

Testing the role of Social Capital as a driver of the relationship between Research Expenditure and Outcomes

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Abstract

Innovation theories have identified and explained the antecedents of innovation outcomes. Theories have advanced from explaining innovation outcomes in terms of individual Research and Development (R&D) effort to include social capital. Although conceptual support for the relevance of social capital as an antecedent of innovation outcomes seems to be thick, measurement and quantitative evidence are scarce. We contribute to filling this gap by empirically testing the role of social capital as a driver of the relationship between research/learning expenditure and outcomes in the context of the Spanish and Italian regions. As there is no consensus on how to measure social capital, we use two different approaches: a rational choice-driven approach and a sociologically driven approach.

Keywords: Innovation, social capital, Italian Regions, Spanish regions, innovation expenditure and outcomes.

Classification: Research Paper

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1. Introduction

The importance of social capital as an antecedent of innovation has received much theoretical attention over the last few years (Landry et al., 2002). But empirical support is scarce, mainly due to: (1) lack of agreement regarding the content of the concept of social capital and the appropriate way of measuring it (Beugelsdijk and Van Schaik, 2005, Pérez et al., 2006) and (2) the lack of empirical research in the area (Evans and Syrett, 2007). Consensus exists regarding the multidimensionality of the concept, but sociologically driven and rational choice-driven approaches to conceptualise and measure social capital differ significantly both internally and between one another. Following the social network theory of innovation and learning region and regional learning approaches, we hypothesise that regional innovation outcomes are a result of Research and Development (R&D) expenditure (as a proxy of effective R&D effort and the learning orientation of a region) and social capital.

We use a rational choice-driven metric and a sociologically driven metric to measure social capital and empirically contrast the impact of social capital on innovation outcomes. We also discuss the predictive validity of both measures as antecedents of innovation outcomes. We believe that by studying the antecedents and consequences of the different measures of social capital, it might be possible to obtain: (1) relevant insights regarding the suitability of the largely different approaches proposed and (2) progress towards broader consensus. Montgomery (2000), among others, suggested the

necessity of studying social capital in a more structured way to avoid the danger that this intuitively appealing concept would remain vague and a black box in social science.

2. Social Capital and R&D Effort as Determinants of Regional Innovation Outcomes

Innovation theories have evolved dramatically over the last 40 years (Landry et al., 2002). During the 1950s, engineering innovation theories stated that R&D effort (basic research and industrial R&D) is the antecedent of innovation outcomes (new or improved products and processes). Innovation was considered a discrete event resulting from knowledge developed by isolated inventors and isolated researchers. In the 1960s, the market pull theories of innovation advanced to consider an external factor: the market. They established that successful innovation should be market-driven (i.e. the sources of ideas should be the market). Later, technological network theories of innovation provided a systemic view of innovation (systems of innovation), within which the innovation results of an individual company are leveraged by other technologically-focused actors.

More recently, social network theories of innovation were developed. As argued by Landry et al. (2002), these theories are based on two already existing ideas and on one new insight. The former state that innovation is determined by R&D (via engineering theory), and by disorderly interaction processes between firms and other actors (via technical network theories of innovation). The new insight is that knowledge plays a more and more crucial role in fostering innovation. It has been said that the availability of knowledge is a main explanatory factor of innovation and as a consequence of the success of a company, or a geographical space (see e.g. Romer, 1986, 1990, Johanssen et al., 2001). The underlying idea is that knowledge plays an increasingly crucial role in

prompting innovation, due to: (1) the continuous expansion of the amount of technical knowledge accumulating over time, and (2) the use of communication technologies that makes knowledge very rapidly available on a worldwide scale (Landry et al., 2002).

But knowledge is a non-rival (several people can use it at the same time) and, in the medium/long run, a non-excludable good (Edwards, 2007). This is why learning economy scholars focus on learning. They affirm that it is the capacity to learn continuously that determines success (Lundvall, 1992, 1996). Previous knowledge matters, because a key input in producing current knowledge is past knowledge (Romer, 1986, 1990). But, as knowledge has a quasi-public character, to obtain a competitive advantage, it is necessary to (continuously) create new knowledge through learning.

The learning economy has its parallel at the regional level in literature on: (1) learning regions (Morgan 1997; Boekema et al., 2000, Cooke and Morgan, 2000, Hassink and Lagendijk, 2001, Cooke, 2002) and on (2) regional learning (e.g. Boekema et al., 2000).

The concept of learning regions refers to networks driven by policy-making that serve as regional development tools, in which, following Hassink (2005): (1) the main actors are strongly, but flexibly connected with each other and (2) are open to both intraregional and interregional learning processes. Regional learning refers to more spontaneous cooperation between actors in a region through which they learn (Boekema et al. 2000).

In these theories, knowledge is embodied in networks and communities, and social capital becomes an essential ingredient for understanding innovation. Social capital refers to connections within (bonding) and between social networks (bridging) (Putnam 2000).

There are a variety of inter-related definitions of this term (for differently focused recent works see e.g. Adler and Kwon, 2002, Borgatti and Foster 2003, and Lin, 2001). In a

sociological sense, social capital refers to the collective value of all social networks and the inclinations that arise from these networks to do things for one other (e.g. Putnam 1995, 2000). A social network is understood as a social structure made up of nodes (generally individuals or organisations) that are tied by one or more specific types of interdependency (such as values, visions, ideas, financial exchange or friendship) (Borgatti and Foster, 2003). It has been shown that social capital and learning have a positive relationship because social capital directly affects the combine-and-exchange process and provides relatively easy access to network resources (Nahapiet and Ghoshal, 1998, McFadyen and Cannella 2004).

Regional literature has singularly focused on Social Capital. Regional economies are viewed as synergy-laden systems of physical and relational assets, and intensifying globalisation is making this situation more and not less the case (Scott and Storper, 2003). As such, regions are an essential dimension of the development process. Agglomeration is a fundamental and ubiquitous constituent of successful development (e.g. Bairoch, 1988; Krugman, 1991; Fujita et al., 1999; Scott, 2002). The spatial proximity of large numbers of firms locked into dense networks of interaction provides the essential conditions for many-sided exchanges of information to occur (Scott and Storper, 2003). Furthermore, firms come together in both formal and informal organisations that help to streamline their interactions and accelerate information transfers, to build trust and reputation effects, and to promote their joint interests (Becattini, 1990; Asheim, 2000). So, “regional economies are internally tied together through human and organisational interdependencies—often untraded—that have a strong quasi-public goods character, meaning they are the source of positive externalities that are more or less freely available to local firms but are the property of none. Such positive externalities are observable in diverse domains of regional

economic activity, including dense information flows, learning processes, the emergence of craft or design traditions, business network formation and so on” (Scott and Storper, 2003, p. 587).

These “regional economic commons” (Scott and Storper, 2003) are crucial for overall regional success, but producers are tempted to engage in free-rider behaviour by poaching these resources from the regional resource pool (Braczyk et al., 1998; Maskell, 1999; Maskell and Malmberg, 1999, Johanssen et al., 2001). “Concomitantly, new kinds of policy interventions based on the concept of regional economies as aggregates of physical and relational assets need to be identified and refined” (Scott and Storper, 2003, p. 587). Evidence of regional governments that have used this approach can be found in regional literature (some recent examples are Barrutia and Echebarria, 2007, Barrutia et al. 2007). One way of encouraging innovation is to foster the conditions needed to create a “knowledge-based economy” by linking the knowledge generation sub-system (mainly laboratory research) to the knowledge-exploitation system (mainly firms and, say, hospitals or schools), via technology transfer organisations in regional innovation systems (Cooke and Leydesdorff, 2006).

As a synthesis of previous literature, we believe that it can be argued that regional innovation outcomes are a function of R&D (learning) effort (relying on previous knowledge) and social capital; and that regional governments can/must foster innovation outcomes by prompting R&D effort and also, and not least important, by fostering policy-making networks of regional actors whose mission is to optimise regional economic commons.

3. Research Objectives, Metrics, and Hypothesis

The main objective of this research is to empirically validate social network theories of innovation in the context of the Italian and Spanish regions, by focusing on social capital and R&D (learning) effort as the main drivers of innovation. To test our approach we study the regions of Spain and Italy. Spain was selected because: (1) in recent years there has been a significant input of R&D effort to measure social capital there, and (2) the specific knowledge of the authors about the Spanish context can facilitate qualitative interpretation of quantitative results. Italy was selected because previous influential research regarding social capital is available for this country (Putnam et al. 1993).

As we have seen, according to social network theories of innovation (and also previous innovation theories), R&D effort is a main antecedent of innovation results. It seems to be generally accepted that R&D effort is a main predictor of innovation results. An example of the political appeal of this view is the European Union's innovation policy addressed at reducing the gap in terms of R&D expenditure between the countries of the European Union and leading countries such as the USA and Japan.

To measure R&D (learning) effort we propose the GDP on R&D in Purchasing Power Standards (PPS). The underlying concept, which is sometimes misunderstood, "comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications" (OECD, 2002, p.63). This is a simple and robust metric, which measures real effort in terms of actual cost expended for the generation of new knowledge or learning. Its use, therefore, constitutes a parsimonious approach for measuring the learning effort of a learning region and it is consistent with social network theories of innovation. We believe that it is a more robust metric to

measure the effective learning effort of a region than those associated, for instance, with the level of education attained, in that it captures the effective application of education in search of, in the last instance at least, new marketable knowledge. Our assertion can be understood by looking at one piece of information: the first places in the EU ranking for education-related metrics are occupied by the recently incorporated countries from Eastern Europe. However, they are at the bottom of the league when it comes to other metrics associated with knowledge, such as those measuring the number of patents. In second place, it is a structural metric that, within the European context, moves slowly and with a generally upward trend and, therefore, makes it possible to estimate the knowledge that has accumulated within a particular geographical area. Thirdly, it reflects the orientation of a specific geographical context in its search for new knowledge.

So we propose:

H1: The higher the Gross Domestic Product (GDP) expenditure on R&D, the more the innovation outcomes.

Additionally, according to social network theories of innovation, a moderator of the relationship between expenditure on innovation and innovation outcomes is social capital. Social capital prompts the efficiency and effectiveness of the innovation process. As has been affirmed by Maskell (2001), social capital helps reduce malfeasance, induces the volunteering of reliable information, causes agreements to be honoured, enables employees to share tacit information, and places negotiators on the same wavelength.

Efficiency, then, is mainly improved by reducing transaction costs (between firms, and between firms and other actors) and the costs of managing the innovation process. And more effectiveness is achieved because more (suitable and reliable) quantity and quality

of knowledge is accessed. Knowledge can more easily be transferred and utilised within a community made up of firms that understand the same language and share norms and codes. The mere location of firms in a geographical cluster represents an irreversible investment that provides them with an arsenal of instruments to obtain and understand the most subtle, elusive and complex information of possible relevance (Maskell, 2001).

Interestingly, Landry et al. (2002), found, in the context of Canada companies, that diverse forms of social capital determine the radicalness of innovation, and that social capital in the shape of research network assets contributes more than any other explanatory variable to explain the radicalness of innovation. Also, Cooke et al. (2005), demonstrated that social capital has a strong impact on the innovativeness of SMEs. They found that innovative firms tend to make greater use of collaboration and information exchange, to be involved in higher trust relationships, and to make greater use of non-local networks.

There is no consensus on how to measure social capital. Previous literature has concentrated on describing the concept of social capital and its implications. As a result, few metrics have been proposed (Beugelsdijk and Van Schaik, 2005, Pérez et al., 2006). From a more economic-driven approach some authors (e.g. Bordieu, 1980, Coleman, 1990, Lin, 2001, McFadyen and Cannella, 2004) refer to social capital as investment in social relations with expected returns in the marketplace. For the purposes of this research we firstly adopt the definition of social capital proposed by the Social Capital Interest Group of the University of Michigan (SCIG, 2001), in accordance with which social capital is the product of social relations, which depend on expectations of benefit deriving from preferential treatment and co-operation between individuals and groups. On the basis of this concept we adopt the approach proposed by Pérez et al. (2006),

incorporating methodology from previous work (Glaeser et al., 2002, ODCE, 2001). Due to space considerations, a synthesis of the methodology applied to arrive at the calculations is presented on table 1. We use the Spanish data provided by the BBVA Foundation (2007) and compute the Italian data following the same methodology (see table 2).

Insert Table 1

Insert Table 2

This approach is mainly derived from rational choice theory and might not appropriately consider the embeddedness of people in their social context (Rutten and Boekema, 2007). From a sociologically driven approach, social capital can be measured by the amount of trust and reciprocity in a community or between individuals (Putnam, 1995, 2000). Putnam et al. (1993), defined social capital as those “features of social organisation, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions” (p. 167). Nevertheless, a broad variety of sociologically driven concepts of social capital has been proposed. A possible common denominator inside this broad and diverse approach of sociologically-driven social capital concepts was provided by van Oorschot et al. 2006, by affirming that what sociologically driven views have in common is that they more or less explicitly emphasise the importance of, first, social relations within families, communities, friendship networks and voluntary associations, and, second, civic morality, or shared values, norms and habits, and, finally, trust in institutions and generalised trust in other people. Following this approach, and using data from the European Value Studies (EVS), two different measures of social capital have recently been proposed: (1) the measurement of social capital put forward by Oorschot et al. (2006), and (2) the social capital index proposed by Beugelsdijk and Van Schaik (2005). Only the second of these

contributions refers to regions, and this is the measurement we will use. The European Value Studies (EVS) is a cross-national survey research programme which was fielded in 33 countries throughout Europe in 1999/2000 (see www.europeanvalues.nl). The nationwide samples consisted of at least 1000 and at most 2000 respondents each. The Eurostat NUTS1 definition of regions was used in the study by Beugelsdijk and Van Schaik. As a consequence, our research employs two different levels of aggregation: (1) NUTS 1 (social capital index, provided by Beugelsdijk and Van Schaik, 2005), and (2) NUTS 2 (rational choice-driven data). Some conclusions regarding the relevance of the aggregation level of the results are provided below.

So we propose:

H2a: The more the social capital, when measured in accordance with the rational choice-driven approach, the more the innovation outcomes.

H2b: The more the social capital, when measured in accordance with the sociologically driven approach, the more the innovation outcomes.

The outcome variable considered is the number of patent applications to the European Patent Office (EPO) per million inhabitants. Although this variable may not include the whole range of innovation outcomes (because not every research work or process or product improvement is suitable to patent), some authors such as Griliches (1995) argue that patents appear to be a good indicator for inventive activity at an aggregated level. Specifically, the number of patents seems to be a good proxy for measuring the most relevant innovation outcomes, because it includes the most radical and long term profit-impacting innovations (i.e. innovations that are new to the firm and the world). Table 3 summarises the variable coding in the analysis.

Insert Table 3

4. Model to be tested and Empirical Results

The proposed and tested parsimonious model is:

$$\text{EPO Patents} = a + b (\text{GDP on R\&D in PPS}) + c (\text{Social Capital}) + e$$

We used the stepwise regression technique to test the model and hypothesis 1 and 2 (a, and b). The results are summarised in table 4. Firstly, we discuss the results obtained when measuring social capital by using the rational choice-driven approach. In the case of Spain, the model tested makes it possible to back up the conclusion that EPO patents maintain a direct significant relation with the variables of GDP on R&D and Social Capital. The full model and the two predictors are statistically significant. The adjusted R square (0.75) is unusually high. So, Spanish regional behaviour is fully consistent with the view underlying social network theories of innovation (and also learning region and regional learning approaches). H1 and H2a cannot be rejected. Madrid is treated as an outlier, due to two reasons: (1) Madrid concentrates an important percentage of total Spanish public investment on R&D, because of the presence in that region of umbrella public research institutions that, at least theoretically, provide service to other regions, and (2) the rational choice approach seems to overestimate the social capital of large successful regions (we discuss this below).

Insert Table 4

The case of the Italian regions is very interesting. GDP on R&D does not explain innovation outcomes. Although some positive correlation between expenditure and innovation outcomes exists in some regions, relevant outliers also exist. This result is not surprising having analysed previous literature. For instance, Evangelista et. al. (2002), after studying the Italian Innovation Survey, found a strong disparity in terms of innovation outcomes between the different Italian Regions. They explained this disparity in terms of the existence or non-existence of “proper innovation systems” or,

at least, of informal technological linkages, knowledge flows and collaborative and learning processes within a substantially coherent and cohesive industrial environment. This explanation is consistent with the predictive power of social capital found in our research in the case of the Italian Regions. Social capital seems to predict innovation outcomes unusually well. Social capital explains 65% of regional variance in patents. So, H2a cannot be rejected. This result is also consistent with the seminal sociologically driven research carried out by Putnam et al. (1993), regarding the relevance of social capital within the Italian context. They found dramatic differences in social capital between the north and south of Italy, by using a sociologically driven approach to measure social capital (civic community).

Jointly considering the results of the Italian and the Spanish contexts, they are consistent with the relevance accorded to the social capital concept by regional literature (e.g. Scott and Storper, 2003). Furthermore, the results show the strong predictive validity of the social capital construct when measured using a rational choice approach. A more surprising result is that when social capital is measured in accordance with the social capital index proposed by Beugelsdijk and Van Schaik (2005), it seems not to be a good predictor of innovation outcomes. H2b has to be rejected. We discuss this result in the next section.

5. Final Discussion and conclusions

The importance of social capital as a determinant of innovation has received much theoretical attention over the last few years. But empirical support is scarce. Following social network theories of innovation, and learning region and regional learning approaches, we hypothesise that innovation outcomes are a result of R&D/Learning effort and social capital.

We use a rational choice-driven metric and a sociologically driven metric to measure social capital and empirically contrast the impact of social capital on innovation outcomes. The first shows a strong predictive validity to explain innovation outcomes. Conversely, the second one does not display predictive validity.

Nevertheless, Beugelsdijk and Van Schaik (2005) tested the predictive validity of this metric by testing the relation between social capital and an increase in GDP. So, when both results are considered jointly, they seem to suggest that different forms of social capital might impact differently on various desired outcomes, such as innovation and GDP increases. An important distinction between the various forms of social capital is that which exists between bonding (exclusive, closed social capital with strong ties) and bridging (inclusive, open social capital characterised by weak ties), (Gitess and Vidal, 1998; Putnam, 2000). Bonding social capital is linked to family or primary friendship relationships. Bridging social capital can be generalised to people who are strangers. Weak ties (Granovetter, 1973) are often temporary and task-related and link actors to distant acquaintances, former associates and colleagues who move in different circles and have different information. Strong ties (Granovetter, 1973) are often intensive and repeated and link actors to close relatives and intimate friends within the same social niche (van Oorschot et al. 2006). The results of our research seem to suggest that, where innovation outcomes are concerned, “weak” professional-driven ties, based on self-interest and reciprocity (more linked to the rational-choice approach), might be more relevant than strong ties based on family/friends (more linked with the sociologically driven approach).

This view is consistent with the view expressed by Granovetter (1973), regarding “the strength of weak ties” and, also, with literature dealing with concepts of regional innovation systems, learning regions and regional learning, in which relatively weak

(professional) ties are considered crucial explanatory factors of successful innovation. It is also consistent with the results of Schneider et al. (2000), when extending Putnam's research to Europe, which indicated that: (1) regions where horizontal social networks seem well developed, experienced growth rates exceeding the average, and (2) trust in compatriots did not seem to support economic performance. Along the same lines of thought, Lorenzen (2007), defines social capital as "social relations among agents combined with social institutions that allow for co-operation and communication" (p. 801) and offers a complex matrix of different kind of relationships that should be explanatory of regional learning, which include, among others, value (user-producer) chains, horizontal alliances, inter-firm project networks, industry-university relations, and professional clubs and associations. Additional support is provided by Fromhold-Eisebith (2004), when differentiating concepts of innovative milieu (which emphasise the benefits of interactions between heterogeneous groups) and a sociologically driven concept of social capital (that emphasises the advantages that emerge from interactions between more homogeneous groups).

An interesting example is the case of Madrid. The specific sociologically driven metric provided by Beugelsdijk and Van Schaik situates Madrid in an intermediate-low position. This metric seems to strongly underestimate the opportunities that Madrid offers for cooperation and the sharing of key professional knowledge regarding innovation (bridging social innovation). This is because these authors use only trust and active and passive group membership to build their index. Conversely, the specific rational choice-driven social capital metric used in this study situates Madrid in first position within the ranking of social capital in Spain. Madrid scores 66% higher than the second region, Catalonia. This approach, therefore, seems to overestimate the social capital of Madrid. This measure should probably be corrected to consider the difficulties

in creating friendship and trust relationships in such a vast, extraordinary, complex and impersonal city.

So, the results of our research seem to suggest that more comprehensive and, at the same time, more analytical metrics of social capital should be developed. It is important to determine whether social capital is just a construct or a combination of several constructs (e.g. a professional oriented construct and a personal oriented construct), and whether it is a first order or a second order model (in which, for instance, trust might be a result of relations, as proposed by Lorenzen, 2007).

A main consideration is that the results of our research should not be interpreted to conclude that one specific approach is superior for measuring social capital. We believe that the two different approaches used in this research might be complementary and that both of them might have different antecedents and consequences. And, also, that by studying the antecedents and consequences of the different metrics of social capital proposed by different authors, there might be more probability of arriving at an agreement regarding the substantive concept. This is the point of this research. But much more research into the concept of social capital, its metrics and its implications is needed.

The results of our research might also be influenced by the use of two different levels of aggregation (NUTS1 and NUTS2). Results are clearly better at a lower degree of aggregation. NUTS1 seems to imply the need for creating some artificial conglomerates. In the case of Spain, for example, the concrete aggregation of administrative NUTS2 regions used to create artificial NUTS1 regions is highly debatable. Moreover, average data hide important disparities between NUTS2 regions. And, as explained by Lorenzen (2007), for instance, social capital seems to be formed at small scales.

Finally, one clear message for politicians emerges from our study. Investment effort in R&D is not in itself enough to achieve innovation outcomes. R&D input should be accompanied by effort to prompt social capital. Some Italian regions are good examples of a low impact of R&D investment input on innovation outcomes, owing to the absence of social capital. Investment rankings, which are very popular in political circles, should therefore be used with care. Both levers (social capital and investment effort) should be employed jointly to obtain innovation outcomes.

References

- Adler, P.S. and Kwon (2002) "Social capital: Prospects for a new concept", *Academy of Management Review*, 27 (1): 17–40.
- Asheim, B. T. (2000) "Industrial districts: The contributions of Marshall and beyond", in: G. L. Clark, M. P. Feldman & M. Gertler (eds) *The Oxford Handbook of Economic Geography*, p. 413–431 (Oxford: Oxford University Press).
- Bairoch, P. (1988) *Cities and Economic Development* (Chicago, IL: University of Chicago Press).
- Barrutia J. M, Aguado I, Echebarria C. (2007) "Networking for Local Agenda 21 implementation: Learning from experiences with Udaltalde and Udalsarea in the Basque Autonomous Community" *Geoforum*, 38:33-48
- Barrutia, J. M., Echebarria, C. (2007) "Regional Network for Quality Promotion: A Case-study of the Basque Country", *European Planning Studies*, 15 (3): 429-451.
- BBVA Foundation (2007), *El capital social en España y los países de la OCDE*, Cuaderno de Divulgacion número 3 (see <http://w3.grupobbva.com>)
- Becattini, G. (1990) The Marshallian industrial district as a socio-economic notion, in: F. Pyke, G. Becattini & W. Sengenberger (Eds) *Industrial Districts and Inter-firm Cooperation in Italy*, p. 37–51 (Geneva: International Institute for Labour Studies).
- Beugelsdijk, S. and Vabn Schaik T. (2005) "Differences in Social Capital between 54 Western European Regions", *Regional Studies*, 39 (8):1053-1064.
- Boekema, F., Morgan, K., Bakkers, S. & Rutten, R. (2000) Introduction to learning regions: A new issue for analysis, in: F. Boekema, K. Morgan, S. Bakkers & R. Rutten (Eds) *Knowledge, Innovation and Economic Growth: The Theory and Practice of Learning Regions*, p. 3–16 (Cheltenham/Northampton: Edward Elgar).
- Bourdieu, P. (1980), "Le capital social. Notes provisoires", *Actes de la Recherche en Sciences Sociales*, 31 : 2-3.
- Borgatti, S.P. and Foster, P.C. (2003), "The network paradigm in organisational research: a review and typology", *Journal of Management*, 29 (6): 991-1013.
- Braczyk, H., Cooke, P. & Heidenrich, M. (1998) *Regional Innovation Systems: The Role of Governance in a Globalized World* (London: UCL Press).
- Bristor, J.M. (1990), "Enhanced explanations of word of mouth communications: the power of relationships", *Research in Consumer Behavior*, (4): 51-83.
- Coleman, J. (1990), *Foundations of social theory*, Belknap Press, Cambridge, MA.
- Cooke, P, Clifton, N. and Oleaga, M (2005) "Social Capital, Firm Embeddedness and Regional Development", *Regional Studies*, (39) 8: 1065-1077.
- Cooke, P. (2002), *Knowledge Economies: Clusters, Learning and Cooperative Advantage*, Routledge, London
- Cooke, P., Morgan, K. (2000) *The Associational Economy: Firms, Regions and Innovation*, Oxford, Oxford University Press.

- Cooke, P. and Leydesdorff, L. (2006) Regional Development in the Knowledge-Based Economy: The Construction of Advantage, *Journal of Technology Transfer*, 31: 5–15.
- Edwards, M.E. (2007) *Regional and urban Economics and Economic Development: Theory and Methods*, Averbach Publications, Taylor and Francis Group, New York.
- Evangelista, R. Iammarino, S., Mastrostefano, V. and Silvani, A. (2002), “Looking for Regional Systems of Innovation: Evidence from the Italian Innovation Survey”, *Regional Studies*, (36) 2: 173–186, 2002
- Evans, M. and Syrett, S. (2007) Generating Social Capital?: The Social Economy and Local Economic Development, *European Urban and Regional Studies*, 14(1): 55–74
- Fromhold-Eisebith, M. (2004) “Innovative milieu and social capital: complementary or redundant concepts of collaboration-based regional development?”, *European Planning Studies*, 12(6): 747-765
- Fujita, M., Krugman, P. & Venables, A. (1999) *The Spatial Economy: Cities, Regions and International Trade* (Cambridge, MA: MIT Press).
- Gitess, R. and Vidal, A. (1998) *Community Organizing: Building Social Capital as a Development Strategy*. Thousand Oaks, CA: Sage.
- Glaeser, E.L., Laibson, D.I. and Sacerdote, B. (2002) “The economic approach to social capital”, *Economic Journal*, 112: 437-458.
- Granovetter, M. (1973), "The Strength of Weak Ties", *American Journal of Sociology*, 78 (6):1360-80.
- Griliches, Z. (1995), “R&D and productivity: econometric results and measurement Issues”. In: P. Stoneman, Editor, *Handbook of the Economics of Innovation and Technological Change*, Blackwell, Oxford, p. 52–89
- Hassink, R. & Lagendijk, A. (2001) The dilemmas of interregional institutional learning, *Environment and Planning C: Government and Policy*, (19): 65–84.
- Hassink, R. (2005) “How to Unlock Regional Economies from Path Dependency?: From Learning Region to Learning Cluster”, *European Planning Studies*, 13 (4): 521-535.
- Johanssen, B., Karlsson, C. & Stough, R. (Eds) (2001) “Theories of Endogenous Regional Growth: Lessons for Regional Policies” (Berlin: Springer).
- Krugman, P. (1991) “Increasing returns and economic geography”, *Journal of Political Economy*, 99: 483–499.
- Landry, R., Amara, N. and Lamari M. (2002) “Does social capital determine innovation? To what extent?” *Technological Forecasting and Social Change*, 69 (7): 681-701
- Lin, N. (2001) *Social capital: A theory of social structure and action*, Cambridge University Press, Cambridge.
- Lorenzen, M. (2007) “Social Capital and Localised Learning: Proximity and Place in Technological and Institutional Dynamics”, *Urban Studies*, 44 (4): 799–817.
- Lundvall, B-A (1992) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Printer, London.

- Lundvall, B-A (1996) *The Social Dimension of the Learning Economy* (Aalborg: DRUID Working Paper No.96-1).
- Maskell, P. & Malmberg, A. (1999) “The competitiveness of firms and regions: ‘Ubiquitification’ and the importance of localized learning”, *European Urban and Regional Studies*, 6(1), p. 9–25.
- Maskell, P. (1999) *Competition, Localized Learning and Regional Development* (London: Routledge).
- Maskell, P. (2001) Knowledge Creation and Diffusion in Geographic Clusters, *International Journal of Innovation Management*, Vol. 5 No. 2, p. 213-238
- McFadyen, M. A., Cannella Jr., A. A. (2004) “Social capital and knowledge creation: diminishing returns of the number and strength of exchange relationships” *Academy of Management Journal*, Vol. 47, No. 5, p. 959-979.
- Montgomery, J. D. (2000) “Social Capital as a Policy Resource”, *Policy Sciences*, 33, p. 227–43.
- Morgan, K. (1997) “The learning region: institutions, innovation and regional renewal”, *Regional Studies*, Vol. 31, No 5, p. 491–503.
- Nahapiet, J., and Ghoshal, S. (1998) “Social capital, intellectual capital, and the organisational advantage”, *Academy of Management Review*, 23, p. 242-266.
- OECD (2001) *Measuring capital. A manual on the measurement of capital stocks, consumption of fixed capital and capital services* (OCDE, Paris)
- OECD (2002) *Frascati manual: Proposed standard practice for surveys on research and experimental development; the measurement of scientific and technological activities*, OECD, Paris.
- Pérez, F., Serrano, L., Montesinos, V. and Fernández de Guevara, R. (2006) *Measurement of social capital and growth: an economic methodology* (Working paper 4, BBVA Foundation)
- Putnam, R. (1995) “Bowling Alone: America’s Declining Social Capital”, *Journal of Democracy*, 6: 65-78.
- Putnam, R. (2000) *Bowling alone: The collapse and revival of American community*, Simon & Schuster, New York, NY.
- Putnam, R., Leonardi R. and Nanetti R. Y. (1993) *Making Democracy Work*, Princeton University Press, Princeton, NJ.
- Romer PM (1986) “Increasing returns and long-run growth”, *Journal of Political Economy* 94(5):1002–1037
- Romer PM (1990) “Endogenous technological change”, *Journal of Political Economy*, 98: 71-102
- Rutten, R. and Boekema, F. (2007) “Regional social capital: Embeddedness, innovation networks and regional economic development”, *Technological Forecasting and Social Change*, 74 (9): 1834-1846
- Schneider, G. Plümper, T. and Baumann, S. (2000) Bringing Putnam to the European Regions: On the Relevance of Social Capital for Economic Growth, *European Urban and Regional Studies*, 7(4): 307–317

SCIG (2001) *Social Capital: a position paper*, Social Capital Interest Group, Michigan State University.

Scott, A. J. (2002) Regional push: Towards a geography of development and growth in low- and middle-income countries, *Third World Quarterly*, 23, p. 137–161.

Scott, A.J., Storper, M. (2003) “Regions, globalisation, development”, *Regional Studies*, 37: 579-593.

Table 1: Rational choice-driven methodology for measuring social capital

The used measure of the stock of social capital is based on two pillars: (1) an optimum decision-making model of the investment and accumulation process in social capital (Pérez et al 2006) and (2) the conceptual framework developed for the measurement of physical capital services (OECD, 2001).

Investment in social capital is modelled on the basis of three basic hypotheses (Pérez et al 2006):

1. Cooperation is favoured by the economic incentives deriving from the expected increasing income resulting from continued growth. Past experiences of social and economic progress are projected into the future and become individuals' expectations of favourable treatment.
2. Individuals' incentives to cooperate are strengthened/weakened by two factors: a) the effective opportunities for participation in the results (higher if income inequality is restricted by social practices and policies of cohesion); and b) a culture of fulfilment of duty or of reciprocity that is increased and transmitted through access to education and the improvement of the population's human capital.
3. The effects of cooperation are extended if the density of the trust relationship networks between individuals is high. This density of trust relations is favoured by the smooth running of long term economic relationships when uncertainty is inevitable and information costs are high, such as employment and financial relationships and markets for durable goods.

Each individual decides their future investment path in social capital over T years, during which s/he expects to participate in the social network, maximising the expected income from the investment. In equilibrium, each individual makes the marginal cost of investing in social capital equal the benefits expected from the investment.

In equilibrium, the social capital will be defined by (Pérez et al 2006):

$$KS_t = \frac{\beta}{\gamma} c(1 + \lambda(N - 1)) \frac{(1 - G)}{C'(I_{s,t})} \frac{1 - (\delta/(1 - \rho))^{T-t}}{1 + \rho - \delta}$$

The variables considered and the proxies used for measuring social capital are shown below.

Factors considered in the measurement of social capital

Variable	Proxy
Degree of connection of the social network, <i>c</i>	Ratio Credit/GDP
Marginal cost of investment in social capital, <i>C'(Is)</i>	1 – proportion of the population of working age with at least secondary education
Index of inequality in distribution of income, <i>G</i>	Gini index
Rate of survival of social capital stock (1- rate of depreciation), δ	Unemployment rate
Discount rate, ρ	Constant discount rate: 4%
Number of expected years of participation in the social network <i>T-t</i>	Life expectancy for the average age of the population
Dimension of the social network, <i>N</i>	Number of people in work
Degree of reciprocity, λ ; contribution of social capital to generation of income, β ; contribution of work to generation of income, γ	Assumed to be constant, the social capital being calculated in relative terms

Source: Author's own work based on BBVA Foundation (2007) and Pérez et al (2006)

Table 2: Calculation of Social Capital (Italian Regions)

	Unemployment Rate	Employment Rate	Life expectancy (at 45)	Gini Index	1-Population with secondary studies	Loans / GDP	Social Capital (Spain = 100, Italy = 90)
Piemonte	0.05	49.21	36.27	0.29	0.27	0.89	105.2
Valle d'Aosta	0.03	53.08	36.27	0.29	0.27	0.81	102.4
Liguria	0.06	43.47	36.31	0.28	0.24	0.91	107.8
Lombardia	0.04	51.59	36.47	0.28	0.25	0.84	113.4
Veneto	0.04	54.72	37.03	0.26	0.28	0.94	100.3
Friuli-Venezia Giulia	0.04	51.36	36.25	0.25	0.26	0.82	109.8
Emilia-Romagna	0.04	48.21	37.05	0.28	0.29	0.89	98.7
Toscana	0.05	48.97	37.12	0.26	0.31	0.84	90.0
Umbria	0.06	47.75	37.52	0.28	0.28	0.85	92.0
Lazio	0.08	45.03	36.23	0.30	0.21	0.86	112.7
Campania	0.15	45.16	35.11	0.34	0.29	0.81	72.4
Abruzzo	0.08	35.43	37.08	0.30	0.29	0.88	86.9
Molise	0.10	43.67	36.90	0.28	0.31	0.87	80.5
Puglia	0.15	39.12	36.88	0.31	0.32	0.91	69.8
Basilicata	0.12	36.94	36.98	0.26	0.32	0.87	70.3
Calabria	0.14	36.27	36.62	0.34	0.31	0.87	62.8
Sicilia	0.16	34.32	35.83	0.33	0.31	0.85	65.4
Sardegna	0.13	33.96	36.63	0.29	0.28	0.88	82.6

Source: Author's own work based on dispersed data from the Italian Central Bank (Bank of Italy, Banca D'Italia) (<http://www.bancaditalia.it/internalandaction=setlanguage.action?LANGUAGE=en>) and the Italian National Institute of Statistics (Istituto Nazionale di Statistica) (<http://www.istat.it/>) (Accessed December 2007)

Table 3: Variable Coding in the Analysis

Concept	Variable	Description	Source
<i>Innovation Outcomes</i>			
Patents	Number of patent applications to the European Patent Office (EPO) per million inhabitants	Applications filed directly under the European Patent Convention or to applications filed under the Patent Co-operation Treaty and designated to the EPO (Euro-PCT).	Eurostat (2000-2003)
<i>Predictors</i>			
Research/Learning Effort	Gross domestic expenditure on R&D in Purchasing Power Standards	Business enterprise expenditure, Higher education expenditure, Government expenditure and Private non-profit expenditure on R&D.	Eurostat (2000-2003)
Social Capital	Social Capital (Rational Choice Approach)	Mean of relations value for Spain = 100 (see Tables 1 and 2)	BBVA Foundation (2007). For the Italian case: author's own work. Raw data have been obtained from the Italian Central Bank (Bank of Italy, Banca D'Italia).
	Social Capital (Sociological Approach)	Social Capital Index	Beugelsdijk and Van Schaik, 2005. Data from European Values Study (1999/2000)

Table 4. Social Capital and R&D as predictors of Innovation Outcomes*

<i>Spanish Regions**</i>				
Model		Explanatory variables		
Adjusted R Square	p-value	Variables	Standardised Coefficients	p-value
0.875	0.000	GDP on R&D	-0.724	0.000
		Social Capital	-0.457	0.000
<i>Italian Regions</i>				
0.652	0.000	Social Capital	-0.820	0.000

* Tests of model applicability were developed with positive results: linearity between dependant and explanatory variables; inexistence of multicollinearity between independent variables, and; normality (Kolmogorov-Smirnov Test) and homocedasticity of errors.

**Madrid (the capital of Spain) is considered an outlier.