

# DEM Working Papers

N. 2019/16

Capabilities and firm growth: the role of formal  
collaboration agreements

*Roberto Gabriele, Andrea Mazzitelli, Giuseppe Espa,  
Maria Michela Dickson*



**UNIVERSITÀ DEGLI STUDI DI TRENTO**  
**Dipartimento di Economia e Management**

## **Università degli Studi di Trento**

Department of Economics and Management, University of Trento, Italy.

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## External Capabilities acquisition and firm growth: the role of formal collaboration agreements

Roberto Gabriele<sup>1</sup>  
Andrea Mazzitelli<sup>2</sup>  
Giuseppe Espa<sup>3</sup>  
Maria Michela Dickson<sup>4</sup>

### Abstract

The paper presents an empirical analysis of the effect of formal collaboration agreements on growth of firm in Italy in the years 2011-2013. Evolutionary theories assign a key role in determining the ability of firms to capture business opportunities to internal capabilities and to external knowledge and capabilities. We suggest that firms establishing formal relationships with other firms can extend the set of capabilities, so that they are able to capture opportunities and grow. The study is based on a novel database of Italian firms that matches networked firms in year 2012 with firms that did not subscribe a formal collaboration agreement but possess similar structural characteristics. To deal with possible self-selection phenomenon, we combine the pre-selection phase with difference-in-differences regression models. Moreover, to study the effect of characteristics of network we employ two stage Heckman regression models.

Results show that firms with a collaboration agreement show higher growth rates and that the size of the network plays a role. Nonetheless, heterogeneity is present. Results are in line with the evolutionary interpretation and suggest that formal collaboration agreements can function as long-range antennas for firms that are more constrained from the geographical point of view.

**JEL Codes:** D22, L25, L52, M21

**Keywords:** firm growth, industrial policy, collaborations, formal contractual agreements

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<sup>1</sup> Roberto Gabriele. Corresponding author. Department of Economics and Management, University of Trento, via Inama, 5, Trento. Italy. E-mail: roberto.gabriele@unitn.it.

<sup>2</sup> Andrea Mazzitelli. Universitas Mercatorum, Piazza Mattei 10, Roma. E-mail: a.mazzitelli@unimercatorum.it.

<sup>3</sup> Giuseppe Espa. Department of Economics and Management, University of Trento, via Inama, 5, Trento. Italy. E-mail: giuseppe.espa@unitn.it.

<sup>4</sup> Maria Michela Dickson, Department of Economics and Management, University of Trento, via Inama, 5, Trento. Italy. E-mail: mariamichela.dickson@unitn.it.

## **1. Introduction**

This study tackles the issue of the role of formal collaboration agreements in shaping firm growth dynamics. The key question is if and how the decision of firms of signing a formal collaboration agreement (FCA) with other firms has implications in terms of their ability to capture business opportunities in the market. Indeed, growth is the counterpart of the firm ability to capture business opportunities (Secchi and Bottazzi, 2006). In this respect, firms' relationships could act as long-range antennas that enable them to exploit competences owned by partners.

A vast literature shows that firm success in the market depends on a complex set of resources and capabilities accumulated inside the firm (Dosi et al, 2001; Wernerfelt, 1984; Teece, 2004) and on their evolution over time (Teece and Pisano, 2003). Meanwhile, several contributions show that if firms do not possess specific capabilities, the environment can provide what is missing (Frenken et al., 2007; Boschma and Iammarino, 2009). The presence of firms in the same geographical location is one of the key features of the economic environment that could boost individual firm competitive advantage (Marshall; 1890; Krugman, 1991; Griliches, 1992). Phenomena like agglomeration and localization of specific economic activities have a positive effect on firms' performance because they change the set of capabilities available for a firm through different kind of relationships they can set up (Gulati and Higgins 2003). Establishing relationships with other firms is one of the most important modes of enlarging the set of competencies owned by firms. Formal business collaborations are a subset of the possible kind of collaborations firms use in the market (other kind of collaborations are, for instance, value chain relationships, informal relationships related to a common supplier). FCA brings together businesses that share the aim of putting in common information and experiences for mutual advantage and can be considered as particular kind of organizations. Hence, business collaborations are considered to be valuable assets that facilitate the acquisition of resources and knowledge essential for firm survival and growth (Parker, 2008).

Being a member of a collaboration can be an important source of competitive advantage (Dyer and Singh, 1998), may allow one to gain access to knowledge and resources at lower costs (Gulati and Higgins, 2003; Zaheer and Bell, 2005) and to benefit from scale economies without the disadvantages of the big dimension (Watson, 2007). The existence of networking benefits is also found in strategy studies (Ostgaard and Birley 1996; Lechner and Dowling 2003; Watson 2007; Park et al. 2010).

The effects of the collaborations for different types of firms are heterogeneous. In particular, there is a general consensus on the positive effect of networks on SMEs (Schoonjans et al., 2013; Cai and Szeidl, 2018), but results are mixed when we consider cooperations among larger firms (Koka and Prescott, 2008), both for weak formal networks (Park et al., 2010; Watson, 2011) and for informal networks (Kingsley and Malecki, 2004).

Given the consensus about the positive effects of collaborations policy makers often try to stimulate this particular activity with the final aim of enhancing the competitive advantage of private firms in a system. As shown by number of firm public policies implemented in many OECD countries (OECD 2013).

The case of Italy is of particular interest, given the persistent performance gap of Italian private businesses and the gap in terms of firm size compared to other OECD countries (Bottazzi, Cefis, Dosi, 2002). In such economic environment, the lack of specific capabilities and resources for firms is endemic and policy makers use a wide set of tools to stimulate different business activities. In the case of Italy policy makers recognize that Italian firms, given their small size, experiment several problems in extending their scope of activity and to innovate. One of the tools introduced in 2009 is the so called “*Contratto di Rete*” (Formal Collaboration Agreement, FCAs from now on). FCA is a legal contract that firms can voluntarily enter with the explicit aim of co-producing, co-marketing, co-purchasing or co-operating in product or market development. In this respect, the formal network definition introduced by Huggins (2001) seems to fit quite well.

The aim of policy maker was to favour the formalization of cooperation and collaboration among firms with the goals of partially overcoming the limits of small businesses. Such agreement, once signed, should lead also smaller firms to exploit all the market opportunities related to the specific objectives of the agreements (e.g. export activities, innovation). In other words, firms sharing competences and resources should exploit the potential economic gains present in the environment. The fact that these agreements are linked to a specific law in Italy should also ensure that opportunistic behaviours are ruled out from collaborations established with other firms that sometimes can be also competitors in the market.

The understanding of all the effects of FCAs on firms’ performance seems to be not fully explored in the literature. Complete comprehension of the impact of such policy measure could be extremely important for policy makers because it could enable them to fine tune or even to completely revise future policies. The existing studies provide some evidence on different effects of the policy. Colombo et al. (2014) propose the first investigation on the effects of FCA on firm’ performance. They show

that the probability of having EBIT improvements is positively related to networking, while, surprisingly, no effect emerges on sales growth. Cisi et al. (2018) offer a comprehensive analysis of the role of FCAs for Italian firms on labor productivity and performance indicators. ISTAT (2017) presents some evidence about the effect on firm's growth showing that FCA has a positive effect on growth.

Building on these contributions, we try to set up a framework of analysis to identify and quantify the effect of the policy under scrutiny on firm growth rate. More precisely, the aim is to explore if and how the improved performance of SME due to FCAs translates into an improved ability to capture business opportunities and grow organically<sup>5</sup>.

From a methodological point of view, we should notice that: (i) our work is in line with ISTAT (2017) and Cisi et al. (2018) that exploit the possibility of using a clear-cut definition of business-to-business formal network: the Italian *contratto di rete*; (ii) the methodology employed share the same philosophy of ISTAT (2017) to isolate the average effect of the policy measure and identify and measure the impact on objective variable even if the models employed –diff-in-diffs regression models– together with pre-selection of the sample (Stuart, 2010) should lower identifications concerns.

We contribute to the literature in different ways. First, we extend previous analyses also to services sectors. Secondly, we try to unfold the mechanisms behind the result using a series of empirical models that should work as background for some theoretical explanations of the reason why FCAs have a positive impact on the growth of SMEs. Finally, we propose a rigorous methodological approach that combines the logic of counterfactual methods with regression analysis –Diff-in-Diffs models– in order to clean for sample selection bias and endogeneity issues due, not only to time invariant, but also time variant characteristics of firms and to single out causal effects of FCAs.

Data used to build the database are coming from different sources: ASIA (ISTAT), Istituto Tagliacarne, Bureau van Dijk. The data hinge on Italian SMEs that signed a FCA in the year 2012. We matched this group of firms to a set of “not-networked” firms in 2012 and subsequent years and we analysed one-year lag growth performance comparing the growth performance of the two groups.

### **The policy measure and the literature about its effects**

In the context of Italian industrial policies aiming at enhancing the competitiveness of SMEs in 2009 was

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<sup>5</sup> We focus on organic growth, i.e. the changes in the size of the firm as measured by the number of employees. The phenomena of mergers and acquisitions analysis is beyond the scope of the present paper.

launched a particular policy measure: the formal collaboration agreement (FCA). FCA, introduced by the Law decree n. 5/2009 converted into Law no. 33/2009, is defined as the agreement between two or more companies, signed reciprocally and deliberately by each economic actor involved to implement a common program by co-operating in manners and areas relating to their own activities, exchanging information and/or services of an industrial, commercial, technical or technological nature (Business Register of the Italian Chambers of Commerce, 2019). Such tool is in line with the definition of collaboration among firms as modes of organizing economic activities that constrain formally independent companies through stable relationships and complex reciprocity between multiple parties, without creating a new legal entity (Amstutz and Teubner, 2009).

The FCA is part of the broader framework of the EU policy, named Small Business Act (SBA), to support the growth and the competitiveness of the Small and Medium Enterprises (SMEs). The small and medium enterprise are the most likely firms to associate in inter-organizational forms, defined in several ways: informal alliances, business networks; quasi-organizations; quasi-firms; contractual networks, etc. (Collins, 2011).

The strategy of the Small Business Act aims at simplifying the regulatory and policy environment for SMEs and removing the remaining barriers to their development, fostering and supporting Micro-SMEs by the endorsement of ad hoc measures. Indeed, the March 2008 European Council expressed strong support for this kind of initiative, setting a global policy program and instrument with specific actions to foster entrepreneurship, applying the strategy of “Think small first”, helping the companies to tackle the problems which hamper to their development. (Ministry of the Economic Development, 2015). In other words, the Small Business Act is a strong change in the strategy for the small enterprise, which are the motors of European economies, and it provides the specific measures and rules to boost European entrepreneurs to innovate, grow, hire and become competitive in global markets.

The underlying idea is to acknowledge that SMEs contribute substantially to employment growth and economic prosperity. To build a new policy framework, based on which integrates the existing enterprise policy instruments, the SBA pursues some important aims, which we can summarize in the following points (Commission of the European Communities, 2008, 4): 1) create an environment in which entrepreneurs and family businesses can thrive and entrepreneurship is rewarded; 2) design rules according to the “Think Small First” principle 3) make public administrations responsive to SMEs’ needs; 4) facilitate SMEs’ access to finance and develop a legal and business environment; 5) help SMEs to benefit more from the opportunities offered by the single market; 6) promote the upgrading of skills in SMEs and all forms of innovation; 7) enable SMEs to turn environmental challenges into opportunities; 8) encourage and support SMEs to benefit from the growth of markets.

The goal is a new cohesion policy complementary and non-conflicting with European industrial policy, that encourages the small-sized enterprises towards new business models, integrated to the local development patterns, and based on production chains and enterprises networks, according to an approach that goes beyond the “district” concept in Italy and the “cluster” one in Europe (Ministry of the Economic Development, 2014). The instruments of the new political vision, above all, referred to micro and small enterprises, would contribute to overcome the economic and financial crisis of 2008, fostering not only the economic growth of the enterprises in quantitative terms (e.g. increasing of the employees and turnover, etc.), but also, above all, encouraging qualitative relationships between firms (e.g. identification of new end markets, making innovation, experimentation of new products, working in network, etc.) in order to improve the competitive location and to be competitive on markets. Particularly, with the aim of to maximize the impact of these policies, reducing the presence of regional imbalances in the national territory, the OECD (2013) recommended for Italy the improvement of the coordination of the actions developed at the national level with those at the regional level.

The rationale behind the policy instrument is to foster strategic cooperation between businesses. Firms that decide to sign such contract share a common project and a common goal, but they maintain their administrative independence. Nonetheless, the policy aims were quite broad: enhance competitiveness of firms and their innovativeness; share knowledge and information. A distinguishing feature of the policy was the absence of constraints related to sectors or dimension of firms. FCAs are particularly designed to overcome dimension barriers of firms and enable them to face market opportunities better (ISTAT, 2016). The phenomenon starts in 2010 (less than 1% of the overall contracts set until 2015; ISTAT, 2016) but only in 2012 reached a consistent take up rate among firms. In 2010 we had 19 FCA, in 2011 around 200 and more than 500 in 2012.

## **Literature**

The theoretical literature emphasizes the positive effect for a firm of establishing relationships. Indeed, there are several advantages of collaboration agreements for a firm. They reduce transaction costs (Lin and Lin, 2016), can supply firms with resources in a flexible manner and at a reduced cost (Li et al., 2015), can facilitate knowledge flows and technological improvements (Vanhaverbeke et al., 2009), as well as can help to stimulate product or process innovation (Schott and Jensen, 2016; Mazzola and Perrone, 2013; Mazzola et al., 2016).

The empirical literature on the impact of collaborations and networking activity shows that there exist



positive effects when the relationships are voluntarily created, while results are mixed when the analysis is referred to “weak” forms of collaborations and networks (Cisi et. al, 2018). The impact on the growth of firms is found positive under the same conditions in different contexts. Watson (2011) studying Australian firms shows that formal networks have a positive effect on firm survival and growth. Park et al. (2010) analyses Korean manufacturing firms and found a positive effect on sales growth and survival.

Nonetheless, some studies do not find clear cut effects in terms of growth. For example, Havnes and Senneseth (2001) found short run mixed results about employment or sales growth working on a sample of European firms.

Coming to the empirical literature about program evaluation aiming at fostering firms’ collaborations, some studies focus on PLATO program in East-Flanders. Schoonjans et al. (2013) find a positive effect of networking program on net assets growth and value-added growth. Van Cauwenberge et al. (2013) found that PLATO participation increases labor productivity.

Focusing on Italy several policies were implemented (Bellandi and Caloffi, 2010) in different regions along the years all aiming at enhancing the level of “networking” of firms in order to spur their performance. The policy under scrutiny in this paper is analysed in some studies that try to investigate the possible effects of FCAs. Colombo et al. (2014) propose an investigation of the effects of FCA on firm’ performance. They show that the probability of having EBIT improvements is positively related to networking, while, surprisingly, no effect emerges in sales growth.

A second contribution on the topic is represented by Cisi et al. (2018) in their in-depth analysis they find that network participation has a positive effect on value added and exports, but not on profitability. The advantages of networking are stronger in the case of: smaller SMEs, firms operating in traditional and in more turbulent markets, firms located in less developed areas and firms not already exploiting the weaker ties offered by industrial districts. Moreover, they provide interesting results about the role of “network characteristics”, such as its size, geographical dispersion, and diversity, are also found to have a positive effect on value added per unit of revenues as well as profitability.

ISTAT (2017) proposes a series of evidence to understand who are the firms that decide to sign a FCA and put forward some preliminary results about the effects of such decision. In particular, using a propensity score technique they show that FCA has a positive effect on growth and that this effect is increasing over time, i.e. the impact after  $t+1$  years from the signing of FCA is bigger than the impact after  $t$  years. They show that the effect is persistent until 4 years lag. Nonetheless, the reasons why the

growth of the firm is influenced by FCA and the rationale behind the persistence of the effect is left out from the picture.

## **Method**

The analysis of the role of formal network agreements on firm's growth has to solve the crucial issue of the potential endogeneity of the inclusion into the treatment group of firms, i.e. those firms that have chosen to sign the contract. This problem is due to potential self-selection into the treatment that in this case can be defined as the decision to sign the contract agreement. In other words, we cannot be sure that no systematic selection is at work in dividing the firms into the group of treated and the group of control (those that did not decide to sign a network agreement in the time window 2011-2015). Under these conditions running an OLS regression conducts to biased results and do not allow to identify the effect under scrutiny. To cope with this issue, we decide to use observable characteristics of the firm as a possible source of self-selection. First, we did a pre-selection phase (Stuart, 2010) so that the two groups of firms become similar in terms of a list of observable characteristics, namely, size, age, capital intensity, vertical integration profile. Secondly, we employ a diff-in-diff model (Ashenfelter and Card; 1985; Athey and Imbens, 2006) that should ensure a further clearance of potential biases arising from endogeneity.

The preselection procedure that select control firms to match with treated ones is based on pre-treatment observable characteristics. The resulting matched sample of control and treated firms should be free from self-selection problems and should ensure that the parallel trend assumption –on which is based the Diff-in-diffs model– holds.

In the models, the treatment variable is represented by the involvement into a FCA of a firm in the year 2012. The outcome under scrutiny is the growth rate of the firm. Hence, the dependent variable of our models is the growth rate of the firm. Independent variables are a set of observable characteristics of the firm.

With respect to the timing of the variables, we consider the year 2011 as pre-treatment period, 2012 as treatment period and 2013 as post-treatment period.

In particular, the group of treated firms is exposed to the treatment in the second period (2012), but not in the first period (2011). The group of control firms is not exposed to the treatment during both periods. To avoid any confounding effect coming from past (i.e. before 2012) and future inclusion into the treatment (i.e. after 2012) we define the control group as the set of firms that did not signed a formal network agreement in the years going from 2010 to 2015 and are active in the same cells of the treated firm given by the sector, the region of activity and the class size. This. The final sample size of control

group is related to the choice of matching each treated firm with three controls when possible.

The difference in differences model estimated is given by the following:

$$gr_{i(2012,2012+k)} = \beta_0 + \beta_1 network_{i,2012} + \beta_1 post2012_i + \beta_2 post2012_i * network_{i,2012} + \delta'_{it} \mathbf{X}_{i,2012} + \varepsilon_{i,2012}, \quad (1)$$

where  $gr_{i,t+k}$  is the outcome of interest,  $post2012$  is a dummy variable equal to 1 in the year 2012 and 0 otherwise. The dummy variable  $network_{i,2012}$  signals the subscription of a formal network agreement by the firm and captures possible differences between the treatment and control groups prior to the policy change. The time period dummy,  $post2012$ , captures aggregate factors that would cause changes in  $gr_{i,t+k}$  even in the absence of a policy change. The coefficient of interest is given by  $\beta_2$  that multiplies the interaction term, which is the same as a dummy variable equal to one for those observations in the treatment group in the second period. To investigate the heterogeneity of the effect we add interaction terms to Equation (1).

We then study the effect on the growth of firm of different network characteristics, namely network size, manufacturing intensity, geographical scope of the network. To this end we use Heckman two stage model (Heckman, 1979). In the first stage, we employ some structural characteristics of the firm to estimate the probability of signing a network agreement contract. In the second stage, we study the effect on the growth of network features controlling for a series of covariates.

## Data and variables

### Data

The study is based on a novel database that matches limited liabilities businesses that in 2012 signed a FCA with firms that did not subscribe to a formal network agreement but possess similar structural characteristics. Both groups are composed by firms that do not have other network relationships and that are active in the period 2011-2015. The choice of the year is due to the fact that 2012 is the first year in which the number of firms that decided to use the policy tool to increase a lot. Data come from different sources. First, we collect information about all firms that stipulated a FCA in the year 2012 from administrative sources (Infocamere, Istituto Tagliacarne). We then matched these firms with other

not-networked firms using an ad hoc survey conducted by Istituto Tagliacarne conducted on a randomized stratified sample of small and medium enterprises (SMEs) in 2012. The final full sample is composed by 3.500 companies. For all the firms in the sample we checked that they were still active until 2015, then we collected information for the years 2011, 2012 and 2013. Asia provided information about the employment levels of firms. Finally, the Italian section of Bureau van Dijk database (AIDA) allowed us to merge also balance sheet and profit and losses indicators. From these sources, we selected from the original sample a subset of firms belonging to two different groups: 348 networked manufacturing firms, i.e. that signed a formal collaboration agreement up to 2012 still in place in 2015; 863 non-networked firms for the years 2010-2014, i.e. that did not sign a formal collaboration agreement in the time window 2010-2014.

### *Variables*

The dependent variable used in the models is of the growth rate of the firm as measured by the differences in log of employment level between two different years:

$$gr_{it,t+k} = \log(emp_{it+k}) - \log(emp_{it}).$$

Our objective variable is defined as a dummy variable that assumes the value of one if a formal collaboration agreement was signed in 2012 by a firm and zero otherwise. In addition, studying the role of collaboration characteristics we also use: formal collaboration size, as measured by the sheer number of firms in the collaboration agreement, the manufacturing intensity (number of manufacturing firms in the agreement), and the geographical scope of the network (province, region, country level).

Independent variables include different sets of variables. First, structural information about the firm: sector of activity (5 digit ATECO sector), age of firms in years, the geographical location of firm expressed by the region of activity, a dummy to signal if the firm is active in an Industrial district, as identified by ISTAT (Italian Statistical Institute). The size of firm expressed by the number of employees; the age of the firm defined by the current year minus the starting year of activity of the firm (ASIA).

Secondly, we add information about economic activity and capital structure of firm: a Vertical disintegration proxy given by the Costs of materials and services over Total costs; a proxy of capital intensity as measured by Physical Assets over Sales. Moreover, we included a proxy of financial constraints of firms as measured by a liquidity index and an index of financial exposure.

## Results

In this section, we first report the results about the treatment effects on treated and then we account for potential heterogeneity of the effects. Finally, we investigate the effect of different network characteristics to understand if and how FCA unleashes its effect.

### *Descriptive results*

Table 1 presents descriptive statistics. Firms in the sample have on average 26 years of activity. The average size is around 79 employees. The vertical disintegration index is around 0.70 and the capital intensity is around 0.50.

Difference in mean tests show that for all the independent variables included in the model no systematic differences emerge after the matching procedure. The only exception being the percentage of exporting firms that is higher for treated firms 58% versus 15% control firms a fact that remind us the importance of including such aspect as a control variable in the model.

*<please insert TABLE 1 around here >*

### *Main result: effect of FCA*

The first question addressed is the role of FCAs on firm growth rate. Table 2 shows the estimation of alternative models that aim at exploring the effect of formal collaboration contract on growth after controlling for a series of covariates. In all the models we assume a one lag between the independent variables and the dependent variable, namely the rate of growth. The logic behind the choice being the fact that structural changes and decisions at year  $t$  should take some time to unleash its effect. Consequently, growth rates at year  $t+1$  are regressed against independent variables at year  $t$ . This in turn should also concur, together with the other methodological tools employed, to cope with reverse causality issues.

All the regressions include sector dummies to control for differences due to structural characteristics of firms and the sector in which they are active. Moreover, we use as control variables a series of observable characteristics that emerges from the literature as related to firm growth (Coad, 2009): Firms age, size, a proxy for financial constraints, the degree of vertical integration, the degree of capital intensity, a dummy that signal the existence of export activity pre-contract agreement and a dummy that indicates if the firm is active in an industrial district.

The coefficient related to the age of the firm turns out to be not significant in all the models. The coefficients of size are negative in most of the models and significant showing a negative relationship

of growth rate with the size of the firm (Bottazzi and Secchi, 2006). The proxy for financial constraints as measured by the index of liquidity of firm is not significant even if the positive sign of the coefficient goes in line with the literature and the intuition (Bottazzi et al, 2014). The degree of capital intensity has a negative impact on growth. The export dummy is positive and significant: if the scope of the firm's activities is beyond the borders there are more growth opportunities available (Love and Roper, 2015). Finally, being in an industrial district seems to be beneficial for growth as a large literature confirms (Bellandi, 2002).

To study the effect of network agreement we estimated different models. Table 2 Column 1 reports results of a model in which the estimation is carried out for the full sample of firms and using a dummy that is equal to one when the firms signed a network contract only in the year 2012 and zero otherwise to signal the inclusion into the treatment of a firm. The estimated coefficient of the dummy is positive (around 0.02), but not significant. Nonetheless, as recalled above, the use of this kind of model could lead to bias in the estimation of the coefficient and also to identification problems. Table 2 Column 2 and 3 present results of the diff-in-diffs models as described in the methodology section. These model exploit before and after treatment differences between firms belonging to control and treatment group to identify the causal effect. In this model we included a dummy for contract agreement ( $D$ ), a dummy for controlling for the time that is equal to zero before year 2012 and equal to one after 2012 ( $T2012$ ) and the coefficient of interest represented by the interaction between the two variables ( $D \cdot T2012$ ) that is equal to one after the year 2012 for the group of firms that in 2012 signed a network contract (Athey and Imbens, 2006). In this case, the estimated coefficient of interest is around 0.04 significant at 10% level signaling a positive impact on firm growth of being in a formal network.

Table 2 column 3 excludes from the estimation micro-firms (i.e. with less than 10 employees). The logic being to have a first evidence of the role of a minimal organizational structure of the firm to benefit from the positive effects of FCAs. Results show that the estimated coefficient of interest is slightly higher than the one estimated for the full sample (0.05) and it is still significant at the 10% level. Hence excluding micro firms slightly enhances the effect of TCAs.

To further investigate the heterogeneity of effect of TCAs we propose a series of regressions aiming at disentangling the role played by different firm characteristics.

*<please insert TABLE 2 around here >*

### *Heterogeneity of the effect*

First, we further investigate the role of size. Table 3 Column 1 presents estimates of a model in which the interaction term ( $T2012 \cdot D$ ) interacts with dummies for different size classes of firms. Results show

that: micro firms (1-9) do not benefit from TCAs –in line with the results presented above– the coefficient is negative (-0.4) but not significant; small firms (from 10 to 49 employees) experiment a positive effect (0.03) significant at 10% level; for firms from 50 to 249 employees the coefficient is around 0.12 significant at 1% level; finally, bigger firms (from 250 employees and more) benefit more from the TCAs the coefficient is around 0.26 significant at 1% level. Increasing the size of firms increases the magnitude of the effect as witnessed by the increase in the value of the coefficient associated to different size classes. This suggests that, once we do not consider micro firms, bigger firms benefit more from the TCAs.

Table 3 Column 2 investigate the effect of firm's age introducing into the model the interaction between the age classes of firms and the main term of interest (T2012\*D). Younger firms (less than 5 years old) coefficient is around 0.26 significant at 1%. Firms from 5 to 10 years old present a positive coefficient estimation (0.23) not significant. For older firms (more than 10 years old) estimated coefficient is negative (-0.01) but not significant. Results show that only younger firms are able to benefit from TCAs.

*<please insert TABLE 3 around here >*

Table 4 presents results to study further heterogeneity of the effects. Table 4 Column 1 and 2 show results, respectively, more or less financially exposed firms. In particular, we used the median value of the ratio between debts and total sales to partition into two groups the firms. In Table 4 Column 1 the coefficient is positive (0.01) but not significant. The coefficient in Table 4 Column 2 referred to firms more exposed is positive (0.08) and significant at 5% level suggesting that to benefit from a TCA in terms of growth firms must have some resources available. Table 4 Column 3 adds the role of size for firms more exposed. Smaller firms (with less than 10 employees) present a negative coefficient (-0.08) but not significant. The estimated coefficient for firms from 10 to 49 employees is positive but not significant. Firms from 50 to 250 employees show a positive coefficient (0.22) significant at 1%. Bigger firms present a higher coefficient (0.47) significant at 1%. These set of estimations show that for this group of firms the mitigating effect of size is more pronounced compared to that of the full sample of the firm.

In Table 4 Column 4 the model is referred to firms that, before their decision to enter into the TCA agreement, declared in the Tagliacarne survey to be geographically constrained to the province of activity. Results show that the effect of TCAs is positive (0.20) and significant at 1%. Lending support to the hypothesis that TCAs help firms in finding the right information and competencies to enlarge their activity. If we look at results for firms of different size we uncover a particular aspect: again, only bigger firms are able to exploit the benefits arising from TCAs. Table 4 Column 5 shows that for firms

smaller than 10 employees the effect is not significant. Firms from 10 to 49 employees experiment a positive significant effect (0.31); firms from 50 to 250 employees have a positive effect (0.17) significant at 5% level and firm bigger than 250 employees present a positive effect (0.76) significant at 5% level. Once again, the effect is increasing as the size of firms increase. Comparing the coefficients with the corresponding estimated for the full sample (Table 3 Column 1) we see that they are bigger in magnitude: from 0.03 to 0.31 for firms in the class 10-50; from 0.13 to 0.27 for those in size class 50-250 and from 0.26 to 0.76 for firms bigger than 250 employees.

*<please insert TABLE 4 around here >*

#### *The effect of collaboration characteristics*

A second set of models analyses the effect of network characteristics on growth of the firm. To analyse FCA we have to overcome a potential self-selection problem. Consequently, we employ a series of two-stage Heckman selection models in which first we model the selection into the FCAs of firms based on observed firm characteristics. Secondly, we model the determinants of growth including as independent variables FCAs characteristics and the inverse mill's Ratio to correct for bias (Heckman, 1979).

Table 5 presents estimates for the two-stage Heckman selection models. Columns 1 and 2 investigate the role of FCAs size as measured by two different proxy, respectively, the sheer number of firms in the FCA and the number of manufacturing firms in the FCA. In the first model (Columns 1) the estimated coefficient of network size is positive (0.004) and significant at 5% suggesting that the higher is the number of firms in the agreement the higher is the firm growth rate. Column 2 focuses on the role of the number of manufacturing firms belonging to FCAs. Results show, also in this model, confirm the positive effect of size of FCAs (0.004). Comparing the magnitude of the coefficients of the two models we note that they are similar suggesting that the fact that the members of the FCA are manufacturing or not is not relevant. Overall, this evidence is compatible with the fact that more firms in the FCA mean more capabilities and more opportunities to be exploited by the individual participant to the FCA.

Models reported in Table 5 Column 3 analyses the effect of network type on firms' growth rate. More specifically, we study if a specialized TCA (i.e. all firms in the network come from the same three digit sector) gives particular advantages in terms of growth. Estimates of the model on a subset of firms that belong to a FCA that is specialized. Results show that the coefficient about the number of firms in the formal collaboration agreement is positive (0.007) significant at 5% level: being in a specialized network have a positive effect on growth performance. This coefficient is almost double compared to the one estimated for the full sample.



*<please insert TABLE 5 around here >*

## **Conclusions**

In this study, we investigated the impact of FCAs on the opportunities capturing ability of firms, as measured by the growth rate of the firm. We find that firm growth is influenced by the participation into a formal collaboration agreement in line with previous literature on the topic (ISTAT, 2017; Cisi et al, 2018). Nonetheless, there seems to exist a huge heterogeneity of the effects for different kind of firms that deserve some attention.

Indeed, results show that to benefit from TCAs firms must possess a minimum level of organizational complexity, indeed, micro firms seem to be excluded from the group of firms able to spur positive effects. Moreover, the positive correlation between size and magnitude of the effects is compatible with the fact that the presence of increasing internal resources and capabilities is complementary to the acquisition of external resources to be able to capture additional market opportunities and grow. Results about the age of firms suggest that younger firms benefit more very likely because they have less knowledge of the market and of its opportunities and can gain more from the acquisition of this external knowledge.

Exploring more the sources of heterogeneity of the effects we discover that to benefit from TCAs firms should show some degrees of “willingness to grow” (that we measure with the degree of exposure to debts). That is to say to grow firms should have some available resources to invest, for instance to reach additional markets. Finally, quite in line with the intuition, firms that are more constrained for their economic activity to the region of residence could benefit more from TCAs, because they can overcome with the help of the partner in the TCA all the obstacles to the expansion of the market scope of their activity.

The number of firms in the TCA, i.e. the size of the TCA, is an important factor to foster the growth of formal network firms. More firms in the TCA means more knowledge and capabilities to be exploited by the partners of the TCA.

The results about the effect of collaboration size confirm that if the network is larger, then firms could exploit more from it in terms of opportunities. Interestingly, being in a TCA with similar firms, i.e. same sector of activity, seems to have a positive impact: the set of missing competencies and information to gain are more probably present in firms that in the market carry on similar activities.

Policy implications can be derived. First, the policy tool seems to be effective in opening business opportunities for firms. An exception being the null effect on micro-firms. Put it differently, the policy is ill suited to transform micro firms into small firms.

Secondly, there is room to improve policy results. Indeed, given the great heterogeneity of the effects policy makers should try to focus to some particular groups of firms. In other words, the policy design could be improved to get stronger results to: (i) nudge firm signing TCAs to invest more to spur bigger effects; (ii) create additional incentives for firms geographically constrained; (iii) ensure the participation of a higher number of firms to each formal agreement; (iv) ensure the participation of more homogeneous firms into the agreements (sectoral definition of the policy matters).

The paper presents some limitations: results are referred only to TCAs signed in 2012; results are only short run effects. Future studies should focus on these aspects to gain additional insights.

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## Tables

**Table 1: Descriptive statistics**

All firms					
variable	N	mean	sd	min	max
D	2420	0.29	0.45	0.00	1.00
FirmAge	2418	26.08	15.93	1.00	112.00
Log employment	2377	79.20	198.08	0.00	4424.00
Vert_dis2	2385	0.70	0.16	0.09	1.00
Cap_Int	2381	0.52	1.68	0.00	48.62
dEX	2420	0.16	0.41	0.00	1.00
Dis	2420	0.06	0.24	0.00	1.00
not TCA firms					
variable	N	mean	sd	min	max
FirmAge	2073	26.53	16.09	1.00	112.00
Log employment	2039	79.01	161.14	0.00	4424.00
Vert_dis2	2048	0.69	0.16	0.09	1.00
Cap_Int	2046	0.55	1.78	0.00	48.62
dEX	2074	0.15	0.36	0.00	1.00
Dis	2074	0.00	0.00	0.00	0.00
TCA firms					
variable	N	mean	sd	min	max
D	346	1.00	0.00	1.00	1.00
FirmAge	345	23.36	14.60	5.00	87.00
Log employment	338	80.37	342.27	0.00	4282.00
Vert_dis2	337	0.75	0.14	0.09	1.00
Cap_Int	335	0.32	0.74	0.00	10.10
dEX	346	0.20	0.49	0.00	1.00
Dis	346	0.43	0.50	0.00	1.00
Size_network I (# of firms)	346	7.52	5.38	2.00	25.00
Size_network II (# of manuf. firms)	346	5.67	4.98	1.00	21.00

**Table 2: Effect of formal networking activity. Difference in differences regression models.**  
**Dependent variable: growth of firm**

VARIABLES	(1) Benchmark model	(2) All firms DiD	(3) No micro DiD
TD		0.0420*	0.0491*
		(0.024)	(0.026)
D	0.0227	0.0021	-0.0164
	(0.018)	(0.022)	(0.024)
T2012		-0.0357***	-0.0151
		(0.013)	(0.015)
FirmAge	0.0001	0.0002	-0.0001
	(0.000)	(0.000)	(0.000)
Employees	-0.0532***	-0.0532***	-0.0530***
	(0.007)	(0.007)	(0.009)
Liquidity index	0.0078	0.0079	0.0048
	(0.005)	(0.005)	(0.007)
Vert_dis	0.0642*	0.0623	0.0482
	(0.039)	(0.039)	(0.046)
Cap_Int	-0.0191***	-0.0188***	-0.0423***
	(0.004)	(0.004)	(0.008)
dEX	0.0335**	0.0335**	0.0351**
	(0.016)	(0.016)	(0.018)
dDistr	0.0431**	0.0431**	0.0413*
	(0.021)	(0.021)	(0.022)
Constant	0.0695**	0.0877**	0.1213***
	(0.035)	(0.036)	(0.044)
Sector controls	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes
Observations	2,343	2,343	1,562
F	0.0446	12.09	8.412
R-squared	0.065	0.068	0.079

*Notes: sectors controls consider ATECO 2 digit sectors. Geographic controls for regions.*

*Standard errors in parentheses*

*\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$*

**Table 3: Effect of formal networking activity. The differential effect of size and age. Difference in differences regression models. Dependent variable: growth of firm**

<i>VARIABLES</i>	<i>Tall2012TDint2</i>	<i>Tall2012TDint3</i>
<i>size TD1</i>	-0.0467 (0.039)	
<i>size TD2</i>	0.0319 (0.027)	
<i>size TD3</i>	0.1225*** (0.041)	
<i>size TD4</i>	0.2593*** (0.074)	
<i>age TD2</i>		0.2596*** (0.078)
<i>age TD3</i>		0.0236 (0.038)
<i>age TD4</i>		-0.0070 (0.016)
<i>D</i>	0.0117 (0.022)	0.0194 (0.019)
<i>T2012</i>	-0.0357*** (0.013)	-0.0258** (0.011)
<i>FirmAge</i>	0.0002 (0.000)	0.0004 (0.000)
<i>lDipendenti</i>	-0.0690*** (0.008)	-0.0526*** (0.007)
<i>Indicediliquidità</i>	0.0084 (0.005)	0.0081 (0.005)
<i>Vert dis2</i>	0.0539 (0.039)	0.0587 (0.039)
<i>Cap Int</i>	-0.0195*** (0.004)	-0.0211*** (0.004)
<i>dEX</i>	0.0373** (0.016)	0.0322** (0.016)
<i>dis</i>	0.0411** (0.021)	0.0445** (0.021)
<i>Constant</i>	0.1318*** (0.037)	0.0806** (0.035)
Sector controls	Yes	Yes
Geographic controls	Yes	Yes
<i>R-squared</i>	0.076	0.072
F	10.74	10.82
p	0	0

Notes: sectors controls consider ATECO 2 digit sectors. Geographic controls for regions.

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$



**Table 4: Effect of financial exposure of firm and of geographical constraints of formal networking activity. Difference in differences regression models. Dependent variable: growth of firm**

<i>VARIABLES</i>	<i>TQ1</i>	<i>TQ2</i>	<i>Tall2012TDq</i>	<i>TVin</i>	<i>Tall2012TDg</i>
<i>TD</i>	0.0061 (0.025)	0.0826** (0.040)		0.1951*** (0.056)	
<i>size TD1</i>			-0.0798 (0.064)		0.0527 (0.106)
<i>size TD2</i>			0.0683 (0.044)		0.1744*** (0.064)
<i>size TD3</i>			0.2214*** (0.065)		0.3136*** (0.095)
<i>size TD4</i>			0.4717*** (0.139)		0.7608** (0.299)
<i>D</i>	0.0483** (0.022)	-0.0444 (0.038)	-0.0285 (0.038)	-0.1888*** (0.049)	-0.1805*** (0.049)
<i>T2012</i>	-0.0125 (0.013)	-0.0581*** (0.022)	-0.0584*** (0.022)	-0.0447*** (0.016)	-0.0447*** (0.016)
<i>FirmAge</i>	0.0001 (0.000)	0.0002 (0.001)	0.0004 (0.001)	-0.0001 (0.001)	-0.0001 (0.001)
<i>lDipendenti</i>	-0.0321*** (0.007)	-0.0710*** (0.011)	-0.0985*** (0.013)	-0.0872*** (0.011)	-0.0975*** (0.012)
<i>Indicediliquidità</i>	-0.0041 (0.005)	0.0142 (0.014)	0.0152 (0.014)	0.0094 (0.007)	0.0096 (0.007)
<i>Vert dis2</i>	0.0702* (0.040)	0.0007 (0.068)	-0.0179 (0.068)	-0.0448 (0.056)	-0.0531 (0.056)
<i>Cap Int</i>	-0.0306*** (0.011)	-0.0172*** (0.004)	-0.0182*** (0.004)	-0.0207*** (0.004)	-0.0211*** (0.004)
<i>dEX</i>	0.0154 (0.017)	0.0600** (0.029)	0.0690** (0.028)	0.1370*** (0.029)	0.1408*** (0.029)
<i>dis</i>	0.0030 (0.022)	0.0693** (0.034)	0.0704** (0.034)	0.1497*** (0.055)	0.1437** (0.056)
<i>Constant</i>	0.0579 (0.039)	0.1618*** (0.061)	0.2397*** (0.063)	0.2534*** (0.055)	0.2832*** (0.056)
Sector controls	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	1,147	1,196	1,196	1,415	1,415
<i>R-squared</i>	0.078	0.089	0.105	0.113	0.118
F	4.826	7.166	7.087	12.44	10.17
p	0.000	0.000	0.000	0.000	0.000

**Table 5: Effect of size of network. Second stage regression results. Heckman selection model.**

VARIABLES	(1) Size of network	(2) Size of network 2	(3) Specialized FNAs
Size_network I	0.0041** (0.002)		0.0069** (0.003)
Tot_man_rete		0.0044** (0.002)	
Employees	-0.0136 (0.010)	-0.0141 (0.010)	-0.0384** (0.018)
FirmAge	-0.0017** (0.001)	-0.0018** (0.001)	-0.0015 (0.001)
Liquidity index	0.0138 (0.010)	0.0157 (0.010)	0.0077 (0.028)
Cap_Int	-0.0503*** (0.015)	-0.0495*** (0.015)	-0.0494 (0.078)
dEX	-0.0447** (0.022)	-0.0417* (0.022)	-0.0461 (0.042)
Constant	0.1067* (0.055)	0.1102** (0.055)	0.1556 (0.101)
Sector controls	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes
Observations	2,370	2,370	1,954
chi2	33.02	34.49	15.88
lambda	-0.0120	-0.0140	-0.00282
Sel. lambda	0.0208	0.0208	0.0320