more vertically disintegrated firms, for firms using more physical assets and for strong exporters, and lower for marginal exporters. H1b is therefore not supported by our findings.

Finally, the last two columns of table 4 report the results of networking effects on export propensity, measured as the ratio of exports over total sales. Our estimates show that after entering formal business networks, SMEs export a higher share of their revenues, even when general time trends have been removed using year fixed effects. The positive coefficient is robust across all specifications and is around 0.0062, more than half a percentage point in absolute terms. Given the average level of exports, near 6% of total sales in 2014, the network participation increases the export share by about 10%. The Italian network agreement seems to be a valid instrument for sharing resources, experience and information with the goal of improving the firms' presence in foreign markets, with a strong support to our H1c. The other controls show, more or less, the expected sign: a firm's past experience, proxied by age, increases the export propensity and vertical disintegration has a similar impact, suggesting that firms which focus more on core activities show higher chances of selling abroad. Finally, also in this case, size impacts non-linearly on exports, but the U-shaped relation is now inverted: small SMEs show only a limited export capacity, while larger SMEs are associated to a higher export propensity. This finding confirms the importance of networking for boosting the export potential of Italian small and medium firms. Exporting is still a strategy mainly pursued by larger SMEs, but sharing resources and experience through networking represents a valid way for enhancing the exporting capacity of small firms, too.

Table 4. The effect of network agreements in term of value added, profits and export propensity

Dependent variables	Value added ratio				ROA				Export share		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	OLS	Fixed-effect			OLS	Fixed-effect			OLS	Fixed-effect	
Networking	0.00402**	0.00611***	0.00546***	0.00558***	-0.00374**	0.000341	0.000565	0.000492	0.0115***	0.00624***	0.00625***
	(0.0174)	(0.00408)	(0.00682)	(0.00631)	(0.0377)	(0.840)	(0.739)	(0.769)	(0.0098)	(0.00306)	(0.00303)
Size	-0.0303***	0.131***	0.0831***	0.0819***	0.105***	0.0193	0.0333	0.0336	-0.0315***	-0.0513***	-0.0495***
	(0.00204)	(0.00142)	(0.000906)	(0.00098)	(0.003)	(0.418)	(0.189)	(0.183)	(0.003)	(0.000216)	(0.00321)
Size squared	0.000289	-0.0054***	-0.0036***	-0.0035***	-0.00329***	0.00124	0.000735	0.000726	0.00184***	0.00215***	0.00209***
	(0.123)	(0.00011)	(0.00151)	(0.00172)	(00.002)	(0.111)	(0.362)	(0.365)	(0.002)	(0.00988)	(0.000123)
Age	0.000187***	0.00386***	0.00285***	0.00292***	-0.00027***	-0.0055***	-0.0053***	-0.0053***	0.004***	0.00208***	0.00212***
	(0.00881)	(0.0002)	(0.0006)	(0.0004)	(0.001)	(0.000002)	(0.00003)	(0.00004)	(0.002)	(0.000107)	(0.00105)
Vertical disintegr.	-0.486***		-0.125**	-0.125**	0.0268***		0.0310***	0.0310***	0.0289***		0.00481**
	(0.006)		(0.0103)	(0.0103)	(0.009)		(0.00134)	(0.00136)	(0.0018)		(0.0112)
Physical capital int.	-0.000561		-0.000676*	-0.000677*	-0.00178***		0.00133**	0.00133**	-0.004		-0.0157
	(0.337)		(0.0567)	(0.0564)	(0.00088)		(0.0115)	(0.0115)	(0.327)		(0.973)
Export share	-0.0690***			-0.0600***	-0.0621***			-0.0326***			
	(0.0001)			(0.00463)	(0.002)			(0.00231)			
Export share squared	0.0797***			0.0466***	0.0852***			0.0500***			
	(0.0002)			(0.00011)	(0.00001)			(0.00365)			
Industry fixed effect	Yes	No	No	No	Yes	No	No	No	Yes	No	No
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm's fixed effect	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Constant	1.072***	-0.475***	-0.0669	-0.0599	-0.786***	-0.397**	-0.519**	-0.520**	0.0470***	0.305***	0.290***
	(0.0003)	(0.00945)	(0.627)	(0.661)	(0.0004)	(0.0357)	(0.0122)	(0.0117)	(0.00462)	(0.00612)	(0.00018)
R-squared	0.654	0.027	0.090	0.091	0.002	0.002	0.002	0.002	0.232	0.020	0.020
Observations	946,997										
Number of cf	167,622										

Robust p-values in parentheses. Standard Errors are clustered by two-digit NACE Code, *** p<0.01, ** p<0.05, * p<0.1

Summarizing, two of the three measures of performances exhibit a positive and significant link to formal networking, providing support for H1a and H1c.[8]

5.2 Differences across firms

Even if we limit our analysis to small and medium firms, it is clear that objectives and characteristics among firms that employ 10 workers and firms that employ 200 workers may diverge. Therefore, also the main motivations or networking-drivers may be remarkably different. We focus on this aspect by splitting our sample of SMEs into two groups, identifying small (up to 50 employees) and large SMEs (between 50-250 employees).

As shown in table 5, the empirical evidence is supportive of a different impact for the two subgroups. The evidence on value added per unit of sales seems to be driven by the subsample of small SMEs. The coefficient (0.0067) is larger than the one reported for the whole sample (0.0055), and the statistical significance is higher, too. For the subsample of large SMEs, instead, the sign is negative, but not statistically significant, suggesting that the main effect of networking is not on value added. While the effect of networks on profits remains negligible for both subsamples, the impact on exports is found to be stronger for larger SMEs (0.017 as compared to 0.006 for the total sample), and weaker (0.003 as compared to 0.006) for smaller SMEs.

However, networking is confirmed as a process helping to increase exports at each firm size, even if the effect is very strong (+25% in relative terms) for more structured SMEs, which probably enter networks with the explicit aim of finding new markets. Our second hypothesis, H2 is substantially confirmed: the effect on VA/S is stronger for small sized firms, while exporting advantages are common to both small and larger SMEs.

[8] For comparisons, in Table 4 we also report the results of simple OLS models, pooling all firms and year observations. While the FE and OLS estimates are not very different in the case of value added, the impact of networking on exports is almost twice as large in the OLS models. Similarly, the impact on ROA is negative and statistically significant according to the OLS estimates, while always insignificant in all the FE models presented in the paper. Overall, these differences suggest that uncontrolled firm characteristics may have biased some of the results obtained in studies unable to rely on longitudinal data. Hence, unless differently stated, we focus on fixed-effect models in the rest of the paper's tables.

Table 5: Effect of network agreements by firm's dimension

	Less than 50 employees			Between 50 - 250 employees		
VARIABLES	VA ratio	ROA	Export share	VA ratio	ROA	Export share
Networking	0.00672***	0.000459	0.00356**	-0.0000045	0.000143	0.0173***
	(0.00446)	(0.801)	(0.0424)	(0.984)	(0.965)	(0.00116)
Size	0.106***	0.0511**	-0.0572***	0.112***	0.141**	-0.0113
	(0.00039)	(0.0489)	(0.000695)	(0.00583)	(0.0439)	(0.660)
Size squared	-0.00454***	0.000076	0.00238***	-0.000028**	-0.00198	0.000565
	(0.00136)	(0.925)	(0.0000408)	(0.0208)	(0.334)	(0.468)
Age	0.00305***	-0.00542***	0.00203***	-0.000369	-0.00399***	0.00335***
	(0.00627)	(0.00432)	(0.000810)	(0.922)	(0.00523)	(0.00597)
Vertical dis.	-0.121**	0.0284***	0.00464**	-0.428***	0.287***	0.00764
	(0.0109)	(0.00150)	(0.0135)	(0.0003)	(0.000132)	(0.342)
Physical capital int.	-0.000636**	0.00133**	-0.0001	-0.000540	0.00671***	-0.000182
	(0.0487)	(0.0136)	(0.834)	(0.610)	(0.000754)	(0.831)
Export share	-0.0573***	-0.0288***		-0.0539***	-0.0299	
	(0.000652)	(0.00434)		(0.000112)	(0.399)	
Export share sq.	0.0449***	0.0462***		0.0438***	0.0518	
	(0.0 057)	(0.00 43)		(0.00039)	(0.135)	
Firm's fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.225	-0.627***	0.337***	-0.439	-1.830***	0.0806
	(0.120)	(0.00306)	(0.00276)	(0.199)	(0.00263)	(0.708)
Observations		864,667			82,330	
R-squared	0.091	0.002	0.020	0.213	0.037	0.026
Number of firms		152,173			15,449	

Robust p-val in parentheses. Standard Errors are clustered by two-digit NACE Code, *** p<0.01, ** p<0.05, * p<0.1

5.3 The role of the external context: geographical divide, market turbulence and industry classification

The other aspects of interest relate to the influence of the external socioeconomic or technical environment in which firms operate. First, we consider economic and infrastructural differences across Italian macro-regions. Table 6 presents separate regressions for different Italian macro areas[9]: North-West, North-East, Centre and South Italy. The South of Italy is commonly considered as the most underdeveloped area, with lacking infrastructures and services for firms, the Centre represents an intermediate situation, while the North-East and the North-West are more developed and characterized by a prevalence of small and medium-large firms, respectively. Our results show that the effect of networking is not homogeneous across these geographical areas. While in the

[9] The approach of grouping firms according to 4 homogeneous socioeconomic subsystems is very common for empirical studies focusing on Italy.

North-West network agreements never affect significantly the economic outcome we are interested in, in the North-East the network advantage is found to be limited to export propensity. The situation changes dramatically if we consider the subsample of firms located in the Central and Southern regions of Italy: here, as expected, the positive outcome of networking is higher as compared to the general case. After entering networks, value added per unit of revenues increases by 0.009 in magnitude (with respect to 0.0055 for whole sample), while export share increases by 0.08 (as compared to 0.0062 for the whole sample) in both central and southern Italy. Also in this case, the results on profits remain inconclusive, but the other findings for VA/S and export propensity support our hypothesis H3. We can conclude that formal network agreements are more effective in less developed areas, where sharing resources, information and experience represents a practical and cost-saving way for preventing isolation and for compensating the lack of infrastructure or services.

Secondly, if the geographical divide proxies the economic and infrastructural context, we expect also that demand specificities may influence the potential outcome from networking. We use a measure of the volatility of sales at a fine-grained industry level for identifying firms that operate in more turbulent environments. In such sectors, we expect that networking can be particularly useful for collecting information, experience and sharing resources with the aim of reducing uncertainty and protect firms from sales fluctuations. We compute our volatility measure as the average standard deviation of year difference in log sales over the period 2005-2010.[10] Each economic activity has been classified as high (low) volatile if the average standard deviation of log sales is above (below) the median computed across all activities. Table 7 shows the results from the subsamples of high/low volatility sectors. While the general positive effect of networking on valued added and export propensity is confirmed, firms operating on turbulent markets show a higher effect on value added (0.066 as compared to 0.041). Our interpretation of this latter finding is that the information/experience and resource flows partially protect networking firms from the negative effect of uncertainty. Conversely, our findings do not show a similar pattern for export shares, for which coefficients are similar across subsamples.

[10] Volatility has been calculated at the NACE 3-digit classification of economic activity (over 350 sectors). We used the entire AIDA dataset to compute this measure of volatility, using years before the introduction of the network contracts, in order to minimize endogeneity concerns.

Table 6: Effect of formal business network by geographical area

	North-West Italy			North-East Italy			Centre Italy			South Italy		
VARIABLES	VA/S	ROA	Exp	VA/S	ROA	Exp	VA/S	ROA	Exp	VA/S	ROA	Exp
Networking	0.00185	0.00298	0.00400	0.00372	-0.00297	0.00566**	0.00926***	0.00390	0.00825*	0.0102**	-0.00265	0.0083***
	(0.456)	(0.279)	(0.252)	(0.170)	(0.358)	(0.047)	(0.009)	(0.388)	(0.0524)	(0.0481)	(0.612)	(0.008)
Size	0.067***	0.0293	-0.037***	0.0717***	0.0375	-0.059***	0.0868***	0.0819	-0.041***	0.112***	0.0772***	-0.0309***
	(0.0015)	(0.309)	(0.0002)	(0.0009)	(0.347)	(0.0026)	(0.008)	(0.119)	(5.74e-08)	(0.0001)	(0.005)	(0.003)
Size squared	-0.0025***	0.00100	0.0016***	-0.0027***	0.00072	0.0025***	-0.0039***	-0.000696	0.0018***	-0.005***	-0.00148	0.00126***
	(0.002)	(0.255)	(0.003)	(0.0028)	(0.571)	(0.0006)	(0.002)	(0.661)	(0.007)	(0.002)	(0.122)	(0.007)
Age	0.0016***	-0.0052***	0.00268***	0.0016***	-0.0047***	0.00281***	0.0035***	-0.0069***	0.0014***	0.0024***	-0.004***	0.0009***
	(0.004)	(0.0006)	(0.00037)	(0.0002)	(0.0003)	(0.0002)	(0.0004)	(0.0002)	(0.005)	(0.002)	(0.005)	(0.006)
Vertical disintegr.	-0.305***	0.0650***	0.0148***	-0.283***	0.076***	0.0170***	-0.0612	0.0217*	0.00203	-0.121***	0.0217**	0.00195*
	(0.0004)	(0.001)	(0.0005)	(0.0024)	(0.001)	(0.002)	(0.116)	(0.0689)	(0.215)	(0.00902)	(0.0124)	(0.0942)
Physical capital int.	0.000471	0.00108*	0.00198	-0.0019**	0.0031***	-0.0002	-0.0023***	0.0038***	0.00125	-0.0011***	0.0006**	-0.0017
	(0.134)	(0.078)	(0.644)	(0.016)	(0.0005)	(0.650)	(0.001)	(0.008)	(0.496)	(0.0047)	(0.046)	(0.756)
Export share	-0.063***	-0.0556***		-0.0396***	-0.0329**		-0.081***	-0.0126		-0.052***	-0.00977	
	(0.0033)	(0.0023)		(0.007)	(0.0126)		(0.001)	(0.432)		(0.0015)	(0.622)	
Export share sq.	0.061***	0.087***		0.0312***	0.0324*		0.045***	0.0202		0.0460**	0.0204	
	(0.0027)	(0.0007)		(0.004)	(0.0919)		(0.001)	(0.241)		(0.0120)	(0.359)	
Constant	0.0749	-0.539**	0.196***	0.0313	-0.621**	0.323***	-0.106	-0.888**	0.240***	-0.170	-0.7***	0.187***
	(0.630)	(0.0214)	(0.004)	(0.815)	(0.0485)	(0.00884)	(0.518)	(0.0393)	(0.000104)	(0.353)	(0.0006)	(0.000160)
Firm's fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		315,850			243,537			199,773			187,837	
R-squared	0.184	0.003	0.023	0.164	0.016	0.028	0.06	0.002	0.016	0.093	0.001	0.008
Number of firms		53,821			41,599			35,937			36,265	

Robust p-values in parentheses. Standard Errors are clustered by two-digit NACE Code, *** p<0.01, ** p<0.05, * p<0.1

Table 7: Effect of formal business network by industry-level sales volatility

	Low volatility			High volatility		
VARIABLES	VA/S	ROA	Exp	VA/S	ROA	Exp
Networking	0.00410*	-0.00116	0.00549**	0.00663**	0.00129	0.00585*
	(0.0757)	(0.606)	(0.0291)	(0.0359)	(0.646)	(0.0772)
Size	0.118***	0.0477	-0.0808***	0.0652***	0.0330	-0.0335***
	(0.00053)	(0.227)	(0.00054)	(0.00943)	(0.256)	(0.000916)
Size squared	-0.00447***	0.000833	0.00340***	-0.00314***	0.000486	0.00142***
	(0.00035)	(0.498)	(0.0001)	(0.000525)	(0.592)	(0.000710)
Age	0.00279***	-0.00575***	0.00281***	0.00281***	-0.00522***	0.00152***
	(0.00018)	(0.0002)	(0.0004)	(0.00018)	(0.0006)	(0.00165)
Vertical disintegr.	-0.0891	0.0309**	0.00528	-0.158***	0.0322***	0.00419**
	(0.179)	(0.0453)	(0.110)	(0.00409)	(0.00379)	(0.0109)
Physical capital int.	-0.00174***	0.00323***	-0.0049	-0.000342	0.000940**	0.000016
	(0.00046)	(0.000101)	(0.985)	(0.248)	(0.0291)	(0.562)
Export share	-0.0651***	-0.0470***		-0.0608***	-0.0270**	
	(0.00069)	(0.00291)		(0.00018)	(0.0188)	
Export share sq.	0.0477***	0.0511***		0.0491***	0.0545***	
	(0.000868)	(0.00442)		(0.000704)	(0.000612)	
Constant	-0.409***	-0.733**	0.469***	0.103	-0.470*	0.195***
	(0.00312)	(0.0236)	(0.00084)	(0.547)	(0.0502)	(0.000386)
Firm's fixed effect	yes	yes	yes	yes	yes	yes
Year fixed effect	yes	yes	yes	yes	yes	yes
Observations		405,039			541,958	
R-squared	0.061	0.002	0.031	0.118	0.003	0.013
Number of firms		69,854			97,768	

Robust p-values in parentheses. Standard Errors are clustered by two-digit NACE Code, *** p<0.01, ** p<0.05, * p<0.1

The last angle of the analysis is focused on the innovative/operative environment characterizing each industrial activity. To that respect, the quasi totality of SMEs in our sample[11], are divided into four homogeneous groups of industries (i.e. Science Based, Specialized Suppliers, Scale and Information Intensity and Supplier Dominated), following the well known Pavitt's taxonomy. Table 8 presents the results separately for the four sub-samples. We can observe that the structural characteristics of the industry influence the outcomes of networking, even after accounting for firms' and years' fixed effects. The large majority of Italian SMEs operate in the specialized suppliers or supplier dominated sectors, in line with the view that Italian firms are more focused on traditional industries than other countries (Germany, France and the UK, for example).

[11] Many different works adopt the Pavitt's taxonomy for classifying sectors according to their main innovation characteristics (see Archibugi, 2001). Bogliacino and Pianta (2015) have recently extended the Pavitt's taxonomy in order to classify both manufacturing industries and service sectors.

Table 8: Effect of network agreements by industries classified according to the Pavitt taxonomy

	Science Based			Specialized suppliers			Scale and information intensive			Supplier dominated		
VARIABLES	VA/S	ROA	Exp	VA/S	ROA	Exp	VA/S	ROA	Exp	VA/S	ROA	Exp
Networking	-0.00297	-0.0051	0.000289	0.00929*	0.0119***	0.00694	0.00534	0.000910	0.00110	0.00412	-0.000139	0.00844***
	(0.196)	(0.172)	(0.757)	(0.0566)	(0.00248)	(0.104)	(0.245)	(0.839)	(0.842)	(0.145)	(0.945)	(0.00198)
Size	0.0181	-0.0104	-0.0668**	0.0602	0.0132	-0.0661***	0.0640***	0.114	-0.055***	0.0876***	0.0522	-0.0454***
	(0.189)	(0.655)	(0.0170)	(0.218)	(0.856)	(0.0035)	(0.00630)	(0.208)	(0.001)	(0.00566)	(0.201)	(0.00938)
Size squared	-0.000125	0.0021**	0.00276***	-0.00254	0.00166	0.0028***	-0.0019***	-0.0013	0.0024***	-0.0036***	0.00024	0.0019***
	(0.768)	(0.0481)	(0.00846)	(0.180)	(0.490)	(0.005)	(0.00620)	(0.589)	(0.0001)	(0.000473)	(0.848)	(0.00295)
Age	0.000467	-0.0055**	0.00274	0.00221**	-0.007***	0.004**	0.00321	-0.0046**	0.0033***	0.0025***	-0.004***	0.002***
	(0.528)	(0.0367)	(0.116)	(0.0467)	(0.0003)	(0.035)	(0.634)	(0.01)	(0.00159)	(0.000871)	(0.000166)	(0.00201)
Vertical disinteg.	-0.649***	0.0980***	0.0335*	-0.297**	0.0479**	0.014***	-0.389***	0.0237	0.0110**	-0.0681*	0.0317**	0.0042*
	(0.00150)	(0.00422)	(0.0677)	(0.0243)	(0.0141)	(0.009)	(0.0005)	(0.735)	(0.0366)	(0.0948)	(0.0218)	(0.0735)
Physical capital int.	-0.0005***	0.0003***	0.0019	-0.0034***	0.004***	-0.00011	-0.0029**	0.0066***	-0.0004	-0.0006	0.0029***	0.008
	(0.00570)	(0.0081)	(0.721)	(0.000539)	(0.0012)	(0.803)	(0.0392)	(0.0014)	(0.327)	(0.429)	(0.000531)	(0.595)
Export share	-0.0726**	-0.113***		-0.0702***	-0.0482***		-0.05***	-0.0901		-0.0529***	-0.0214*	
	(0.0107)	(0.0007)		(0.00206)	(0.0009)		(0.0001)	(0.130)		(2.74e-05)	(0.0557)	
Export share sq.	0.0703***	0.125**		0.0596***	0.0635***		0.0472***	0.0980*		0.0343***	0.0290**	
	(0.00712)	(0.0147)		(0.00284)	(0.0003)		(0.0001)	(0.0850)		(0.00283)	(0.0461)	
Constant	0.545***	-0.212	0.384*	0.192	-0.396	0.371***	0.0757	-1.250*	0.294**	-0.202	-0.708**	0.255**
	(0.00116)	(0.273)	(0.0706)	(0.581)	(0.467)	(0.0002)	(0.547)	(0.0765)	(0.0259)	(0.367)	(0.0368)	(0.0249)
Firm's fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		43,588			130,264			86,016			484,647	
R-squared	0.47	0.055	0.036	0.192	0.016	0.033	0.194	0.001	0.031	0.052	0.002	0.02
Number of firms		7,278			23,069			14,590			85,613	

Robust p-values in parentheses. Standard Errors are clustered by two-digit NACE Code, *** p<0.01, ** p<0.05, * p<0.1

The estimates reported in table 8 highlight that firms operating in specialized suppliers industries benefit more from network agreements. For such firms, entering a network implies an increase in value added per unit of revenues (+ 0.009), an increase in export share (+0.007) and, rather surprisingly, an increase in ROA (+0.01). In all cases, the impact is higher with respect to the results for the whole sample. Similar considerations, but limited to the case of the export share, are also valid for supplier dominated industries, in which networking is found to increase the propensity to export: the coefficient (0.008) is larger than the one recorded for the whole sample. Therefore, contrary to expectations, only firms operating in more traditional sectors seems to benefit from networking, at least in the short and medium period; as a consequence, our findings do not lend support to hypothesis H4.

5.4 Strong and weak ties: the role of industrial districts

Networking is a multifaceted phenomenon, as highlighted in the literature review, and the presence of formal network agreements cannot exclude the existence of other weaker ties among firms. The interaction of multiple level of networking offers a new interesting angle of analysis, which has been rarely investigated in the past. In our case, the signature of formal contracts (*Reti d'impresa*) is not limited by any economical/geographical clause or by any pre-existing kind of cooperation. We exploit this by adding into the analysis the presence of industrial cluster (labeled districts), a specificity of the Italian production system. Industrial districts, clearly identified by ISTAT (the official Italian statistical institute) are well defined geographical areas with strong industrial specializations and strong cohesion at social/institutional level. Such local areas are characterized by stronger cooperation among firms, typically promoted by local institutions, generating links that resemble closely the weak ties identified by Li et al., (2015) for industrial clusters. Some firms which are already cooperating through weak ties may decide to strengthen and formalize the relationship by adhering to the "*reti d'impresa*" scheme. In order to account for the differential impact of formal network agreements, we split our sample in two groups: firms operating into industrial districts and firms operating outside industrial districts.

Table 9: Interaction between formal business networks and industrial clusters / districts

	Firms outside industrial clusters			Firms inside industrial clusters		
VARIABLES	VA/S	ROA	Exp	VA/S	ROA	Exp
Networking	0.00609***	0.00118	0.00528*	0.00361	-0.00178	0.00689**
	(0.00502)	(0.574)	(0.0529)	(0.290)	(0.571)	(0.0297)
Size	0.0869***	0.0427*	-0.0427***	0.0526***	0.0108	-0.0522***
	(0.008)	(0.0961)	(0.0012)	(0.00458)	(0.750)	(0.00203)
Size squared	-0.00381***	0.000379	0.00176***	-0.00226***	0.00157	0.00243***
	(0.0068)	(0.635)	(0.0086)	(0.00752)	(0.171)	(0.0072)
Age	0.00294***	-0.00572***	0.00161***	0.00214***	-0.00434***	0.00347***
	(0.0003)	(0.0202)	(0.003)	(0.00023)	(0.0008)	(0.0012)
Vertical disintegr.	-0.113**	0.0281***	0.00277**	-0.247***	0.0591***	0.0229***
	(0.0165)	(0.00284)	(0.0258)	(0.0032)	(0.00186)	(0.0045)
Physical capital int.	-0.00105***	0.00154**	0.0036	-0.00512	0.000948*	-0.00190
	(0.00434)	(0.0177)	(0.507)	(0.988)	(0.0812)	(0.871)
Export share	-0.0607***	-0.0361**		-0.0548***	-0.0356***	
	(0.0045)	(0.0100)		(0.0019)	(0.000347)	
Export share sq.	0.0482***	0.0587***		0.0432***	0.0419***	
	(0.0012)	(0.000633)		(0.0034)	(0.0082)	
Firm's fixed effect	yes	Yes	yes	yes	yes	yes
Year fixed effect	yes	Yes	yes	yes	yes	yes
Constant	-0.0877	-0.572***	0.258***	0.167	-0.404	0.245**
	(0.545)	(0.00662)	(0.0027)	(0.208)	(0.126)	(0.0443)
Observations	690,473	690,430	690,473	256,525	256,507	256,525
R-squared	0.085	0.002	0.015	0.147	0.037	0.034
Number of firms	125,053	125,051	125,053	42,569	42,569	42,569

Robust p-values in parentheses. Standard Errors are clustered by two-digit NACE Code, *** p<0.01, ** p<0.05, * p<0.1

Table 9 shows that firms located outside industrial districts strongly benefit from networking both in term of value added and export share, while for firms located inside industrial districts the effect on VA/S disappears. Finally, the usual negligible effect on profits is confirmed for both subsamples. Our findings confirm that if firms are already cooperating, the effect of formal agreements is lower, in line with our hypothesis H5. In addition, the main driver for entering formal networks seems to be the desire to increase exports.

5.5 Network characteristics and partners' economic performances

The previous sections suggest that network agreements sustain value added creation and export propensity, but some important aspects regarding the structural characteristics of the network are worth to be investigated. We tackle the issue by running separate OLS estimates, as explained on the methodological part, on the subsample of firms entering a network agreement during the period under investigation. The size of the sample decreases dramatically, since only firms that enter a network agreement before 31/12/2013 have been included[12]. We use the number of members as a measure of network size, while we measure network dispersion as the number of provinces in which firms operate divided the total number of members. Finally, we compute network diversity as the number of different sectors (NACE two-digit codes) involved divided by the number of members. Table 10 reports the estimated coefficients for the three variables of interest, (i.e. network size, diversity, and dispersion) following an empirical specification very rich in terms of control variables. We include many interactions dummies isolating the effect of a time specific trend in particular industries (years/two-digit NACE codes interactions) as well as regional time specific trends (years-regions interactions), in order to remove all potential heterogeneity left by the absence of firm fixed effects.

Table 10: Performance and partner diversity in terms of geographical and activity dispersion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	VA/S	ROA	Exp	VA/S	ROA	Exp	VA/S	ROA	Exp
Network size	0.00014***	0.00023***	0.00002						
	(0.0072)	(0.000720)	(0.837)						
Network Diversity				0.0034	-0.0047*	-0.0038			
				(0.145)	(0.067)	(0.45)			
Network Dispersion							-0.0005	-0.0014	-0.014***
							(0.823)	(0.578)	(0.0018)
Controls (from table 8)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-sector (2 digit)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Regions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations firms-years	21,929	21,927	21,929	21,929	21,927	21,929	21,929	21,927	21,929

Robust p-val in parentheses. SE are clustered by two-digit NACE Code, *** p<0.01, ** p<0.05, * p<0.1.
Control variables are the same reported in table8. Estimates using OLS method with interaction dummies

[12] This is because for firms entering a network in 2014 we cannot collect financial statement information for year 2015.

Table 10, columns 1-3, report the results about the impact of network size on value added, profits and exports, respectively. The number of partners positively influences VA per unit of revenues as well as profitability (ROA). The small magnitude of the coefficient represents the marginal effect from increasing by one member the number of firms involved in the network. This evidence is substantially in line with the results by Lechner et al. (2006) and Goerzen and Beamish (2005), who both show a positive effect of network size on the economic performance of network members. On the contrary, larger networks (in terms of number of network participants) seem to be less effective in increasing the export share. Overall, we can conclude that size has a positive effect on performance, lending support to our hypothesis H6a. Considering the indicator of network diversity, the results are only significant for the profitability ratio, and show a negative impact of diversity on ROA. Our findings confirm the ones reported by Goerzen and Beamish (2005) and by Parida *et. al* (2016), and are partially supporting hypothesis H6b. Finally, the last 3 columns of table 10 show that the increasing geographical distance among partners does not reduce performance in terms of value added and profitability, but seems to reduce the incentive for network members to sell abroad. After entering highly dispersed networks, firms seem to prefer to exploit new national markets that become accessible through networking, instead of selling in foreign markets. This is an interesting pattern, which has never been highlighted in the literature: when the geographical dispersion increases, the impact of networking on export share is negative. Overall, our results are only partially supporting our last hypothesis H6c.

6. Conclusion

This paper proposes a large-scale empirical analysis of the effects of membership in formal business networks on firms' performance. We analyze a representative and longitudinal sample of Italian SMEs (i.e. firms employing between 10 and 250 employees), for which we have collected financial statements, export data and information on membership in business networks, for the years 2008-2014. Our econometric analyses estimate the short term consequences, in terms of firm economic performance, from entering a specific type of formal business network agreement, the so-called "*Reti d'impresa*", recently introduced in Italy. Such a network contract provides a precise and well defined definition of the network relationship, aimed at "bringing together firms to co-produce, co-market, co-purchase or co-operate in product or marked development". The main advantage is a clear distinction among firms included and those not included into the definition of formal

network. Moreover, the explicit cooperation in production or marketing activities is the only aim of the contract, without any other kind of public support or interaction with other policy interventions (e.g. training) that might make it difficult to isolate the specific effects of the networking agreements. To eliminate, or at least reduce, the bias in the estimated impacts potentially arising from the non-random selection of specific firm types into networking - a selection likely to be driven by firms' *unobservable* characteristics - we rely on a fixed effect estimator that purges from firm time-invariant specificities. We adopt three different measures of performance: value added per unit of revenues, profitability (i.e. return on assets) and export intensity (i.e. export over revenues). We find a general positive and significant effect of formal network agreements on both value added and export shares, but no discernible effect on profits. We then investigate the influence of the socio-economic environment and of various firm's observable characteristics on the estimated impact of membership in formal network agreements. First, by splitting our sample into small (less than 50 employees) and large SMEs, we find that networking increases value added for small SMEs, while the effect on export shares is higher for large SMEs. Second, we find that the advantages from networking are stronger, in terms of both value added and export propensity, for firms located in more underdeveloped areas. Finally, investigating differences across industries through the Pavitt's taxonomy, we observe that the results on value added and export share are mainly driven by firms operating in more traditional sectors (i.e., specialized suppliers or supplier-dominated industries).

Our empirical evidence seems to support the idea that networks are more beneficial for firms operating in less favorable environments or characterized by an intrinsic weakness. In this sense, stimulating resources sharing, as well as firms' interactions or information exchanges trough networking, can be a win-win opportunity for the Italian SMEs. On the one hand, networking can represent an alternative to dimensional growth in order to reach a critical mass of resources, information and experiences. On the other hand, networks can represent a valid way to overcome the lack of infrastructures and isolation, which are typical problems of less developed areas.

Similarly, networking seems to be a valid instrument for sustaining performance in case of highly turbulent environments. Our estimates highlight that when the volatility of sales is high, formal networks are more effective in increasing value added, while the effects on export propensity are not different with respect to the ones reported for more stable sectors. Another important contribution of our work is the explicit consideration of the overlap

between weak and strong forms of networking. Taking advantage of the Italian industrial structure, we identify well defined local areas (the so-called industrial districts) characterized by a high level of relatively weak forms of cooperation among firms. Our results show that formalizing network agreements through contracts has a higher impact on value added for firms localized outside industrial districts.

Finally, the results regarding other structural aspects of networks, like the number of ties, partner diversity and geographical dispersion, are mixed. Network size shows a positive effect on value added ratio and profits, while network diversity is confirmed as a critical aspect that is negatively related to profits. The geographical dispersion shows a negligible effect on value added ratio and profits, but seems also to limit the pressure for international sales.

The fact that we focus on a specific kind of formal business network represents both a strength and a weakness of our analysis: we are able to clearly observe the moment in which the network is formalized, and its main characteristics, but our data do not allow us to identify other kinds of formal and/or informal cooperation that are not embedded under the term *Reti d'impresa*. In fact, our study is entirely focused on the differential in performances coming from the formalization of networking activities (e.g., pre-existing forms of collaboration of firms within industrial district). Our results lend support to the idea that declaring and formalizing objectives through a contract helps firms to benefit from networking activities (Huggins, 2001). However, since we cannot observe a firm's participation in other formal agreements, such as joint ventures, supplying contracts or franchising relationships, our estimates may represent a lower bound of the true impact of formal networking on firms' performance. Moreover, at the present stage of research, we are only able to catch short-term effects, due to the fact that a consistent group of firms enter network agreements only after 2012, leaving us with just two years of data in the post-network period. Notice, also, that the observations for the years after entering a network agreement partly overlap with the recent economic crisis, and it would therefore be of interest to assess whether this too is leading us to underestimate the effects that would prevail under normal times. Finally, even if we believe that our estimation techniques are broadly appropriate for attenuating any concern related to omitted variable biases and self-selection into treatment status, it is perhaps worth remembering that our results are, nevertheless, obtained from observational data; hence, an interpretation in terms of direct causality between networking and economic performance should still be taken with care and further assessed in future research endeavors.

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