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Networked resource access and networked growth:

A double network hypothesis on the

innovative entrepreneurial firm

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Abstract

Through an empirical study on new and innovative entrepreneurial firms, we test the hypothesis that there is a virtuous circle between the networked access to knowledge and financial resources and the networked growth of those firms. This 'double network hypothesis' is connected to a view of entrepreneurial firms generating value through shifting combination of resources and growing by external networks. This view integrates and provides a dynamic version and application of resource-based and transaction-based considerations on firms and networks, more suitable for analyzing innovative entrepreneurial firms than the currently dominant static versions.

1. INTRODUCTION

A main ingredient of entrepreneurship is the recombination of resources for the discovery and development of new goods and services (Schumpeter 1911; Penrose 1959). In Schumpeter's view, the focus on resources was due to the understanding that the development of new goods and services is a discovery process sustained by the pooling of resources in new ways. In Penrose's view, the focus on resources was due to the understanding that the expansion and change of services is due to the multifunctionality of resources: the capacity of generating more activities than those for which they were initially developed and invested. These dynamics of resource recombination and utilization over an expanding range of services were at the basis of the explanation and prediction of value creation and the growth of the firm within a resource-based perspective. Contemporary debate in the resource based view, with perhaps the exception of literature on related diversification, has however lost most of that dynamic connotation (Grandori 1999a; Foss 1999). Discussion has become primarily centered on the strength of a firm's competitive 'position' as determined by the 'amount' of resource controlled and by their rarity, value and inimitability (Barney 1991; Wernerfelt 1984). In this view, the 'lock-in' of unique resources is the major source of competitive advantage and even the very 'nature' of the firm.

The extensive literature on organizational networks in new high tech sectors (Saxenian 1991; Powell, Koput and Smith-Doerr 1996; Elfring and Hulsink 2003 to

quote only a few) suggests that this static portrait of value creation and firm growth is in fact a special case, to which we became accustomed in mature industrial sectors, but which is highly inadequate in the case of entrepreneurial firms based on new technologies and operating in new sectors (Grandori 2003). In industries based on new technologies, technology is itself unstable and its applications are not fully known. Typical “operational principles” (Vincenti 1990), configurations of products (dominant designs) and production processes have yet to be discovered (Abernathy and Utterback 1978; Klepper 1997). In this uncertain environments in which firms experiment with a technology and its applications, shifting rather than stable combinations of resources are likely to be superior in the discovery and design of these new solutions (Meyerson, Weick and Kramer, 1996). Hence, it is not necessary to *assume* that resources have special attributes of rarity and uniqueness for them to be important in those contexts.

On those bases, this paper undertakes a conceptual and empirical study on entrepreneurial firms in innovative settings – or New Technology Based Firms (NTBFs). Firstly, we focus on identifying what aspects of organizational arrangements may help in generating and governing a shifting combination of complementary resources, building on the hypothesis that one of the most important organizational practices that can arguably contribute to build such an organization is networking (Doeringer and Piore 1971; Saxenian 1991; Powell, Koput and Smith-Doerr 1996; Powel et. al 2005 to quote only a few).

It is widely recognized that organizing transactions through networks is an important governance alternative with respect to organizing within the firm or through markets (Williamson 1991; Thompson et al 1991). It is deemed to be suitable especially when there are advantages in tight coordination among different activities, but economies of specialization and scale (Richardson 1972; Mariotti and Cainarca 1986) or when relative efficiency in innovation (Nooteboom 1998) are configured to the advantage of separate firms. However, these transaction-based arguments on the role of networks have typically been static in nature, i.e. asserting that certain types of activities are better organized by external networks rather than within firm boundaries. Dynamic considerations and network formation has been much less analyzed (Ebers and Grandori 1999). The importance of networks, in general and in entrepreneurship in new high-tech sectors, furthermore, is not confined to access to resources. The second aspect of our conceptual and empirical exploration of entrepreneurial firms in innovative settings, will be to provide a dynamic model of network formation. The argument builds on an interpretation of networks as both a predictor of internal

growth and as alternative to it. In fact, it has been argued that networks are important for overcoming the 'liability of newness' (Powell et al 2005; Pennings et al 1994); and there is broad support for the hypothesis that networking has a positive impact on new firms survival and growth (e.g., Brüderl and Preisendörfer 1998), in particular for NTBFs (e.g., Baum, Calabrese et al.1990; Elfring and Hulsink 2003; Almus and Nerlinger 1999). Alternatively, sometimes networks have been recognized as a different *form of growth* of the firm (Pfeffer and Salancik 1978) rather than as an alternative to growth. In fact, recent literature has emphasized that NTBFs are important in economic development not so much because some of them grow to be large firms, but because many of them remain small specialized suppliers that act as catalysts for the growth of other firms (Autio 1997a; Fontes and Coombs 2001). Therefore, networking is not only a strategy for the acquisition and rapid recombination of resources that best fit the demands of turbulent environments, but also a means through which NTBFs contribute to economic development and the development of other firms.

The paper is organized as follows. Section 2 reviews what we know about the role of various types of networks in ensuring NTBFs access to the shifting combination of resources they need to survive in the turbulent environment that they inhabit. Section 3 discusses the shift in the literature on NTBFs from an emphasis on growth in terms of revenues and employment to an emphasis on growth in terms of activity expansion through external networks. Section 4 builds on the two preceding sections by putting forward a 'double network hypothesis', i.e. that NTBFs that have highly developed networks for accessing resources achieve superior development in terms of their outbound networks. Section 5 describes the empirical study conducted on a sample of Italian NTBFs and discusses its relevance for the double network hypothesis, while the last sections draws conclusions and implications for further research.

2. NETWORKED RESOURCE ACCESS IN NTBFs

It is widely recognized that networks are important in helping newly founded businesses (e.g., Brüderl and Preisendörfer 1998) and NTBFs in particular (e.g., Baum, Calabrese et al.1990; Elfring and Hulsink 2003; Almus and Nerlinger 1999) to overcome the difficulty caused by the 'liability of newness' in accessing resources, contributing to improve their chances of survival and growth. Indeed, networks perform a fundamental role in attracting both the main types of resources NTBFs need: knowledge and money. In fact, it is widely known that sheer market

transactions are bound to fail when the knowledge to be transferred is complex and investments are risky (Williamson 1979; Alvarez and Barney 2007). This holds for knowledge transfers and investments, but also for the attraction of financial investments into very uncertain ventures. The alternative forms of governance usually considered in these cases are either sheer integration or networks. The latest have been typically conceived as a hybrid form between market and hierarchies, which enables the parties to maintain separate legal entities, but to coordinate their action through organizational, voice-based mechanisms. Various forms of networks have been identified, mostly on the basis of the type of coordination mechanisms employed. It is commonly hypothesized and found that the more complex and risky the transaction, the stronger the needs for integration, thereby bringing governance from simple communication and informal contact, to contractually regulated exchanges, to property right sharing (Grandori 1997).

As it has been observed, however, this 'comparative institutional assessment' perspective is static; in particular what enables the *formation* of the needed networks has not been particularly clarified (Ebers and Grandori 1999). In the present study we make a further distinction among networks, not by form or content, but by the input versus output processes they sustain and regulate, thereby introducing a dynamic dimension. In relation to knowledge access, we consider the main forms in which knowledge can be accessed: through access to qualified human resources; through contractual relationships, including the acquisition of technology via licensing and of specialized competencies via outsourcing or franchising; and through proprietary agreements. The acquisition of technology via licenses is a relatively 'market-like' form of networking. It is known, however, that market exchange unsupported by human interaction soon fails as knowledge complexity increases (e.g., Ouchi and Bolton 1988) and that licensing in complex sectors is significantly integrated by organizational interaction (Grandori and Soda 1995). Outsourcing represents an important mode through which new small firms can access knowledge, either as embodied in capital goods such as information systems or in the form of expertise (including traditional areas such as legal, tax and financial advice) but also specialized technical expertise (for instance in design and production).

The outsourcing of part of the firm's activities in order to access specialized knowledge is an appropriate solution as long as the knowledge being transferred does not require significant specialized investments. When this is the case, and knowledge is embodied in the form of expertise, the acquisition of knowledge implies the acquisition of people through employment contracts. It has been empirically

widely shown how important networks are in providing input knowledge through communication or circulation of personnel in systems of NTBFs (e.g., Saxenian 1992). Indeed, NTBFs tend to cluster in areas where there is an abundant supply of qualified personnel (e.g., among the more recent contributions, Armington and Acs 2001). While the literature exploring the role of networks in labor markets has initially underlined the role of *social* networks (understood as networks deriving from family acquaintances and friendship relationships) (e.g., Granovetter 1973), the literature on the labor dynamics of innovative clusters such as Silicon Valley (Saxenian 1992) and on high-tech innovative firms in general (e.g., Bagdadli et al. 2003; Roberts 1991; Prevezer 2001) show that *professional* networks (understood as the networks deriving from either shared higher education or shared work experiences) play a prominent and even more important role in the careers of high-tech professionals. The importance of professional networks derives from their performing of two functions that are particularly important in high-tech innovative contexts. Firstly, they enable entrepreneurs to perform knowledge brokerage. A wide range of contacts deriving from previous business relationships provide entrepreneurs with partner-specific knowledge and enables them to build a map of the distribution of competencies among actors. This is clearly of paramount importance in an uncertain dynamic environment that requires the ability to rapidly recombine resources. Secondly, while social networks may be sufficient to enable entrepreneurs to solve the classic problems of adverse selection and moral hazard in evaluating resources that do not have an important technical component, professional networks become crucial when entrepreneurs need to overcome the problems of asymmetric information related to the level of technical competence of potential business partners and employees.

With regard to financial resources, it is well known that the mere provision of finance to technically excellent but often business naïve entrepreneurs by actors who do not have a substantive knowledge of the field is bound to fail. This is the main reason why 'networked finance' based on co-investment rather than traditional finance based on bank loan has become so central to successful high-tech districts. The risky investment required in NTBFs need to be sustained by informed investors, with specialized knowledge of the field and capacity of substantive knowledge sharing with the entrepreneur, rather than by traditional financial institutions (Sapienza and Gupta 1994; Clarisse et al 2007). In addition, the more networked not only with entrepreneurs, but even among themselves the capital providers are, the more sustained the growth of the system of innovating firms (as shown in a comparative

study on Silicon Valley and Route 128; Castilla 2003). Networked finance is not only a matter of risk sharing, is also a matter of knowledge sharing and specialized co-investments. For this reason, the financing of NTBFs takes place primarily through equity investments – which identify proprietary networks, where, as it is the case for highly skilled people, resources are co-invested and associated, rather than ‘exchanged’.

3. NETWORKED GROWTH

As mentioned above, networks are important not only because they enable faster recombination of resources than traditional integration, but also because they represent a form of growth. Indeed, it was recognized very early in organization studies that what counts as the ‘boundary’ of the firm, and therefore its size, depends of what aspect of the firm is being looked at and that networks of relations allow firms to influence the use of human and technical capital well beyond their ‘boundaries’ as traditionally intended (March and Simon 1958; Pfeffer and Salancick 1978; Grandori 1999a). The debate on what is the most appropriate measure of firm size and firm’s growth has recently been renewed in the context of the policy discussion on NTBFs. This section briefly reviews this debate, to set the ground for our empirical analysis of the relationship between traditional size (revenues and number employees) versus ‘networked’ size (number of networking relationships) in the case of NTBFs.

Since at least the 1980s, the new wave of firm founding and entrepreneurship giving raise to the ‘new economy’ have been the object of growing interest from both academics and policy makers (for reviews: Autio 2000; Storey and Tether 1998). This interest has been driven by the belief that, through the development of new markets and technologies, entrepreneurial firms, and especially innovative and new technology based firms, play a central role in enabling the economies of developed countries to escape stagnation. The policy objectives inspiring research have been dominated by a concern for the identification of factors that affect the ability of these new firms to grow (e.g., Almus and Nerlinger 1999; Autio 2000; Bantel 1998; Brüderl 1992). In other words, the objective underlying much research on new firms has been to identify the conditions that allowed the expansion in size of firms like Microsoft, Apple or Adobe, in order to facilitate similar developments in other countries and industries.

As part of this line of research, several contributions have examined whether and to what extent inter-organizational networks contribute to the survival and growth of

NTBFs. A review of the available evidence shows that there is robust empirical support for the positive effect of inter-organizational networks on growth in terms of traditional measures of size - turnover and number of employees (e.g., Baum, Calabrese et al. 1990; Elfring and Hulsink 2003; Almus and Nerlinger 1999). Almost three decades of research, however, have shown that the emphasis on growth in this sense is likely to be at least partially misled (Autio 1997a). NTBFs that grow to be large firms are a very small minority and, particularly in Europe, there have been very few stories of spectacular growth comparable to the major US success stories (Storey and Tether 1998). To counter this rather bleak assessment, however, research has shown that NTBFs play a crucial role in fostering economic development by nurturing inter-organizational networks of innovators, as well as the innovation capacity of large established firms (e.g., Powell et al. 1996, Saxenian 1994, Orsenigo, Pamolli and Riccaboni 2001). Over the last years, then, the focus of research has been shifting from the identification of fast growers and of the environments nurturing them, towards a more sophisticated understanding of the role of entrepreneurial firms as agents of economic development at a wider level. This shift in emphasis derives from several arguments.

Firstly, over the years empirical evidence has accumulated showing that there are internal differences between types of entrepreneurial firms in growth respects. In particular, while the rate of growth of NTBFs is usually higher than that of other start-ups, they typically do not grow much and often have little *intention* to grow.ⁱ Albeit the no growth choice has been considered, and sometimes is, a pathology, it can also be effective on many grounds: avoiding bureaucratic escalation, keeping a substantive professional rather than administrative orientation, maintaining intrinsic motivation and the working 'imprinting' of the NTBF (Baron and Kreps 2000). Finally, but of primary importance here, the 'lack' of expansion of organizational boundaries of the firm may hide other forms of growth: growth by changing the combination of resources, by the development of resources in terms of knowledge and experience, and growth by spin-offs and external alliances and collaborations.

Secondly, there has been a shift away from a linear to an interactive model of innovation, and the understanding of the role of NTBFs has correspondingly changed (Autio 1997b). In the linear model of innovation, in which a sequential series of steps transforms advances in scientific knowledge into new technologies and new products, NTBFs are seen as the introducers of new and disruptive technologies that, if successful, would grow to replace existing large firms. The systemic view of innovation highlights the interactive and recursive nature of the process, in which

science and technology influence each other and are at least partly shaped by interaction with markets and a broad range of constituencies. Within this view, NTBFs find a role as agents of innovation contributing both to the phases of exploration and discovery of new technologies (Freeman and Soete 1997; Nooteboom 1998) and to their diffusion and adaptation to a variety of contexts (Autio 1997b; Fontes and Coombs 2001), in particular contributing to the renewal of the competencies of large, established firms (Beesley and Rothwell 1987; Rothwell 1983; Orsenigo, Pamolli and Riccaboni 2001; Lipparini and Lomi 1999; Powell et al. 2005). Their role as catalysts, however, makes growth particularly difficult as NTBFs tend to occupy specialised niches. Indeed, recent studies have shown that there is a portion of firms that are highly successful in terms of innovative output (measured in terms of patenting activities), which remain relatively small (less than 500 employees) (Hicks and Hedge 2005). These small 'serial innovators', who act prevalently in industries characterised by the growth of 'markets for technologies' (Arora and Gambardella 1994), are less likely to be manufacturer than large patenting firms, therefore supporting the view that they act as specialist technology suppliers running R&D or consultancy activities.

Thirdly, in highly innovative settings, where firms are 'trials' in a 'trial and error' process of discovery of new combinations, survival and growth of every single firm is just not possible and arguably not effective from the standpoint of the overall process of economic discovery (it would be as if no hypothesis were ever rejected in a research process) (Campbell 1960; Klein and Klein 2001; Klein and Foss forthcoming; Pennings, Lee and Witteloostuijn 1998). Indeed, 'failed' NTBFs still contribute to the economy by producing qualified human resources (cf. Møen 2007). This aspect contributes to identify a role, and related 'success' criteria, for NTBF, that do not include stability, duration and growth. Actually a key parameter for firm-level success in successful high innovation systems of NTBF is even their 'termination' through sale and transformation in something else (Grandori and Furlotti 2006).

The discussion above on the role of new innovative firms in promoting the growth of large established firms and of networks of further new firms suggests that (a) traditional measures of size may not correlate with size measured as a firm's network of relationships and (b) the contribution of NTBFs to the economy can be better captured by indicators of their inter-organizational activity than by the traditional measures of firm survival and size. In first approximation, it can be hypothesized that the networks through which NTBFs contribute resources to the activity of other firms are the same through which they receive them. NTBFs can

provide knowledge in the form of human expertise when their former employees go to work in other firms; furthermore, former employees can in turn become channels enabling the originating firm to provide products and services to their new firms or to other new clients via subcontracting. NTBFs can input knowledge into the system by licensing their technologies, by acting as subcontractor for other firms or as franchiser.

4. A 'DOUBLE NETWORK' HYPOTHESIS

Bringing together the two lines of argument on the role of networks in the acquisition and recombination of resources and on the networked growth of new innovative entrepreneurial firms, we advance a 'double network' hypothesis. Networks are fundamental both in attracting and combining an internally varied set of inputs, and in sustaining the growth of entrepreneurial firms as a system. It can be argued that (a) the management of networks constitutes a distinct capability and that, therefore, the extent of use of networks in ensuring access to resources is likely to positively influence the extent of use of networks for distributing the firm's outputs to other economic actors; and (b) networks that are used to access resources may in time become networks through which firms sell their product and services. In other terms, the capacity of forming networks thanks to outflows of financial and knowledge resources is sustained by the experience and contacts deriving from having utilized external sources of those types of input in the constitution of the firm in the first place. Therefore, we *hypothesize that there are interaction effects between the two types of networks, a virtuous circle between the 'vortexes' of knowledge and financial resources in input and the new firms' vitality in terms of inter-firm networking as an output.*

A second research question regards the interactions between qualitatively different types of networks. In order to distinguish types of networks, either in input or in output, we shall use the threefold typology distinguishing among networks according to governance and coordination properties: i.e. proprietary networks (based on equity or other property rights sharing); bureaucratic/contractual (based on formal contracts rich in procedural clauses, rules and arbitration provisions); and social/personal networks, developed in Grandori and Soda (1995) and Grandori (1997). The further question addressed here is: *does experience in managing one type of network relationship in input (say contractual), sustain the formation of the same type (i.e. contractual again) or of other types of networks in output (say proprietary) ?*. An 'experience' and capability argument would suggest that *there*

should be a positive interaction between inbound and outbound networks of the same type.

As to possible synergies and complementarities among inbound and outbound networks of different type, two countervailing arguments may be conceived. On the one hand, the formation of inter-firm networks of the contractual or proprietary types is most often nurtured by the embeddedness of firms in wider social and professional networks. Furthermore, in the case of entrepreneurial firms in the most innovative sectors of the economy, social and professional networks can be seen as a relatively stable organizational and social structure, while firms can be seen as arrangements for combining resources into 'projects' that may well be temporary (Grabher 2002). In fact, entire groups of connected people do migrate from firm to firm (Meyerson et al. 1996; Bagdadli et al. 2003), firm tenure is relatively short (Grandori and Solari 2002) and entrepreneurial project-based firms as such may be short-lived - they may die tout court, terminate for completion of projects, or 'die' by transformation into corporations, by aggregation via mergers and acquisitions, or by disaggregation into networks of new entrepreneurial firms (Lindkvist 2002; Hannan and Freeman 1989; Miles et al. 1997; Ebers 1997; Burt 2004). Conversely, the use of formal network for attracting resources may contribute to build informal business contacts. This type of factors should foster positive relationships among different types of networks. In particular the 'social embeddedness hypothesis' points at a special role of informal and interpersonal networks in nurturing the formation of networks of other types.

At a more general level, we may notice that both previous factors – positive interaction effects between similar or dissimilar networks – are based on complementarity among mechanisms. On the other hand, the contingency argument – fit to context - says that the effectiveness of different types of network (social/professional, contractual or proprietary) depends upon the characteristics of resources and tasks, and implies that there may be only limited fungibility among networks of one type in input and networks of other type in output.

Given those possible countervailing factors, the issue of which type of inbound and outbound networks sustain each other will be explored empirically. Furthermore, we explore the relationships between the size of the firm as traditionally measured and networks variables.

5. A TEST OF THE DOUBLE NETWORK HYPOTHESIS

Sample and measures

The data employed in testing our double network hypothesis relate to a sample of Italian new technology based firms (NTBFs): The database (RITA), initially developed at Politecnico di Milano in 1999 (with up-dates in 2001 and 2003), contained information on about 630 Italian NTBFs, founded in 1980 or later, and independent at start-up. Firms in the RITA database operate in high-tech sectors in both manufacturing and service sector, including telecommunications, industrial automation, computing, software, e-commerce, multimedia services, aerospace and biotechnology. RITA was used as a basis for a joint project between Politecnico and Crora-Bocconi, in which the data set on technology and financial structure was integrated with data on human resources practice and organization.ⁱⁱ The data for this paper has been gathered through a survey, conducted during the summer 2004. Firms were contacted by phone and e-mailed or faxed the questionnaire. Two rounds of follow-up calls were made in July and September in order to increase the response rate. Of the initial 630 target firms, 48 had ceased to exist, had been acquired or could not be reached. From the remaining firms, we were able to collect 110 completed questionnaires, equivalent to a response rate of 19%. The data from the questionnaire were then integrated with other information available in the updated RITA, in particular in relation to age. The integration process brought the number of complete records to 84.

The variables examined in our study are shown in Figure 1. The following paragraphs will describe the construction of the variables in more detail.

----- FIGURE 1 ABOUT HERE -----

5.1.1. Independent variables: Inbound networks

Three independent variables are defined.

Inbound HR from Networks is measured by the intensity in the use of networks in order to access human resources. The measure is an index ranging from 0 to 4 constructed summing the answers (0 for no, 1 for yes) to four questions asking whether new employees were recruited by using referrals from professional contacts,

from personal contacts, from former employees or from firms with which the focal firm has any type of relationship.

Inbound Contractual Networks are measured by the intensity of use of contractual networks as a means to procuring and accessing resources within the economic system. Contractual Networks In is an index constructed as the average number of relations in which the firm is as licensee, as franchisee or by outsourcing part of its activities – each of which is measured on a 0-4 scale, with 0 for no relationship, 1 for 1 to 3 relationships, 2 for 4 to 6 relationships, 3 for 7 to 9 relationships and 4 for ten or more relationships.

Inbound Proprietary Networks is measured by the intensity of use of proprietary networks in accessing capital on a 0-4 scale, constructed by asking the number of other firms that hold equity stakes in the focal firms on a 5-point scale, with the following values: 0 (no equity stakes); 1 (between 1 and 3); 2 (between 4 and 6); 3 (between 7 and 9) and 4 (10 or more).

5.1.2. Dependent variables: outbound networks.

Three dependent variables are defined.

Networks from Outbound HR are measured by the intensity of the relationships maintained by the firm with its former employees. The question asked is whether they became sources of new employees, new clients, new projects, information on industry evolution. This variable has been constructed by summing dichotomous (yes or no) variables for each of the component, resulting in a 5-point scale with values ranging from 0 (no network whatsoever from former employees) to 4 (all types on networks are used).

Outbound Contractual Networks are measured by the intensity of use of contractual networks as a means to distributing the firm's resources within the economic system. Contractual Networks Out is an index constructed as the average number of relations in which the firm is licensor, franchisor or subcontractor – each of which is measured on a 0-4 scale, with 0 for no relationship, 1 for 1 to 3 relationships, 2 for 4 to 6 relationships, 3 for 7 to 9 relationships and 4 for ten or more relationships.

Outbound Proprietary Networks is measured by the number of other firms in which the focal firm has equity stakes, on a 5-point scale, with the following values: 0 (no equity stakes); 1 (between 1 and 3); 2 (between 4 and 6); 3 (between 7 and 9) and 4 (10 or more).

5.2.3 Control variables

We considered the following control variables:

Industry. We controlled whether firms in our sample are active in manufacturing or service by assigning a dummy to firms working in the service industry (a more fine-grained distinction was not possible given the magnitude of our sample). In our sample, 66% of firms is active in services and 34% in manufacturing.

Age. This dummy controlled for the age of the NTBF, distinguishing firms founded earlier than 1999 (value 1) and those founded later (value 0). In our sample, 41% of firms were founded after 1999, while 59% were founded in the period (1980-1999).

The descriptive statistics for each of these variables are provided in Table 1 below.

-----TABLE 1 ABOUT HERE-----

5.3 Data analysis and results

Independent variables are not significantly correlated or only weakly correlated among each other, as are the dependent variables. In addition to be a good news as far as multicollinearity is concerned, this lack of correlation is interesting in substantive terms. In fact, it says that there are few complementarities among different types of networks for attracting human, technical and financial resources; as well as among different types of networks for disseminating, transferring and investing them.

This established, we can turn to the analysis of the relations between inbound and outbound networks. We have conducted Seemingly Unrelated Regression (SUR) to test the relationships between each of the dependent variables with all the independent variables. Because of the need to eliminate cases with missing values in the indexes, the number of observation for the SUR is 58. Results are shown in Table 2. Since some index (i.e., HR and Proprietary Networks indexes) can only assume a finite set of integer values, we have also run ordered probit analysis. Here the number of valid cases is 64. Table 3 reports the results. OLS regression was employed for the Contractual Networks variables, the results of which are shown in Table 4.

----- INSERT TABLES 2, 3 AND 4 ABOUT HERE -----

All the analyses support the general double network hypothesis: the formation of outbound networks is supported by the use networks in accessing resources.

As to the types of networks, the results show that related inbound and outbound networks are 'similar in kind', i.e. that the extent of use of one type of outbound network (e.g., proprietary networks) depends on the use of the corresponding inbound network (i.e. proprietary) and not on other types of networking activities.

This result supports a specialized competence argument: the management of networks is not a generic competence, but, as networks differ, firms develop competencies in particular types of networks that they then use for both the acquisition of resources and as a way to interact with the rest of the economic system.

The relationships among different types of networks are, instead, non significant. This result suggests that complementarities among them are low, and that contingency variables across sectors and tasks may differentiate the type of network used.

The analysis of control variables lends some indirect support to this interpretation, as the coefficient for the industry dummy is positive and significant, albeit for the Networks from Outbound HR only. In other terms, being a service industry has a strong positive influence on the formation of networks thanks to former employees that enable the focal firm to make its knowledge, in the form of product and services, available to the rest of the economy.

Age does not seem to play a role in the development of outbound networks, again with the exception of Networks from Outbound HR.

Finally, we have regressed a traditional measure of size (revenues) against both network variables inbound and outbound (Tables 5 and 6). Among the outbound networks variables, only Proprietary Networks Out is positive and significant. This can be simply the result of the fact that only relatively large firms engage in equity operations in other firms. More interestingly, among the inbound variables, only the coefficient of HR from Networks is related to size. This suggests the tentative conclusion that the internal growth of the firm, even when measured in terms of revenues (rather than of number of people) is distinctively supported by the

networked access of human resources, beyond and above the networked access to financial capital and technological assets. .

More generally, the result that traditional measures of size are poorly explained by networks variables – with the exception of inbound HR networks - provides support for the argument that internal and networked growth are two distinct phenomena; that formal networks distinctively contribute to networked growth rather than to the (internal) growth of firm; and that only HR networks are multifunctional, i.e. contribute to all forms of growth.

----- INSERT TABLES 5 AND 6 ABOUT HERE -----

6 SUMMARY AND CONCLUSIONS

This paper has highlighted that there are two forms of growth – internal and networked; maintained that the latter should be particularly relevant for new firms; and inquired in its predictors. The conceptual framework set out a ‘double network hypothesis’, namely, that there are interaction effects between the two types of networks, a virtuous circle between the ‘vortexes’ of knowledge and financial resources in input and the new firms’ vitality in terms of inter-firm networking as an output. In addition we inquired in the interactions between the qualitative composition of inbound and outbound networks.

The results support the double network hypothesis in its general form: the formation of outbound networks is supported by the use networks in accessing resources

The empirical analyses respond to the research question about the qualitative composition of networks by indicating that there are more intense and positive interactions among networks of ‘the same type’ , rather than of different type: in particular inbound contractual networks sustain outbound contractual networks, and the same holds for proprietary networks, supporting the explanation of the double network effect in terms of competencies and contingencies, rather than in terms of complementarities.

HR networks, however, behave in a somewhat different way. They seem to be more multifunctional. The outbound flows of former employees do sustain the formation of both formal and informal types of network (albeit especially in service rather than industrial sectors). And the inbound flows of HR through networks do contribute to both types of firm growth: internal and networked; while the other types of inbound networks contribute in a discriminating way to networked growth.

Hence, on a theoretical ground, the paper contributes, as intended, a dynamic model of the growth of the firm that innovates with respect to the currently dominant static versions of both resource-based and transactional views of the firm, and is more suitable for analyzing innovative entrepreneurial firms. In addition, though, the findings about the special role of human resource networks have also provided a test of the 'social embeddedness hypothesis' expressed in a particular way (previously unavailable to our knowledge): namely that social and professional networks not only sustain the formation of contractual relations in general, but sustain the formation and growth of firms in particular, and more so than contractual and proprietary networks do.

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TABLES AND FIGURES

Figure 1 – The double network hypothesis

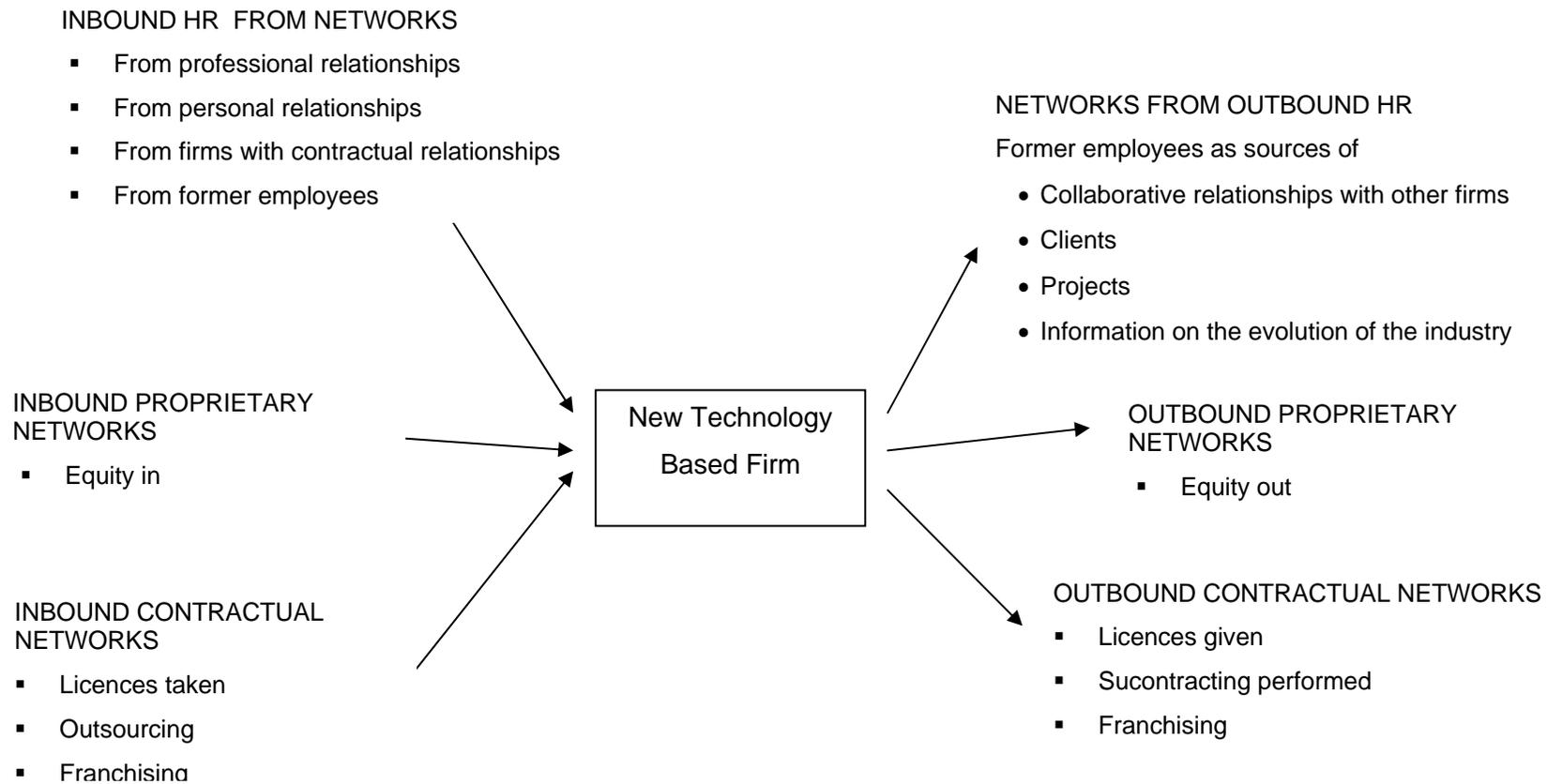


Table 1. Correlation table

	Inbound HR from Networks	Inbound Proprietary Networks	Inbound Contractual Networks	Networks from Outbound HR	Outbound Proprietary	Outbound Contractual	Service sector	Revenues
Inbound HR from Networks	1							
Inbound Proprietary Networks	-0.0275	1						
Inbound Contractual Networks	0.2741*	-0.1851	1					
Networks from Outbound HR	0.4043*	0.1216	0.162	1				
Outbound Proprietary Networks	0.1860^	0.3453*	0.0419	0.1499	1			
Outbound Contractual Networks	0.2608*	-0.1482	0.6844*	0.1012	0.2759*	1		
Service sector	-0.0335	0.0245	0.3145*	0.1203	0.0621	0.2262^	1	
Revenues	0.1622^	0.045	0.1373	0.1309	0.2349*	0.2996*	0.0105	1
Older than 5 yeras	0.1098	0.0481	0.1616	-0.0646	0.2413*	0.2150^	-0.1569	0.2199*
* p<5%; ^p<10%								

Table 2 – Seemingly unrelated regressions

	Networks from outbound HR	Outbound propr. Networks	Outbound contract. Networks
<i>Pseudo R-sq</i>	.35	.34	.52
Inbound HR from Networks	.59*	-.003	.05
Inbound Propr. Networks	.47	.32*	-.08
Inbound Contract. Networks	.36	.09*	.61
Services	.95*	.02	.10
>5_years_old	-.64^	.10	.04
Revenues	-1.78e-08	2.68e-08*	1.94e-08
Const.	-.31*	-.38*	.10

Table 3 – Ordered Probit Regressions

	Networks from outbound HR	Outbound propr. Networks
<i>Pseudo R-sq</i>	.11	.33
Inbound HR from Networks	.55*	-.162
Inbound Propr. Networks	.39	1.48^
Inbound Contract. Networks	.03	.50
Services	.88*	-.08
>5_years_old	-.47	.91
Revenues	-4.01e-09	1.20e-07^

Table 4 – OLS regression for Outbound Contractual Networks

	Outbound contract. Networks
<i>Adj R-sq</i>	.46
Inbound HR from Networks	.05
Inbound Propr. Networks	-.08
Inbound Contract. Networks	.61*
Services	.10
>5_years_old	-.64^
Revenues	1.94e-08
Const.	-.04

Table 5 – OLS for revenues and inbound variables

Revenues	
<i>Adj R-sq</i>	.15
Inbound HR from Networks	1,157,374*
Inbound Propr. Networks	454,584
Inbound Contract. Networks	-30,722
Services	37,010
>5_years_old	2,775,108*
Const.	-1,307,485

Table 6 – OLS for revenues and outbound variables

Revenues	
<i>Adj R-sq</i>	.15
Networks from Outbound HR	190,592
Outbound Propr. Networks	2,469,860^
Outbound Contract. Networks	1,117,203
Services	-537,640
>5_years_old	2,434,647*
Const.	-50,533

ⁱ Reviews of the empirical evidence are provided by Autio (1997) and Storey and Tether (1998).

ⁱⁱ This study adopts a definition of NTBFs as firms younger than 25 years operating in high-tech industries. There are a variety of definitions for NTBFs (see Storey and Tether (1998) for an in-depth discussion). In particular, some studies adopt a definition similar to ours, while others opt for narrower definitions such as firms engaged in the development of new technologies.