

THE ROLE OF SOCIAL NETWORKS FOR NATIONAL INNOVATION SYSTEMS' DYNAMICS

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Abstract:

The theoretical framework of national innovation systems constitutes an important step forward in understanding the nature of technological change and sources of national competitiveness. We argue, however, that studies of innovative activities of individual actors and related institution-building processes are incomplete without taking into account the social structures that underlie economic actions. This paper examines how economic, social, and institutional context affect learning processes of individual actors. Our theoretical contribution to the study of National Innovation Systems' dynamics consists of developing a conceptual model that combines the analysis of social networks with the study of technological change and institutional-building processes.

Keywords: Systems of Innovation, Learning, Technological Change, Social networks, Institutions

JEL - code(s): D21, L16, L23, O33, P31

1. Introduction

An increasing number of researchers in fields such as industrial dynamics, technology policy and firm strategy claim that technological development of a country cannot be viewed as an isolated phenomenon but has to be analyzed as a part of a larger system, a National Innovation System (NIS). Although there is no unified definition of NIS, it is generally viewed as an interactive set of national institutions, enterprises and individuals whose activities contribute to the technological and economic development of the country (Freeman, 1988; Lundvall, 1992).

The concept of NIS proved to be very rewarding for the studies of developed economies. More recently, NIS framework attracts increasing attention as a means to address some of the more profound issues for developing nations:

- on one hand, NIS analytical framework brings into focus countries' abilities to generate innovation that is increasingly recognized as crucial for international competitiveness and sustainable economic growth;
- on the other hand, NIS characteristics, structure, and efficiency vary largely across the countries which suggest that sources of technological competitiveness have country-specific origins.

With this respect, endogenous growth theory (Romer, 1990) made an important contribution to the study of different forms of accumulation of technical knowledge, measured by certain economic indicators, as number of patents, R&D expenditures, public expenditures, education system performance, etc.

The concept of NIS further deepened the understanding of the nature of technological change showing that its pattern is largely influenced by institutional setup and cultural context. The production of new knowledge by various actors depends on their learning capacity, where learning is seen as an incremental process incorporated in the daily activities of individuals and firms. However, learning doesn't occur in isolation from the external environment: it is a fundamentally interactive process that involves various actors. Within a given NIS learning by firms and individuals and their interactions are motivated, activated and directed by formal and informal institutions that define the "rules of the game" in the society (North, 1990).

Institutions themselves are also subject to change, and their evolution is seen as one of the prerequisites for continuous and accelerating technological innovation. The assumption of interactive nature of learning processes implies that technologies and institutions evolve along the same path. Therefore, interactive learning process, which relates the actors of the NIS, affects and is affected by the institutional structures that shape the actors behavior.

In developed countries with stable and sophisticated institutions, institutional change is incremental and relatively slow, especially if compared to the increasing pace of technological change. As a result, increasing returns from adopted technologies that reinforce existing institutions are most often considered as a driving force of institution-building process in the studies of innovation systems. An important role in the institution-building process is also traditionally attributed to the nation-state responsible for policy formulation.

However, in the developing world the assumption of relative stability of formal institutions cannot be applied. The history of post-Soviet transition offers the example of radical institutional change which was seldom taken into account in the studies of NIS.

Another problem resides in the NIS interpretation of the modes of interaction between individual actors and institutional structures. Within the NIS conceptual framework, all the individual actors have equal opportunities and function according to the same institutional rules. Regional or sectoral variants of innovation system approach narrow the analysis at geographical or economic scale but preserve an undifferentiated view of interactions within the system. This representation doesn't explain the existence of intra-national disparities: If the institutional environment affects the functioning of all the actors of the system in the same undifferentiated way, it is not clear why some regions, industries and firms perform differently within the same institutional setup. The individual capabilities of the actors and disparities in resource endowment provide a part of the explanation. However, a growing number of studies brings into light the importance of social structures for the organization and outcome of technological and economic activities (Powell, 1990; Saxenian, 1994).

The main argument of this paper is that the representation of interactive processes within the NIS is incomplete without taking into account social structures that actively participate in technological, economic, and institutional change. Therefore, the purpose of this paper is to integrate social context of technological change into NIS conceptual framework.

The paper is organized as follows.

First, we introduce selected concepts from the analysis of social networks that provides the necessary tools for studying the impact of social structure on economic activities. Second, we elaborate on social networks transformation and dynamics based on the embedding and decoupling processes. Third, we propose a model of national innovation system's dynamics that combines the existing NIS framework and social networks analysis. Fourth, we discuss the results of the model and the effects of social and institutional structures on the NIS dynamics. Finally, we present some conclusions and a program for further research.

2. Argument of Embeddedness: Social Networks in the Economy

As several studies of regional and sectoral sources of competitiveness have demonstrated, the activities of economic actors are influenced by contextual factors that cannot be reduced to the general rules of behavior (Saxenian, 1994, Powell, 1990, Powell and Smith-Doerr, 1994). In particular, social dimension seems to play an important role in the decision-making process. It was shown that social structures affect various areas of the economy, such as labor markets (Granovetter, 1973; Saxenian, 1994), price formation (Uzzi, 1999), industrial organization (Sabel, 1984), financial markets (MacKenzie, Milo, 2003) and mergers and acquisitions (Haunschild, 1994).

The guiding idea behind these studies is the argument of social embeddedness of economic structures. Since every society is built around relationships, the behavior of an individual actor cannot be fully understood unless we relate it to the actions of others with whom the individuals are connected through various social ties (Granovetter, 1985). Therefore, the behavior of economic agents and institutions is inevitably constrained by ongoing social relations and construing them as independent considerably distorts the picture of the reality (Granovetter, 1985).

The main ambition of the thesis of embeddedness was to provide a more realistic way to explain the interactions within the economy that would escape the limitations of under-socialized representation of economic action by traditional economists and over-socialized sociological view of patterns of behavior. Studies of embeddedness define the contingent nature of economic action with respect to cognition, culture, social structures and political institutions that reflects the immersion or partial dissolving of one interactive structure into another (Zukin and DiMaggio, 1990).

A key feature of this approach is the idea that networks of firms, individuals and organizations operate on logic of exchange which differs from the logic of markets (Uzzi, 1994). The interactions between the economic actors could therefore be separated in two distinct categories:

- “Arm’s-length” ties that designate what is generally viewed as market transactions. These ties are characterized by lean and sporadic interactions and function without any prolonged human or social contact between parties, who need not enter into recurrent or continuing relations as a result of which they would get to know each other well (Powell, 1990; Uzzi, 1996).
- Embedded ties that imply some kind of social relations between the interacting parties that shift actors’ motivations away from the narrow pursuit of immediate economic gains to the enriching of relationships through trust and reciprocity (Powell, 1990). Social networks are constructed by such ties. Therefore, they constrain the set of actions available to the individual actors and change the dispositions of those actors toward the actions they may take.

The key implication of this distinction between the “arm’s-length” and socially embedded ties is that social structures constitute an alternative system of exchange that produces opportunities and constraints particular to network forms of interactions. The implication of social networks in the economy results in outcomes that cannot be predicted by studying exclusively the market form of exchange.

The importance of social networks for economic action resides in their ability to provide resources that are not accessible in the open market, but could leverage important economic benefits (Gibbons, 2005; Granovetter, 2005):

- 1) Trust is a fundamentally social resource that is essential for cooperation among economic actors and central for institution-building process.
- 2) Knowledge flows within the economy are facilitated and partly directed by social structures: the information provided by social ties is more subtle and nuanced because actors generally have more trust in and affinities with their personal relations.
- 3) Social networks constitute a significant source of social control. Social ties restrict the access to the resources or creating additional opportunities for certain actors, which has a major impact on entrepreneurial activities.

The scarcity of social resources and their reliance on the characteristics of a particular social tie mean that resources and opportunities are not evenly distributed within the economy, but are greater if the actor belongs to the social networks or parts of networks that are most privileged in resource endowment.

In general terms, a social network is broadly defined as an arrangement of differentiated elements (individuals, firms or organizations) linked to each other by multitude of ties of a specified type. According to their content (information, advice, friendship, trust, etc.) and strength (amount of time spent together, emotional intensity, etc.), relationships in the network vary between strong and weak.

The strength of a social tie is defined in terms of time and emotions invested in a relationship, as well as reciprocity involved between participating actors. Typical examples of strong ties include friendship and family relations. Weak ties, by contrast, entail more limited investment of time and intimacy, subsuming an array of social acquaintances.

The importance of distinguishing between strong and weak ties resides in their different abilities to transmit resources. These considerations are at the core of Granovetter's (1973, 1985) influential 'strength-of-weak-ties' thesis. Granovetter maintained that weak ties are more important in spreading information because they serve as bridges between otherwise disconnected social groups. Later works by Uzzi (1997) show that strong ties can also provide access to important sources of knowledge. In the case of the strong ties, knowledge transfer is more 'fine-grained' and provide a higher quality information than the one transmitted through the weak ties.

As a result, the nature of social resources accessible to a particular actor depends on his/her position in the network(s) and the nature of the ties that link him/her to the network(s).

Trust among the economic actors can be supported by both strong and weak ties. However trust based on the strong tie tends to be exclusively related to this particular tie. On the other hand, trust, based on the weak linkages doesn't have the quality of dyadic exchange provided by the strong ties, but is extended to a larger number of actors. This second form of trust plays an important role for economic activities because it enables a governance structure that is based on heuristic rather than calculative processing (Uzzi, 2001). Relations based on trust help reducing transactional uncertainty and create opportunities for the exchange of goods and services that are difficult to price or enforce contractually. Trust generated by the weak ties increases the degree to which exchange parties consider each other's needs and

goals, and the needs and goals of other actors in the network. Trust supported by the weak ties establishes the basis for cooperation and risk-sharing that is extended to a larger number of actors, than in case of trust based on the strong ties. When social structures are diversified and based on a large number of social ties of different kinds, they enable the environment of trust. In a trustful environment, calculative risk and monitoring systems often play a secondary role during the transactions between the parties.

Informational exchange in social networks also provides important economic benefits. For example, dense networks with the dominance of strong ties enable a 'thick' informational exchange that makes new knowledge quickly available for all the actors in the network. On the other hand, loose networks composed by a large number of weak ties give access to a larger amount and novelty of information that might, however be less detailed and strategic that provided by the strong ties.

Trust and diffusion of information in social networks provide economic actors with additional resources, but also serve as an important form of social control. Network structures represent a powerful mechanism of social sanctions: news about malfeasance or bad reputation that spread through networks considerably reduce the chances of the concerned actor for future transactions and therefore limit his access to the network's resources.

The effectiveness of the system of social sanctions depends on the organization of the networks and the nature of informational exchange between the actors. Open structures and unimpeded knowledge flows are essential conditions for effective social control, because the parties must know about misfeasance in order to act jointly to condemn or ostracize perpetrators.

Through weak and strong ties, social networks enable the development and dissemination of a system of shared and tacitly understood norms on the one hand and a specific language on the other. Social networks also play an active and dynamic role in enabling and directing cooperative solutions between the economic actors, by providing coordination structures, and by participating in the development of micro and macro-culture. As a result, social networks allow their members to act appropriately not only under well-defined conditions but also under dynamically changing contingencies.

The dynamism of the networks comes from heterogeneity of social structures and diversity of actors and linkages, which create an uneven distribution of social resources and differentiated access to the new opportunities. The inhomogeneous nature of social networks

and unequal opportunities create incentives to change social contexts if the actors consider that it could leverage bigger economic benefits.

The nature of interactions in social networks is fundamentally different from the market transactions: they enable a prolonged interaction between economic actors, yet they are more flexible and versatile than institutions. Social structures constitute a fundamental basis of the functioning of the society, including the functioning of the economy. Social networks and dynamic social processes that shape their evolution play critical role in economic action, especially when it involves increased uncertainty.

The next section provides an overview of the transformations of social networks that are shaped by two dynamic processes – embeddedness and decoupling.

3. Social Networks' Dynamics: Embedding and Decoupling Processes

Embeddedness was for some time viewed as a given characteristic of the economies: economic action was seen as embedded in ongoing social relations. The durability of social relationships was often understood too literally overlooking the fact that social networks are not static structures: new relations arise; existing ties can change their status (for example, a weak tie can develop into a strong tie over time); the actor can split apart voluntarily or under external changes interrupting an existing relation.

Put in a dynamic perspective, social structures are shaped by two opposite processes: the embedding process responsible for the emergence and development of social networks, and decoupling process that ensures the loosening of the strings of network ties and the consecutive network's fragmentation into a 'social gel' (White, 2001).

The notion of 'social gel' is a more complete way of representing social structures that goes beyond the idea of a network (White, 1992, 1995). While network analysis has made strides in the empirical study of social interactions, it only reflects a static part of the reality. The network metaphor reflects a snapshot of a structured set of actors related by certain ties. Social networks are about embeddedness – over both micro and macro scales – that brings social content and stability to the economic transactions. The metaphor of social gel shows how sociality escapes and exceeds specific networks through the process of decoupling, when the actors voluntarily or involuntarily disengage from their social context.

Whereas networks connect smaller units into larger entities, and such entities in turn form their own networks which constitute still larger social organizations, a gel is something in which such levels are not distinct. Socialities are always grounded in physical space and time, but in contexts of sheer messiness:

'We are creatures living within social goos, shards, and rubbery gels made up by and of ourselves. We, like gels, may dissolve into a different order under some heat. Even the frozen shards exhibit only limited orderliness, and even then an orderliness lacking in homogeneity, and an orderliness made more problematic through its dual relation to physical space' (White, 1992, pp. 337-338).

Thus rather than a clean break between the micro and the macro, the private and the public, or the local and the global, we can think of a society in terms of a dynamic gel of sociality occurring at different scales and scopes.

The social gel is inhomogeneous and full of contingencies— possibilities for embedding and decoupling processes to emerge and vanish.

The speed and characteristics of the embedding process is largely dependent on the characteristics of surrounding social and institutional structures, because social ties most often emerge and develop within the existing communities (families, neighborhoods, organizations, associations of friends, etc.). The characteristics of the embedding process and of the tie in which it results (strong or weak) are determined by various factors, including the individual features of the interacting actors¹, institutional environment and the social context of the first contact. As the embedding processes go along, the actors become related by the strings of ties that make up networks of various kinds. Therefore, the embeddedness does not signify the dissolution of the economy in the social context, but rather the (partial) reliance of economic structures on social relations.

The opposite, but equally important, decoupling process is affected to an even larger extend by the aspects of institutional context. The process of decoupling loosens the string of social ties making it possible for firms, organizations and individuals, to interact on a basis that doesn't involve continuing social relations. Decoupling process is not a destruction of

¹ For example, small firms or firms with restricted resources seem to be more depended on social support and therefore more inclined to develop and maintain social relations with their partners (Baker, 1990). In general, identity of the actors matters in embedded relationships because it assigns value to the transaction and enriches the resources of exchange partners in the network (Portes and Sensenbrenner 1993).

networks, but a mechanism that ensures flexibility and dynamics of social structures. Decoupling means that the interactions between the actors do not involve a social interdependence anymore – they are ensured by the arm’s-length ties (market relations). The arm’s-length transactions are possible only if there is an adequate set of arrangements that substitute to the social relations: public information, judiciary system, conventions, legal rules, etc. that guarantees the equity of exchange. In other words, decoupling process is only possible in a context of institutional development that provides a relatively autonomous exchange system that enables an independent economic action.

Studies of social networks and social dynamics are important for understanding the patterns of economic development. Particularly, as it will be discussed in the next section, the transformations of social networks are essential for understanding the process of interactive learning.

4. Social Processes in NIS Dynamics: A Conceptual Model

The conceptual model that we present in this section draws on the existing NIS framework that brings together the studies of innovation activities by individual actors (firms, organizations and individuals) and broader analysis of institutional structures of the economy. The co-evolution of institutions and technologies is studied from a dynamic perspective using the concept of interactive learning that put emphasis on the interdependence between the behavior of micro-economic actors and institutional environment that enables and restricts their scope of actions.

However, social structures that constitute one of the main modes of interaction are not taken into account in the NIS analysis. As it was discussed in the previous sections, social networks play an important and active role in the functioning of the economy. We argue, therefore, that in order to understand how production, innovation and learning take place within a system, which is not locked into a single institutional pattern, we need to introduce the studies of social networks in NIS analysis.

The functioning of the NIS is generally considered as structured by the following elements:

- 1) At the microeconomic level, technological change is a function of individual economic actors, and especially private firms who, in market economies, are the

primary actors of innovation process. The study of innovative activities of firms in NIS framework is based on the evolutionary approach of firm's capabilities which are considered as their main sources of competitive advantages (Nelson and Winter, 1982; Dosi et al., 1999; Teece, 1996).

- 2) At the macroeconomic level, national institutions, their incentive structures and their competencies determine the rate and direction of technological progress (or the volume and composition of innovation activities) in a country. Institutions consist of both informal constraints (sanctions, customs, traditions, norms and codes of conduct) and formal rules (financial markets, property rights, including intellectual property rights, contract laws, corporate law, arbitration institutions, collective bargaining, labor market institutions, etc.) (North, 1991).

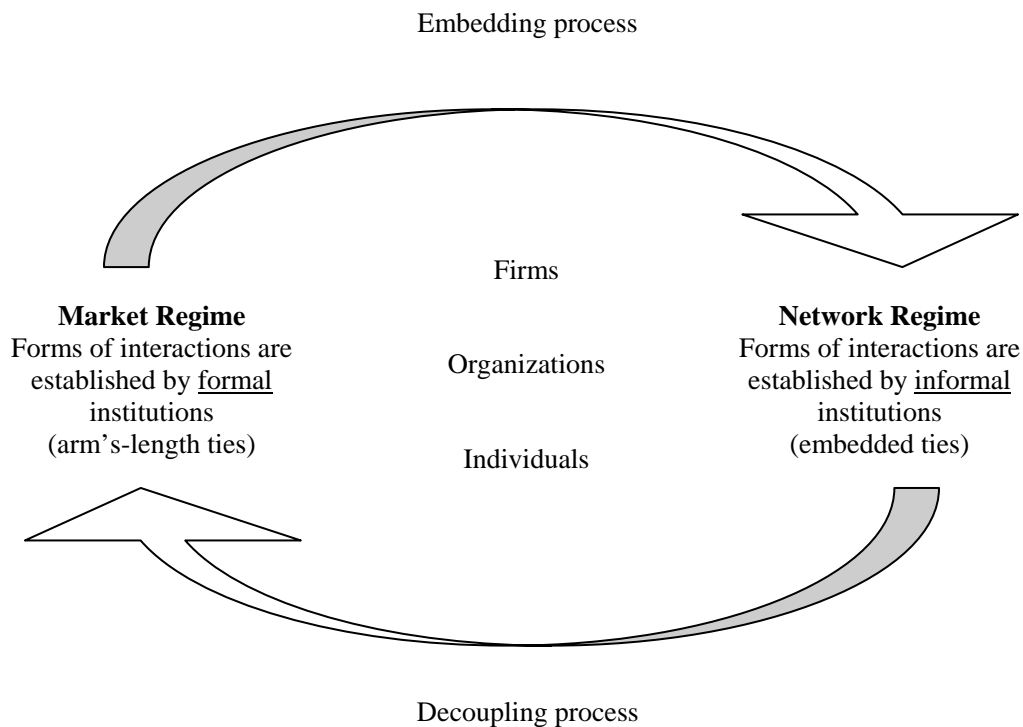
Therefore, innovation and technological progress of a particular NIS are induced by a complex set of relationships among individual actors producing, diffusing and applying various kinds of knowledge within institutional structures that provide them with general rules of interactions and behavior.

NIS framework is therefore an essentially interactive approach that rests on the premises that understanding the linkages among the actors involved in innovation is key for understanding the differences in technological performance. Nevertheless, the relations among the actors are not restricted to the pure market transactions. In order to understand the nature and the organization of interactive learning process, one also needs to understand the social basis of interactions and decision-making processes of individual actors.

The elements of economic sociology that we introduced in this paper (social networks, social resources, embedding and decoupling processes) provide a systematic way to study the organization of personal interactions which lies beneath most economic arrangements.

By integrating the elements of social networks' analysis into the existing NIS framework, the conception of interactive learning is extended to social processes, which underlie the differentiated cooperative arrangements between the actors of technological change (Figure 1).

Figure1: Social Processes in National Innovation Systems Dynamics



Since networks and markets operate in a different logic of exchange, we make a clear distinction between market and network regimes according to the type of rules that shape the interactions between the individual actors of NIS (firms, organizations and individuals):

- 1) In the market regime, interactions between the actors are defined by formal institutions and are ensured by the “arm’s-length” transactions.
- 2) In the network regime, interactions are organized according to the informal norms, customs and traditions that constitute a cultural basis of the economy. Actors are connected by ongoing social relations and their actions are embedded into heterogeneous social structures constructed by strong and weak ties.

These two regimes are not isolated from each other, since economic actors can have both formal and informal relations with their partners.

The functioning in both types of regimes has its benefits and costs:

- On one hand, actors functioning in the market regime have a clear understanding of their rights and responsibilities and are protected from malfeasance by official

judiciary system. They are not constrained to continue their market relations beyond the time of legal contract and have no moral obligations towards their partners beyond the formal transaction. However, the functioning in the market regime has its costs, or transaction costs incurred in making an economic exchange in the open market (Coase, 1937; Williamson, 1975, 1985). Markets and formal rules also have their limitations and failures, which can be especially important in case of developing and transitional economies.

- On the other hand, social relations provide resources that can be critical for economic activities, but are not accessible through market transactions, such as trust, knowledge transfer and social support of entrepreneurial activities. At the same time, social relations are also time-consuming, require an important affective investment and bring a burden of moral obligations.

In the ideal case, the actors of the NIS can freely navigate between the two regimes and develop an optimal mix of arm's-length and embedded relations.

If the resources required for a particular activity are not available in the market regime, the actors try to acquire them using their existing social relation or seek to embed a new network that bring additional advantages. This transition from market to network regime is insured by the embedding process.

If the social aspects of exchange in the network supersede by far the economic imperatives, the actors would tend to emanate from social attachments and use market mechanisms as an alternative mode of interactions. This transition from network to market regime is insured by the decoupling process.

Furthermore, since social networks are heterogeneous structures constituted by ties of different nature and actors of various capabilities and characteristics, the opportunities and benefits are not the same for different actors in different networks or different parts of the same network. Therefore, in our model the internal structures of NIS are viewed as social gel. Social gel represents an inhomogeneous environment full of contingencies: the possibilities for embedding and decoupling processes. The actors who are most able to quickly link up with others (or de-link from a given social context and switch into another) are in the best position to negotiate these contingent possibilities.

The capacity of the actors to maneuver across multiple social contexts of network regime and navigate between network and market regime constitute one of the major sources of innovation systems dynamics.

As a result, the configurations of NIS are shaped by continuous transformations of social structures that arise from dynamic social processes and their interactions with the institutional context:

- (i) Formal and informal institutions condition the behavior of individual actors in the market and social networks regime, respectively. Formal institutions provide general rules of individual action. Informal institutions make it possible to integrate the individual action into broader collective action. The actors related by social ties have shared perceptions and understandings which can eventually institutionalize their beliefs, norms, and values through the networks' interactions (DiMaggio & Powell, 1983).
- (ii) The existing institutions constantly interact with social structures through the actions of individual actors navigating between market and network regimes.
- (iii) Heterogeneous social structures create different opportunities within the NIS providing some actors or groups of actors with additional resources and possibilities of using their power to modify or considerably influence their environment.

These mechanisms constitute important sources of interactive learning because they bring together different actors and provide support for knowledge-sharing and cooperation. Trust, for example, constitutes an essential condition for learning process, since one cannot learn from somebody unreliable. The continuity of the learning process is insured by the renewal of information and resources, including social resources. The dynamics of the learning process largely depend on the capacity of the actors of NIS to search for new resources and bring them together in an original way.

As the presented model helped to demonstrate, social networks and processes play an important role in NIS dynamics and the development of interactive learning. In the final section of the paper we will discuss the possible applications of the model for the studies of NIS dynamics in developed and developing countries.

5. Social Networks in NIS Dynamics: Curse or Blessing

The main implication of our theorization and the proposed model is that social networks and processes do play a critical role for economic activities and NIS dynamics. Social structures provide resources essential for the functioning of the economy, such as trust. They also serve as an alternative mode of coordination of the activities and support prolonged economic interactions. They contribute to the institution-building process. They participate in the technological change by transmitting knowledge and allowing cooperation and risk-sharing, which is critical in a situation of radical uncertainty often related with innovative activities.

Application 1: Social barriers to innovative activities.

The term “networking” generally has a positive connotation in economics. While dynamic embedding processes and development of social networks can have beneficial effect on the economy in general and on cooperation and trust in particular, too much embeddedness (over-embeddedness) can be damaging for economic activities (Uzzi, 1997).² For example, the analysis of transformation of Russian innovation system has revealed important social barriers to institutional, economic and technological change (Agapitova, 2005).

Studies of social capital³ in the developing countries also showed possible negative consequences of social networks on economic action, including discrimination, collusion, downward leveling pressure and entry barriers (Portes, Landolt, 1996). These problems are especially important in the context of underdeveloped institutional structures, when the actors cannot freely switch between the market and network regimes of interactions. Unstable or costly institutional system (due to corruption, for example) locks the actors of NIS into a network regime, considerably diminishing the system’s dynamics. In other cases, close social networks of strong ties can increase the opportunity of misfeasance:

² In his studies of apparel industry in the New York City, Brian Uzzi (1997) shows that feelings of obligation and friendship may be so great in the socially embedded relations that a firm becomes a “relief organization” for the other firms in its network. Therefore, the over-embeddedness if defined as a socially embedded tie or network, where the social aspects of exchange supersede by far the economic imperatives.

³ In the fundamental works of Robert Putnam, “social capital” refers to the collective value of all social networks and the inclinations that arise from these networks to do things for each other.

- First, because the relations of trust make the network's actors more vulnerable.
- Second, because force and fraud are most efficiently pursued by teams of closely related actors who are isolated from the rest of the networks in the NIS (Granovetter, 1985).

It is often argued, that in developed societies misfeasance is averted, because existing institutional arrangements make it too costly to engage in illegal activities. However, while even in leading economies this argument could be contested, in developing countries with unclear laws and unsteady institutional structure, misfeasance could be an important issue in functioning of social networks.

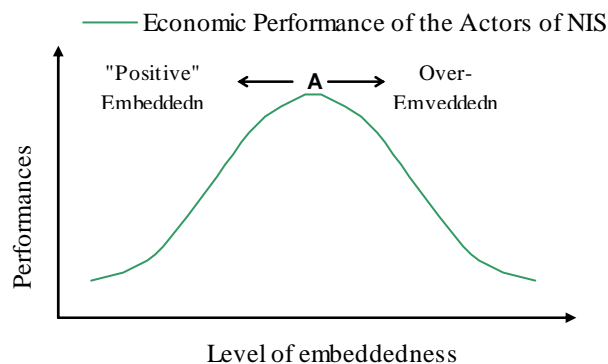
Moreover, the negative effects of the social networks are not limited to the developing economies, as it has been demonstrated by Uzzi's studies of the US apparel industry. In fact, in some cases even in the NIS with developed and stable institutions, social networks could stifle effective economic action, leading to the structural inertia. For example, feelings of obligation and friendship may be so great between trans-actors in certain types of social ties that a firm becomes a "relief organization" for the other firms in its network (Uzzi, 1997).

Furthermore, the over-embeddedness of the economy in the rigid and exclusive types of networks (for example, *Chaebols* in Korea) may have positive effects on a macro-scale, but be damaging for innovative activities of smaller enterprises.

Questions for further research: How could we define "the threshold of embeddedness"?

In other words, how and why social embeddedness become over-embeddedness, harmful for economic and innovative activities of the actors of NIS (point A on Figure 2).

Figure 2 The Role of Embeddedness in Economic Performance



Application 2: What are the prerequisites of an efficient NIS?

The question of international differences in the structure and functioning of innovation system was one of the first to be addressed by the founders of the NIS concept (Freeman, 1987). After more than a decade of studies of NIS of developed economies, it is clear that several successful models are possible.

The model of NIS dynamics would suggest that an efficient innovation system should have the following characteristics:

- 1) Technologically advanced individual actors (firms, individuals, etc.) that possess economic and social capabilities. These capabilities enable them to effectively use and produce knowledge, as well as connect to the external sources of knowledge and create strategic alliances that reinforce their competitive position.
- 2) Sound and sophisticated formal institutions that provide a full range of services and legal basis that support economic and innovative activities.
- 3) Open, flexible and dynamic social networks that generate trust, cooperation, facilitate knowledge flows and support entrepreneurial activities by providing support and opportunities for innovative activities of individual actors.

Of course, these criteria are very broad and leave place to the national particularities. Most of the developed countries manage to build capacities in all three areas. Nevertheless, the relation between institutions and social networks and composition of social structures differs significantly across the countries.

For example, Scandinavian economies are often cited as one of the more dynamic NIS that achieved a high level of social cohesion, institutional coherence and industrial sophistication that put them in the range of one of the most competitive of the world's economies (World Competitiveness Report, 2004). However, nobody will dispute that the Finnish NIS (first place in 2004-2005 rating) is very different from US NIS (second place in the rating the same year).

The important point in this argumentation is that the interactive evolution of institutions, social networks and technologies often results in a country-specific NIS that is difficult to imitate.

Question 2: What could be the basis of NIS dynamics in the developing economies?

Social and cultural contexts are very often country specific. By opposition to the developed NISs, the underdeveloped NISs generally have one or all of the following shortcomings:

- 1) Immature industry and private sector with insufficient economic and technological capacities of individual actors (including poor human capital development).
- 2) Underdeveloped, corrupt or unstable institutional system that fails to provide the rules of interaction in the market regime.
- 3) Lack of social cohesion (unwillingness of the actors to engage in social relations), over-embeddedness, domination of particular social network or type of networks.

Unfortunately, most of the policy-making mechanisms fail to take into account the country specific social structures. Social structures and culture are often considered as elusive and non-operational concepts, but the recent history of Soviet transition provided a dramatic demonstration of their importance.

Application 3: Social dynamics play a key role in an institution building process.

More specifically, social processes provide essential dynamics for incremental institution-building process. Of course, social structures are not the only sources of institutional transformations, but even if the institutional change is initiated by another party, for example, the nation-state, social networks play an important role in the adjustment process of the new institutions to the existing social and economic context.

All social structures are, more or less, important for institutional change and innovation activities. Nevertheless, a systemic approach to technological change requires an effort of classification of social networks according to their modes of influence on technological and institutional choices.

Taking up the classification criteria suggested by Powell and Smith-Doer for productive networks typology, we developed the following typology of social networks in NIS (Table 1): traditional networks, business groups, regional networks and research, development and production (RDP) networks.

Table 1 Four Types of Networks in NIS

<i>Types of Networks</i>	<i>Examples</i>	<i>Fundamental concepts</i>	<i>Trust sources</i>
<i>Traditional Networks</i> Coleman [1998]	Chinese <i>guanxi</i> , Russian <i>blat</i> networks	Social resourcing, social capital	Shared culture, continuity of relationships
<i>Business Groups</i> Granovetter [1994]	Japanese <i>keiretsu</i> , Corean <i>chaebol</i>	Benevolent authority	Common business group identity
<i>Regional Networks</i> Sabel [1988], Saxenian [1994]	Industrial Districts in Italy, high tech in Silicon Valley	Flexible specialization	Location, kinship, norms of reciprocity
<i>Research, Development and Production Networks</i> Powell [1993], Grossetti & Bès [2001]	Biotech industry, Scientific collaborations in Toulouse region in France	Innovation, learning	Common technological community based on subjacent social relations

Source: Powell and Smith-Doerr, 1994, modified by the author

The impact of these networks on institution building process and innovative activities varies significantly. In all the cases, the impact could be positive or negative, depending on the particular composition of the network (strong or weak ties, open or exclusive structures). The extent and the nature of overlap between different networks are especially important for innovative activities, bearing heavily on the extent to which cooperation can be produced over large sectors of the economy, without the intervention of the government. For example, regional networks and business groups generally have more distinct boundaries – geographically or organizationally – than traditional or RDP networks that integrate a broader set of actors. Social networks that involve a bigger number of actors and have relatively few barriers at the entrance are generally much more dynamic. When different types of networks are interconnected, sharing the same resources and participants, the heterogeneity of internal structures creates additional source of dynamics, preventing the networks lock-in.

Question 3: Is it possible to formalize the interaction between social networks and institutions?

The proposed typology was developed on the basis of the existing literature on social networks in economic action, and then applied to the study of Russian transition. Although the classification proved to be very rewarding in this particular study, more extensive analysis of developed and developing economies should be conducted before we could generalise the results or develop an integrated framework of social networks in innovation and institution-building processes.

Application 4: Undifferentiated representation of internal NIS structures.

Social networks represent heterogeneous structures that create internal disruptions and an environment full of contingencies. The social network approach to SNI development offers important insights into the structure and dynamics of regional and sectoral economies. It brings into light the complex networks of social relationships within and between firms and between firms and local institutions.

In particular, regional social networks approach helps to explain why equally endowed regions performs so differently within the same institutional context. The best-known example is the analysis of divergent patterns of development of Silicon Valley and Route 128 (Saxenian, 1985).

Silicon Valley has a regional network-based industrial system that promotes learning and mutual adjustment among specialist producers of a complex of related technologies. The region's dense social networks and open labor markets encourage entrepreneurship and experimentation. Companies compete intensely while at the same time learning from each other about changing markets and technologies through informal communications and collaborative practices. Loosely linked team structures encourage horizontal communication among firm divisions and with outside suppliers and customers. The functional boundaries within firms are porous in the network-based system, as are the boundaries between firms and between firms and local institutions such as trade associations and universities. The structure of social networks in Silicon Valley encourages the diffusion of knowledge and reallocation of different types of resources in a fast and cheap manner.

The Route 128 region, in contrast, is dominated by autarkic (self-sufficient) corporations that internalize a wide range of productive activities. Practices of secrecy and corporate loyalty govern relations between firms and their customers, suppliers, and competitors, reinforcing a regional culture that encourages stability and self-reliance. Corporate hierarchies ensure that authority remains centralized and information tends to flow vertically. Social and technical networks are largely internal to the firm, and the boundaries between firms and between firms and local institutions remain far more distinct in this independent firm-based system.

To recapitulate, even within the same institutional context, social networks could have both the most beneficial effects on the society, generating trust and encouraging cooperation, and cause damage by locking economic actors into rigid networks of connivance. The impact

of social networks on innovation and economic activities is even more important in the countries with weak and underdeveloped institutional system.

Social processes are responsible for development of various kinds of networks that exercise different impact on innovative activities. Social networks might either facilitate or hinder innovation in emerging economies. They can facilitate technological change by supporting trust, cooperation, circulation and dissemination of new knowledge, process of reciprocal innovation that reduces the distinctions between large and small firms and between industries and sectors. On the other hand, social networks can hinder innovation by creating barriers to new entrants and thereby limiting opportunities to experiment with new technology. Given their ubiquity, it is important to understand how social networks affect innovation, which is critically important to economic and social development in emerging economies.

6. Conclusions

Studies of social networks are essential not only for explaining the logic of interactions between individual actors, but also for understanding broader patterns of institutional learning, evolution of economic structures and creation of new technological knowledge. To date, though, little research addresses the interface between social networks, institutions and technological change.

Our model provides a first demonstration that the NIS dynamics originate from the interactions between social structures and the institutional context, and from internal dynamics of heterogeneous social structures. Further studies and comparative analysis should provide more insights on social logics of institutional and technological change.

The presented model of NIS is the result of an effort to study in a systematic and dynamic way the emergence and development of multiple sources of national competitiveness. The paper demonstrates that social structures and processes are essential ingredients of innovation systems. They provide additional coordination solutions, resources not accessible through economic mechanisms and participate in the development of markets and institutions.

Our main ambition was to create a coherent conceptual model that combine NIS theoretical framework and the element of social network analysis. By including social

structures and social dynamics in the analysis, our modeling effort allowed a deeper understanding of mechanisms that drive institutional and technological development.

Furthermore, we showed that the outcomes of the modeling shed light on the social sources of the NIS dynamics and competitiveness. The quality and structure of social networks have an important impact on NIS efficiency along with the characteristics of institutional environment and technological capabilities of the national firms.

This model and its application can be particularly useful for the studies of developing and transitional economies where they often substitute deficient institutional systems.

7. References

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