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Firm aggregations and firm performance: Evidence from network contracts

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ABSTRACT

In Europe, the economic contraction starting in 2007–2008 has called for new economic policy tools. This paper analyses one of such policies, i.e. the *network contract*. Network Contracts are an innovative policy introduced in Italy with Law 9 April 2009, N. 33. This policy fosters the creation of firm aggregations with an ad hoc contract, without resorting on mergers. Network contracts are meant to increase economic efficiency for all firms involved in the contract. The paper employs a unique data base with panel data on companies' balance sheets for the period 2007–2012 along with data on the characteristics of their network contract. The effect of signing a network contract on the economic performance of the single firms and their aggregations is econometrically analyzed. Empirical results suggest in particular that (i.) firms signing a network contract tend to outperform firms that do not, and (ii.) network contracts whose members agree to commit more effort in the contract tend to outperform network contracts with less formally stated degrees of commitment.

1. Introduction

In Europe, the economic contraction triggered in 2007–2008 by the global overexposure of financial institutions to high-risk mortgages has called for a profound revision of existing economic policies. On the one hand, the interaction between the need for Keynesian public intervention with the aim to decrease the pressure exerted on the real economy by GDP contraction and the feeling that public budgets should be maintained strictly in equilibrium, has led to reduced room for maneuver for public authorities (Ghellab and Papadakis, 2011); reduced funding for public bodies was also evidenced by turmoil on state bonds markets (Greenwood and Vayanos, 2010). On the other hand, pressure from international financial markets has led to a postponement of supply-side policies in favor of more urgent demand-side ones (Capello et al., 2023; evidence on the prevalence of the latter, which address the short/run components of business cycles, on the former, which instead target more structural mechanisms, has recently been presented in Benguria and Taylor, 2020).

The crisis has hit particularly hard Small and Medium Enterprises (henceforth, SMEs). While several firms have been able to restructure and downsize, this is clearly not an option for companies that are already small. Furthermore, for SMEs there are two other stress factors: *"a) increased payment delays on receivables which added - together with an increase in inventories- result in an endemic shortage of working capital and a decrease in liquidity and b) an increase in reported defaults, insolvencies and bankruptcies"* (OECD, 2009, p. 6).

The combination of these two conditions – the global crisis and the fact that the latter hit SMEs the hardest – prompted a new awareness of the need for cutting–edge economic policies for SMEs. This paper analyses an innovative type of such policies that has recently come to the fore, i.e. Network Contracts (henceforth, NCs). NCs have been first introduced in Italy with Law 9 April 2009, N. 33 to foster the creation of firm aggregations. NCs can be considered as "*a flexible model for inter-firm coordination aimed at fostering competitiveness and innovation. The Network Contract Law […] can help SMEs overcome limitations due to their dimension without causing them to lose their legal independence, while also enabling them to collaborate with firms of different dimensions*" (Ferrari, 2010, p. 80).[1]

The Italian Chambers of Commerce, in charge of overseeing the data base of NCs, stress a relevant element of novelty stemming from the

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[1] For reasons of space limitations, descriptive statistics about the performance of firms in our sample during crisis years in and outside a network contracts, as well as their Kernel distributions, are presented in the Technical Appendix. Both pieces of evidence suggest that firms in a network contract tends to outperform those that do not join this institute during a crisis period: in fact, the former tend to achieve on average higher profits, or else face lower losses. This line of argument will be further analyzed in Section 5, when moving to the empirical analyses of this paper.

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Table 1
Network Contracts – (*Contratti di rete* in Italian).

RQ.	*What is the impact of the Network Contract policy on firm performance?*
Law	Network contracts were introduced in Italy with Law 9 April 2009, N. 33. The legislation has been subsequently expanded and modified.
Organisations	Two or more Italian *for profit* organizations
Legal structure	Formal contract registered and deposited in a Chamber of Commerce
Aim	A flexible model for inter-firm coordination aimed at fostering individual and conjoint competitiveness and innovation
Object	The firms should adopt a written common program entailing common activities or exchange of information or exchange or products/services
Tools	The collaborating firms can establish: 1. an ad hoc organizational unit to coordinate and/or execute the activities of the network contract; 2. a common fund to centralize the expenses of the network contract.
Fiscal incentives	The net profit invested in the network contract activities are not taxed
Basic statistics	As of December3, 2015 there were 2,542 network contracts involving 12,770 firms (2,379 in Lombardy) – Unioncamere data

Note: a limited number of network contracts are incorporated as autonomous legal entities (the law explicitly allows this possibility)

creation of this new legal framework: "*As the business network regulation framework doesn't entail the creation of a new legal corporation, the constitution of a legal entity instead of being a mandatory requirement is left to the mere discretion of the network participants*" (Bergamo Chamber of Commerce, 2014, p. 1). The novelty of this legal scheme lies therefore in the relative simplicity of the NC to stimulate cooperation across firms, without the burden and the loss of independence of creating a new legal entity. In light of the current macroeconomic conditions, a cooperative strategy would allow the more productive firms to improve their performance, while enhancing survival rates for SMEs that have been hit the hardest during the slump.

In order to more clearly introduce the novelty of this instrument, Table 1 summarizes its main characteristics (legal framework, aim, main requirements, tools, etc.) and basic summary statistics.

Despite the novelty of this policy tool, to date few empirical assessments of the impact of NCs on the economic performance of firms has been conducted (see Section 2 below). This paper fills this gap and provides an empirical answer to the following research question:

RQ. *What is the impact of the Network Contract policy on firm performance?*

In order to answer this research question, the paper employs a unique data base assembled by the authors with panel data on 1,709 companies' balance sheets for the period 2007–2012. These data have been merged with data on the characteristics of the NCs as can be inferred from the text of the contracts. Two types of analysis have been carried out. On the one hand, the date when the NC has been officially signed by the firms creating the contract is used as a predictor of a (possibly, improved) economic performance of all firms signing the contract. On the other hand, all economic and balance sheet data of all firms belonging to the data base have been aggregated at the NC level; this strategy allowed us to assess the determinants of the contracts' economic performance as a function of the contract characteristics (which do not vary across contracts and over time, and would therefore be considered as contract fixed effects with the first approach).

The paper proceeds as follows. In Section 2 a critical review of the existing literature is presented, with the aim to highlight the case for this paper. Section 3 describes the empirical strategy adopted to answer the research question mentioned above, while Section 4 introduces the data base collected for this work. Section 5 discusses the empirical results, while, finally, Section 6 concludes deriving some policy implications.

2. Cooperation and economic performance

The issue of whether cooperative behavior leads to better economic performance can be seen from different perspectives, and has been object of a long-standing academic debate. While from an aggregate perspective it is far from clear whether more competitive markets are characterized by overall improved efficiency (Nickell, 1996), at the firm level firms face several possible advantages from cooperating with other firms.

A first explanation relates to the concept of social capital (Putnam et al., 1993; Coleman, 1988). Firms being more prone to cooperating, in particular on specific functions or for specific purposes, would face lower transaction costs (Williamson, 1981, 2002; Capello et al., 2011). Collaborative firms can also share the burden of the typically risky activity of innovating (Belderbos et al., 2004), and local environments high in social capital can in turn further enhance this mechanism (Cooke and Will, 1999).

From an aggregate perspective, several positive externalities can be expected to arise in more cooperative environments). More specifically, in the theoretical debate in the field of regional science two main effects of a more cooperative attitude among firms – be it formal or informal – may be expected.

On the one hand, firms (with our without their co-location) thrive in contexts of socio-economic proximity, whose most direct channel of impact is through enhancing productivity (Caragliu, 2022). This is the story of the Italian Industrial District (Cooke, 2009), which has explained the so called Third Italy miracle, i.e. the (then) unexpected spurt of growth characterizing the North-East of the Country (Bagnasco, 1977). This literature deals with the explanation of static externalities, i.e. unintended positive consequences on firm *productivity* as cooperation takes place.

However, firms also reap dynamic benefits from (long-distance) cooperation networks. One major channel this goes through is due the fact that cooperative firms also tend to be more innovative, typically socializing the structural risk associated to innovative activities, as discussed by the GREMI in the *Milieu Innovateur* school (Aydalot, 1986).[2] The riskiness of innovative activity in high-tech industries can thus be minimized by resorting to strategic alliances, although the benefits stemming from cooperative behavior seems to accrue mostly to high-tech companies (Singh, 1997). A germane strand of literature in regional science has provided a different explanation for dynamic externalities; this is the contribution of the learning region (Asheim, 1996). The main contribution of this branch of the scientific debate lies in the stress on institutional context characteristics that may make firms (i.) cooperate at lower costs, and (ii.) be more innovative.

A second externality argument relates to the fact that thicker networks are expected to increase a firm's absorptive capacity (Cohen and Levinthal, 1990), with particularly relevant benefits for organizational units occupying "*central network positions that provide access to new knowledge developed by other units*" (Tsai, 2001, p. 996). At the same time, inter-firm cooperation also helps contract enforcement (Luo, 2002).

Furthermore, a wide set of managerial studies have shown the positive impact of collaborations on innovation output, and many authors talk of a new 'Open Innovation paradigm' (e.g., Shan et al. 1994,

[2] The GREMI (Groupe de Recherche Européen sur les Milieux Innovateurs) was created by Philippe Aydalot in 1984, and focused its research on the determinants of the spatial concentration of small firms.

Chesbrough, 2003, Chesbrough, 2012, Nieto et al. 2013). Large firms today are likely to set up these collaborations with other firms and/or with universities (Link and Rees, 1990; Leten et al., 2014; Can Karahasan, 2023): large firms also conduct analyses on technologies (technology foresights) and markets to understand which type of organizations to involve (Roveda et al., 2007).

SMEs on the contrary continue to rely on informal networks and suppliers, and they do not consider the potential benefits that might be generated by other collaborations (Hussler et al., 2010). SMEs have limits in terms of absorptive capacity (Cohen and Levinthal, 1990), in terms of articulation of their needs and assessment of the returns to cooperation (Gittell and Kaufman, 1996), and also in terms of development of familiarity and trust with the potential partners (Sherwood and Covin, 2008; Sala et al., 2011). However, given their resource limits, SMEs may have a comparative advantage at exploiting collaborations. For instance, rates of return to R&D can be greater for SMEs than for larger firms (Acs et al., 1994; Link and Rees, 1990), and if collaborations are aimed at enhancing innovative activities, small firms may reap higher benefits from a cooperative attitude (Hoffman et al., 1998).

Before moving to the gap in the literature addressed by our analyses, it is worth mentioning that network contracts are not the only strategy for firms to join forces. Prior to this institute, other voluntary and formal ways to collaborate existed, including joint ventures and formal firm alliances. These imply a higher level of coordination among parties, and while empirical evidence does hint a productivity levels for joint venture members, it also suggests that non negligible issues with coordination may arise (Li et al., 2009). Alternatively, cooperation among firms can also be the result of spontaneous aggregations of firms in space, which is another way to speak of agglomeration economies. However, agglomeration is the result of spontaneous market forces, in the form of cost savings and productivity advantages stemming from sharing, matching, and learning (Rosenthal and Strange, 2004; Caragliu et al., 2022Morin and Védrine, 2022).

Finally, it must be acknowledged that the literature on inter-firm cooperation is not exempt from criticism about the effectiveness of cooperative behavior. Combs and Ketchen (1999), for instance, argue that companies are typically concerned more about organizational issues when deciding whether to engage in interfirm cooperation, thus achieving possibly suboptimal levels of cooperation.

To date, limited attention has been paid to the issue of cooperation activities in firm aggregations. As above clarified, most extant literature focuses on formal cooperation. Instead, the Italian NC strikes a balance between formal and market-driven firm aggregations; this allows a more flexible tool to access the benefits deriving from cooperation without embarking in costly and, therefore, risky business ventures. Because of the informal and less defined set of benefits that cooperating firms are expecting to reap from cooperation in these aggregations, a sound empirical assessment of the effects of the NC should take several different firm performance measures into account.

Within Italy, recent evidence on the impact of joining a NC is presented in Caragliu et al. (2019), where Propensity Score Matching techniques are used to identify causal effects in the decision of the firm to join a NC. However, in their work no analysis of aggregate (i.e., contract-level) characteristics is discussed. In Leoncini et al. (2020), a short time span, and a smaller sample, of NCs is analyzed, and the focus is on static effects only. While dynamic effects are mentioned in the interesting recent analyses presented in Pieroni et al. (2023), the effects captured are actually level ones (comparable to our baseline model presented in Sections 4 and 5), with the main differences lying in the focus on effects persistency; instead, no attention is paid on contract-level impacts. Lastly, in Cisi et al. (2020), the evidence collected again focuses only on the firm-level, thereby missing our contribution to contract-level externalities, while also being based on a more recent sample of network contracts, which therefore makes it impossible to capture the effects of network contracts on making firms more resilient to an economic downturn.

As the network contract is a relatively recent, and, to date, typically Italian institute, it is not easy to explicitly isolate the differences between this institute and other examples outside the Italian context. As for formal collaborations among firms, the review in Bentivogli et al. (2013) particularly mentions cartels (Bos and Hanrrington, 2010) and patent pools (Lerner et al., 2007); the paucity of similar examples further strengthens the case for a rather unique legal institute.

In the remainder of this paper we will set up an empirical framework allowing an econometric test of the above mentioned assumption, viz. that firms setting up more informal cooperation agreements (firm aggregations) perform, all else being equal, better than firms that do not join these contracts. In this paper, as previously noted, by firm aggregations it is meant a cooperation contract (such as the NC) that defines a more informal collaborative framework that, while setting limits and rules for cooperation, do not force either the creation of a new company, or the merger between the companies entering the contract.

3. Empirical strategy

This paper exploits a unique data base assembled by the authors on the universe of Italian firms belonging to a NC since the inception of this policy tool. We have focused on "*Lombard NC*", that is on NC where at least one firm has its main legal branch in Lombardy, the most economically advanced region in Italy. For this reason, firms located outside the region also belong to the analyzed sample, although they represent a smaller share (about 80 per cent of the sample of firms is located in Lombardy[3]). The focus on Lombardy is coherent with the aim of obtaining a significant sample of firms and to reduce the impact of diverse regional economical contexts (some Italian regions are significantly less economically developed than Lombardy).

Data are collected in panel form, for a vector of 1,709 firms covering the period 2007–2012. This allows the following empirical two-stage approach (Fig. 1).

In a first stage, this paper exploits balance sheet data collected in the AIDA data base, a data base created by Bureau van Dijk from official balance sheet data deposited by firms at the Italian Chambers of Commerce. This data allows to analyze the impact of the adoption of a NC on firm performance, while also controlling for other firm characteristics. As shown in Fig. 1, this first approach does not allow assessing whether specific network contract characteristics are more conducive to a better overall economic performance of the contract (Fig. 1, top-right quadrant). In fact, any characteristic of the contract, by definition stable over time, would work as a contract fixed effect, not varying for n firms belonging to the contract and over the contract duration.

In order to overcome this limit, the bottom row in Fig. 1 shows that the balance sheet data of the firms in the analyzed sample have been aggregated at contract level, with weighted averages or sums depending on the type of data (see Section 4 below). The aggregation of data at contract level allows to separate the effect of the NC characteristics on the economic performance of the contract, i.e. the sum of all firm turnovers, profits, value added, and so on for all firms belonging to each contract. Therefore, an additional element of novelty in this paper lies in the semantic research carried out on the text of the contracts: for each contract, a textual search has highlighted the contract's objectives, foreseen duration and other relevant contract characteristics (presence of a joint control authority, availability of common funds, etc.).

The estimated models in the first stage of the empirical analyses takes on the following functional form (Eq. 1):

[3] This figure represents the overall mean share of Lombardy firms of the whole sample, i.e. the weighted average of Lombardy firms in the sample (where the weight is represented by the share of each company in the total number of firms in the contract). Interestingly, the unweighted average (i.e. the overall mean share of firms located in Lombardy, irrespective of the number of firms in each contract) is equal to 89 per cent. This suggests that contracts with a higher number of Lombardy firms tends to have on average more firms in the contract w.r.t. other contracts with a lower incidence of firms located in Lombardy.

Stage and methodology of the research	Problems and suggested solutions
Stage 1 'Binary' evaluation of the effect of the network contract on firm performance: construction of a dummy variable, equal to 0 until the firm joins a NC, and equal to 1 thereon.	1. Contract characteristics covary with the dummy variable; thus, their effect cannot be evaluated. For this problem the solution requires moving to Stage 2. 2. The time horizon of the analysed data is relatively short– the first NC were signed in 2010. For this second problem the ideal solution would be to analyse data covering a longer time span.
Stage 2 Characteristics of firms joining a network contract are aggregated at contract level (turnover, labour productivity, etc.) and joined to the characteristics of the contract itself. Econometric analysis pertains therefore the relationship between characteristics of the firms joining the NC, and the contract itself, on the overall performance of the contract.	1. The time horizon of the analysed data is relatively short– the first NC were signed in 2010. For this second problem the ideal solution would be to analyse data covering a longer time span. 2. The number of observations in the data set aggregated at contract level does not allow an ideal identification of the effects of all NC characteristics. This issue will be solved as soon as larger data sets will be available.

Fig. 1. Logical sequence in the econometric evaluation of network contract effects. Source: Authors' elaboration.

$$\dot{Y}_{i,T-t} = \alpha + \beta Z_{i,t} + \delta D_{i,t} + \mu_k + \eta_t + \varepsilon_{i,t} \quad (1)$$

where:

- A dot on variables indicate time derivatives (t and T representing time periods, t indicating a date prior to T);
- The Z matrix includes all relevant firm level controls (size, productivity, means of financing);
- The D vector is a dummy variable, equal to 1 since th date of inception of the contract for the i^{th} firm;
- μ_k e η_t represent respectively industry (k) and time fixed effects;
- $\varepsilon_{i,t}$ is the usual i.i.d. disturbance.

The dummy $D_{i,t}$ is the crucial variable for assessing the effect of signing a network contract on firm performance. The precise information on the date of inception of the contract for each firm, in fact, can be used as a treatment proper and, therefore, its effect can be isolated from those of other time-varying firm characteristics.

As for the second stage analyses, a model similar to Eq. (1) is estimated, whereas the unit of observation is no longer the firm (indexed as i in Eq. 1), but the contract. Hence, the estimated model takes on the following functional form (Eq. 2):

$$\dot{Y}_{j,T-t} = \alpha + \beta Z_{j,t} + \gamma X_{j,t} + \mu_j + \eta_t + \varepsilon_{j,t} \quad (2)$$

where indexes are the same as in Eq. (1.), but for the unit of observation (j contracts as anticipated above), while an additional matrix X of contract characteristics also enter the estimated model. Thus, with this second approach we are able to disentangle the pure effect of entering a NC (captured by the estimated δ parameter) from the additional effect of idiosyncratic characteristics of the contracts.

Data collected for estimating Eq. (1.) and (2.), and in particular entering the Z and X matrices, are described in Section 4. For both Eqs. (1) and (2.) Section 5 will also present estimates of network contract, and their characteristics, on level outcomes. While a detailed explanation of the data collected for measuring firm performance is going to be presented in the next section, it is worth anticipating that in our empirical analyses we will present the impact of joining a network contract (Eq. 1) and, within network contracts, of their characteristics on Earnings Before Interest, Taxes, Deductions and Amortization (henceforth, EBITDA), profits, and return On Equity (firm-level outcomes), and profits growth (contract-level outcomes).

The choice of three alternative outcomes is aimed at shedding light on possible multiple level and growth effects of the decision of a firm to join a network contract. EBITDA became a prominent measure of firm performance during the 1980s, especially "*in capital-intensive industries, in which expensive assets had to be written down over longer periods*" (Bouwens et al., 2019, p. 55). This seems particularly appropriate for our analyses, as most firms in the sample are active over a long run time horizon. As an alternative measure of performance, accounting profits are also taken into account, as this is the classical decision lever in a standard model of producer theory; in other words, profits are the decision lever that the representative agent in producer theory seeks to maximize (Mas-Colell et al., 1995). Lastly, ROE can is also used as "*it measures operating performance from shareholders' point of view (i.e., interest expense is removed from earnings)*" (Brown and Caylor, 2009, p. 132).

4. Data description and distribution

In order to empirically estimate Eq. (1.) and (2.) the following data and indicators have been collected. Table 2 shows the type of data used and the sources for the raw indicators for the first stage regressions (i.e.

Table 2
Data and indicators used in the firm-level regressions.

Type of variable	Type of indicator	Indicator	Source
Dependent	Profits	EBITDA[d]	AIDA-Bureau Van Dijk
		Profits	AIDA-Bureau Van Dijk
	Firm profitability	Return On Equity	AIDA-Bureau Van Dijk
Independent	Firm characteristics	Labur productivity	AIDA-Bureau Van Dijk
		Firm size (total assets)	AIDA-Bureau Van Dijk
		Debt/equity ratio	AIDA-Bureau Van Dijk
	Industrial structure	Industry dummies	Own calculation on AIDA-Bureau Van Dijk data
	Network contract	Dummy, =0 in years when firms do not take part in a NC, 1 otherwise	Own elaboration on the Chambers of Commerce Network Contract data base
	Crisis effect	Dummy, = 1 in 2009, 2011, and 2012 (years in which Italy's GDP has been officially shrinking according to ISTAT estimates)	Own elaboration on the Chambers of ISTAT data

[d] Earnings Before Interest, Taxes, Depreciation, and Amortization is among the most common measures of a company's profitability.

Table 3
Data and indicators used in the contract-level regressions.

Type of variable	Type of indicator	Indicator	Source
Independent	Characteristics of the firms joining a NC	Labour productivity	Own calculation on AIDA-Bureau Van Dijk data
		Initial level of the dependent variable	Own calculation on AIDA-Bureau Van Dijk data
		Debt/equity ratio	Own calculation on AIDA-Bureau Van Dijk data
	Industrial structure	Industry dummies	Own calculation on AIDA-Bureau Van Dijk data
	Characteristics of the network contract	Presence of an ad hoc organizational unit	Own elaboration on the basis of textual analysis
		Length of the NC in years	Own elaboration on the basis of textual analysis
	Contract size	Number of firms joining the contract	Own elaboration on the basis of textual analysis
		Number of firms outside the region joining the contract	Own elaboration on the basis of textual analysis
	Aims of the NC	Dummies for the six possible contract objectives	Own elaboration on the basis of textual analysis

firm-level analyses); Table 3 displays instead the same information related to the second stage (contract-level) regressions.

For both analyses, viz. firm-level and contract-level regressions, all dependent variables have been analyzed both in levels as well as in differences. This approach allows to separate the NC effect on the chances that firms joining a NC reach a larger size, and better *levels* of performance; or if instead the effect of this tool is mostly related to its capability to foster *growth rates* of firms joining the contract.

As anticipated in Section 3, in the second type of empirical analyses individual firms data are aggregated at contract level. In particular, absolute firm-level characteristics (i.e. EBITDA, profits, employees, and total assets) are summed for all firms belonging to a given network contract, while relative/intensity variables (Return on Equity, Debt/Equity ratio) are aggregated by calculating weighted averages at contract level, using the share of firm turnover in the overall network contract turnover as weight.

5. Empirical results

5.1. Firm characteristics, presence in a network contract and firm performance

Results of the empirical estimates of Eq. (1.) are presented in Table 4 below. The first three columns display the results of estimating Eq. (1.) in levels: EBITDA, Return on Equity (henceforth, ROE) and profits. In the last three columns, instead, results obtained regressing growth rates of these three indicators are presented. Across all columns, estimates are based on choosing between pooled OLS and random/fixed effects, by running Breusch-Pagan tests.[4] The latter posit a null hypothesis such that variance is constant among residuals (which implies their normality). For firm-level tests, Breusch-Pagan outcomes are associated with p-values above .1, which suggests that the null hypothesis is not rejected, and hence Pooled OLS must be preferred to Fixed/Random effects.

Table 4 suggests a relatively similar behavior for EBITDA and profits, while ROE presents rather different findings. In fact, it could be argued that the impact of NCs varies for different performance indicators. Even controlling for several firm-specific characteristics (labor productivity, capital structure, size), entering a NC is positively and significantly associated to the levels and growth rates of both EBITDA, ROE, and profits. It is worth stressing that the NC-EBITDA association suggests a level effect equal to.06 % per cent (column 1), which implies a EBITDA grows in equilibrium faster by a factor of almost.1 per cent on an yearly basis, on the basis of the analyzed data sample.

In Table 4, interaction terms between the NC dummy and firm characteristics are not presented. In fact, all possible interactions turn out to be not significantly associated with firm performance. No firm characteristic's effect on firm performance becomes thus stronger as firms enter a NC.

As for the main control variables included in these regressions, firm size is positively and significantly associated to levels of EBITDA and profits, while firm profitability measured with ROE is found to be negatively related to firm size.

Models using profits and EBITDA as dependent variables tend to present much higher levels of fit w.r.t. the ROE specifications (columns 1–2 and 4–5 vs. columns 3 and 6, respectively). For ROE, a possible solution could entail the analysis of a longer time span with more firms being part of a NC.[5,6]

[4] Hausman tests cannot be run on the basis of estimates with clustered standard errors, which are instead shown in Table 4.

[5] Throughout all analyses discussed in this paper, heteroskedastic-robust standard errors are employed. Growth rates are regressed against time-lagged explanatory variables (e.g., the growth rate of ROE between 2010 and 2009 is regressed against explanatory variables measured in 2009). These two solutions allow us to minimize endogeneity issues, although a more sound identification strategy would ideally entail the use of credible instruments, presently not available.

[6] All estimates presented in Table 4 are based on standard OLS techniques. All main findings can be replicated with Random Effect techniques, which yield qualitatively similar results. Fixed effects are by nature hampered by the relatively limited number of firms and time periods in the analysed sample. Possible idiosyncratic differences across the analysed industries are, nevertheless, controlled for by means of industry fixed effects.

Table 4
Estimates of the effect of the Network Contract on firm performance (Eq. 1).

Model	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Dependent variable	*EBITDA*	*ROE*	*Profits*	*Growth of EBITDA*	*Growth of ROE*	*Growth of Profits*
Labor productivity	0.185***	0.191***	0.149***	0.133***	0.054**	0.038***
	(15.12)	(9.60)	(10.51)	(5.93)	(2.25)	(3.05)
Firm size (Total assets)	0.799***	-0.250***	0.632***	-0.078***	-0.029	-0.072
	(85.15)	(-12.86)	(47.79)	(-3.79)	(-1.26)	(-1.38)
Debt/equity ratio	-0.053***	0.021	-0.276***	0.009	0.007	0.007
	(-6.75)	(1.35)	(-24.71)	(0.49)	(0.37)	(0.24)
Dummy for the crisis period (2009–2011–2012)	-0.028***	-0.008	0.001	-0.082***	0.003	-0.028*
	(-3.65)	(-0.43)	(0.04)	(-4.22)	(0.14)	(-1.88)
Labor productivity	0.013*	-0.010	-0.003	0.045**	-0.029	0.005
	(1.72)	(-0.54)	(-0.25)	(2.41)	(-1.33)	(0.40)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS
Observations	3700	3044	3049	2998	2225	3396
Adjusted *R2*	0.801	0.060	0.579	0.020	0.001	0.003
Joint F-test of significance	2091.75***	35.37***	710.51***	9.21***	1.20	2.81***

Note: Standardized beta coefficients shown. Heteroskedastic-robust standard errors in brackets. *: significant at 10% level. **: significant at 5% level. ***: significant at 1% level.

5.2. Robustness checks: firm characteristics, presence in a network contract and firm performance

In this second empirical subsection we discuss a number of robustness checks, aimed at shedding light on some of the main findings discussed in Subsection 5.1 First, we directly tackle the theoretical question illustrated in the introductory section: do Network Contracts make firms more resilient to the 2007/2008 economic contraction? Table 5 shows the results of replicating the main (significant) results in Table 4, with the inclusion of an interaction term between the network contract participation dummy and the dummy variable for the crisis years. In Table 5, Column (1) corresponds to Column (1) in Table 4, while Column (2) corresponds to Column (4) in Table 4.

Results of this robustness check suggest that – at least for what concerns levels -EBITDA in firms is less affected by the crisis period, when they (have) join (ed) a network contract, thus becoming more resilient to overall periods of downturn.

In a second robustness check (Table 6 below) we verify whether the growth regression results shown in Table 4, Columns 4–6 hold when also controlling for the initial levels of, respectively, EBITDA, ROE, and profits. This resembles a Mankiw-Romer-Weil approach to growth econometrics (Mankiw et al., 1992).

Table 6 documents that the main findings about network contract impacts remains unaffected by the inclusion of the initial levels of the growth outcomes: firms joining a network contract tend to outperform in terms of growth rates of EBITDA, while no statistically significant association is found between joining a network contract and the other two growth outcomes.

For both baseline estimates as well as for robustness checks presented in this section, we may argue that the recent emergence of this policy tool only allows an imperfect knowledge of its real effect by making inference difficult. In particular, the perfect collinearity between the dummy capturing the time period when a firm enters a NC and the contract's main features prevents, as anticipated in the Introduction, from separating the overall NC effect from the individual characteristics of the contract itself, that may enhance, or hamper, a stronger impact. To address this issue, in the next subsection we aggregate all data collected at firm level, thus analyzing a contract level data base. The results of estimating the basic model for data aggregated at the contract level are thus presented in Subsection 5.3.

5.3. Network contract characteristics and contract performance

In the third empirical subsection the use of contract-level data allows to disentangle the effects of the characteristics of the NCs on the overall contract economic performance. In fact, once a firm enters a network contract the dummy variable capturing the effect of the network contract on the firm's economic performance covaries with other characteristics of the contract. For this reason, any characteristic of the contract other than its existence[7] would act as a contract fixed effect, and would be, therefore, discarded from the empirical analyses.

In order to overcome this limitation we resort to contract-level data, as already discussed in Section 4. Among all measures of economic performance discussed in Subsection 5.1, we here show empirical analyses related to the growth of contract-level profits, because of the superior explained linear variance. However, qualitatively similar results are obtained for most other dependent variables explained in Table 7.[8]

Across all analyses, contract characteristics can be summarized in five main classes:

Table 5
Robustness checks: estimates of the effect of the Network Contract on firm performance (Eq. 1) during the 2007/2008 economic crisis.

Model	*(1)*	*(2)*
Dependent variable	*EBITDA in crisis*	*Growth of EBITDA in crisis*
Labor productivity	0.185***	0.137***
	(15.17)	(6.08)
Firm size (Total assets)	0.799***	-0.076***
	(85.10)	(-3.68)
Debt/equity ratio	-0.052***	0.010
	(-6.67)	(0.54)
Dummy for the crisis period (2009–2011–2012)	-0.030***	-0.010
	(-3.01)	(-0.40)
Network contract dummy * crisis	0.020**	0.012
	(2.02)	(0.51)
Industry fixed effects	Yes	Yes
Estimation method	OLS	OLS
Observations	3700	2998
Joint F-test of significance	2060.88***	6.62***
Adjusted *R2*	0.80	0.014

Note: Standardized beta coefficients shown. Heteroskedastic-robust standard errors in brackets. *: significant at 10% level. **: significant at 5% level. ***: significant at 1% level.

[7] This statement is valid only in case, as verified in the analyzed data, contract characteristics do not vary over the life of the contract. For instance, partners in a NC may activate a Joint Control Unit after the inception of the contract.

[8] Results of alternative specifications are available upon request from the authors.

Table 6
Robustness checks: estimates of the effect of the Network Contract on firm performance (Eq. 1) controlling for initial levels in the growth specifications.

Model	*(1)*	*(2)*	*(3)*
Dependent variable	*Growth of EBITDA*	*Growth of ROE*	*Growth of Profits*
Lag of the log of EBITDA	-1.185***	-	-
	(-22.24)		
Lag of the log of Return on Equity	-	-0.459***	-
		(-19.14)	
Lag of the log of profits	-	-	-0.114***
			(-3.12)
Labor productivity	0.253***	0.122***	0.043***
	(11.14)	(5.52)	(4.05)
Firm size (Total assets)	0.911***	-0.130***	-0.015
	(19.43)	(-6.12)	(-0.37)
Debt/equity ratio	-0.060***	-0.001	-0.033
	(-3.64)	(-0.06)	(-1.25)
Dummy for the crisis period (2009–2011–2012)	-0.065***	0.002	-0.015
	(-4.02)	(0.11)	(-0.91)
Network contract dummy	0.044***	-0.028	0.004
	(2.86)	(-1.38)	(0.32)
Industry fixed effects	Yes	Yes	Yes
Estimation method	OLS	OLS	OLS
Observations	2998	2225	2635
Joint F-test of significance	80.42***	53.17***	7.25***
Adjusted *R*2	0.330	0.201	0.010

Note: Standardized beta coefficients shown. Heteroskedastic-robust standard errors in brackets. *: significant at 10% level. **: significant at 5% level. ***: significant at 1% level.

- Characteristics of the firms belonging to the NC;
- Industry structure;
- Characteristic of the contract;
- Aim of the contract;
- Effects of the economic crisis.

Table 7 shows the results of estimating Eq. (2). Starting from model (1), each column includes an additional class of regressors among those above listed, while also controlling for industry fixed effects from Column 5. All estimates in this section are based on Random Effects. This is based on the structure of our data set: in fact, for most characteristics, contracts remain constant over time, and thus their impact on aggregate contract-level performance would become impossible with the inclusion of firm fixed effects.[9]

Across all regressions, the growth of contract-level profits is positively associated to the initial level of profits and the debt-equity ratio. The first result suggests that NCs tend to be affected by hysteresis: contracts involving profitable firms also tend to maintain such good performance in the medium run. The negative sign associated with the number of firms involved in the contract (statistically significant at the 95/99 per cent level throughout the estimates, with the exception of Column 5) tells instead a different story: managing such complex structures as network contracts is costly, cooperation also implies relevant costs and it can safely be assumed that an excessive number of partners in a contract can make the contract difficult to handle. An interesting additional result relates instead to the positive and statistically significant sign associated to the number of firms with registered office outside Lombardy. This result is in line with the literature discussing the relevance of complementary skills for the success of cooperative agreements (see, e.g., Blankenburg Holm et al., 1996; Rothaermel, 2001). A similar argument on the existence of positive cooperation externalities has been posited by the milieu innovateur literature (Aydalot, 1986; Camagni, 1991).

Whether a partner is more or less committed to the goal of the NC also matters for the overall economic performance of the contract itself. While no significant result is found for the variable measuring the length of the contract, the existence of an ad hoc organizational unit is found to be positively and significantly associated with the growth rate of the contract's overall profits.

Furthermore, the nature of NCs as a relatively light policy instrument is confirmed by the positive and significant sign estimated for the dummy variable that equals one for contracts with majority of firms with Limited Liability Company (LLC) as legal form (Società a responsabilità limitata – S.r.l. – in Italian). As anticipated in the Introduction, NCs are meant to help SMEs overcome the structural limits typically associated

with limited size. In turn, smaller firms also tend to be legally registered as LLCs; this clearly offers many advantages for firms aiming at protecting what is often family-owned risk capital from possible bankruptcies.

Our results suggest that indeed a lighter legal structure is positively and significantly associated to a better overall contract performance, thereby also providing evidence about the fact that this tool is better suited for relatively small firms looking for broadening the scope and breadth of their activity without necessarily resorting on merging with other firms.

No statistically significant difference across different aims of the contract have been identified; instead, results confirm that during the crisis years firms part of a network contract have indeed displayed a worse performance.

A final analysis pertains a potentially interesting policy decision related to network contracts. A fundamental policy question regards the optimal size of network contracts: in the absence of specific limits for the maximum number of firms to be allowed in a NC it is not unconceivable to observe very large NCs. While the empirical analyses discussed above suggest a negative and significant relationship between contract size and economic performance, it could be argued that a minimum number of members is required for cooperation to be effective. Evidence on the existence of an optimal number of business partners has been found in many different fields and on several different measures of economic performance and efficiency (see, e.g., Deeds and Hill, 1996 on product development; Bakos and Brynjolfsson, 1993 on supply relations; McFadyen and Cannella, 2004 for social capital and knowledge creation).

Empirically, this assumption translates into including a quadratic term for the number of firms in the contract in the last regression (Column 8 in Table 7). Fig. 2 plots the overall economic performance of a network contract as a function of the number of firms belonging to the contract (marginal effects of firm size as the latter increases). We find that a negative impact of pure size (linear term) is partially counterbalanced by decreasing (negative) effects of size (quadratic term). The net effect of firm size remains positive only for relatively small network contracts (the threshold for crossing the zero line being found for n = 7). This result hints at possible decreasing returns to scale to contract size: despite its positive effects, excessively large contracts may make joint decision-making overburdened with managerial complexity.

As many of our controls variables are dichotomous in nature, the expected *net* impact of firm size seems to be actually often negative. So one may wonder what characteristics firms with a positive impact of firms size look like. In terms of outcomes, these firms tend to be more profitable, be less indebted, and have a higher EBITDA. They also tend to be on average slightly smaller – about 25 per cent so with respect to

[9] The choice between pooled OLS and fixed/random effects estimators went through the usual procedure of first estimating Pooled OLS, then running for each model Breusch-Pagan tests for verifying whether variance is constant among model residuals. Across all specifications, the null hypothesis of constant variance has always been strongly rejected (the highest p-value being equal to.0001). For the sake of transparency, Hausman tests were then performed to discriminate between Random and Fixed effects, with the latter being constantly suggested by the test (but with the negative consequence of causing time-invariant characteristics to be dropped from the estimate results as their role is absorbed by firm-level fixed effects).

Table 7
Impact of NCs' features on NC profits growth rates (Eq. 2).

Model	*(1) Baseline model*	*(2) Contract size*	*(3) LLC*	*(4) Contract characteristics*	*(5) Industry FEs*	*(6) Joint Unit*	*(7) Crisis*	*(8) Nonlinearities in size effects*
Initial profits	0.396***	0.430***	0.430***	0.439***	0.498***	0.454***	0.457***	0.462***
	(7.53)	(8.00)	(8.08)	(8.15)	(8.45)	(6.72)	(6.80)	(6.88)
Labor productivity	-0.014	-0.021	-0.029	-0.029	-0.024	-0.013	-0.032	-0.031
	(-0.46)	(-0.71)	(-0.97)	(-0.96)	(-0.83)	(-0.37)	(-0.86)	(-0.84)
Debt/equity ratio	0.057*	0.088**	0.082**	0.084**	0.092**	0.098**	0.087**	0.087**
	(1.69)	(2.56)	(2.41)	(2.47)	(2.53)	(2.26)	(2.04)	(2.01)
Number of firms in the contract	-	-0.211***	-0.293***	-0.300***	-0.127	-0.236**	-0.245**	-0.784***
		(-4.83)	(-5.18)	(-5.29)	(-1.50)	(-2.33)	(-2.44)	(-3.00)
Square of the number of firms in the contract	-	-	-	-	-	-	-	.0028 ***
								(2.62)
Number of firms with registered office outside Lombardy	-	0.138***	0.207***	0.218***	0.435***	0.377***	0.383***	0.444***
		(2.85)	(3.42)	(3.33)	(7.18)	(5.20)	(5.27)	(5.56)
Contracts with majority of firms with LLC legal form	-	-	0.101**	0.100**	0.270***	0.247***	0.256***	0.273***
			(2.54)	(2.45)	(5.09)	(3.51)	(3.65)	(3.79)
NC has operations as objective	-	-		-0.010	-0.072	-0.049	-0.041	-0.051
				(-0.23)	(-1.59)	(-0.95)	(-0.80)	(-0.98)
NC has access to credit and public tenders as objective	-	-	-	-0.010	-0.015	-0.037	-0.038	-0.042
				(-0.34)	(-0.58)	(-1.21)	(-1.17)	(-1.30)
NC has R&D as objective	-	-	-	-0.044	-0.037	-0.028	-0.022	-0.019
				(-1.34)	(-1.08)	(-0.73)	(-0.57)	(-0.49)
NC has support processes as objective	-	-	-	-0.019	-0.020	-0.019	-0.021	-0.020
				(-0.47)	(-0.49)	(-0.51)	(-0.56)	(-0.52)
Dummy, =1 if NC includes a Joint Unit	-	-	-	-	-	0.056***	0.057***	0.046***
						(3.28)	(3.36)	(2.86)
Length of the NC	-	-	-	-	-	0.003	0.004	0.007
						(0.07)	(0.10)	(0.18)
Crisis (Italy's GDP shrunk: 2009, 2011, and 2012)	-	-	-	-	-	-	-0.135***	-0.135***
							(-3.79)	(-3.81)
Industry Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Estimation method	RE	RE	RE	RE	RE	RE	RE	RE
Observations	1017	1003	1003	1003	955	771	771	771
Within *R*2	0.4514	0.4382	0.4373	0.4376	0.4363	0.3956	0.3439	0.3452
Between *R*2	0.0084	0.0225	0.0286	0.0276	0.0816	0.0558	0.0552	0.0559
Overall *R*2	0.0613	0.0792	0.0833	0.0845	0.1121	0.097	0.1136	0.1147

Note: Standardized beta coefficients shown. Heteroskedastic-robust standard errors in brackets. *: significant at 10% level. **: significant at 5% level. ***: significant at 1% level

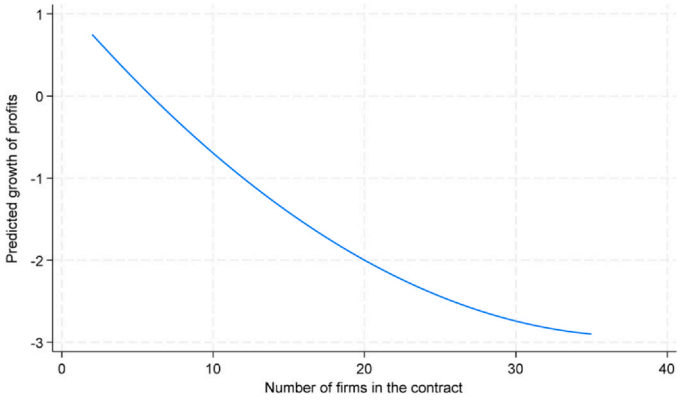

Fig. 2. Effect of the NC as a function of the number of firms in the contract. Source: Authors' elaboration.

the mean of the analyzed sample; this point may be due to the fact that small firms are actually those that reap the most benefits from connecting through a network contract, while larger units may be more prone to do things in house, without necessarily resorting to external linages.

In terms of *contract* characteristics, among those that turn out to be significantly and positively associated with profit growth in Table 7, contracts with a positive impact of the number of firms belonging to the contract are more likely to be registered as LLC; more capable of accessing public funds supporting their activities; and slightly more likely to be characterized by the presence of a joint control unit.

5.4. Robustness checks: network contract characteristics and contract performance

In this last empirical subsection we provide further robustness checks on the impact of contract features on aggregate firm profitability *within* the contract.

This check is shown in Table 8. Here we verify whether, as most network contract characteristics remain roughly time-invariant, they may suffer from structural under-reporting of statistical significance within a Random Effect estimation.[10] A solution to this potential pitfall implies constructing interaction terms between each network contract characteristic and a time trend, to verify whether the impact of these characteristics varies over time (Wooldridge, 2018, Ch. 14).

Table 8 shows the results of interacting each of the contract characteristics included as controls in Table 7, Column 7 (most general specification) with a time trend (2007–2012). The evidence found confirms the main results in Table 7, while hinting at a growing impact of (i.) having easy access to credit, and (ii.) setting R&D as the main goal of the network contract on the aggregate profits of firms belonging in the contract.

[10] We thank an anonymous reviewer for hinting us at this potential issue.

Table 8
Robustness checks: Impact of NCs' features on NC profits growth rates (Eq. 2).

Model	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Time interaction	*Size*	*Non-Lombard control*	*LLC*	*Operations*	*Credit*	*R&D*	*Support*	*Joint unit*	*Length*
Initial profits	0.482***	0.479***	0.485***	0.482***	0.482***	0.487***	0.475***	0.482***	0.483***
	(6.84)	(6.83)	(6.92)	(6.87)	(6.84)	(6.92)	(6.83)	(6.88)	(6.81)
Labor productivity	-0.038	-0.038	-0.040	-0.039	-0.036	-0.038	-0.041	-0.039	-0.040
	(-0.99)	(-0.99)	(-1.04)	(-1.01)	(-0.92)	(-0.99)	(-1.05)	(-1.02)	(-1.02)
Debt/equity ratio	0.057	-0.035	-0.009	-0.042	-0.054	-0.103**	-0.039	-0.014	-0.056
	(0.55)	(-0.91)	(-0.17)	(-0.97)	(-1.46)	(-2.11)	(-1.07)	(-1.15)	(-1.26)
Number of firms in the contract	48.683	-0.250**	-0.248**	-0.251**	-0.252**	-0.251**	-0.249**	-0.252**	-0.255**
	(1.15)	(-2.41)	(-2.38)	(-2.41)	(-2.42)	(-2.41)	(-2.40)	(-2.42)	(-2.44)
Number of firms with registered office outside Lombardy	0.400***	33.682	0.402***	0.396***	0.398***	0.403***	0.395***	0.397***	0.398***
	(5.23)	(1.10)	(5.27)	(5.17)	(5.24)	(5.33)	(5.26)	(5.23)	(5.24)
Dummy, =1 for contracts with majority of firms with LLC legal form	0.265***	0.262***	47.230	0.264***	0.265***	0.266***	0.265***	0.264***	0.264***
	(3.63)	(3.60)	(1.02)	(3.61)	(3.63)	(3.66)	(3.67)	(3.64)	(3.64)
NC has operations as objective	-0.041	-0.041	-0.044	6.715	-0.044	-0.044	-0.043	-0.042	-0.043
	(-0.77)	(-0.77)	(-0.83)	(0.15)	(-0.83)	(-0.82)	(-0.80)	(-0.79)	(-0.80)
NC has access to credit and public tenders as objective	-0.039	-0.040	-0.040	-0.040	-52.711*	-0.038	-0.038	-0.040	-0.040
	(-1.16)	(-1.17)	(-1.18)	(-1.17)	(-1.77)	(-1.10)	(-1.13)	(-1.18)	(-1.18)
NC has R&D as objective	-0.023	-0.022	-0.022	-0.021	-0.019	-83.201*	-0.021	-0.021	-0.022
	(-0.58)	(-0.54)	(-0.56)	(-0.53)	(-0.49)	(-1.86)	(-0.53)	(-0.53)	(-0.55)
NC has support processes as objective	-0.023	-0.023	-0.022	-0.023	-0.024	-0.023	26.384	-0.022	-0.022
	(-0.59)	(-0.60)	(-0.56)	(-0.59)	(-0.61)	(-0.58)	(0.49)	(-0.58)	(-0.57)
Dummy, =1 if NC includes a Joint Unit	0.060***	0.060***	0.061***	0.060***	0.060***	0.060***	0.059***	3.645	0.061***
	(3.45)	(3.39)	(3.45)	(3.40)	(3.39)	(3.42)	(3.33)	(0.96)	(3.45)
Length of the NC	0.005	0.005	0.006	0.005	0.005	0.003	0.005	0.005	-21.416
	(0.13)	(0.12)	(0.15)	(0.13)	(0.13)	(0.07)	(0.12)	(0.13)	(-0.37)
Dummy, = 1 when Italy's GDP shrunk (2009, 2011, and 2012)	-0.121***	-0.120***	-0.122***	-0.120***	-0.121***	-0.120***	-0.121***	-0.121***	-0.121***
	(-3.22)	(-3.19)	(-3.22)	(-3.19)	(-3.20)	(-3.21)	(-3.21)	(-3.20)	(-3.20)
Year * Number of firms in the contract	-.05563								
	(-1.16)								
Year * Number of firms with registered office outside Lombardy		-.0063826							
		(-1.09)							
Year * Dummy, =1 for contracts with majority of firms with LLC legal form			-.011						
			(-1.01)						
Year * NC has operations as objective				-.008					
				(-0.15)					
Year * NC has access to credit and public tenders as objective					.136*				
					(1.76)				
Year * NC has R&D as objective						.097*			
						(1.86)			
Year * NC has support processes as objective							-.0566		
							(-0.49)		
Year * Dummy, =1 if NC includes a Joint Unit								-.0261	
								(-0.95)	
Year * Length of the NC									.001
									(0.37)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	771	771	771	771	771	771	771	771	771
Within *R2*	0.3632	0.3671	0.3666	0.3696	0.3679	0.3672	0.3688	0.37	0.3689
Between *R2*	0.0519	0.053	0.052	0.0519	0.0514	0.0523	0.0496	0.0516	0.0512
Overall *R2*	0.1144	0.1138	0.1138	0.1131	0.1144	0.1159	0.1135	0.1131	0.1133

Note: Standardized beta coefficients shown. Heteroskedastic-robust standard errors in brackets. *: significant at 10% level. **: significant at 5% level. ***: significant at 1% level.

6. Conclusions

This paper has provided an empirical answer to the question whether the innovative Italian policy instrument Network contract is conducive to a better economic performance.

The empirical assessment of the research question has exploited a new data base of 1709 Italian companies, with data, covering the period 2007–2012, on the companies' balance sheets. These data have also been complemented with information on the characteristics of the network contract obtained via a content analysis of the contracts.

While further research on the effectiveness of this policy tool would be beneficial for better understanding its applicability to other contexts, our empirical analyses do allow to draw some conclusions.

First, firms signing a network contract tend to achieve both higher levels of profits as well as faster growth rates. Similarly, their return in equity tends to be, *ceteris paribus*, higher than firms that do not enter such a contract.

Second, while no statistically significant difference is found across different contract aims, overall contract performance is positively associated to a stronger commitment of the contract members, captured

by the creation of a Joint Unit, as well as to a generally lighter legal structure of the contract members, as evidenced by the prevalence of LLCs in the contract.

Network contracts are therefore found to be conducive to a better economic performance for their members; while causality issues are presently not addressed, the direction of causality in our empirical findings seem to support this statement and to provide evidence of the initial positive effect of this new policy tool.

All in all, results complement nicely the findings illustrated in Caragliu et al. (2019), where the contract characteristics are not included among the factors determining this policy instrument's success.

The relevance of the problems addressed by network contract suggests, however, caution in interpreting these results. In order to strengthen our findings, additional evidence should be collected both for longer time spans, as well as through quasi-experimental data (for instance, resorting on propensity score matching). Alternatively, credible instruments should be sought with the aim to better identify the strength of the effect of the network contract.

These findings bear relevant policy implications. This innovative policy tool presents an interesting and relatively simple alternative to more traditional policies, such as policies aimed at promoting mergers and acquisition, tax breaks, innovation vouchers (Sala et al., 2016) and other financial incentives. SMEs are often confronted with the need to grow and acquire scale advantages, especially in standardized industries where production is un-customized and firms compete on price, rather than on quality. Countries and regions with a prevalence of SMEs in their industrial fabric may resort to this policy tool to favor firm aggregations and stimulate firm performance and competitiveness. In fact, the potential risk of firm over-aggregations seems presently rather remote, thus suggesting the potential effectiveness of this policy tool for effectively stimulating firm aggregations.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.rspp.2024.100064.

References

Acs, Z.J., Audretsch, D.B., Feldman, M.P., 1994. R&D spillovers and recipient firm size. Rev. Econ. Stat. 76, 336–340.

Asheim, B.R.T., 1996. Industrial districts as 'learning regions': a condition for prosperity. Eur. Plan. Stud. 4 (4), 379–400.

Aydalot, P., (ed) (1986). "Milieux innovateur en Europe", Paris (FR): Groupe de Recherche European sur les Milieux Innovateurs (GREMI).

Bagnasco, A. (1977). "Tre Italie, la problematica territoriale dello sviluppo italiano", Bologna (IT): Il Mulino.

Bakos, Y.J., Brynjolfsson, E., 1993. Information technology, incentives, and the optimal number of suppliers. J. Manag. Inf. Syst. 10 (2), 37–53.

Belderbos, R., Carreeb, M., Lokshinb, B., 2004. Cooperative R&D and firm performance. Res. Policy 33 (10), 1477–1492.

Benguria, Felipe, Taylor, Alan M., 2020. After the panic: are financial crises demand or supply shocks? Evidence from international trade. Am. Econ. Rev.: Insights 2 (4), 509–526.

Bentivogli, C. Quintiliani, F., and Sabbatini, D. (2013). "The Network Contract". Bank of Italy Occasional Paper No. 152, retrieved online on Feb. 9, 2024 at the URL SSRN: 〈https://ssrn.com/abstract=2243585〉.

Blankenburg Holm, D., Eriksson, K., Johanson, J., 1996. Business networks and cooperation in international business relationships. J. Int. Bus. Stud. 27 (5), 1033–1053.

Bergamo Chamber of Commerce (2014). "The business network contract", retrieved online on Dec. 30, 2014 at the URL 〈http://issuu.com/camcomitbg/docs/best_practices_collection_proactive〉.

Bos, I., Harrington, Jr, J.E., 2010. Endogenous cartel formation with heterogeneous firms. RAND J. Econ. 41 (1), 92–117.

Bouwens, J., De Kok, T., Verriest, A., 2019. The prevalence and validity of EBITDA as a performance measure. Comptab. é-ContrôLe. -Audit 25 (1), 55–105.

Brown, L.D., Caylor, M.L., 2009. Corporate governance and firm operating performance. Rev. Quant. Financ. Account. 32, 129–144.

Camagni, R., 1991. Local milieu, uncertainty and innovation networks: towards a new dynamic theory of economic space. In: Camagni, R. (Ed.), Innovation Networks: Spatial Perspectives. London (UK): Belhaven–Pinter, pp. 121–144.

Can Karahasan, B. (2023). Spatial distribution of new firms and firm-level innovation: Evidence from Turkey. Regional Science Policy & Practice.

Capello, R., Caragliu, A., and Dellisanti, R. (2023). "Integrating digital and global transformations in forecasting regional growth: The MASST5 model", Spatial Economic Analysis, online first. DOI: 〈10.1080/17421772.2023.2278514〉.

Capello, R., Caragliu, A., Nijkamp, P., 2011. Territorial capital and regional growth: increasing returns in knowledge use. Tijdschr. voor Econ. En. Soc. Geogr. 102 (4), 385–405.

Caragliu, A., 2022. Measuring the unmeasurable: the empirics of non-geographical proximity. In: *Handbook of Proximity Relations*. Edward Elgar Publishing, pp. 138–164.

Caragliu, A., Landoni, P., Sala, A., 2019. Network contracts and firm performance: Evidence from matching estimates of a regional programme impact. Sci. Reg. 18 (2), 173–192.

Caragliu, A., Smit, M., and Van Oort, F. (2022). "Who's right, Weber or Glaeser?", paper presented at the 2022 online ASSA conference. 〈https://www.aeaweb.org/conference/2022/preliminary/paper/KR35TYiB〉.

Chesbrough H. (2003), Open Innovation: The New Imperative for Creating and Profiting from Technology. Harvard Business School Press, Harvard, MA.

Chesbrough, H., 2012. Open Innovation. Where we've been and where we're going. Res. -Technol. Manag. 55 (4), 20–27.

Cisi, M., Devicienti, F., Manello, A., Vannoni, D., 2020. The advantages of formalizing networks: new evidence from Italian SMEs. Small Bus. Econ. 54, 1183–1200.

Cohen, W.M., Levinthal, D.A., 1990. Absorptive capacity: a new perspective on learning and innovation. Adm. Sci. Q. 35 (1), 128–152.

Coleman, J.S., 1988. Social capital in the creation of human capital. Am. J. Sociol. 94 (suppl), S95–S120.

Combs, J.G., Ketchen, D.J. Jr, 1999. Explaining interfirm cooperation and performance: toward a reconciliation of predictions from the resource-based view and organizational economics. Strateg. Manag. J. 20 (9), 867–888.

Cooke, P., 2009. Technology clusters, industrial districts and regional innovation systems. A Handb. Ind. Dist. 295–306.

Cooke, P., Wills, D., 1999. Small firms, social capital and the enhancement of business performance through innovation programmes. Small Bus. Econ. 13 (3), 219–234.

Deeds, D.L., Hill, C.W.L., 1996. Strategic alliances and the rate of new product development: An empirical study of entrepreneurial biotechnology firms. J. Bus. Ventur. 11 (1), 41–55.

Ferrari, C., 2010. The Italian "network contract": a new tool for the growth of enterprises within the framework of the Small Business Act. Columbia J. Eur. Law Online 16, 77–83.

Ghellab, Y., and Papadakis, K. (2011). "The politics of economic adjustment in Europe: State unilateralism or social dialogue?", in AA.VV., "The global crisis. Causes, responses and challenges", Geneva (CH): ILO, pp. 81–91. Retrieved online on March 16 at the URL 〈http://ilo.org/global/publications/books/WCMS_157530/lang–en/index.htm〉.

Gittell, R.J., Kaufman, A., 1996. State government efforts in industrial modernization: using theory to guide practice. Reg. Stud. 30 (5), 477–492.

Greenwood, R., Vayanos, D., 2010. Price pressure in the government bond market. Am. Econ. Rev. 100 (2), 585–590.

Hoffman, K., Parejo, M., Bessant, J., Perren, L., 1998. Small firms, R&D, technology and innovation in the UK: a literature review. Technovation 18 (1), 39–55.

Hussler, C., Picard, F., Tang, M.F., 2010. Taking the ivory from the tower to coat the economic world: Regional Strategies to make science useful. Technovation 30 (9-10), 508–518.

Leoncini, R., Vecchiato, G., Zamparini, L., 2020. Triggering cooperation among firms: an empirical assessment of the Italian Network Contract Law. Econ. Polit. 37 (2), 357–380.

Lerner, J., Strojwas, M., Tirole, J., 2007. The design of patent pools: the determinants of licensing rules. RAND J. Econ. 38 (3), 610–625.

Leten, B., Landoni, P., Van Looy, B., 2014. Science or graduates: how do firms benefit from the proximity of universities. Res. Policy 43 (8), 1398–1412.

Li, J., Zhou, C., Zajac, E.J., 2009. Control, collaboration, and productivity in international joint ventures: theory and evidence. Strateg. Manag. J. 30 (8), 865–884.

Link, A.L., Rees, J., 1990. Firm size, university based research and the returns to R&D. Small Bus. Econ. 2 (1), 25–31.

Luo, Y., 2002. Contract, cooperation, and performance in international joint ventures. Strateg. Manag. J. 23 (10), 903–919.

Mankiw, N.E., Romer, D., Weil, D.N., 1992. A contribution to the empirics of economic growth. Q. J. Econ. 107 (2), 407–437.

Mas-Colell, A., Whinston, M.D., & Green, J.R. (1995). Microeconomic theory (Vol. 1). New York: Oxford university press.

McFadyen, M.A., Cannella, A.A., 2004. Social capital and knowledge creation: Diminishing returns of the number and strength of exchange relationships. Acad. Manag. J. 47 (5), 735–746.

Morin, Y., Védrine, L., 2022. Do agglomeration economies affect firms' returns to training? Evidence based on French industrial firms. Papers in Regional Science 101 (5), 1135–1157.

Nickell, S.J., 1996. Competition and corporate performance. J. Political Econ. 104 (4), 724–746.

Nieto, M.J., Santamaria, L., Fernandez, L., 2013. Understanding the innovation behavior of family firms. J. Small Bus. Manag. 53 (2), 382–399.

Organisation for Economic Cooperation and Development (2009). "The impact of the global crisis on SME and entrepreneurship financing and policy responses", Paris (FR): OECD.

Pieroni, V., Lattanzi, N., Riccaboni, M., 2023. The dynamic impact of inter-firm network agreements. Small Bus. Econ. 1–31.

Putnam R.D., Robert L., and Nanetti R. (1993). "Making democracy work: civic traditions in modern Italy", Princeton (NJ): Princeton University Press.

Rosenthal, S.S., Strange, W.C., 2004. Evidence on the nature and sources of agglomeration economies. In *Handbook of regional and urban economics* Vol. 4. Elsevier, pp. 2119–2171.

Rothaermel, F.T., 2001. Incumbent's advantage through exploiting complementary assets via interfirm cooperation. Strateg. Manag. J. 22 (6-7), 687–699.

Roveda, C., Vecchiato, R., Verganti, R., Landoni, P., 2007. A new methodology for regional foresight. Int. J. Foresight Innov. Policy 3 (2), 218–234.

Sala, A., Landoni, P., Verganti, R., 2016. Small and Medium Enterprises collaborations with knowledge intensive services. Explor. Anal. Impact Innov. vouchers" *RD Manag.* 46 (S1), 291–302.

Shan, W., Walker, G., Kogut, B., 1994. Interfirm cooperation and start up innovation in the biotechnology industry. Strateg. Manag. J. 15 (5), 387–394.

Sherwood, A.L., Covin, J.G., 2008. Knowledge acquisition in university–industry alliances: an empirical investigation from a learning theory perspective". J. Prod. Innov. Manag. 25 (2), 162–179.

Singh, K., 1997. The impact of technological complexity and interfirm cooperation on business survival. Acad. Manag. J. 40 (2), 339–367.

Tsai, W., 2001. Knowledge transfer in intraorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance. Acad. Manag. J. 44 (5), 996–1004.

Williamson, O.E., 1981. The economics of organization: the transaction cost approach. Am. J. Sociol. 87 (3), 548–577.

Williamson, O.E., 2002. The theory of the firm as governance structure: from choice to contract. J. Econ. Perspect. 16 (3), 171–195.

Wooldridge, J.M. (2018). Introductory Econometrics. Cengage Learning.