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Regions Matter: How Localized Social Capital Affects Innovation and External Knowledge Acquisition

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To introduce new products, firms often use knowledge from other organizations. Drawing on social capital theory and the relational view of the firm, we argue that geographically localized social capital affects a firm's ability to innovate through various external channels. Combining data on social capital at the regional level, with a large-scale data set of the innovative activities of a representative sample of 2,413 Italian manufacturing firms from 21 regions, and controlling for a large set of firm and regional characteristics, we find that being located in a region characterized by a high level of social capital leads to a higher propensity to innovate. We find also that being located in an area characterized by a high degree of localized social capital is complementary to firms' investments in internal research and development (R&D) and that such a location positively moderates the effectiveness of externally acquired R&D on the propensity to innovate.

Key words: social capital; social interaction; external R&D acquisition; internal R&D; product innovation
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Introduction

The ability of firms to introduce product innovations is acknowledged to be a key determinant of organizational performance. As long ago as 1890, Marshall argued that geographical proximity promotes knowledge spillovers that benefit firms' knowledge production—i.e., positive externalities in the form of ideas that are "taken up by others and combined with suggestions of their own; and thus becomes the source of yet more new ideas" (Marshall 1890, p. 332). In other words, the production of knowledge in the local geographical environment affects the ability of firms to introduce innovations based on new ideas. Following Marshall (1890) and Jacobs (1969), various studies have analyzed knowledge spillovers and highlighted their localized nature (e.g., Alcácer and Chung 2007, Almeida and Kogut 1999, Bell and Zaheer 2007, Gambardella and Giarratana 2010, Jaffe et al. 1993, Owen-Smith and Powell 2004, Sorenson 2003). In a seminal quantitative empirical study, Jaffe et al. (1993) find that citations in patents tend to come from the same geographic areas and that the intensity of knowledge spillovers is uneven across regions because of different region-specific mechanisms. Owen-Smith and Powell (2004) show that membership in a geographically colocated network ("Boston+"), based on formal contractual relationships, positively affects innovation, whereas in a geographically dispersed network, membership per se does not affect innovation. In addition, Alcácer and Chung (2007) analyze the conditions under which firms may choose to locate in regions with high levels of spillovers while taking account of the increased probability of knowledge leakage to competitors in the regions. Although these contributions are very valuable, they do not model the social mechanisms that transmit knowledge in geographical locations, and they do not examine the effects of these mechanisms on firm-level outcomes, such as innovation, in general (however, see Owen-Smith and Powell 2004).

We help fill this gap in the literature by introducing the notion of geographically localized social capital to explain outcomes in the form of product innovation. We posit that geographically bound social capital is the key transmitter of knowledge spillovers within geographically constrained areas and that the resulting existence of localized social capital has implications for firms' abilities to innovate. Specifically, this paper is, to our knowledge, the first to identify geographically localized social capital as a key factor in promoting firm-level innovation and to provide quantitative evidence to support the claims made. The extant empirical literature on knowledge sourcing suggests that firms rely heavily on knowledge exchange with external parties, such as suppliers, customers, universities, other key individuals, and sometimes even competitors (Chesbrough 2003, Landry et al. 2002, Laursen and Salter 2006, von Hippel 2005). The central argument in this paper is that geographically bound social capital facilitates joint learning for innovation and reduces the search and transaction costs of both contractual and noncontractual interaction among the economic actors in a region. We define regional social capital as the localized norms and networks that enable people to act collectively within a region. This conceptualization follows Woolcock and Narayan's (2000, p. 226) general definition of social capital. We examine a key dimension of social capital—namely, the level of social interaction at the regional level.

This paper draws on social capital theory, the relational view of the firm, and the geography literature to examine the importance of regional social capital for firms' innovative capabilities. Using these elements, we build a theory that predicts a positive effect of regional social capital on firm-level innovation outcomes, and we explain how investments in both internal and externally acquired research and development (R&D) interact with regional social capital in explaining firm-level innovation. Our empirical investigation exploits within-country regional variation to investigate the effects of social capital on innovation. We use the case of Italy because we have access to regional data and also to reliable microeconomic data on firms and their innovative activities. Italy also provides an interesting test case because (a) social capital is unevenly distributed across Italian regions (Putnam et al. 1993), (b) Italy constitutes an empirical focus for prominent sociology inputs to the social capital debate (Banfield 1958, Putnam et al. 1993), and (c) Italy features prominently in the tradition of research on industrial districts (e.g., Brusco 1982, Piore and Sabel 1984). To analyze the effect of social capital on product innovation, we combine data on social capital at the regional level with a large-scale data set on innovative activities in a representative sample of 2,413 Italian manufacturing firms from 21 regions. We show that being located in a region characterized by a high level of localized social interaction leads to a higher propensity to innovate. This result holds after controlling for a large set of firm and regional characteristics, as well as regional political participation.[1] We find that firms that have invested in absorptive capacity in the form of internal R&D are more likely to benefit from localized social interaction. Moreover—and in line with our proposed theory of localized social capital—we find that social capital in terms of localized social interaction represents an external contingency that positively affects the efficiency of the external sourcing of R&D; i.e., location in an area characterized by a high degree of social interaction positively moderates the effect of externally acquired R&D on innovation outcome.

In terms of the originality of our contribution, our study is novel in introducing social capital into the literature on geographically localized knowledge creation: to the best of our knowledge, this is the first study that demonstrates the existence of Marshallian knowledge spillovers linked to localized social capital. One set of important contributions in the management literature (e.g., Nahapiet and Ghoshal 1998, Tsai and Ghoshal 1998) focuses on social capital and innovation in intrafirm relationships, but as the authors in this tradition themselves acknowledge, their analyses can be extended to other institutional settings characterized by enduring relationships, including interorganizational interactions. Another pertinent contribution (Owen-Smith and Powell 2004) addresses the issue of firms' network positions in local networks and firm-level innovation and emphasizes the strategic benefits of formal connections, but does not address the role of ties to individuals or the social aspects of collaboration. We also extend the literature on geographically localized social capital (e.g., Kalnins and Chung 2006, Uzzi 1997) to encompass firms' product innovation more explicitly by explaining how firms' investments in internal and external R&D are intertwined with localized social capital—derived from the social interaction of individuals—in producing innovation outcomes, and we provide a set of micromechanisms that underpin the macroconcept of localized social capital in the context of innovation. As a starting point, we posit that interaction on innovation between a focal firm and its environment has two essential requirements: the exchange of information/knowledge, and the provision of trust to support joint activities in a highly imperfect market. We add to the social capital literature by specifying two theoretical effects of localized social capital that facilitate these requirements: geographically localized connectivity and trust effects. On a related note, we extend the argument made in the innovation literature that external knowledge acquisition can be an important ingredient in product innovation beyond the focus on the relationship between internal and external knowledge sources and its effect on firms' abilities to introduce product innovation (Arora and Gambardella 1990, Cassiman and Veugelers 2006, Schmidt 2010). Given pervasive market failures in the markets for technology (Arora et al. 2001)—and holding the interaction between internal and external R&D constant—we introduce localized social capital as an important contingency for effective external R&D investments.

Finally, we make an important empirical contribution in considering social capital as a factor that is embedded in the local geographical environment of the firm—not something linked to its narrow external relationships, e.g., associations with suppliers, customers, and universities. In following the original idea by Putnam et al. (1993) to link social capital to the local geography, we avoid a setup where observed social capital could be nothing more than a reflection of a focal firms' ability to establish well-functioning external relations. Our approach, on the other hand, creates a desirable distance between the independent and dependent variables.

Empirical and Theoretical Background

The importance of social variables to explain differences in economic outcomes across regions has a long tradition. Banfield (1958) argued that southern Italy's economic backwardness was due to a lack of social capital, while Putnam et al. (1993) has found that the performance of Italian social and political institutions is influenced strongly by citizens' engagement in community affairs, i.e., by social capital. The study by Putnam and his colleagues prompted a substantial body of research on the relationship between social capital and economic outcomes (Nahapiet and Ghoshal 1998) as well as many empirical studies focusing on the role of geographically constrained social capital at different levels of aggregation, ranging from cities (e.g., Jacobs 1961) and regions (e.g., Beugelsdijk and van Schaik 2005, Putnam et al. 1993) to entire nations (e.g., Knack and Keefer 1997, Zak and Knack 2001).

The relational view of the firm prompts the conjecture that firms' critical resources often span firm boundaries and are embedded in interfirm resources and routines (Dyer and Singh 1998); therefore, complementary resource endowments, effective governance, and external partners are important sources of knowledge for new ideas and information that can result in product innovations and consequential supernormal profits. The Marshallian view posits that agglomeration is driven by spillovers of information, knowledge, and new ideas. Spillovers are context-dependent as a result of two interrelated factors. First, an important component of knowledge is tacit, difficult to unbundle from its context ("sticky"), and complex; therefore, its transfer requires information-rich, face-to-face interactions (Nelson and Winter 1982, Szulanski 1996, von Hippel 1994). Second, personal contacts—the major means of face-to-face interaction—are fostered by proximity and are less likely to be established over larger geographical distances (Rosenthal and Strange 2003, Storper and Venables 2004). In the words of Rosenthal and Strange (2003, p. 387), "Information spillovers that require frequent contact between workers may dissipate over a short distance as walking to a meeting place becomes difficult or as random encounters become rare." Given that individuals are proximate within geographical regions, these geographic spaces play a key role in defining the geographic boundaries of social capital. In addition, through their social interactions, the individuals residing within particular regions develop shared identities based on industry similarities and associated communication codes, which facilitate cooperation within these individual regions (Romanelli and Khessina 2005).

Our analysis rests on three additional assumptions. First, personal relationships overlap work relationships because social capital is dependent on individual attitudes and behaviors, which impinge on the collective behavior of firms. This assumption is supported by the literature on localized economic activities, which argues that multiple-level networks (professional and personal) eventually merge within geographical locations (Brusco 1982, Saxenian 1994). Saxenian (1994) argues that the success of Silicon Valley compared with other regions, such as Route 128, is based on a more robust exchange of ideas among firms and other local institutions, facilitated by a system of collaboration and learning. Second, we take location as a given. To a degree, this assumption is supported by Dahl and Sorenson (2009), who find that entrepreneurs place much more emphasis on closeness to family and friends when deciding where to locate those businesses than on regional characteristics that might influence the performance of their ventures. Third, we assume that social capital is effective as a factor that facilitates the transmission of information and creates trust, irrespective of the regional level of development (we control for the level of development in the empirical analysis). As North (1989) suggests, once economic relations extend beyond the local level, transaction costs related to monitoring and enforcement increase markedly, and the local social network has to be replaced and/or complemented by formal organizations and institutions. There is evidence of a substitution effect between social capital on the one hand and other institutions associated with higher levels of development and overall more efficient markets on the other hand (see, for instance, Guiso et al. 2004). Although this evidence implies that social capital is more important in underdeveloped areas, this is not definitive. For instance, Knack and Keefer (1997) demonstrate that trust and civic norms are stronger in countries with formal institutions that enable effective contract and property rights protection, and La Porta et al. (1997) suggest that public and private institutions are less effective in countries with low levels of trust among citizens.

Hypotheses

Social Interaction and Innovation

The innovation literature demonstrates that firms' innovation processes depend strongly on external actors, e.g., users, suppliers, universities, and competitors (see, e.g., Arora et al. 2001, Shan et al. 1994, von Hippel 1988). The distributed or open (Chesbrough 2003) nature of the innovation process is derived from its information and knowledge requirements: innovation necessitates combinations of a variety of new and existing knowledge bases located inside and outside the focal firm. We develop the hypothesis that high levels of geographically bounded social capital, in terms of social interaction in the home region, may generate competitive advantage for local firms in the form of innovation, because localized social capital favors information and knowledge flows among firms and external actors within regions.

The idea central to social capital theory is that high levels of social interaction provide information benefits in terms of access, i.e., the opportunity to obtain a valuable piece of information; of timing, i.e., the opportunity to be informed early; and of referrals, i.e., having your name prominent at the right time and in the right place (Burt 1992). The central contributions to social capital theory (as expressed in the work of, e.g., Ronald Burt or Sumantra Ghoshal) have been cast mostly in rather general terms and do not relate to geographic proximity. However, some authors within the sociological network tradition emphasize the important role of geographical proximity in the context of innovative activities (e.g., Owen-Smith and Powell 2004, Stuart and Sorenson 2003). Stuart and Sorenson (2003, p. 232) describe this proximity in the context of innovation as follows: "When people with common professional interests cluster in physical space, informal social and professional networks emerge and serve to disseminate information." Indeed, as Uzzi (1997, p. 62) suggests, some of the benefits of geographically localized networks is that they allow for the transmission of face-to-face interaction channeling "fine-grained information" that allows later information processing and problem recognition. Given that regional social capital is defined in terms of norms and networks, it favors innovation because it helps to connect people across different organizations and to combine their knowledge components within particular regions. We term this the *localized connectivity effect*. Whereas explicit knowledge may be relatively easy to obtain through minor efforts, such as reading journals or benchmarking, social interactions enable a closeness between firms that facilitates the exchange of the deeper, tacit components of knowledge (Kogut and Zander 1996, Lane and Lubatkin 1998). An implication of the relational view (Dyer and Singh 1998, Lane and Lubatkin 1998) is that social interaction among knowledge workers within a region also may enhance the ability of firms to recognize and evaluate local external knowledge, providing better access to and understanding of specialized information, language, know-how, and the operations of other actors and allowing more efficient communication. Localized social interaction not only can improve flows of knowledge from the supply side, but it also can function as a channel to enhance firms' understanding of the demand side, enabling a better knowledge about (local) user needs—a factor that has been found to be critical for innovation success (Rothwell et al. 1974, Slater and Narver 1994).

The social interaction component of social capital supports access to informal channels of knowledge within a region. Following Granovetter (1973), Burt (1992) argues that the strength of weak ties stems from the possibility of these ties bridging otherwise disconnected groups of individuals and firms. Such relations can lead to boundary-spanning searches, often seen as necessary for successful innovation (Fleming and Sorenson 2001, Rosenkopf and Nerkar 2001). Provided that localized (in our case, intraregional) networks are effective for facilitating innovation, localized social capital in terms of social interaction may ease the process of an external knowledge search by providing a richer set of communication channels (Sorenson 2003, Sorenson and Audia 2000), thereby increasing the chances that problem solvers with complementary knowledge can make fruitful connections with respect to innovation.

Not only does localized social capital connect knowledge workers through connectivity effects, but it also improves the functioning of knowledge connections by alleviating potential moral hazard problems through the creation of trust. We term this the *localized trust effect*. Transaction cost theory suggests that a solution to problems related to information asymmetries would be the use of formal safeguards—for instance, in terms of hostage exchange of assets—and third-party interventions for conflict resolution (Pisano 1990, Williamson 1979). In contrast, the relational view of the firm suggests informal safeguards as alternatives or complements to formal safeguards (Dyer and Singh 1998). Informal safeguards rely on trust and embeddedness as well as related reputation effects.

Previous research suggests that informal safeguards are more effective for complex exchanges, such as those related to innovation (Dyer and Singh 1998, Hill 1995, Uzzi 1997). Central to this argument is that repeated social interaction leads to increased trust (Granovetter 1985, Gulati 1995, Tsai and Ghoshal 1998). This implies that localized, regional social interaction would lead to localized trust, which is in line with Saxenian's (1994) findings for Silicon Valley. According to Gulati (1995), there may be at least two reasons why repeated social interaction increases trust. First, as firms interact via the interactions of their employees, they learn about each other and develop trust based on shared notions of fairness (Gulati terms this "knowledge-based trust"). Second, trust arises from repeated interactions: the behavior of one firm may be perceived as untrustworthy by another local firms' workforce, leading to costly sanctions that exceed the potential benefits of opportunistic behavior (Gulati terms this "deterrence-based trust"). Reports of noncooperation are likely to spread rapidly within a geographically bounded area, such as a region, as a result of the high degree of social connectedness in that location. Regardless of how trust is created within a geographically proximate area, it is likely to increase both formal and informal knowledge exchange among firms, and to increase the likelihood that the firms will be innovators. Because product innovation is the result of a combination of internal and external knowledge, we suggest that innovation is affected by social connections and consequential trust within regions; i.e.,

Hypothesis 1. *Firms operating in regions with high levels of social capital in terms of social interaction are more likely to introduce product innovation.*

Social Capital and Internal R&D

Previous research suggests that there is complementarity between internal and external knowledge sources (Arora and Gambardella 1990, Cassiman and Veugelers 2006), i.e., that the return from one variable increases with increases in another variable. In our case, we expect that (1) firms' own investment in R&D will increase the value of social capital for producing innovative output, and (2) the value of R&D investments will increase with higher levels of regional social capital. The first expectation is grounded in the literature on absorptive capacity (Cohen and Levinthal 1990): to benefit from external knowledge transmitted through social capital and the localized connectivity effect described previously, firms must invest in in-house knowledge. Without such investment, it will be very difficult—if not impossible—to identify, assimilate, and exploit knowledge from the external environment. In other words, not all firms can be expected to benefit equally from regionally bound social capital in the form of social interaction. Those that invest more in R&D should benefit more from location in an environment endowed with high levels of social capital.

The second expectation is based on the idea that in-house R&D may not provide sufficient inspiration or variety to enable combinations of knowledge required to produce innovation (Rosenkopf and Almeida 2003, Rosenkopf and Nerkar 2001). Thus, a combination of in-house and beyond-firm boundary search is required (Rothaermel and Alexandre 2009). Rosenkopf and Nerkar (2001, p. 292) state that "the gains associated with the internal development of technology are not sustainable unless the organization is able to integrate external developments." Note that our focus in this paper is on organizational boundary spanning through the localized connectivity effect exerted by the focal firm on other agents within the region, but it does not preclude the importance of boundary spanning outside the region. However, out-of-region organizational boundary spanning is more difficult to handle in the case of innovation, given that it is likely to involve less face-to-face interaction because this is more costly over longer geographical distances (Morgan 2004).[2]

In sum—and factoring in both absorptive capacity and localized boundary-spanning arguments—we hypothesize the following.

Hypothesis 2. *Social capital and internal R&D spending are complementary in affecting the likelihood of introducing product innovation.*

Social Capital and Externally Acquired R&D

There are several reasons why investment in externally acquired R&D might fail to facilitate innovation in the acquiring firm.[3] In this context, research on external knowledge acquisition is informed by transaction cost economics (Pisano 1990; Teece 1986, 1988; Williamson 1985). Because R&D projects are complex and involve asset-specific investments, R&D contracts are hard to define ex ante (Arora et al. 2001), introducing imminent risks of hold up (Oxley 1997, Williamson 1979). The relational view of the firm posits that social capital may work as an institutional reparation mechanism for the implied market failures, facilitating solutions to ex ante and ex post transaction cost problems (Dyer and Singh 1998). Following this more general logic, high levels of regional social capital should enhance intensive and repeated interactions, as well as the creation of trust, reciprocity, and mutual expectations among the actors in the region. In addition, social interactions develop over time in dyadic relationships as formal exchange partners become more comfortable with and confident about each others' competencies and reliability in economic exchange (Larson 1992, Ring and van de Ven 1994). Repeated interactions—including localized geographical interaction—may augment the actors' incentives to exchange information relevant to transforming outsourced R&D into innovations (Dyer and Singh 1998, Larson 1992, Zahra et al. 2000), and recurring social interactions facilitate the sharing of expectations and goals and reduce the need for formal monitoring (Yli-Renko et al. 2001). Certainly, regions that are characterized by extensive social interactions may favor the sharing of expectations and reduce the need for formal monitoring within the region. Indeed, these localized factors increase the probability that outsourced R&D will result in product innovation.

Reduced transaction costs is not the only determinant of external knowledge acquisition, however. The resource-based approach highlights the process of resource accumulation and learning in the decision to acquire external knowledge (Robins and Wiersema 1995). Specifically, successful outsourcing may require outsourcing experience and involve trial and error. In fact, the effectiveness of external R&D acquisition depends on the ability of the firm to recognize and assess the value of external knowledge and to understand the willingness of other actors to share useful information (Dyer and Singh 1998, Yli-Renko et al. 2001). Obtaining this ability through learning on the part of acquiring firms may be facilitated by geographical locations characterized by high levels of social interaction and derived trust (Brusco 1982, Lundvall 1992).

In sum, high levels of regional social capital generate an environment that facilitates the process of search for complementary knowledge and increases trust among the parties involved through localized connectivity and trust effects. Operating in a region with high levels of social capital may provide better opportunities to learn how to deal with the management of outsourced R&D activities. In short, if two otherwise equal firms invest the same amounts in outsourced R&D, the firm located in a social capital-rich region is more likely to produce an innovation than the firm in a social capital-poor region. Accordingly,

HYPOTHESIS 3. *The effectiveness of externally acquired R&D on the likelihood of introducing product innovation is higher for firms operating in regions associated with high levels of social capital.*

Data Description

This research uses firm- and region-level variables, constructed from data from different databases. The firm-level data on innovation come from Capitalia (an Italian banking group), which collects data on Italian manufacturing firms through stratified random sampling of manufacturing firms with more than 10 employees (Capitalia 2006). The survey refers to the three-year period 2001–2003, and the sampling plan was created by subdividing the population of assigned firms into layers (strata). The population from which the sample was extracted consists of approximately 70,000 firms, representing about 7% of the total number of firms and 9% of the total employees. The survey was based on a questionnaire instrument administered through telephone interviews and achieved a response rate of 28.5%. The final sample is representative of Italian manufacturing firms across four macroregions (i.e., northwest, northeast, center, and south), Pavitt's (1984) sectors (i.e., supplier-dominated, scale-intensive, science-based, specialized supplier), and firm sizes (11–20, 21–50, 51–250, 251–500, more than 500 employees) (Capitalia 2006). The number of observations with no missing values for any of our variables is 2,413 firms.

The regional-level data used to analyze structural social capital were collected by the Italian National Institute of Statistics (ISTAT) through multiscope analyses in 1999. Response to this survey, which was based on telephone interviews, was compulsory: the response rate was 82.5%. Individual responses were aggregated by ISTAT at the level of the 21 Italian regions. To validate the geographical unit of analysis (the 21 regions) against the alternative of the Italian provincial level (regions were selected to include at least 2 provinces, and the 21 regions chosen represent 103 provinces), we conducted a components of variance analysis with random effects (see, e.g., McGahan and Porter 1997) for three variables related to geographic structural social capital, which are available also at the provincial level: (1) per-capita gross domestic product (GDP) for 2001, (2) participation rate in the 2001 referendum on institutional reform, and (3) per-capita legal protests for lack of payment of obligations for 2001. For these three variables, we find that the regional level accounts for between 68% and 77% of the total variance, whereas the provincial-level accounts for between 18% and 26% (the residual represents 5%–6%). Accordingly, we believe that the level of the 21 Italian regions is the most relevant level of aggregation for our purposes, because variation in social capital levels is more likely to be between rather than within regions. To measure regional expenditure on R&D as a percentage of regional GDP, regional human capital, and population size, we use data from EUROSTAT, the European Commission (EC) statistical office, for 1999. The units are the regions corresponding to the Nomenclature of Territorial Units for Statistics level 2 (NUTS 2), the classification adopted by the EC.

To an extent, we avoid the problem of common method bias because our dependent variables are collected at firm level, whereas some of the key independent variables (in particular, those related to social capital) are collected at the individual level and aggregated at the NUTS 2 regional level. To reduce the effects of consistency artifacts for the firm-specific variables, the questions related to outcome variables were positioned in the survey after the questions related to the independent variables (Salancik and Pfeffer 1977). We performed a Harman's one-factor test on firm-level variables on the models in this paper to examine whether common method bias might be augmenting the relationships detected (Podsakoff and Organ 1986). Because we found multiple factors, and because the first factor did not account for the majority of the variance (the first factor accounts for only 18% of the variance), the test does not indicate common method bias.

The Structural Social Capital Measure

The issue of how to measure social capital and identify its sources and consequences is contested (Portes and Landolt 1996). Nahapiet and Ghoshal (1998) and Lindenberg (1996) propose distinguishing between the structural and relational dimensions of social capital. The structural dimension refers to informal social interactions amongst individuals; the relational dimension refers to the assets rooted in those relationships (e.g., trust and trustworthiness). Following mainstream research on social capital (e.g., Coleman 1988, Portes 1998, Putnam et al. 1993, Woolcock and Narayan 2000), we consider the structural dimension to be the most suitable for empirical analysis because it focuses on the sources as distinct from the consequences of social capital. The structural dimension is also considered the most suitable for an empirical analysis because it is much easier to achieve an accurate measure. To measure the structural social capital of the Italian regions, we selected a total of 10 regional social capital variables (see Table 1). We include variables for friendships and spare-time socialization (*Meeting friends regularly,*

Table 1 Description of the Variables Included in the PCA

Variable	Description
Participation in cultural associations	People age 14 and older who have joined meetings in cultural circles and similar ones at least once a year in the 12 months before the interview, for every 100 people of the same area
Participation in voluntary associations	People age 14 and older who have joined meetings in voluntary associations and similar ones at least once a year in the 12 months before the interview, for every 100 people of the same area
Participation in nonvoluntary organizations	People age 14 and older who have joined meetings in nonvoluntary organizations at least once a year in the 12 months before the interview, for every 100 people of the same area
Voluntary associations per region	Number of voluntary organizations for every 10,000 people
Meeting friends regularly	People age 6 and older meeting friends at least once a week, for every 100 people of the same area
Social meetings	People age 6 and older attending bars, pubs, and circles at least once a week in the 12 months before the interview, for every 100 people of the same area
Satisfaction as to relationships with friends	People age 14 and older who are satisfied with their relationships with friends
Unpaid work for political parties	People age 14 and older who have carried out unpaid work for a political party in the 12 months before the interview, for every 100 people of the same area
Money given to parties	People age 14 and older who have given money to a political party at least once a year, for every 100 people of the same area
Participation in political meetings	People age 14 and older who have joined a political meeting in the 12 months before the interview, for every 100 people of the same area

Social meetings, and *Satisfaction as to relationships with friends*), participation in social organizations (*Participation in cultural associations, Participation in voluntary associations, Participation in nonvoluntary organizations,* and *Number of voluntary associations per region*) and participation in political movements (*Unpaid work for political parties, Contributions to political parties*, and *Participation in political meetings*).

We ran a nonparametric principal component analysis (PCA) on the social capital variables. This differs from the standard PCA and derives eigenvalues from a cograduation matrix (Spearman's rho or rank-order correlation coefficients). The aim is to minimize the effect of outliers. Table 2 presents the two principal components we extracted from the analysis. These two components explain 81.6% of the total variance. This is considered a very satisfactory result for the analysis of social variables. The first factor captures "social interaction," and the second captures "political participation." The social interaction component, which is of key interest, appears to capture important aspects of individuals' social networks consistent with our adopted definition of social capital and the social capital literature; the variable for political participation is a control variable because of its ambiguous effect in the Italian context. Specifically, and in line with Putnam's proposed measurement of social capital for social interaction, we consider items that capture regional participation in informal associations (Putnam et al. 1993) and socialization with friends (Putnam 2000). Both items reflect the breadth of social ties essential in social capital theory.

Table 2 Matrix of Factor Loadings

Variable	Component 1: Social interaction	Component 2: Political participation
Participation in cultural associations	**0.877**	−0.324
Participation in voluntary associations	**0.890**	−0.222
Participation in nonvoluntary organizations	**0.928**	−0.267
Number of voluntary associations per region	**0.745**	−0.380
Meeting friends regularly	**0.827**	0.104
Social meetings	**0.908**	−0.055
Satisfaction as to relationships with friends	**0.861**	0.039
Unpaid work for political parties	−0.410	**0.838**
Money given to parties	−0.184	**0.880**
Participation in political meetings	−0.631	**0.693**

The individual items underlying the social capital–social interaction construct can be linked to geography in the following way. For the three items for participation in organizations, our reasoning is based on the fact that all these items relate to participation in physical meetings (see Table 1). These meetings are almost certain to have been within-region meetings. For the item on the number of associations per region, this necessarily relates to a region. Based on insights from the sociological literature (e.g., Sorenson and Audia 2000), we would argue that friendships also are most likely to be local, i.e., within-region.

Econometric Analysis

Measures

Dependent Variables. The dependent variable for the first logit analysis is a dummy variable that takes the value of 1 if the firm introduced a product innovation and 0 if it did not. This variable is based on the responses to the following question: "Over the three-year period 2001–2003, did your firm introduce product innovation, by which we mean did the firm introduce at least one new (or a significantly improved) product?"

Key Independent Variables. Our research uses three key independent variables: (i) *social capital–social interaction*—from the factor analysis of social capital items at the regional level; (ii) *R&D intensity,* a firm-level variable reflecting internal R&D efforts, measured by the percentage of sales revenue spent on R&D; (iii) *external R&D acquisition*, captured by externally acquired R&D as a percentage of firm sales.

Firm-Specific Control Variables. In line with the existing literature, we control for the interaction between R&D intensity and externally acquired R&D (Cassiman and Veugelers 2006, Schmidt 2010). Moreover, although the empirical research indicates that the advantages of size for innovativeness are ambiguous, size is a commonly used variable in firm-level studies of innovation (Cohen 1995). We measure firm *size* by the number of employees. We control for firm *age* and for *percentage of employees with degrees*, which measures the firm's human capital. In addition, because the innovation literature shows that attention to user needs is important for innovation success (Pavitt 1984, Slater and Narver 1994), we use a dummy variable to describe the degree of attention to *customer satisfaction*. Principal activities are measured by three dummies for the Pavitt (1984) sectors: *supplier-dominated, scale-intensive,* and *science-based*, with *specialized suppliers* as the benchmark. To achieve a more fine-grained picture of the industry, we control for average *industry-level R&D intensity*, captured by R&D as a percentage of sales.

Region-Specific Control Variables. Region-specific characteristics that might influence innovation include political participation (*social capital–political participation*); the percentage of the workforce with a science and technology degree, which measures *regional human capital*; and (public and private) *regional expenditure on R&D* as a percentage of regional GDP. *Population* is captured by the number of residents in a given region in millions of people. To measure regional infrastructures, we include the control variables *passengers by air* (the number of passengers embarked and disembarked by air per every 100 inhabitants), *port infrastructures* (tonnages of inbound and outbound goods transported by sea per 100 inhabitants), and *road infrastructures* (tonnages of inbound and outbound goods transported by road per 100 inhabitants). These infrastructure variables can be seen as a reflection of the general "openness" of a region (Gambardella et al. 2009). As proxies for the region's economic activities, we use the number of *firms over population*, and the *Herfindahl index of industry concentration* by region. The latter we measure using industry sales data pertaining to 38 industries in each region. Furthermore, we add total *tax paid* on productive activities (IRAP) by region expressed in billions of euros. Finally, we introduce dummy variables for the 103 provinces and industry dummy variables for the 96 industries classified according to a mix of two- and three-digit industry codes (aggregated such that each industry includes at least five firms). Table 3 presents descriptive statistics and correlations among the variables, two of which are quite high. This points to the need to investigate problems related to multicollinearity, as we discuss below.

Regression Analysis

Means of Estimation. Because our dependent variable (product/no product innovation) is a binary variable, our estimation is based on a logit model. The potential presence of endogeneity means we need to take account of management's anticipation of performance outcomes because the chosen strategy may lead to biased coefficient estimates. An endogeneity problem emerges when there is a third, unobserved variable (e.g., whether or not the firm in question is competent) that would affect investment in both R&D and innovation. A competent firm will be more likely to invest in internal and external R&D but will also be more likely to innovate. Indeed, the management in competent firms will have much stronger incentives to invest in external or internal R&D because an innovation outcome will be more likely. If this is the case, part of the observed correlation between R&D investments and innovation will be spurious because it could be ascribed to management self-selection, not to the fact that internal and external R&D drive innovation (see Wooldridge 2002, pp. 50–51).

It is possible to eliminate the endogeneity bias using a two-stage instrumental variables (IVs) regression approach, provided that the chosen instruments from the first-stage model are not correlated with the unobserved variable representing managers' self-selection in the second stage of the model (Hamilton and Nickerson 2003). As we have two dependent variables in the first stage, with a lower and an upper bound (R&D intensity and the percentage of acquired R&D over total sales), the fractional logit regression may be applied (Papke and Wooldridge 1996). The model ensures that the predicted values of the dependent variable are in the interval $(0, 1)$. We use the predicted values from this first stage of the model in lieu of the observed values for R&D intensity and external R&D acquisition in the second-stage equation.

Table 3 Correlation Matrix

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 *Product innovation*	0.429	0.50																					
2 *Social capital–Social interaction*	−0.003	0.76	0.10																				
3 *R&D intensity*	0.828	2.82	0.23	0.05																			
4 *External R&D acquisition*[a]	0.781	0.42	0.78	0.42	0.16																		
5 *Size*	93.619	324.92	0.10	0.02	0.05	0.16																	
6 *Age*	27.467	18.72	0.03	0.09	0.00	0.08	0.08																
7 *Percentage of employees with a degree*	5.230	7.32	0.16	−0.05	0.24	0.35	0.06	0.01															
8 *Customer satisfaction*	0.713	0.45	0.08	−0.02	0.06	0.26	0.06	0.04	0.09														
9 *Industry-level R&D intensity*	0.804	0.86	0.18	0.06	0.33	0.40	0.04	−0.01	0.25	0.05													
10 *Social capital–Political participation*	0.040	0.84	−0.02	−0.10	0.03	0.13	0.05	−0.02	0.03	0.03	0.00												
11 *Regional human capital*	6.274	1.77	0.05	0.45	0.05	0.02	0.00	0.09	0.01	−0.01	0.12	−0.23											
12 *Regional expenditure on innovation*	0.980	0.36	0.02	0.02	0.08	−0.04	0.07	0.12	0.04	0.07	0.11	0.34	0.37										
13 *Population*	4.900	2.67	0.02	0.00	0.01	−0.22	−0.01	0.15	−0.03	0.05	0.07	−0.21	0.32	0.39									
14 *Passengers by air*	131.663	107.15	0.00	0.01	0.04	−0.07	−0.01	0.13	0.01	0.05	0.08	−0.12	0.29	0.48	0.81								
15 *No. of firms over the population*	0.087	0.02	0.01	0.12	0.00	−0.07	−0.01	0.00	−0.01	−0.01	0.00	−0.39	0.31	−0.34	−0.09	−0.23							
16 *Herfindahl index of industry concentration*	0.152	0.03	−0.06	−0.43	−0.04	−0.14	−0.04	−0.04	0.01	−0.01	−0.09	−0.13	−0.43	−0.24	−0.08	−0.02	−0.23						
17 *Road infrastructures*	24.071	7.58	0.10	0.94	0.05	0.11	0.01	0.09	−0.04	−0.01	0.07	−0.31	0.52	−0.03	0.11	0.06	0.30	−0.42					
18 *Port infrastructures*	72.629	108.70	−0.07	−0.28	−0.04	0.05	−0.03	−0.05	0.02	−0.04	−0.07	0.14	−0.05	−0.26	−0.37	−0.17	−0.04	0.48	−0.38				
19 *Tax paid*	46.327	30.11	0.04	0.21	0.03	−0.17	0.00	0.17	−0.02	0.05	0.09	−0.30	0.47	0.48	0.95	0.82	−0.05	−0.20	0.32	−0.46			
20 *Member of a commercial consortium*	0.133	0.34	0.03	0.00	0.00	0.40	−0.01	0.06	−0.04	−0.01	−0.04	0.01	−0.04	−0.07	−0.05	−0.02	0.01	0.03	0.00	0.08	−0.06		
21 *Labor flexibility*	0.085	0.14	0.04	0.06	0.01	0.34	−0.04	0.00	0.08	0.01	−0.02	−0.01	0.05	0.06	0.05	0.08	0.00	−0.03	0.07	−0.06	0.08	0.02	
22 *Gearing ratio*	2.143	15.66	−0.01	0.00	−0.02	−0.09	−0.01	−0.03	−0.02	0.01	−0.03	−0.01	0.00	0.04	0.01	0.01	0.00	0.00	0.00	−0.01	0.02	0.02	0.00

Note. Correlation coefficients above |0.04| are statistically significant at the 5% level.
[a]Indicates a predicted variable from the first-step fractional response estimation.

Because the instruments must not encompass the same problem as the original regressor (Wooldridge 2002), finding the most suitable instruments is crucial. The instruments must be strong (i.e., must have an effect in the first stage of the model) and valid. As a rule of thumb, we would say that the instruments should not be correlated with the dependent variable in the second stage of the model, although the true test of a valid instrument is that it should not be correlated with the part of the error term that is related to the problem of endogeneity. We base our selection of instruments on theoretical arguments and the Amemiya-Lee-Newey minimum chi-square test, which tests whether the group of instruments is valid according to the above. This tests for whether it is necessary to accept (or reject) the entire group of excluded instruments.

To measure R&D intensity, we identify three instruments likely to influence a firm's investment in R&D but not likely to influence innovation. The first is *current ratio*, which is the current assets over current liabilities and can be considered an indication of the firm's ability to meet its obligations. The higher the ratio, the more liquid the company; the greater its financial strength, the more likely the company will invest in R&D. However, it is difficult to predict the effect of a high current ratio on innovation because unpredictable events can intervene in the relationship between liquidity and innovation outcome. Second is *equity less noncurrent assets,* which is a measure of the difference between owners' equity and tangible fixed assets. A positive value for this variable means that the firm's investment in fixed assets was financed using its own equity. The higher the value of this variable, the more the firm draws on equity for current activities. Consequently, it is reasonable to believe high values for this variable mean that firms are more likely to invest in R&D, but it may be difficult to establish a direct effect on innovation. Third is the *gearing ratio*, measured as owner's equity over borrowed funds, which provides a measure of the degree to which the company's activities are financed by the owner or creditor(s). When the gearing ratio is high, firms are more vulnerable to business cycle downturns because they must continue to pay off debts regardless of poor sales. Thus, firms that present a high gearing ratio may find it more difficult to invest in R&D because of their greater vulnerability and resource constraints; however, the effects of this variable on innovation are unclear.

To estimate external R&D acquisition, we use three instruments. The first measures whether the firm is a *member of a commercial consortium*, the argument here being membership in a commercial consortium is indicative of more experience in cooperating with other organizations, which means that the variables are likely to have a positive effect on external R&D acquisition without any direct link to the introduction of innovation. Second is *labor flexibility*, measured as the number of employees on short-term contracts over the total number of employees, which describes a human resource practice that may contribute to the utilization of external knowledge, increasing the possibility that the firm will forge new linkages outside its boundaries. Third is *gearing ratio*, which, as described above, does not seem to have a clear effect on the propensity to innovate. However, it is conjectured that it has an effect on external R&D acquisition: a high gearing ratio implies a resource constraint and reduces the possibility that the firm will acquire external R&D.

All the instruments in the first-stage regression model are correlated (see Tables A.1 and A.2 in the appendix) to the variables for which they instrument (R&D intensity and external R&D acquisition), which shows that we have reasonably strong instruments. Because we are using a fractional response logit-logit specification, we have no perfect test for instrument validity. However, the probit model with endogenous regressors allows us to test the validity of our instruments. To get a better understanding of instrument validity, we use an IV probit estimation of our equations (the IV probit model produces results consistent with the fractional response logit-logit model). The joint null hypothesis is that the group of instruments is valid, i.e., the instruments are uncorrelated with the error term in the structural equation, and the excluded instruments are correctly excluded from the estimated equation. Using the three instruments described above for R&D intensity, the Amemiya-Lee-Newey minimum chi-square test statistic is 1.29, with a corresponding p-value of 0.53. In other words, we cannot reject the null hypothesis. However, with seemingly valid and strong instruments, we need to confirm the existence of an endogeneity problem. In this case, a Wald test for exogeneity does not reject the idea that R&D intensity is exogenous to defining the probability to introduce a product innovation. Thus, we treat R&D intensity as exogenous. Using the three instruments for external R&D acquisition, the Amemiya-Lee-Newey minimum chi-square test static has a corresponding p-value of 0.31. This means that we cannot reject the null hypothesis. In this case, the Wald test for exogeneity rejects the idea that acquisition of external R&D is exogenous to determining the probability of being a product innovator at the 5% level. Hence, we treat the acquisition of external R&D as endogenous when considering product innovation.

Results

The results of the logit estimations for the second stage of the procedure are reported in Table 4. Models I and II represent our empirical model estimated with all controls, including fixed effects for province and the two- to three- digit industry for product innovation.[4] These estimations suffer from serious multicollinearity problems. In models I and II, the variance inflation factor

Table 4 Results of the Logit Regressions for Product Innovation Using Instrumental Variables

	Model I		Model II		Model III		Model IV		Model V	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Social capital–Social interaction	16.509***	[1.585]	18.460***	[1.537]	0.149*	[0.076]	0.286***	[0.079]	0.275***	[0.080]
R&D intensity	5.318***	[0.563]	6.012***	[0.580]	5.459***	[0.546]	5.885***	[0.550]	6.076***	[0.561]
External R&D acquisition	4.676*	[2.033]	4.739*	[2.111]	3.332*	[1.930]	3.235†	[2.029]	3.385*	[2.001]
Social interaction × R&D intensity			2.726***	[0.569]			2.761***	[0.528]	2.638***	[0.548]
Social interaction × External R&D acquisition[a]			4.316*	[1.994]			4.410*	[2.162]	4.081*	[2.141]
R&D intensity × External R&D acquisition[a]			−4.425***	[1.187]					−4.480***	[1.202]
Size	0.002***	[0.000]	0.002***	[0.000]	0.002***	[0.000]	0.002***	[0.000]	0.002***	[0.000]
Age	0.001	[0.003]	0.000	[0.003]	0.001	[0.002]	0.001	[0.003]	0.001	[0.003]
Percentage of employees with a degree	0.023**	[0.008]	0.022**	[0.008]	0.020**	[0.007]	0.020**	[0.007]	0.019**	[0.007]
Customer satisfaction	0.138	[0.115]	0.132	[0.116]	0.097	[0.075]	0.102	[0.075]	0.100	[0.075]
Supplier-dominated					−0.421***	[0.120]	−0.392***	[0.122]	−0.390***	[0.122]
Scale-intensive					−0.455**	[0.151]	−0.424**	[0.152]	−0.418**	[0.152]
Science-based					−0.561†	[0.313]	−0.415	[0.313]	−0.417	[0.312]
Specialized suppliers					Benchmark		Benchmark		Benchmark	
Industry-level R&D intensity	0.126	[0.125]	0.149	[0.126]	0.149	[0.108]	0.145	[0.109]	0.138	[0.109]
Social capital–Political participation	−2.401***	[0.424]	−2.703***	[0.431]	−0.091	[0.071]	−0.137†	[0.073]	−0.135†	[0.073]
Regional human capital	−0.106	[0.183]	−0.137	[0.179]	−0.026	[0.039]	−0.023	[0.039]	−0.023	[0.039]
Regional expenditure on innovation	0.722	[1.890]	1.212	[1.855]	−0.070	[0.198]	0.034	[0.209]	0.034	[0.209]
Population	0.000	[0.000]	0.000	[0.000]	0.000*	[0.000]	0.000	[0.000]	0.000	[0.000]
Passengers by air	0.009	[0.012]	0.008	[0.012]	−0.002*	[0.001]	−0.001	[0.001]	−0.001	[0.001]
No. of firms over the population					−1.368	[3.228]	0.063	[3.399]	0.066	[3.398]
Herfindahl index of industry concentration					−0.621	[1.895]	−1.386	[1.895]	−1.306	[1.894]
Road infrastructures	−1.568***	[0.163]	−1.776***	[0.157]						
Port infrastructures	−0.005	[0.005]	−0.004	[0.005]						
Tax paid	0.000	[0.000]	0.000	[0.000]						
Industry dummies	Yes		Yes							
Provinces dummies	Yes		Yes							
Constant	—	—	—	—	0.024	[0.550]	−0.098	[0.557]	−0.093	[0.557]
No. of observations	2,406		2,406		2,413		2,413		2,413	
Log likelihood	−1,389		−1,370		−1,443		−1,428		−1,426	
Chi-square	510.62***		548.57***		409.25***		439.20***		443.42***	
Pseudo R^2	0.155		0.167		0.124		0.133		0.135	

[a] Indicates a predicted variable from the first-step fractional response estimation. Standard errors are in brackets.
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed tests for controls, one-tailed tests for hypothesized variables).

(VIF) is higher than 9,500, which, among other things, leads to greatly inflated parameters for the social capital variables (partly expected, given that we have continuous geographical and industry variables as well as detailed geography and industry dummies). To circumvent these multicollinearity problems, in the determinants of innovation, we dropped the geographic dummies and used the Pavitt sectors to control for industry-level heterogeneity rather than the full set of industry fixed effects. We also dropped three additional province-level variables. This reduces the VIF to well below the typically recommended threshold of 10 (Belsley et al. 1980) in models III–V while still maintaining a sufficient number of control variables. Adding any of the dropped variables produces VIFs well in excess of 10.

Models I–V provide support for Hypothesis 1 (ceteris paribus, firms operating in regions with high levels of social capital in terms of social interaction are more likely to introduce product innovation), to the extent that the social interaction component of social capital is significant for explaining the likelihood of introducing product innovation. Furthermore, we find support for

Hypothesis 2 (ceteris paribus, social capital and internal R&D spending are complementary in affecting the likelihood of introducing product innovation). The interaction effect between the social interaction component of social capital and R&D intensity is positive and significant (see model V). Because of the nonlinear nature of the logit model, however, the marginal effect of an interaction effect is not simply the coefficient of their interaction (Hoetker 2007, Norton et al. 2004). In addition, because there are two additive terms, each of which could be positive or negative, the interaction effect may have different signs for different values of the covariates. To deal with this complication, we apply a procedure developed by Ai and Norton (2003) that computes correct magnitudes and standard errors for the interaction effect. The vertical axis in Figure 1 presents the magnitude of the interaction effect, and in Figure 2 the vertical axis shows the significance of the effect for each of the observations. The horizontal axes show the model's predicted probability—taking account of the effect of all the covariates—that the given firm is a product innovator. Figure 1 illustrates that the strongest interaction effect occurs at the lower end of medium predicted levels of probability of being innovative (approximately 0.2 to 0.6), whereas the effect is less clear-cut for very low and very high levels of the predicted probability of being an innovator. Figure 2 also shows that in the majority of cases the interaction effect is positive and significant at the two-sided 5% level (in 89.0% of cases). The effect is negative when the probability of being an innovator is very high (the interaction effect is significant and negative in 116 of the 2,413 cases). Thus, although our findings are generally in line with Hypothesis 2, there is a minority of observations to which it does not apply (see the next section for a discussion of this finding).

Regarding Hypothesis 3 (ceteris paribus, the effectiveness of externally acquired R&D on the likelihood of

Figure 1 The Size Effect of the Interaction Between Social Interaction and R&D Intensity

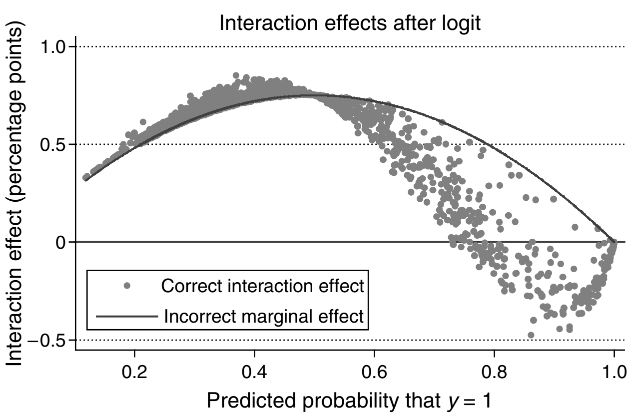


Figure 2 The Significance of the Interaction Between Social Interaction and R&D Intensity

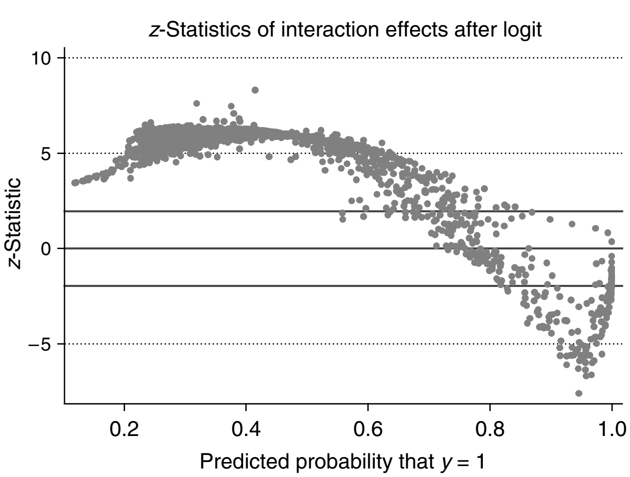
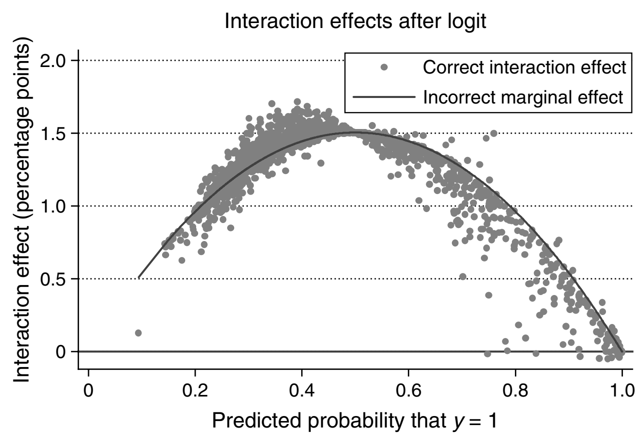
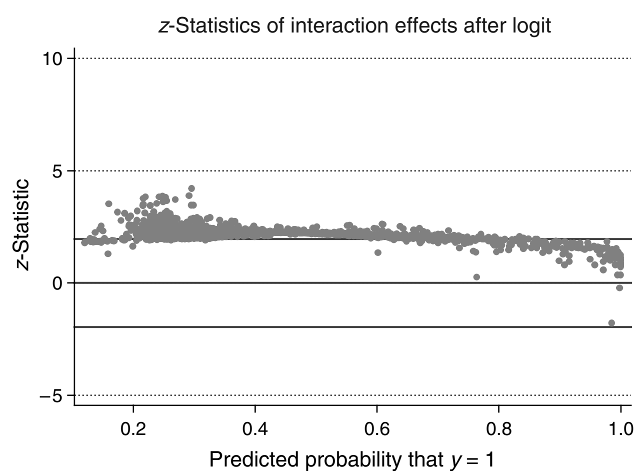


Figure 3 The Size Effect of the Interaction Between Social Interaction and External R&D Acquisition



Note. External R&D acquisition is a predicted variable from the first-step fractional response estimation.

Figure 4 The Significance of the Interaction Between Social Interaction and External R&D Acquisition



Note. External R&D acquisition is a predicted variable from the first-step fractional response estimation.

introducing product innovation is higher for firms operating in regions associated with high levels of social capital), we can detect a positive and significant interaction effect on product innovation of the social interaction component of social capital and the level of the firm's R&D that is externally acquired (see model V). Figure 3 illustrates that the strongest interaction effect occurs at the medium predicted levels of the probability of being innovative (approximately 0.3 to 0.6), whereas the effect is less obvious at low and high levels of predicted probability of being an innovator (the effect is negative in only 15 of the 2,413 cases). In other words, for firms with low predicted probability of being innovators, acquisition of external R&D combined with location in a region with a high level of social capital makes little difference. Similarly, firms with a high predicted probability of being innovators are likely to innovate regardless. Figure 4 illustrates that the interaction effect is positive and significant in the majority of cases (95.4% of observations). This result provides rather general evidence of the positive role of social capital in firms' acquisitions of external R&D.

Concerning the results for our control variables, it should be noted that the interaction between R&D intensity and externally acquired R&D is negative and statistically significant. This finding is in contrast to some contributions (e.g., Cassiman and Veugelers 2006) and in line with other contributions (e.g., Laursen and Salter 2006, Schmidt 2010). As a robustness check, we ran the model with process rather than product innovation as the dependent variable. We found a significant direct effect of social interaction on innovation. In addition, social interaction positively and significantly moderates the effect of external R&D acquisition on innovation, whereas regional social interaction does not appear to moderate the effect of R&D intensity on innovation.

Discussion and Conclusion

This paper demonstrates that geographically bound social capital affects the innovative ability of firms in 21 Italian regions. We theorized that regional social interaction helps shape product innovation through *localized connectivity* and *trust effects*, and we found empirical support for the significance of regional social capital, in the form of social interaction, as an important driver of firm-level product innovation. In other words, we provide evidence that location matters: firms located in regions characterized by a high level of structural social capital in terms of social interaction display a higher propensity to innovate. This is consistent with the literature on the role of geographical context for firm performance—e.g., industrial clusters, industrial districts, and territorial innovation systems (Asheim and Gertler 2005, Brusco 1982, Porter 1990, Romanelli and Khessina 2005, Tallman et al. 2004, Ter Wal and Boschma 2011).

We found also that such regional social capital is complementary to internal R&D in affecting innovation and that regional social capital enhances the functioning of externally acquired R&D in the sense that it increases the probability that external R&D leads to product innovation. However, our research also reveals an important nonlinearity: we found that among firms with a high probability of being innovators (or "leading-edge organizations"), high levels of regional social interaction mean that internal R&D is less likely to result in innovation. We suggest that there may be two reasons for this. The first could be that although social capital makes inbound spillovers flow more easily, it also facilitates knowledge leakage—and this could pose a problem, especially for the most advanced firms (Alcácer and Chung 2007). The second could be that leading-edge firms are often embedded in the local region but are unable to find sufficient inspiration for knowledge recombination in the local regional context. For these few more advanced firms, there seems to be some evidence of "overembeddedness" in the local region (Uzzi 1997).

In the case of both internal and external R&D, we found that the positive interaction effects on the probability of innovating are stronger for firms with a medium probability of innovating. These "medium-innovators" are generally considered to constitute the backbone of the Italian economy, and the fact that they benefit the most from social interaction effects is further empirical confirmation that this contextual knowledge factor is a key advantage for a local economy. It favors greater participation in the innovation process of otherwise more disadvantaged firms, thus generating further positive spillovers in the local context.

Our work provides two main contributions. First, we have described explicit social mechanisms that underlie the notion of spillovers and that link a focal firm to its geographical environment in the context of innovation. At the theoretical level, we have suggested that the connectivity and trust effects of localized social capital play a central role in this regard. This study is a first systematic attempt to demonstrate the existence of Marshallian knowledge spillovers linked to localized social capital from both theoretical and empirical angles. From an empirical viewpoint, there is practically no econometric analytical evidence on this issue. An important feature of our analysis is that it is based on a detailed data set built from different data sources, constructed to enable the selection of variables most appropriate for our purposes. Our story and the suggested micromechanisms fit nicely with one of the main results of the spillover literature: to absorb spillovers from the local environment, a degree of absorptive firm-specific absorptive capacity is needed. Second, this paper adds to the literature on the markets for technology (Arora et al. 2001, Fosfuri and Giarratana 2010), which so far has not examined the role of geographically constrained institutions in explaining the degree of well-functioning of these markets. We find support for the role of geography in this regard but also for the more general point that institutions not linked to the market in a narrow sense play a central role in the functioning of the markets for technology.

The findings of this study have implications for managerial practice. Whereas in regions with high levels of social capital, this capital positively affects the effectiveness of externally sourced R&D and favors firm-level innovation, in regions with low levels of social capital, it is necessary for firms to invest more in accumulating their own firm-specific social capital. For instance, they can promote meetings, partnerships, and communication with other firms and organizations—both inside and outside the local region. For leading-edge firms, within-region social interaction—even in a social capital-rich region—may not provide enough potential for knowledge recombination per se, making it essential for such firms to establish social connections with firms and individuals located outside the region to fuel their investments in R&D. Finally, the theory and evidence provided here show that the absorptive capacity hypothesis holds also in the case of localized social capital: even when firms have the advantage of location in a social capital-rich geographical environment, social capital is not a free lunch. To properly benefit from localized social capital, serious investment in one's own knowledge generation is required.

This study has some limitations. We focus on the positive net effects of social capital. However, social capital can also have negative consequences if the underlying networks become too tight-knit. Prominent social capital theorists, such as Coleman (1988), stress the importance of dense networks as a prerequisite for the creation of social capital. However, dense networks may incur penalties, e.g., the exclusion of outsiders, excess claims on group members, restrictions on individual freedoms, and downward leveling norms (see Portes 1998, p. 15, for a detailed discussion of these effects). Although our measure of social capital can be considered a mix of strong and weak ties, we acknowledge that it is not possible to identify these two types empirically. Although research that could separate these ties would be of great value, not least to enable further examination of the downsides of social capital in the form of overembeddedness (Uzzi 1997), such an analysis would be extremely difficult at the relatively high level of aggregation of the region.

Another limitation of this paper is that we focus on only one period. Although we have corrected for endogeneity problems, controlled for the large number of firm- and region-specific factors, and have a large sample of firms, the results of this study are based on cross-sectional data. Also, although we rely on two data sources, collected at the firm and regional levels, we do not know whether the externally acquired R&D was purchased in the home region. Accordingly, the positive moderating effect of the regional social interaction variable on the relationship between externally acquired R&D and innovation may be related to the fact that a high level of regional structural social capital makes the acquiring firm better able to learn to deal with the process of outsourcing R&D and, at the same time, more likely to be better connected socially to a selling firm located in the home region. Future research should collect data on the geographic origins of acquired R&D to disentangle these two effects.

Greater emphasis on how geographically bound social capital enables and constrains managerial behavior in other parts of the organization would appear to offer fertile ground for future research. In this paper, we focus on R&D processes, an important element in the innovation process, but regional social capital might influence the effectiveness of other of the firm's external relations, including formal collaboration between firms and external parties. Another avenue for future research would be to separate out the effects of social capital and (internal and external) R&D spending on innovation at the level of individual industries to explore possible industry variation. Insights from such research would provide guidance for managers making decisions about how to work with external parties in their environment.

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Appendix

Table A.1 First-Step Fractional Response Regressions Explaining R&D Intensity

Explanatory variable	Coeff.	S.E.
Current ratio	0.620*	[0.300]
Equity less noncurrent assets	0.000*	[0.000]
Gearing ratio	−0.006**	[0.002]
No. of observations	2,472	
Log likelihood	−77.3	

Notes. Estimates for the instruments are excluded in the second step (parameters for the included instruments are not reported). Standard errors are in brackets.

$^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$ (two-tailed tests).

Table A.2 First-Step Fractional Response Regressions Explaining External R&D Acquisition

Explanatory variable	Coeff.	S.E.
Member of a commercial consortium	0.552***	[0.148]
Labor flexibility	0.967**	[0.314]
Gearing ratio	−0.004*	[0.002]
No. of observations	2,520	
Log likelihood	−641.3	

Notes. Standard errors are in brackets. Estimates for the instruments are excluded in the second step (parameters for the included instruments are not reported).

[†] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed tests).

Endnotes

[1] Although political participation is an interesting variable and is considered very significant by an important part of the regional social capital literature (Putnam et al. 1993), we do not theorize about it because, given the ambiguous effect of this variable on innovation outcomes, Italy currently does not represent an empirical context that is appropriate for an examination of this potentially interesting issue; i.e., according to observers, political parties in Italy are increasingly "personal machines" (Calise 2000, p. 5), no longer accountable to members and activists sensitive to appeals for collective action (Della Porta 2004).

[2] Empirically, we control for the general openness of the region, which to some extent may reflect out-of-region boundary spanning (see Gambardella et al. 2009).

[3] By externally acquired R&D, we mean R&D conducted by other than the acquiring firm, excluding the acquisition of technologies.

[4] Stata automatically drops the variable for the number of firms over the population for reasons of collinearity.

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CORRECTION

In this article, "Regions Matter: How Localized Social Capital Affects Innovation and External Knowledge Acquisition" by Keld Laursen, Francesca Masciarelli, and Andrea Prencipe (first published in *Articles in Advance*, May 17, 2011, *Organization Science*, DOI: 10.1287/orsc.1110.0650), Stuart and Sorenson (2003, p. 232) were misquoted. The quote has been corrected to read as follows: "When people with common professional interests cluster in physical space, informal social and professional networks emerge and serve to disseminate information."