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POLICY DEBATES

Formal cooperation and the performance of Italian firms operating inside and outside industrial districts

Jacopo Canello[a,b] and Francesco Vidoli[c]

ABSTRACT
This paper discusses the impact of formal cooperation on the performance of Italian firms operating inside and outside industrial districts (IDs). The analysis is focused on a policy tool (*Contratti di Rete* or network agreements) introduced in Italy to promote the use of non-equity alliances among smaller firms. We claim that the impact of both inward- and outward-looking partnerships is moderated by the local environment in which member firms are embedded. The results show that the benefits from the policy measure are more evident for outward-looking agreements that do not involve ID firms. Inside IDs, firms do not seem to be capable of reaping significant gains from the use of formal cooperation. From a policy perspective, our findings suggest that decision-makers should tailor their interventions to the features of the local economic environment, promoting strategies aimed at maximizing the outcomes of formal cooperation while accounting for geographical differences.

KEYWORDS
networks; industrial districts; formal cooperation; Italy; non-equity alliances

INTRODUCTION

In the last decades, the geography of knowledge creation has changed dramatically at the global level. Firms continuously relocate their activities domestically and internationally, triggering translocal information flows and generating opportunities as well as threats for local economic networks. The recent global transformations pose major challenges for industrial clusters and industrial districts (IDs), which traditionally rely on accumulation of endogenous knowledge through a dynamic system of informal local interactions (Markusen, 1996; Dunford, 2006; De Propris & Lazzeretti, 2009). In the fast-changing world of technology, localized learning is still relevant, but no longer sufficient to ensure the degree of sophistication and technological advancement required to foster local economic growth (Li & Bathelt, 2018). The inability of ID firms to tap into external knowledge pools can generate detrimental effects, such as technological lock-in and over-embeddedness, eventually fading the advantages associated with agglomeration economies (Giuliani & Rabellotti, 2017). For this reason, ID firms should identify and pursue alternative strategies to enhance their knowledge accumulation process.

In this paper, we claim that the use of formal cooperation can provide significant benefits for ID firms, facilitating local interactions between insiders, as well as enhancing the acquisition of knowledge located outside the ID. Following this approach, formal cooperation can be viewed as a complement rather than a substitute for informal interactions (Beuve & Saussier, 2012). In an attempt to verify this hypothesis, our contribution investigates the impact of a policy measure (*Contratti di Rete* or network agreements – NAs) introduced for the first time in Italy in 2009 and still in force at the time of writing. This framework was originally conceived in response to the European Union's (EU) Small Business Act to enhance firm competitiveness by promoting inter-organizational collaboration among small and medium-sized enterprises (SMEs). NAs attracted considerable interest, considering that, between 2010 and 2015, approximately 1700 contracts were signed by more than 9500 Italian businesses operating in different economic sectors. This tool was praised by the Organisation for Economic Co-

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operation and Development (OECD) as an example of innovative policy instrument to promote formal cooperation among SMEs (Cisi et al., 2020).

The proposed empirical analysis focuses on a sample of machinery producers involved in NAs during the 2013–15 period, combining information from the *Contratti di Rete* database[1] with firm-level data extracted from ORBIS BvD. The choice of the time interval is motivated by the need to use a sufficiently long pre- and post-treatment period for all units, given the data availability. The key assumption is that the benefits of formal cooperation are influenced by the location of the focal firm, as well as that of partner firms involved in the agreement. More specifically, we expect the impact of NAs to be significantly different when the partnership involves ID firms. In this respect, Italy appears to be an ideal setting for the purpose of our research, given IDs still represent a relevant feature of the local economy.

The main research questions are addressed combining multinomial logistic regression with counterfactual analysis, in order to evaluate the allocation outcome and the treatment effect of the policy measure, disentangling the role played by locational factors. In both stages of the empirical analysis, we discriminate between inward-looking NAs, involving exclusively domestic firms located in the same local labour market area (LLMA), and outward-looking NAs, involving at least one firm that is characterized by one of the following features:

- it is located in a different LLMA; or
- it is identified as a multinational enterprise (MNE), regardless of the LLMA in which this MNE is located.

We assume that, in either case, the presence of differentiated knowledge bases in the NAs potentially enhances cross fertilization of ideas and translocal learning.

The results provide a grim portrayal of the impact of NAs inside IDs. On the one hand, ID firms display higher propensities to choose inward over outward-looking partnerships, possibly formalizing existing informal relationships with neighbouring peers. However, both inside and outside IDs, inward-looking agreements are not associated with better economic performances for the firms involved. On the other hand, even when ID firms choose outward-looking partnerships, they do not seem to benefit from the presence of differentiated knowledge bases in the NA. The patterns detected for ID firms do not mirror those visible for non-ID firms: indeed, our evidence shows that non-ID firms are capable to reap significant benefits from outward-looking agreements in the period following the decision to enter an NA. Several factors, including performance gaps between ID actors, lack of investment by successful firms in the local community and the inability to recombine external knowledge effectively, might contribute to explain the inability of ID firms to benefit from both inward- and outward-looking NAs.

The contribution of this paper is threefold. First, we combine insights from economic geography, international business and strategic management, contributing to the debate on knowledge connectivity (Cano-Kollmann et al., 2016). The theoretical framework uses a comprehensive approach, explaining why the knowledge acquisition process in non-equity alliances can be influenced by the local environment in which the focal firm is embedded. More specifically, the territorial characteristics can shape the recombination ability of local businesses, as well as the extent to which external knowledge is used effectively, influencing firm-level performances. Second, we provide valuable evidence to support decision-makers in the ex-post evaluation of an important policy tool that has been used extensively in Italy. Previous research has shown that inter-firm network policies face a number of significant constraints to implementation (Huggins, 2001): therefore, disentangling the main dynamics through a fine-grained territorial perspective can add valuable support for academics as well as for practitioners and policymakers. Finally, we contribute to the ID literature by providing evidence of the evolving role of formal cooperation in these specific contexts (Felzensztein et al., 2010). The presence of formal partnerships is not new inside IDs. However, evidence shows that only a small share of all ID interactions is formalized (Rama et al., 2003). The empirical setting used in this paper provides the opportunity to evaluate the degree to which these patterns have changed in response to a policy stimulus, discussing the implications for knowledge creation and firm performances.

THEORETICAL BACKGROUND

Translocal linkages and knowledge creation in IDs

The literature on industrial agglomeration has shown that clustering generates multiple advantages for firms, ranging from labour market pooling to the availability of specialized input suppliers (Delgado et al., 2014). One of the main benefits of geographical proximity is the opportunity for local actors to exchange know-how on a regular basis, exploiting repeated face-to-face contacts and employees mobility (Felzensztein et al., 2010; Li & Bathelt, 2018). The majority of these daily interactions occur at the informal level and facilitate the creation of a shared system of values in the local community, increasing generalized trust and reducing transaction costs (Dunford, 2006). The presence of knowledge spillovers has been associated with stronger entrepreneurial propensity, higher innovation rates and higher productivity levels (Audretsch & Feldman, 1996; Baptista & Swann, 1998). The same factors contribute to explain why agglomeration continues to play a central role in a 'slippery' world (Markusen, 1996).

In the recent past, a number of scholars have started to debate whether agglomeration and specialization always generate beneficial effects for business performances: for example, Beaudry & Schiffauerova (2009) have shown that, despite the positive impact of Marshall–Arrow–Romer externalities (MAR), excessive specialization may

also hinder economic growth. Similar findings were reported by the recent contributions on regional resilience, which showed that the lack of diversity might hamper the ability of economic regions to react and withstand economic and structural shocks (Boschma, 2015; Martin et al., 2016; Canello, 2016; Canello & Vidoli, 2020). Local dynamics of knowledge diffusion inside clusters and districts has also been revisited by the literature, highlighting that knowledge does not freely circulate among the members of a local community (Breschi & Lissoni, 2001). In several cases, informal contacts are only exploited to share small ideas rather than strategic knowledge (Breschi & Lissoni, 2001). These findings are related to the idea that geographical proximity is neither a necessary nor a sufficient condition for effective knowledge sharing, unless other factors, such as cognitive or institutional proximity, are also present (Boschma, 2005).

In light of these findings, the debate has recently revolved around the factors that could ensure the effective exploitation of external economies of scale and foster growth inside embedded local networks. Consensus has been reached on the fact that the mere reliance on localized resources is not sufficient to generate competitive advantages in the global knowledge economy (Dei Ottati, 2018). Therefore, the success of ID and cluster firms has been increasingly associated with the ability to tap into more distant knowledge pools (Bathelt et al., 2018; Turkina & Van Assche, 2018). Translocal linkages are beneficial in that they enhance resource flows between the local network and the external environment, facilitating knowledge exchange and technological upgrade (Bathelt et al., 2004; Lorenzen & Mudambi, 2013; Li & Bathelt, 2018). By accessing distant knowledge, local actors can overcome their weaknesses, preventing the risk of technological lock-in and avoiding cognitive inbreeding (Li & Bathelt, 2018).

Translocal learning can be enhanced in different ways, exploiting alternative sources of external knowledge. First, cluster and ID firms can establish links with partners located outside the local production system: distant relationships generally provide direct and indirect benefits, in that outward-looking businesses can acquire and process valuable information before disseminating it among the local community (Morrison et al., 2013; Giuliani, 2011; Canello et al., 2017; Buciuni & Pisano, 2018). Alternatively, local actors can interact with domestic or foreign MNEs, indirectly exploiting the ability of these businesses to tap into globally distributed knowledge pools (Kafouros et al., 2012). MNEs are valuable sources of information, in that they use internal transmission mechanisms to combine tacit and codified knowledge embedded in different locations (Tallman & Chacar, 2011). The literature shows that collaboration between MNEs and local firms is beneficial for both parties (Turkina & Van Assche, 2018). In this respect, international business scholars have acknowledged that MNEs act both as knowledge generators and knowledge seekers in host countries (Inkpen et al., 2019; Hervas-Oliver et al., 2021) and that the establishment of global inter-organizational linkages foster a co-evolutionary

process involving both the firms and the locations affected by such processes (Cano-Kollmann et al., 2016).

Despite the potential benefits of establishing bridging ties outside the ID, this value creation process is often hindered by the presence of multiple frictions (Bathelt et al., 2018). While informal cooperation is generally effective inside the locality, the same dynamics is not sufficient to ensure knowledge transmission when unfamiliar partners are involved. As discussed in the following subsection, non-equity alliances can represent a valuable tool to reduce some of the frictions associated with translocal learning.

The role of contextual factors in influencing the outcome of formal cooperation

Strategy and management scholars have been inspecting the dynamics of inter-organizational cooperation for a long period of time. Despite using different interpretative lenses, the approach proposed by this strand of the literature mirrors that introduced in the previous section and used by economic geographers to study the recent transformations occurred within clusters and IDs. The main assumption is that economic agents are not isolated entities that autonomously acquire resources to achieve competitive advantage (Gulati et al., 2000). In most cases, firms do not possess sufficient resources and capabilities to develop the know-how required to be successful in their competitive environment (Rosenkopf & Almeida, 2003; Kok et al., 2020). During the last globalization wave, this aspect has become even more evident: indeed, most businesses face uncertainty on a regular basis and the set of competencies required to preserve the competitive advantage in the long term is constantly expanding (Heimeriks et al., 2009). In this respect, non-equity alliances, defined as 'voluntary arrangements between firms involving exchange, sharing and co-development of products, technologies, or services' (Gulati, 1998), are regarded as effective tools to enrich firms' knowledge bases and reduce the risk that internal competences become obsolete (De Propris, 2002).

Policymakers and practitioners generally expect firms engaging in formal cooperation to benefit from substantial performance and efficiency gains. The advantages of formal cooperation are mainly associated with the opportunity to share costs and risks and access diverse sources of knowledge. In reality, evidence shows that non-equity alliances often fail to achieve the expected goals (Heimeriks et al., 2009). Therefore, one of the main objectives of the recent empirical research has been to identify the main factors that influence the successful or unsuccessful outcome of formal cooperation.

Performance gains from formal cooperation have been mainly associated to the characteristics of the focal firm and those of its partners, as well as to the structural features of the network (Baum et al., 2010; Kok et al., 2020). Regarding the former aspect, evidence shows that absorptive capacity and knowledge recombination capabilities, together with size and relational skills, are crucial to explain the learning ability of the focal firm (Larsson et al., 1998; Escribano et al., 2009). Partners' reputation

and innovativeness can also generate substantial benefits for the network members (Saxton, 1997; Stuart, 2000). Regarding network properties, studies have highlighted that geographical and technological diversity allows firms to overcome organizational constraints that limit the search for new knowledge (Rosenkopf & Almeida, 2003). Kok et al. (2020) have shown that partnership among distant firms is beneficial in that it allows partners to access different knowledge pools (Rosenkopf & Almeida, 2003). This benefit is much larger for those firms occupying bridging positions, in that they can receive strategic information sooner than their partners (Burt, 2009).

Despite the relevance of firm- and network-level factors, the local economic environment often plays a crucial role in influencing the outcome of formal cooperation (Jansen et al., 2006). Therefore, empirical findings are likely to be inaccurate when this specific aspect is ignored by the investigator. In this paper, we expand upon this line of work by claiming that the benefits of inward- and outward-looking NAs are moderated by the local environment in which member firms are embedded. More specifically, the territorial characteristics can shape the recombination ability of local businesses, as well as the extent to which knowledge is exchanged effectively (Yan et al., 2020). Several studies have highlighted the central role of geography in the organization and dynamics of networks (Gluckler et al., 2010), suggesting that the local territory plays a key role in influencing alliance decisions (Powell et al., 2005) and other knowledge seeking strategies (Davenport, 2005). As we discuss in the following section, such an approach could also contribute to explain why the benefits from alliance participation are not equally visible among a sample of firms with similar characteristics (Wuyts & Dutta, 2014).

Hypotheses development

In the empirical analysis that follows, we combine the insights from strategic management and economic geography introduced in the previous sections to evaluate how firms located inside and outside IDs may benefit from the participation in different types of non-equity alliances. Following Hervas-Oliver & Albors-Garrigos (2008), we expect that the relational resources of the local economic environment will influence the internal resources of local firms, affecting their ability to reap significant benefits from formal cooperation.

We assume that formal cooperation can be inward-looking, when the agreement exclusively involves domestic firms located in the same LLMA, or outward-looking, when the partnership includes at least one firm that is located in a different LLMA or is identified as an MNE, regardless of the LLMA in which this MNE is operating. The two types of formal cooperation are expected to have different characteristics and outcomes, depending on the territorial context in which member firms are embedded. On the one hand, inward-looking agreements are more commonly aimed at formalizing

existing relationships and collectively leveraging familiar knowledge. Inward-looking arrangements are generally formed by peers located in close proximity and previously engaged in informal interactions, and are aimed at exploiting knowledge in familiar fields. Locally bounded partnerships are beneficial in that they reduce the costs of the search process and are aimed at sharing knowledge that can be more easily recognized and processed by the firm using the existing routines (Rosenkopf & Almeida, 2003). Furthermore, the opportunity to interact with familiar partners reduces the risks of opportunistic behaviour, decreasing transaction costs. At the same time, as discussed in the previous sections, inward-looking collaborations tend to add limited value, in that the high degree of similarity between member firms can generate information redundancy, favouring over-embeddedness and technological lock-in.

On the other hand, outward-looking agreements are formed to directly or indirectly acquire and process translocal sources of knowledge. As discussed, the global economy has significantly increased the pressures to diversify knowledge sources (Lavie & Rosenkopf, 2006), negatively affecting those economic actors that are not capable to effectively tap into multiple knowledge pools. In this respect, outward-looking agreements can be more valuable, in that they provide access to a greater variety of knowledge sources, allowing the firm to acquire complementary assets and increasing the potential for effective synergies (Gluckler et al., 2010). The opportunity to absorb unfamiliar ideas from outsiders is critical to expand the knowledge endowment of the focal firm, increasing the chances to reap significant benefits from the alliance (Kok et al., 2020). Despite these advantages, outward-looking alliances require more coordination costs and are more exposed to opportunistic actions, making knowledge transfer more complicated (Mascia et al., 2017). Therefore, outward-looking alliances also present a trade-off between growth opportunities and greater uncertainty and risks.

In this paper, we claim that the decision to join inward-looking and outward-looking agreements, as well as their impact on firm-level performance, are influenced by the local environment in which the focal firm and its partners are embedded. More specifically, the analysis focuses on the differential effects of operating inside or outside an ID. Regarding the choice of the agreement type, we argue that, inside an ID, the existence of a trust-based community often implies the presence of a widespread network of informal collaborations. Such an environment positively influences alliance formation by reducing search costs for partners and by acting as a substitute for formal control mechanisms. Moreover, given the presence of a shared system of values and generalized trust, ID actors expect their partners to refrain from engaging in opportunistic behaviour and free riding practices (Molina-Morales & Martinez-Fernandez, 2004; Giuliani, 2013). Opportunistic actions are generally limited by the social monitoring system that transforms economic transactions inside IDs

in repeated games with punishment. This process minimizes the risk that any of the partners will deviate from a socially accepted behaviour (Dei Ottati, 1994). For all these reasons, it is expected that the probability to engage in an inward-looking NA will be higher among ID firms. Thus, we specify the first hypothesis as follows:

Hypothesis 1: The propensity to choose inward-looking NAs is higher for ID firms compared with non-ID firms.

The local environment is assumed to moderate also the impact of inward- and outward-looking NAs on firm-level performances. Regarding the former type of alliances, the moderating effect of IDs is expected to be negative. Inside IDs, inward looking collaborations basically represent a formalization of informal agreements already in place between the local actors. This aspect increases the likelihood that inward-looking NAs inside IDs will lead partners to exchange redundant information, preventing any meaningful learning and limiting access to valuable sources of knowledge (Stadler et al., 2014). Furthermore, excessive levels of generalized trust can trigger paradoxical outcomes, in that underinvestment in monitoring activities can lead to higher risk of opportunistic actions by partner firms (Molina-Morales et al., 2011). In a global setting, these aspects are expected to play a more evident role, leading to lock-in effects and negative performances. The same issues are less likely to be present outside IDs, given local connections are sparse and firms are not embedded in a trust-based system. Therefore, we formulate the following hypothesis:

Hypothesis 2: The benefits of inward-looking NAs are lower for ID firms compared with non-ID firms.

Finally, the ID effect is expected to positively moderate the impact of outward-looking NAs on firm performances. As highlighted in the previous sections, the main advantage of outward-looking agreements lies in the opportunity to access diverse knowledge pools, overcoming the limits of local search (Padula, 2008). However, distant knowledge should be effectively processed and disseminated in order to generate benefits for all partners. We claim that IDs can facilitate this process, thanks to their dense local networks that can act as transmission facilities for local actors. Previous contributions have highlighted the key role played by specific leader firms (Morrison, 2008; Buciuni & Pisano, 2018) in acquiring external information and disseminating it to local partners inside the ID, exploiting existing relationships. This strategy follows an utilitaristic approach, in that by accessing diverse knowledge pools, leader firms can improve their own performances and benefit their partners (Giuliani, 2011). Finally, outward-looking NAs inside IDs can reduce the risks associated with suboptimal monitoring (Molina-Morales et al., 2011), given the simultaneous presence of insiders and outsiders. Therefore, the following final hypothesis is specified:

Hypothesis 3: The benefits of outward-looking NAs are higher for ID firms compared with non-ID firms.

The NA classification used in the empirical analysis is depicted in Figure 1, whereas the main hypotheses are summarized in Figure 2. Two remarks should be made regarding the NA classification proposed in this work:

- Typology A identifies agreements signed by partners located in the same LLMA. Therefore, the condition 'at least one firm located in an ID' for typology A implies that all member firms in these NAs are located in an ID. In the following sections, we will refer to typology A as inward-looking NAs with all ID firms.
- Typology B identifies agreements including at least one partner firm that is located in a different LLMA or is classified as an MNE. Additionally, this typology includes at least one firm located in an LLMA identified as ID. Therefore, in the following sections we will refer to typology B as outward-looking NAs with at least one ID firm.

DATA AND METHODS

The empirical analysis is based on a policy tool (*Contratti di Rete*, or NAs) that was introduced in Italy with Law n. 33/2009 and amended by Law n. 122/2010. This legislative framework regulates two main types of agreements, which can be chosen by firms depending on their specific legal and economic needs (Pastore et al., 2019). In the most commonly used agreement type, defined as *reti contratto*, member firms voluntarily agree to collectively implement a predefined program aimed at reaching a common goal. Generally, the agreement aims at exchanging information, knowledge and/or services of an industrial, commercial, technical or technological nature (Cisi et al., 2020). Each partner is required to contribute financially to a joint capital fund and to cooperate in the identification of a joint body that represents the members in all interactions with third parties.

The present analysis is based on *reti contratto* stipulated between 2013 and 2015[2] and is focused on a sample of machinery producers. The choice of this specific manufacturing sector is motivated by two main reasons: first, it is the most represented industry in terms of number of firms involved in this policy tool (RetImpresa & ISTAT, 2017). Second, a relevant share of Italian IDs are specialized in machinery production (Lissoni, 2001; Canello & Pavone, 2016): this share has increased in the recent past, after a number of low-tech IDs upgraded their strategies, specializing in the mechanical industry (Rabellotti et al., 2009; Giuliani & Rabellotti, 2017).

The dataset used for the empirical analysis combines information from the *Contratti di Rete Database*, containing data on NAs stipulated in Italy, with data extracted from ORBIS BvD, a firm-level database with financial

	Inward-looking (all domestic firms in the same LLMA)	Outward-looking (firms located in different LLMAs or at least one MNE)
Inside ID (at least one firm in a LLMA classified as an ID)	A	B
Outside ID (all firms in LLMAs classified as non-IDs)	C	D

Figure 1. Network agreements (NAs) classification used in the empirical analysis.

and structural information on more than 20 million global businesses.

The empirical analysis is based on the following two-step approach:

1. Analysis of the allocation outcome.
2. Estimation of the treatment effect.

In both stages of the empirical analysis, we discriminate between inward-looking NAs, involving exclusively domestic firms located in the same LLMA, and outward-looking NAs, involving at least one firm that is located in a different LLMA or is identified as a domestic/foreign MNE, regardless of the LLMA in which this MNE is located. We assume that, in both cases, the presence of one or more outsiders generates opportunities for the other members of the agreement to acquire and exploit diverse knowledge sources. The proposed NA classification also distinguishes between those agreements involving only producers that are located inside an LLMA classified as non-ID and agreements involving at least one partner located inside an LLMA classified as an ID. ID firms are distinguished from non-ID firms using the empirical procedure proposed by Canello & Pavone (2016). This algorithm allows one to map and classify Italian IDs overcoming the main limitations of the procedure proposed by Sforzi (1990). Following this methodology, it is possible to identify some important IDs excluded from the original method, without introducing significant distortions to the original framework.

Hypothesis	Relationship
H1	Propensity(A) > Propensity(B)
H2	Benefit(A) < Benefit(C)
H3	Benefit(B) > Benefit(D)

Figure 2. Summary of the three main hypotheses.

Stage 1: Analysis of the allocation outcome through a multinomial logit model with random effects

In the first part of the analysis, formal cooperation strategies are evaluated using a multinomial logistic model with random effects. Such an empirical approach is designed to identify a specific set of factors that are associated with the decision of a firm to establish an inward- or outward-looking NA. The main aim is to evaluate how the ID dummy affects the probability to sign each of the two above mentioned NA types, in an attempt to test the validity of Hypothesis 1.

The empirical investigation is implemented on the sample of machinery producers, selecting both those producers that signed an NA and those that did not in any engage in any NA during the time period considered. For this sample, the probability to engage in an inward- or outward-looking NA in year t is modelled as a function of a set of financial, structural and territorial variables measured at year $t - 1$. In both cases, we categorize firms' decisions as follows: 1 = no NA; 2 = engagement in an inward-looking NA; and 3 = engagement in an outward-looking NA. The first outcome is used as the reference group in the estimation.

In each subsample, firms are observed in different time periods T, where T depends on the number of years in which the firm is active. Therefore, the multinomial logit model should account for the unobserved firm heterogeneity (Choumert-Nkolo et al., 2019). For this reason, the preferred specification is a multinomial logistic model with random effects, where the conditional probability that firm i chooses strategy j at time t is defined as follows:

$$Pr\left(f_{it} = t_j | \boldsymbol{x}_{it-1}, \boldsymbol{u}_i\right)$$
$$= \begin{cases} \dfrac{exp(\boldsymbol{x}_{it-1}\beta_j + \boldsymbol{u}_{ij})}{1 + \sum_{k \neq B} exp(\boldsymbol{x}_{it-1}\beta_k + \boldsymbol{u}_{ik})} & j \neq B \\ \dfrac{1}{1 + \sum_{k \neq B} exp(\boldsymbol{x}_{it-1}\beta_k + \boldsymbol{u}_{ik})} & j = B \end{cases}$$

where B stands for the reference outcome category (no NAs). The probability to choose a specific NA is conditional on the set of firm-level effects and on a

combination of observable firm characteristics and contextual variables, and is evaluated through a maximum likelihood estimator. The main independent variable of this model is the ID dummy, equal to 1 if the firm is located inside an ID specialized in the mechanical industry according to the algorithm developed by Canello & Pavone (2016). We expect that the ID dummy will have a positive impact on the probability to engage in an inward-looking NA and a negative impact on the probability to engage in an outward-looking NA (Hypothesis 1).

The following set of control variables is included in the model:

- Size: the formation of formal cooperative agreements is associated with significant fixed costs, related with the process of searching, assessing, selecting and negotiating with partners (Colombo et al., 2006). It is expected that these costs will represent a significant entry barrier, especially for smaller firms. The impact of size is evaluated by controlling for the number of employees operating in the firm.
- Labour productivity: previous studies have highlighted the potential presence of selection bias in formal cooperation analyses (Kim, 2015). This aspect is associated with the fact that more productive firms are more likely to engage in non-equity alliances. We control for this aspect by including the value added per employee in the specification.
- Start-up: when firms are in the initial stages of their activities, they often cannot rely on a widespread business network. In such cases, the NA can represent a useful tool to establish such a network. For this reason, we expect the propensity to engage in formal cooperation to be higher for start-up firms.[3]
- Access to credit: when financial constraints are not present, a firm can often rely on more financial resources to contribute to the joint capital fund of the NA. Therefore, availability of financial resources is expected to increase the likelihood to find partners for the NA. The presence of financial constraints is evaluated by including a dummy equal to 1 if the firm has access to credit.
- Previous experience with NA: previous participation and experience with inter-firm cooperation can represent an important driver influencing alliance creation (Franco & Haase, 2015). This aspect is evaluated by adding a dummy equal to 1 if the firm has been engaged in other NAs in 2010 and 2011.
- Share of firms engaged in at least one NA in the local production system: institutional theory suggests that bandwagon pressures might play a relevant role in influencing firms' strategic decisions (Abrahamson, 1991), including formation of non-equity alliances. Evidence of bandwagon effects in alliance formation was found by Pangarkar & Klein (1998). This aspect is controlled in the model by including a variable for the share of firms engaged in NAs in the same local production system in which the focal firm is located.

- International propensity of the local production system: given one of the main goals of NAs is to increase partners' international outlook, it is expected that firms located in globally connected areas will have lower incentives to participate in these networks. This aspect is controlled by including the percentage of exports over the added value generated by the local production system in which the focal firm is located.
- Number of active firms in the local production system: a greater number of peers located in close proximity increases the chances of finding a suitable partner for an NA.
- Institutional quality of the local production system: weak institutional regimes can generate appropriability hazards in non-equity alliances, increasing transaction costs and limiting the incentives to engage in formal cooperation (Oxley, 1999). This aspect is evaluated by including the institutional quality index devised by Nifo & Vecchione (2014), which estimates institutional quality at the local level.

The model also includes a set of industry, territorial and cohort dummies, as well as a set of interaction terms between industry and cohort dummies to account for industry-level changes during the considered period that might influence firms' participation in NAs.

Stage 2: Evaluation of the treatment effect through a panel-matching procedure

The second part of the empirical analysis is focused on the performance of ID and non-ID firms involved in inward- and outward-looking NAs. The investigation is conducted separately for each of the four following NA typologies:

- Inward-looking NAs with all ID firms (A).
- Outward-looking NAs with at least one ID firm (B).
- Inward-looking NAs with all non-ID firms (C).
- Outward-looking NAs with all non-ID firms (D).

The letters refer to the classification presented in Figure 1. This classification allows to test whether Hypotheses 2 and 3 are verified in the sample of firms considered in the analysis.

The empirical strategy implemented at this stage is designed to account for the self-selection bias inherent to formal cooperation: indeed, previous research has found evidence of higher propensities among the most productive and successful firms to engage in inter-organizational partnerships (Arend, 2006).

In order to identify the causal effects associated with the participation into the different NA types, the estimation process relies on quasi-experimental methods to identify appropriate comparison groups, that is, a subset of untreated firms with similar observed characteristics of the treated group in the pre-treatment period. In this respect, matching techniques provide the opportunity to address self-selection issues, facilitating causal inference in observational studies, when selection into treatment is

caused by a set of common unobservable factors (Morgan & Winship, 2015).

In the recent past, the literature on counterfactual analysis has proposed a wide number of matching methods, including exact matching, full matching, nearest neighbour matching, as well as the propensity score method (Rosenbaum & Rubin, 1983) and alternative techniques to correct for selection bias (Abadie & Imbens, 2011). Most of these approaches share the same limitation, in that they are specifically designed for cross sectional datasets. Therefore, their ability to estimate causal effects could be limited when the same unit is observed for a relatively long period of time and multiple treatments are received by some units during the considered period. The described pattern is consistent with the structure of our dataset, considering some mechanical producers established links with multiple networks, often in different years.

Given the specific features of the investigated phenomenon, the procedure proposed by Imai et al. (2022) seems the most appropriate to evaluate the impact of the different NA types on firm-level performances. One of the main advantages of this method is the possibility to estimate causal effects with time-series cross-section (TSCS) data, allowing to control for multiple treatments occurring in different time periods. The proposed method can be summarized by the following three-step sequence. First, a subset of potential control observations with identical treatment history at time t is extracted from the sample. Second, the initial control group is further restricted, focusing on a subset of units that are more similar to the treated group in terms of outcome and a set of covariates: this step can be performed using different weighting methods, such as the covariate balanced propensity score matching. The refining process implemented in the second stage is crucial, in that it allows to control for relevant confounders, such as past performances and other time-varying and time-invariant factors that are expected to influence the treatment. Using this approach, the assumption of parallel pre-treatment trends is more likely to be fulfilled. In the final stage of the process, a difference-in-difference estimator is applied to the two groups (treated and untreated) to correct for a potential time trend and to estimate the average treatment effect on the treated (ATT).

Using the methodology proposed by Imai et al. (2022), treatment effects can be evaluated minimizing the amount of bias and allowing a more reliable assessment of the impact of this specific policy tool.

RESULTS

Descriptive analysis

We initially provide a descriptive overview of the characteristics of NAs in Italy, analysing all the agreements initiated by Italian machinery producers during the 2013–15 period. In this section, the main distinction is between NAs not involving ID firms and NAs with at least one ID firm. The data reported in Table 1 show

Table 1. Characteristics of network agreements (NAs) inside and outside industrial districts (IDs).

Variable	NAs without ID firms	NAs with ID firms	Total
Number of networks	280	225	505
Total number of firms	1761	1429	3190
Network size	6.3	6.4	6.3
% of networks with at least one firm in another manufacturing sector	90%	86%	88%
% of networks with at least one non-manufacturing firm	74%	68%	72%
% of networks with multi-network firms	31%	37%	34%
Average firm age	17.5	21.1	19.2
Average turnover (€ millions)	10.4	31.5	20.3
Average number of employees	53	83	67
Agreement goal			
Services	21%	29%	25%
Research and development (R&D)	43%	39%	40%
Internationalization	16%	19%	18%
Competitiveness	20%	13%	17%

that, among the 505 agreements with at least one machinery producer, 225 (45% of the total) involved at least one ID firm. These networks were characterized by relatively older and larger partners, both in terms of revenues (€31.5 million versus €10.4 million) and number of employees (83 versus 53). On average, NAs involved 6.3 partners, with negligible differences in the two groups considered. Not surprisingly, most machinery producers exploited NAs to establish links with other manufacturing firms: in 72% of the cases, the network involved also partners operating in the tertiary sector. The presence of multi-network firms is visible in 34% of the NAs considered, with a slightly higher diffusion in NAs with at least one ID firm.

The descriptive analysis reported in the present section also investigates the most common goals of these NAs. In order to evaluate this specific aspect, the text clustering procedure proposed by Feinerer & Meyer (2008) was implemented on all the NAs signed during the 2013–15 period: the algorithm was applied to the textual description of the agreement provided to Unioncamere by member firms. The results are reported in Figure A1 in Appendix A in the supplemental data online and highlight the presence of four main clusters of agreements, associated with the following four goals: provision of services, enhancement of market competitiveness, Research and development (R&D) and internationalization. Within

the subset of NAs considered in this section, Table 1 shows that the most common goal was the initiation of collaborative R&D projects (40%) and the provision of services (25%). Internationalization and competitiveness enhancement seem to be less relevant for this specific sample of producers. It is worth noting that the aim of NAs is not significantly different in the two main groups considered in this subsection.

Allocation outcome

The results of the allocation outcome (Table 2) show that the decision to join inward- and outward-looking NAs is influenced by a combination of firm-level and contextual factors. As far as inward-looking NAs are concerned, older firms with previous NA experience display higher propensities to choose this specific type of partnership. Regarding contextual factors, a larger share of local peers engaged in NAs at $t-1$ seems to positively influence the decision of the focal firm to join inward-looking NAs at time t. This finding suggests the possible presence of mimetic isomorphism in non-equity alliance decisions, and could be explained by the fact that firms observe the decisions of neighbouring peers before engaging in an alliance.

The results for outward-looking NAs show a higher diffusion of this type of agreements among larger and more experienced firms that have achieved better performances in the preceding year: the latter aspect is testified by the positive and significant coefficients of the variables *labour productivity* and *access to credit*. Not surprisingly, previous experience with formal cooperation is a significant predictor of the propensity to engage in this type of agreements. Contextual factors also influence the decision to sign an outward-looking agreement: according to the estimations, this decision seems to be associated with the presence of a smaller number of potential partners and lower levels of internationalization in the local production system where the focal firm is embedded. The indications regarding the role of local peers are consistent with those emerging from the analysis of inward-looking NAs, suggesting that mimetic behaviour might also influence the decision to engage in outward-looking NAs.

Finally, and most importantly, the model provides clear indications regarding the attitude of ID firms towards NAs: the results show that firms located inside IDs display lower propensities to choose outward-looking NAs, whereas inward-looking agreements are more frequent. These indications are consistent with Hypothesis 1 and confirm the inward-looking attitude of ID firms. In the following section, we evaluate the implications of these strategies on firm-level performances.

Treatment effect

The results reported in the previous section have shown a higher propensity among ID firms to select inward-looking NAs: as discussed in the theoretical framework, these partnerships are mainly aimed at exploiting existing informal relationships with partners located in close proximity. In this section, we assess whether the decision to engage in inward- or outward-looking NAs is associated

with higher or lower benefits, depending on the location of the focal firm and that of its partners.

In order to evaluate the treatment effects associated with each NA type, the matching procedure was applied to a balanced panel of Italian machinery producers operating during the 2010–18 period. The counterfactual analysis was implemented separately for ID and non-ID firms, to evaluate the possible presence of heterogeneous patterns associated with the characteristics of the local environment in which the focal firm is embedded. For this reason, the control group is selected among those businesses having the same locational characteristics of the treated group.

Firm-level performances are evaluated using turnover as outcome variable.[4] In the preliminary stage of the process, we selected a subset of potential control observations for each treated observation, identifying those units with the same treatment history in the two years preceding the decision to choose an NA at time t. The initial control set was further refined using the 'covariate balanced propensity score matching' method: following such an approach, we were able to identify, for each treated unit, the optimal set of untreated units with similar characteristics in the two years preceding the decision to engage in a specific type of NA. The final control group was identified using a combination of the time-varying and time invariant variables identified in the first stage of the analysis, adding the turnover values in the two years preceding time t.

Figures A2 and A3 in Appendix A in the supplemental data online report the turnover dynamics before and after the matching procedure for the four NA types considered in the analysis. The reported patterns confirm the effectiveness of the method in identifying control groups that satisfy the parallel trends assumption before the treatment period.

In the final stage of the analysis, the treated units for each NA type are compared with the relevant control group, in an attempt to identify the ATT associated with the participation in the specific NA. Table 3 and Figure 3 show the trend of the average estimated effect of treatment in the period following the decision to enter an NA. For inward-looking NAs, the following patterns are visible:

- Inside IDs, the pattern of turnover is clearly declining. However, the treatment effect is not significant, except for the last year of the post-treatment period.
- Outside IDs, the pattern of turnover is more heterogeneous, with a trend that is initially declining and then rising with time. The treatment effect is mostly insignificant throughout the entire time period.

For outward-looking NAs, the main findings can be summarized as follows:

- Inside IDs, turnover levels are initially declining, whereas the outcomes are more heterogeneous as time passes. In all cases, turnover levels are not found to be significantly different from those of the control group.

Table 2. Multinomial logistic regression with random effects: probability to join inward- or outward-looking network agreements (NAs) at time *t*; base outcome = no NA.

Variable	Model I		Model II		Model III	
	Inward-looking NA Coefficient; SE	Outward-looking NA Coefficient; SE	Inward-looking NA Coefficient; SE	Outward-looking NA Coefficient; SE	Inward-looking NA Coefficient; SE	Outward-looking NA Coefficient; SE
Firm-level characteristics						
Size	−0.001	0.007***	−0.002	0.007***	−0.002	0.007***
	0.002	0.001	0.002	0.001	0.002	0.001
Labour productivity	−0.000	0.001*	0.000	0.001**	0.000	0.001**
	0.000	0.000	0.000	0.000	0.000	0.000
Start-up	−0.911***	−0.280	−0.889***	−0.278	−0.889***	−0.278
	0.318	0.234	0.323	0.242	0.323	0.242
Access to credit	0.117	0.275*	0.078	0.305**	0.067	0.325**
	0.148	0.142	0.154	0.148	0.160	0.154
Presence of financial	−0.201	−0.267	−0.241	−0.298	−0.298	−0.368**
losses	0.183	0.176	0.193	0.183	0.195	0.185
Previous experience	3.388***	4.396***	3.511***	4.262***	3.504***	4.300***
with NA	0.455	0.429	0.467	0.426	0.468	0.430
Contextual factors						
Location inside an ID			0.447***	−0.409***	0.397**	−0.423**
			0.167	0.181	0.182	0.191
Share of firms			0.931***	0.896***	0.857***	0.947***
engaged in at least			0.100	0.090	0.119	0.103
one NA in the local						
production system						
Number of active			−0.000	−0.003***	−0.000	−0.003***
firms in the local			0.000	0.000	0.000	0.000
production system						
International			0.057	−2.209***	0.248	−1.838***
propensity of the local			0.610	0.580	0.637	0.645
production system						
Institutional quality of			−0.954	1.031*	−1.079	0.652
the local production			0.668	0.596	0.908	0.805
system						
Industry dummies	No	No	No	No	Yes	Yes
Territorial dummies	No	No	No	No	Yes	Yes
Cohort dummies	No	No	No	No	Yes	Yes
Industry × Cohort	No	No	No	No	Yes	Yes
dummies						
Observations	87,632		83,786		83,786	
Log-likelihood	−3664.35		−3396.57		−3352.52	

- Outside IDs, we detect a clear upward trajectory, with turnover levels significantly higher for treated firms in the post-treatment period. The treatment effect is positive and significant for this type of NAs.

A summary of the main findings for the three hypotheses is reported in Figure 4. On the one hand, the results are consistent with Hypothesis 2. On the other hand, the counterfactual analysis does not provide sufficient evidence in support of Hypothesis 3. It is worth noting that the performances of the four treated groups can be analysed by transitive comparison. As highlighted in Table A1 in Appendix A in the supplemental data online, the four untreated groups do not differ significantly in terms of the main variables in the pre-matching period: this pattern is confirmed by the *p*-values of the pairwise *t*-tests and

Table 3. Estimated average treatment effect (ATT) of network agreements (NAs) on firm performances – turnover.

Agreement type	*t*	Estimate	SE	*p*-value 2.50%	*p*-value 97.50%
Inward-looking NAs with all ID firms (A)	*t* + 0	145,361	135,604	−130,965	386,162
	t + 1	−106,583	136,381	−387,498	137,679
	t + 2	−248,961	164,305	−604,393	42,927
	t + 3	−338,491	183,036	−728,550	−3363
	t + 4	−511,805	236,530	−1,009,836	−104,777
Outward-looking NAs with at least one ID firm (B)	*t* + 0	773,190	376,864	95,149	1,533,332
	t + 1	289,790	430,749	−483,562	1,141,205
	t + 2	174,227	438,231	−683,892	1,046,460
	t + 3	1,229,048	825,485	−370,660	2,903,860
	t + 4	1,628,347	1,022,498	−298,315	3,788,398
Inward-looking NAs with all non-ID firms (C)	*t* + 0	143,975	176,206	−164,420	485,103
	t + 1	100,271	194,408	−258,267	485,166
	t + 2	425,997	192,301	22,184	782,257
	t + 3	270,299	256,855	−270,951	762,505
	t + 4	494,323	314,040	−138,839	1,070,875
Outward-looking NAs with all non-ID firms (D)	*t* + 0	147,208	190,409	−200,006	525,862
	t + 1	689,624	305,788	109,853	1,272,491
	t + 2	906,001	345,340	256,136	1,586,946
	t + 3	968,243	329,966	303,842	1,609,926
	t + 4	738,006	434,008	−109,228	1,554,833

proportion tests reported in Table A1, which show that in most cases there is no significant difference between the groups' proportions and means. Therefore, it is possible to use the results of the panel-matching procedure to infer the comparative performance between the different treated groups.

The analysis was repeated using a different outcome variable (number of employees) to verify the robustness of our findings. The results are reported in Table A2 and Figure A4 in Appendix A in the supplemental data online and are consistent with those presented for turnover, showing positive and significant treatment effects for outward-looking NAs involving exclusively non-ID firms. This finding is again inconsistent with Hypothesis 3.

DISCUSSION AND POLICY CONSIDERATIONS

The results of our investigation provide a grim portrayal of the performances of NAs involving ID firms. The negative dynamics identified in this paper for ID firms raise important concerns, considering the analysis is focused on one of the best performing manufacturing sectors in the post 2008 crisis period (Giuliani & Rabellotti, 2017).

Several factors could contribute to explain the inability of ID firms to benefit from both inward- and outward-looking NAs. As far as the former type of agreement is concerned, the results could be associated with the recent social and economic transformations occurred inside IDs.

Recent contributions show that social cohesion within IDs has declined in the last decades (Ramazzotti, 2010) and that the district effect is gradually fading (Giuliani & Rabellotti, 2017). This negative pattern has been associated with the emergence of significant performance gaps between ID firms: on the one hand, certain producers display a higher ability to effectively exploit ID assets (Cucculelli & Storai, 2018). One the other hand, the wide majority of ID firms are migrating to peripheral positions of the local network. The lack of investment by successful firms in the local community has contributed to accelerate this pattern (Morrison et al., 2013): indeed, the recent contribution of Giuliani et al. (2019) suggests that, in declining clusters, best performing firms could intentionally distance themselves from the other members of the local network, refusing to engage in meaningful knowledge exchange. Therefore, even when local agreements are established, the uncooperative attitude of these partners could generate significant constraints for the effective flow of knowledge (Dei Ottati, 2018).

Regarding outward-looking agreements, our results contrast previous findings (e.g., Munari et al., 2012) and suggest that the integration process of distant codified knowledge into the district is not functioning effectively. Several factors might contribute to explain this result. First, the globalization process might have negatively affected the ID cognitive structure, limiting the opportunities of transformation and renewal and reducing the ability of ID firms to recombine external knowledge (Bellandi et al., 2018). Without such conditions, translocal networks are unlikely to be beneficial (Bahlmann, 2016). Second,
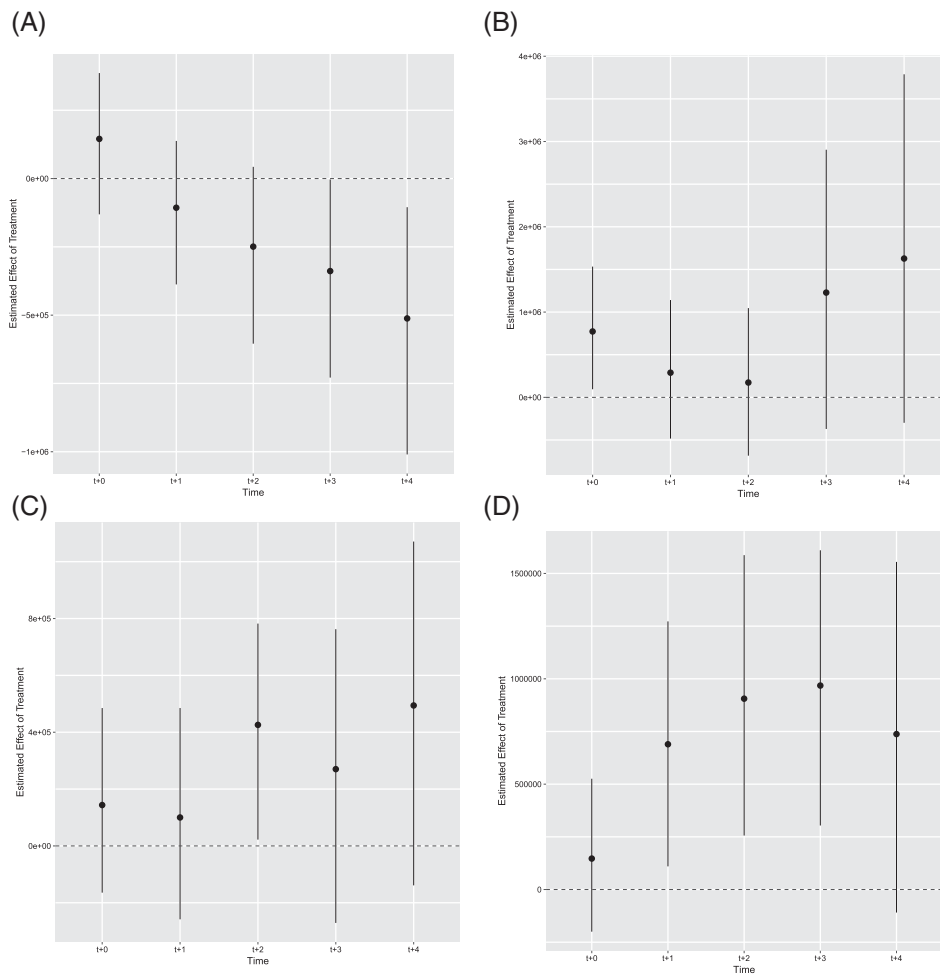
Figure 3. Estimated average effects of network agreements (NAs) on firm performances – turnover.
Note: Inward-looking network agreements (NAs) with all industrial district (ID) firms (A); outward-looking NAs with at least one ID firm (B); inward-looking NAs with all non-ID firms (C); and outward-looking NAs with all non-ID firms (D).

the presence of asymmetric interactions between MNEs and local firms inside IDs might have limited the inter-organizational flow of knowledge. Indeed, evidence shows that, inside IDs, MNEs often use their bargaining power to acquire substantial knowledge while sharing limited know-how with local firms (Singh, 2007; Pavlínek, 2018). Therefore, it is possible that formal cooperation between ID firms and outsiders results in further depletion of ID resources, instead of feeding these local production

systems with valuable know-how (Hervas-Oliver et al., 2021). Finally, it should also be noted that outward-looking alliances might take time to function, because translocal knowledge is more difficult to transfer (Bathelt et al., 2018) and trust-based relationships are less likely to develop in the short term when social capital endowments are significantly different.

From a policy perspective, the results of this paper call for a twofold response by decision-makers to improve the

Hypothesis	Relationship	Result
H1	Propensity(A) > Propensity(B)	Supported
H2	Benefit(A) < Benefit(C)	Supported
H3	Benefit(B) > Benefit(D)	Not supported

Figure 4. Summary of the hypotheses and main findings.

beneficial effect of NAs: on the one hand, these policy tools should be designed to promote and facilitate formal cooperation between distant and global actors, providing higher tax incentives for outward-looking agreements. On the other hand, policymakers should be aware of the limitations of one-size-fits-all policies, considering the key role played by the local environment in which partner firms are embedded. This assumption holds especially true for IDs, given the peculiar characteristics of their social and economic fabric. Within the wide range of ID assets, decision-makers should especially consider the set of supporting organizations (including technical research centres, local universities and business associations) that provide collective support services to local actors (Molina-Morales & Martínez-Cháfer, 2016). Historically, this specific feature of the ID infrastructure has played a decisive role in removing local frictions, reducing search costs and fostering vertical and horizontal cooperation within IDs. We claim that the role of these intermediaries should be rethought in light of the transformations occurred in the global economy. More specifically, local organizations should be redesigned in order to foster the establishment and consolidation of bridging ties between clustered firms and more distant actors, facilitating potential synergies and cross-fertilization of knowledge.

CONCLUSIONS

In this paper, we discussed how formal cooperation affects the strategies and economic performances of machinery producers located inside and outside Italian IDs. Combining insights from strategy, management and economic geography, we claimed that the local environment in which partner firms are embedded can influence the outcome of formal cooperation. In an attempt to test this assumption, we evaluated the impact of NAs inside and outside IDs, discriminating between inward- and outward-looking agreements based on the locational and structural characteristics of the partners involved.

The results of the allocation outcome show that ID firms have a stronger propensity to choose inward- over outward-looking partnerships, possibly formalizing existing informal relationships with familiar peers. However, both inside and outside IDs, this type of agreement does not seem to provide significant benefits in terms of economic performances. Our analysis also reveals that, even when outward-looking partnerships are chosen, ID firms do not seem to benefit substantially from the possibility to exploit diverse sources of knowledge. The detected pattern differs considerably from that visible outside IDs, where outward-looking agreements seem to enhance significant performance improvements in the period following the decision to cooperate.

This analysis can be expanded in several directions. First, the NA classification obtained from the text clustering exercise (see Figure A1 in Appendix A in the supplemental data online) could be further exploited to verify whether the impact of inward- and outward-looking

NAs is influenced by the goal of the agreement, assessing whether the ID effect is more relevant for certain types of formal collaboration. At this moment, the sample size does not allow us to use such a fine-grained classification, which would certainly have been desirable. Second, the analysis could be expanded to labour-intensive manufacturing industries, such as clothing or footwear production, in an attempt to verify whether the same dynamics are present in low-tech sectors. In this respect, the results reported in this article suffer from generalizability issues, in that they provide evidence for a capital-intensive manufacturing industry in a specific country. Third, the role of space could be further investigated, accounting for possible sources of non-stationarity and heterogeneity within and outside IDs: more specifically, the use of more fine grained quantitative tools (Canello & Vidoli, 2020) could allow one to identify specific subsets of producers that responded in the same way to the policy impulse. Finally, the availability of more recent data will allow us to expand the present analysis and to evaluate the impact of this policy tool on additional performance measures (such as patent activity). At this stage, the post-treatment period available in our database is not sufficiently long to capture patented innovation, considering the significant R&D to patent application lag (Hall et al., 1984).

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

NOTES

1. See http://contrattidirete.registroimprese.it/reti/. We are grateful to Unioncamere Lombardia for providing an updated version of the database.
2. The decision to focus on this time span is motivated by the need to have sufficient data before and after the network formation, thus increasing the robustness and reliability of the counterfactual analysis.
3. In the model, a firm is identified as a start-up if it was established in the three years preceding time t.
4. The same analysis was performed using the number of employees as outcome variable. The results of this robustness check are reported in Appendix A in the supplemental data online and discussed at the end of this section.

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