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Commonalities, differences, and interplay between global production networks and global innovation networks in two multinational companies

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Abstract

The increased number of global production network (GPN) and global innovation network (GIN) has been the most notable characteristics of globalisation. Yet the distinction and relation between GPN and GIN are still in lack of empirical research. This paper set out to analyze the distinction and relations between GPN and GIN based on the primary relational data of both internal and external linkages in two multinational firms? global networks for production and innovation. It is found that GINs have more diverse actors and are more concentrated than GPNs. GINs do overlap with GPNs and such overlap is higher in mid-tech industry than in high-tech industry.

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Keywords: Global production network, Global innovation network, Commonality, Differences, Interplay, Multinational companies

1. INTRODUCTION

One of the most distinctive characteristics of the recent wave of globalisation has been the increased number of cross-border production networks (Kogut and Kulatilaka, 1994; Gereffi and Korzeniewicz, 1994; Bonacich et. al. 1994; Sturgeon 1997, Borrus and Zysman, 1997), and the formation of international joint ventures and strategic alliances for R&D (Budd, 1995; George, 1995; Bowonder and Miyake, 1995; Zander, 1999). Nevertheless there are still big research gaps in both theory and methodology of this field.

Theoretically, the distinction between global production network (GPN) and global innovation network (GIN) is very blurry and the discussion on the interplay between GPNs and GINs has been often based on theoretical assumptions than on sound evidence. It is difficult to clearly identify the main body of literature dealing with GINs as it draws from insights from international business (Cantwell and Piscitello, 2002, 2005a; Cantwell and Piscitello, 2005b, 2007; Dunning and Lundan, 2009; Le Bas and Sierra, 2002; Zanfei, 2000), economic geography (Hamilton, 2006; Hotz-Hart, 2003) and innovation studies (Archibugi and Michie, 1995) (Borras and Lorentzen, forthcoming; Barnard and Chaminade, forthcoming). The possible causes of the conceptual neglect are twofold. On the one hand globalisation of production started much earlier than globalisation of innovation thus, with few exceptions (Audrescht and Feldman, 1996, Mariani, 2002), most researches implicitly assume that GINs evolve from GPNs. On the other hand, the tendency to add innovation as another function developed within the framework of GPN instead of clearly distinguishing the GPN and GIN blurs the distinction between the two kinds of networks.

The literature on GPN and GIN has been often criticised for the excessive focus on inter-firm networks and almost totally neglect intra-frim relationships (Coe et al., 2004; Liu 2011).With few exceptions (Liu, and Baskaran, 2009; Liu and Chaminade, 2009) almost all the literature has treated the firm as a "black box" ignoring the boundaries between internal and external networks and their interdependencies (Dicken and Malmberg, 2001) as well as the power relationships within firms' internalised production and innovation networks. Such external-network-bias may lead to insufficient understanding of networking as a process with both internal and external aspects and may exclude the study on interplay between internalised and externalised networks for production and innovation which can be an important dynamic of GPN and GIN.

This paper aims at addressing these research gaps by explicitly analyzing the relationships between GPN and GIN based on the primary relational data of both internal and external linkages in two multinational firms' global networks for production and innovation.

Using social network analysis the aim of this paper is to map the GPNs and GINs of two multinational firms to investigate the commonalities, the differences, and the interplay between their GPNs and GINs. The paper addresses four research questions:

1. What are the commonalities between GIN and GPN?
2. What are the differences between GIN and GPN?
3. Do the GIN and GPN overlap? If so, how do they overlap?
4. What are the implications of the commonalities, differences, and overlaps?

The rest of the paper is presented in four sections. The first is the theoretical framework in which the relevant literatures are reviewed, the concept of GPN and

GIN are defined, and the main hypotheses are generated. The second is the analytical framework for mapping and studying the commonalities and differences, as well as overlap of the firms' GPN and GIN. The third is method including the design of case study, the selection of case firms, the identification of network and network actors, and the selection of network structural indicators to analyse GPN and GIN. The forth is main findings. The fifth is conclusions.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

It is only recently that studies in economic geography have started to move the focus from local networks to interactions at international level highlighting the interplay between the local buzz and global pipelines (Amin and Thrift, 1994; Bathelt, 2005; Maskell, 2006).

The term GPN emerged in the international business literature to capture a major organizational innovation in global operations at the end of the nineties (Dicken et al., 2001; Ernst and Kim, 2002; Henderson et al., 2002; Dicken and Henderson, 2003; Coe et al., 2008). The concept of GPN was explicitly suggested as an alternative to Global Value Chains (GVC), to highlight the networked character of production and its global geographical scope. Value chains were basically defined as a sequence of functions, each of them adding value to the previous one. Global Value Chains (GVC) occurred when the functions were spread geographically, with different firms specializing in one or several functions (Gereffi, 2005). As different empirical studies shown, the reality of many industries was far from the simple linear model that the GVC literature suggested. Functions are not sequential and there are many different organizational configurations of production. The reality is that instead of chains, most industries could be better characterized as networks. Networks are complex structures embracing horizontal and vertical linkages and embracing all activities supporting the production of a good or services (Dickens, 2007). As in the case of Value Chains, the networks can be spread geographically and organizationally (different organizations might be responsible for different functions in the network) and, as in the case of GVC, there is a certain degree of coordination/governance in the network. When the organizations conforming the network are spread globally, we can talk about global production or innovation networks.

In this paper GPNs are defined as "the globally organized nexus of interconnected functions and operations by firms and non-firm institutions through which goods and services are produced and distributed' (Coe N.M. et al., 2004). One of the main characteristic of a GPN is that it involves simultaneously a high degree of geographical dispersion worldwide with a high degree of concentration in few specialized local clusters (mainly in US, Europe, Japan and some emerging economies) thus pointing out to the strong relationship between the local and the global (Bathelt, 2005; Giuliani, 2004, 2007; Giuliani et al., 2005)

The growing literature on GPNs has greatly contributed to our understanding of the structure of the networks (Burt, 1992; Dickens, 2007; Giuliani, 2011) and its impact on how knowledge is distributed across members of the network (Giuliani and Bell, 2005), the value of the GPN (Henderson et al., 2002), the governance of the networks (Gereffi, 2005) and their spatiality and territorial embeddedness (Ivarsson and Alvstam, 2009; Ivarsson and Göran Alvstam, 2004; Powell and Grodal, 2004) (Mackinnon, 2012) and more recently on the impact of the position of the agents in the network on their innovation performance(Giuliani, 2008).

GIN is defined here as (Barnard and Chaminade, 2011; Chaminade, 2009) "A globally organized network of interconnected and integrated functions and operations by firms and non-firm organizations engaged in the development or diffusion of innovations"**.** This definition captures the main features of a GIN, that is its truly global character: going beyond the traditional triad of US-Europe-Japan, the variety of actors engaged in innovation: both firms and non-firms organizations are part of a GIN, the integration of internalized and externalized networks, a high degree of functional integration and the focus on innovation.

GPN and GIN have often been analyzed by looking only at one type of actors. Thus one can hit a number of studies focusing on "business networks" or "academic networks" (Dickens, 2007). The literature of Global Value Chains and GPNs are examples of the first ones, while the literature on the "invisible college" is an example of the later. As we will argue, possibly, GINs are a combination of the two, as both firms and universities and research centers play a key role in innovation. The variety in the organizational composition of the network might probably be one characteristic of a GIN in contrast to GPN. We therefore expect that

HYP1: GINs will be formed by a larger number of diverse actors than GPNs

Evidences suggest that differences exist between GPN and GIN. Audrescht and Feldman (1996) already in the mid-nineties linked the type of industry to the geography of production and innovation. They indicate that resource-based and science-based industries are geographically more concentrated than scale intensive ones. Furthermore, in the case of science-based, they compare the geography of production to the geography of innovation and show that both production and innovation tend to be concentrated in high-tech or R&D intensive industries. They also indicate that the propensity to concentrate innovation activity cannot be completely explained by the propensity to concentrate manufacturing activity and that the concentration is higher in highly skilled industries (Audretsch and Feldman, 1996). We therefore expect that

HYP2. GINs are more concentrated than GPNs

It has been found that there is always some innovation occurring in production and there is a certain overlap between GINs and GPNs[1] (Fifarek and Veloso, 2010; Mariani, 2002; Verspagen and Schoenmakers, 2004). In this line of research, Mariani (2002) using data on Japanese subsidiaries in Europe suggests that innovation tends to follow production but that the more R&D intensive the firm is, the more likely they will be to establish R&D units independent of production. The higher the technology intensity of the firm or the industry is, the higher is the probability to have innovation independent from production. We therefore expect that:

HYP3a. There is a certain degree of overlap between GPN and GIN

HYP 3b. The overlap between GPN and GIN will be higher in low and medium tech industries (like automotive) than in high tech industries (like ICT)

The extent to which these hypothesis hold for two firms in two different industries will be investigated using social network analysis.

3. METHODS

Design of the comparative case study and selection of companies

This research is based on comparative cases studies of the inter-firm and intra-firm production and innovation networks of two multinational companies. Firm selection is based on four criteria, namely firm's global presence, production and innovation capabilities, firm size, and market structure in which the firm operates. These four criteria were chosen from the perspective of geography, firm, and market, which have fundamental influence on firm's production and innovation process. Based on these

[1] Understood as the geographical dispersion of production and innovation

four criteria, we selected a company in telecommunication industry and a company in autoparts industry. Thanks to the anonymous request from both companies, we use TELE to name the telecommunication case company and AUTO to name the autoparts case.

Both companies are headquartered in Sweden and have strong global presence in most of the countries and regions in Europe, Asia and Pacific, North and South America, as well as some countries in Africa. The reason why we chose firms with strong global presence is that it is easier to observe and collect data on their global distribution of production and innovation activities compared with those have low global presence.

Both firms have strong production and innovation capabilities, both firm are large companies, and both firms operate in oligopoly market in which a small number of sellers dominate.

Collection of data

Data sources of this paper include interviews, questionnaires, archives, websites, internal reports, internal documents and press news. Multiple data sources provide more accurate information and improve the robustness of the results (Jick, 1979). One questionnaire was developed and administered to elicit responses from the middle managers and top management team members, namely the VP for research in these two companies. In total, 4 interviews were conducted. Each interview lasted from one to three hours. All the interviews were recorded. The interviews were done between 2010 and 2011 in both the headquarters and their branches in other locations in Sweden.

The interview started by asking the informants some background questions about their company and the industry, such as the history of the company, the organisational structure of the company, their strategy of innovation, the technology nature and competition in the industry, etc. Then the questions went to the relationship between the functional departments or groups in the headquarter, the relationships between the headquarter functional departments/groups, the outside organisations (the subsidiaries of the mother company are considered as outside organisations), and the relationships among the outside organisations. The informants were reminded constantly that all the relationships should be relevant to either the companies' production, or the companies' technological innovation activities. At the end of the interview, open-ended questions were asked to identify the purpose of the companies' strategy of going global for both production and innovation.

Potential informant bias is addressed in three ways. First, we selected highly knowledgeable informants. Top management team, namely the VP of Research or the VP of R&D operations were interviewed. The VPs of Research or R&D operation usually know the whole picture of the innovation activities in the company at local, regional, national, and international level. Second, we used "courtroom questioning" technique to focus on factual accounts (Lipton, 1977; Huber and Power, 1985). We asked the informants to specify what kind of activities have been carrying on in each specific relationship so as to ensure that the informant did not mix the relationship for innovation and for production or any other activities. It was also helpful for informants to avoid the confusion between what had happened and what should happen. Third, we gave anonymity to the informants and their firms on. The informants were very motivated to give accurate information because they knew that networking is critical to the companies' innovation but they did not know the very precise picture of the their companies at different geographic levels. Strong interest of informants ensures the accuracy of their accounts (Miller et al., 1997).

The case companies' GPNs and GINs are weighted and undirected whole networks. GPN in this paper refers to the set of relationships of the case company aiming at manufacturing products. GIN in this paper refers to the set of relationships of the case company aiming at technological innovation including both product and process innovation. Provision of services and service innovations are excluded from this research to facilitate the comparison between networks and between firms.

We identified two groups of actors in GPNs and GINs. One is the group of internal actors including the functional departments or groups within the company's headquarter and the company's subsidiaries. The functional departments/groups refers to the department/groups for production, R&D, marketing, financial, human resource, and purchasing/sourcing of which the taxonomy follows Porter's (1985) value chain analysis. The subsidiaries refer to the company's sub-organisations for R&D, production, and marketing. These three groups of subsidiaries are the main types of subsidiaries for the case companies' global operation. The other group is the external actors which refer to the outside organisations namely customers, suppliers, universities, research institutes, competitors, and government agencies as the main actors in the innovation system (Lundvall, 1992; OECD, 1999). The differentiation of internal network and external network is to better observe if the core of the networks for production and innovation lay within the firm or outside of it.

We identified three different geographic levels of GPN and GIN. They are local, national, and international levels. Local level refers to the Swedish region where the case companies are headquartered. National level refers to the rest of Sweden excluding the headquarter region. International level refers to the rest of the world excluding Sweden.

The names and abbreviations of the actors of both GPNs and GINs are shown in Table 1. We used one initial letter to distinguish the different geographic locations of external actors. L, N, and I represent respectively Local, National, and International. For example, LCST refers to Local CuSTomers in Stockholm region. NGOV refers to National GOVernment agencies. ISRD refers to International Subsidiaries for R&D located in other countries.

Table1. Name and abbreviation of internal and external actors of production/innovation network

	Internal Actors		External Actors
R&D	R&D Department	CST	Customers
PRD	Production coordinator[2]	SPL	Suppliers
HR	Human Resource	CPT	Competitors
MKT	Marketing Department	U&R	Universities and research institutes
FIN	Financial Department		
PCH/SOC	Purchasing Department/ Sourcing Department	GOV	Government agencies
SPD	Subsidiaries for production		
SRD	Subsidiaries for R&D		
SMK	Subsidiaries for marketing		

The relational data of the ties was collected through a roster recall method (Wasserman and Faust, 1994). Each case company was presented with a complete list (roster) of the actors in the network and was asked the following questions:
Q1: Do the following actors contact each other for your company’s production/innovation activities?
Q2: If do, what are the types of these connections, for production, for innovation, or for both?
Q3: How is the strength of these connections in terms of the intensity they contact each other, the frequency they contact each other, and the trust between each other? Please give a score to represent the strength of the connections:

[2] In both case companies’ headquarter, there is not a department of production but a person who act as the production coordinator. We still consider it as a function of the headquarter even though there is just one or several persons are in charge.

Strength	Very strong	Strong	Normal	Weak	Very weak	No connection
Score	5	4	3	2	1	0

We mapped the GPNs and GINs of the two case companies using UciNET social network analysis software.

Analysing GPN and GIN

The analysis of the networks presented in this paper has been done using social network analysis (SNA). SNA facilitates the comparison of networks- for example, for the purpose of understanding how the same actors can configure different networks to carry different types of knowledge (Giuliani, 2011)

To explore the structural property of the GPNs and GINs, we did four analyses. They are network property analysis, Clique analysis, core/periphery analysis, and node centrality analysis. These analyses aim to answer the questions as shown in Table 2.

Table 2. Network structural indicators and the related research questions

Analyses	Indicators	Questions to answer
Network property analysis	Size, density, network centralisation	How is the connectedness of the GPN/GIN?
Clique analysis	Clique	Who and where are the sub-groups of the GPN/GIN?
	Lambda sets and bridges	Who and where are the most important connections?
Core/periphery analysis		Who and where is the core of the GPN/GIN?
Node centrality analysis	Freeman degree	Who and where are the most connected actors?

For finding the sub-groups we produced a census of all cliques of both GPN and GIN. Clique is a sub structure in a network. In this paper, a clique is the maximum number of actors who have all possible ties present among themselves. A clique is a maximal complete sub-network in which everybody is connected to everybody and it has as many actors as possible. Divisions of actors into cliques can be a very important aspect of social structure (Hanneman and Riddle, 2005). It can be important for understanding how the network as a whole is likely to behave. One the one hand, clique is a form of network that guarantees a cooperative environment where social monitoring and trust are bound to be high, and resource distributing are expected to be equal (Giuliani and Pietrobelli, 2011). On the other hand, overlap of cliques between two networks indicates the degree of information sharing and knowledge transferring between these two networks. If there is a clique overlap between two networks, it means there is a clique whose actors work closely for both networks. In such circumstance, one may expect that conflict and obstacles of information sharing and knowledge transferring within the overlapped clique is less while trust and understanding is more than that between two different cliques. Where the cliques overlap, diffusion of knowledge and information may spread rapidly, consensus and common awareness may build up quickly across these two networks. On the contrary where the cliques do not overlap, traits may occur in one group and not diffuse to the other. So clique overlap is an indicator of smooth interplay between two networks. We study the overlapped clique between GPN and GIN so as to see how close that GPN and GIN interplay with each other. If a certain clique of GPN overlaps a clique of GIN, it means the same group of actors work together for both production and innovation. It can be assumed that GPN and GIN interplay with each other via this overlapped clique.

For identifying the key connections we adopted a lambda set approach which ranks each of the relationships in the network in terms of importance by evaluating how much of the flow among actors in the network go through each link of GPN and GIN. The most important connections are those relationships which, if disconnected, would most greatly disrupt the flow among all of the actors.

For distinguishing the key actors, we calculated the freeman degree of each actor in both GPN and GIN. Freeman degree is a measure of the connectedness of a specific actor in a local environment. It measures the centrality of the node in the network and shows the potential of the node's positional power. It is used to identify who are the most well connected actors in the innovation networks. The most connected actor has the highest possibility to reach heterogeneous resources in the network and has the most opportunities to choose the proper partner in the network.

4. MAIN FINDINGS

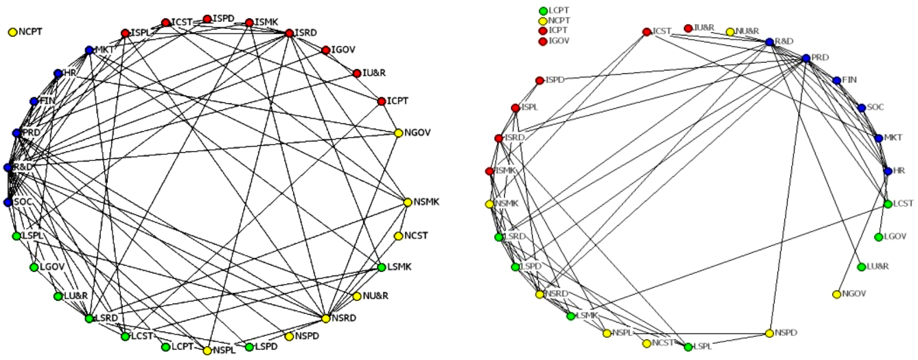
GINs have more diverse actors than GPNs and are more centralised than GPNs

Both case companies' GINs have more diverse actors than their GPNs (see Figure 1 and Figure 2) which confirms HYP 1. In the case of TELE, GIN has local competitors, international competitors, and international government which its GPN does not have. The connections with these actors are all for the purpose of negotiating on new standards. In the case of AUTO, GIN has international universities and research institutes which its GPN does not involve.

Both case companies' GINs have higher network centralisation than their GPNs (see Table 3) which confirms HYP2. This can also be visually seen in Figure 1 and Figure 2. It is more obvious in GIN than in GPN that a certain group of the actors are more intensively connected than the others, which also points out to the skewedness of knowledge distribution in the network.

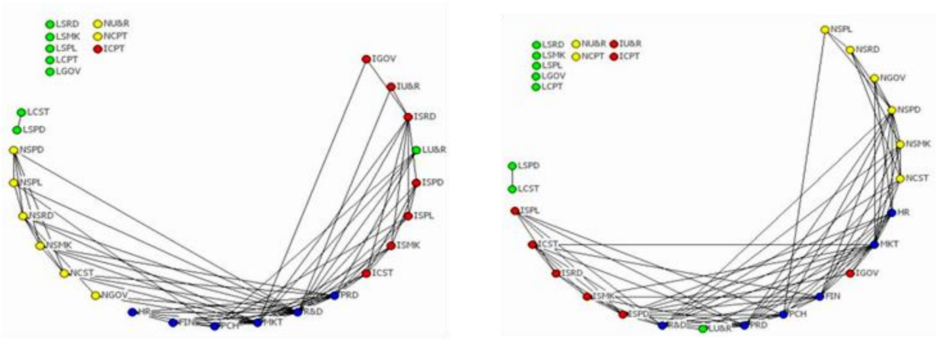
Table 3. Network centralisation of GPNs and GINs (%)

	GPN	GIN
TELE	30.44	44.09
AUTO	20.26	32.52



TELE GIN TELE GPN

Figure 1. The socialgram of TELE's GIN and GPN



AUTO GIN AUTO GPN

Figure 2. The socialgram of AUTO's GIN and GPN

Heterogeneity plays bigger role in GIN than in GPN, as variety increases innovation. But higher heterogeneity of actors goes with higher inequality of connectedness of the actors in GIN. This implies that increase the heterogeneity of the network may increase the innovativeness of the network but may not necessary to make them equally connected.

GIN and GPN have same pattern of ties but there are industry/firm differences

Both case companies' GIN and GPN have same pattern of ties. As shown in Figure 3 and Figure 4, there are several aggregations in the socialgram of the GPNs and GINs with principal component layout. It can be clearly seen that the aggregations in each of the case companies' GIN and GPN are organised in the same way.

In the case of TELE (see Figure 3), the actors aggregated together are for the same function, such as R&D, marketing, suppliers, customers, government agencies, competitors, etc. However, for AUTO (see Figure 4), the actors aggregated together in the socialgram are in the same geographic scope, such as headquater, local, national and international. These two socialgrams are drawn using NetDraw MDS with principal component layout. In these drawings, when a group of nodes are close to each other, it means they have similar pattern of ties, esp. they are connected with the same nodes and they have similar number of connections and similar geodesic distance to all other nodes. The colour of the nodes represents number of connected members.

Hence for the same company its GIN and GPN has a similar pattern of ties while such pattern is different between two different companies in different industries.

The fact that for the same company its GIN and GPN have same pattern of ties can be considered as one of the evidences that GINs follow or were evolved from GPN which confirms Hyp 3a.

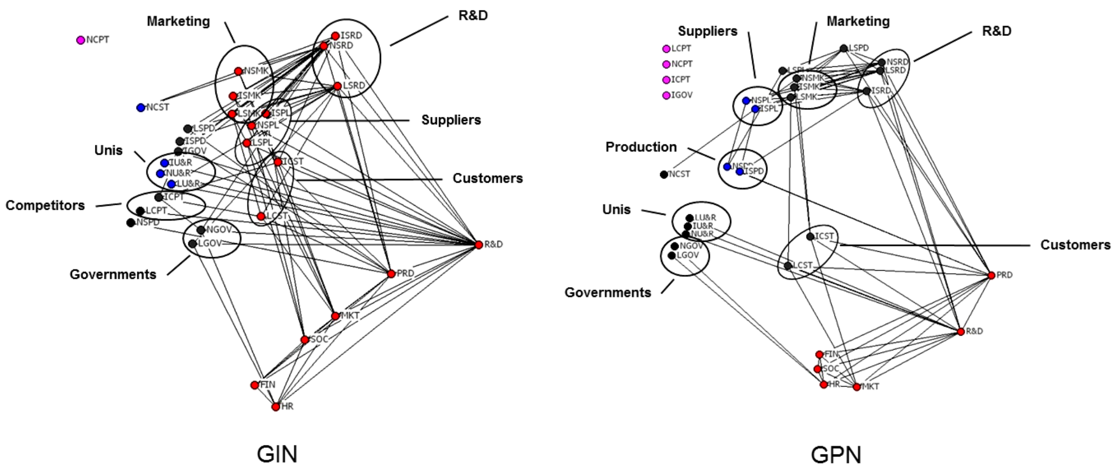


Figure 3. TELE's GPN and GIN of principal component layout

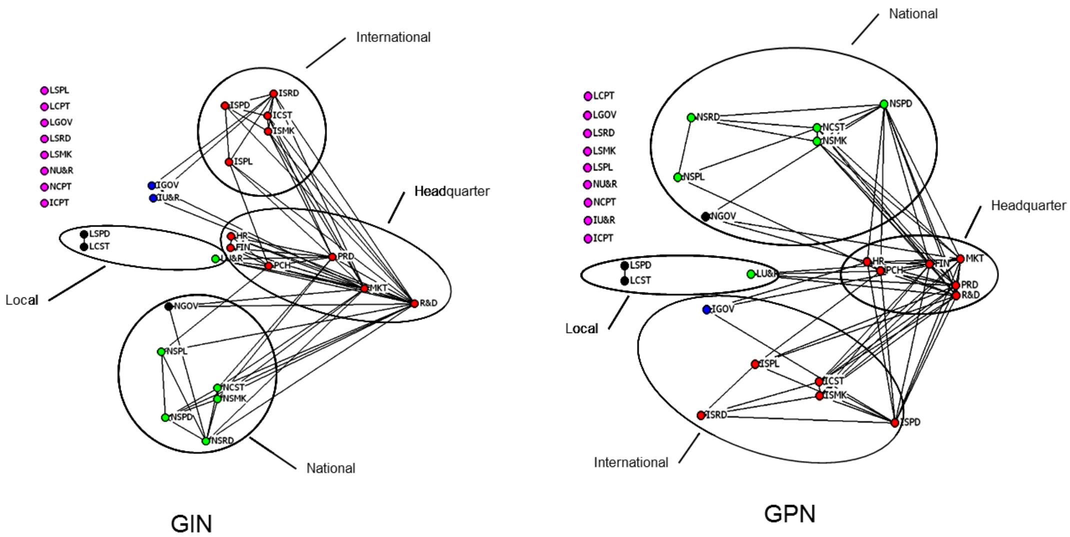


Figure 4. AUTO's GPN and GIN of principal component layout

We also expect that GIN and GPN interplay with each other but that such interplay shows industry/firm difference. There are two evidences of such interplay.

First, for both TELE and AUTO, the headquarter's R&D Department plays a core role both in GINs but also in GPNs, while headquarter Production Department are not only important roles in GPNs but also in GINs. This is shown in Figure 5 and Figure 6 that headquarter R&D and headquarter PRD are both most connected actors in both GPN and GIN of both case companies.

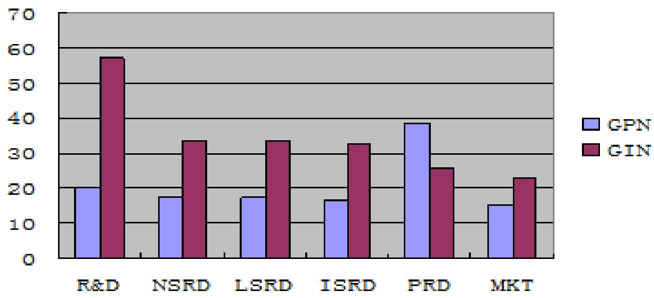


Figure 5. TELE’s most connected actor’s Freeman degree

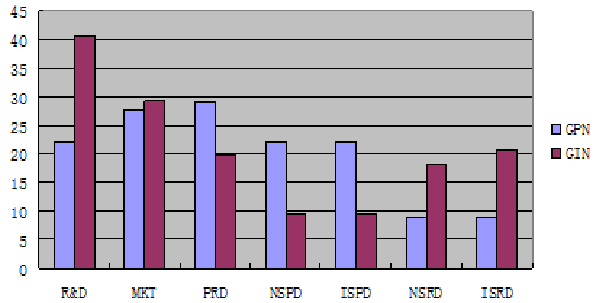


Figure 6. AUTO’s most connected actor’s Freeman degree

Second, in both cases, there are clique overlaps between GPN and GIN. For example, there is an overlapped clique between GPN and GIN which consists of the headquarter’s R&D Department (R&D), headquarter’s Production Department (PRD), the international customer (ICST), and the international R&D subsidiaries (ISRD). This means this group of actors closely work together for both GPN and GIN. Thanks to the cooperative environment and mutual trust created within the cliques, information and knowledge are able to smoothly travel between GPN and GIN via this sub-group.

Nevertheless, the GPN-GIN interplay is different between the two case companies. TELE’s GPN and GIN has more interplay between each other than AUTO, which rejects HYP3b. In TELE, 44.4% of cliques in GPN overlap 21.6% of the cliques in GIN, while in AUTO only 7.6% of cliques in GPN overlap 6.7% of the cliques in GIN. This situation is illustrated in Figure 7. One can clearly see that TELE has more clique overlap than AUTO which means more sub-groups in TELE work for both GPN and GIN than in AUTO. Clique overlap is an important social structure between two networks which indicates smooth information exchange and knowledge transfer between the two networks in question. The more cliques overlap between two networks, the less conflict, more consensus and common awareness, faster knowledge and information diffusion may occur between these two networks. We assume such difference may result from the different knowledge base of industries or from the different strategy of the firms.

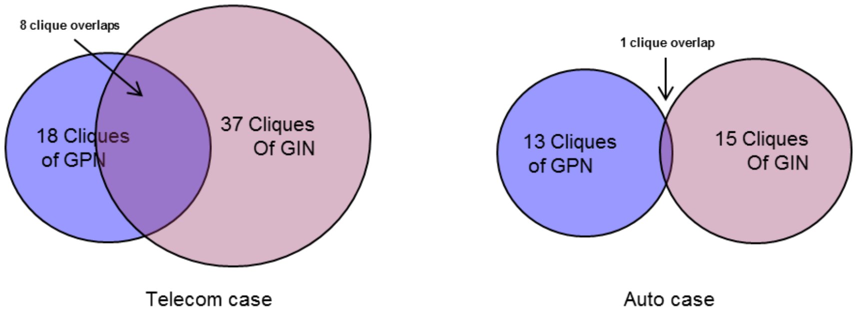


Figure 7. Illustration of clique overlap between GPN and GIN of the two cases

Table 4 summarises the main results and hypothesis

Hypotheses	Results
1. GINs have a larger number of diverse actors than GPNs	Confirmed. GINs are more heterogeneous than GPN
2. GINs are more concentrated than GPNs	Confirmed. Both for AUTO and TELE, GINs are more concentrated than GPNs
3a. There is a overlap between GPNs and GINs	Confirmed, both for AUTO and TELE
3.b. The overlap will be higher in AUTO than in TELE	Rejected. The overlap is higher in TELE than in AUTO.

5. CONCLUSIONS

This paper investigates the GINs and GPNs of two MNCs from two different industries but both headquartered in Sweden. It explores the commonality and differences as well as interplay between the GIN and GPN of each case company.

We were able to confirm three of our initial hypothesis and reject the forth one. GINs are formed by a larger number of diverse actors than GPNs, which reflects the need to tap into diversified sources of knowledge. GINs are also more concentrated than GPNs thus reflecting the strategic importance of innovation activities and their complexity. Finally, we also find overlap between GPN and GIN, but we find no supporting evidence for our hypothesis that the overlap between GPN and GIN is higher in low and medium tech industries –autoparts- as compared to high-tech ones –telecommunications.

We find however, differences in the two cases in the pattern of ties, the heterogeneity of the actors and their degree of centrality. Whether these differences are explained by their belonging to different industries or by different strategies remain to be studied. More cases within the same industry may help to understand if the observed patterns are industry or firm specific.

References

Amin, A., Thrift, N., 1994. Living in the global. Oxford University Press, USA.

Archibugi, D., Michie, J., 1995. The globalisation of technology: a new taxonomy. Cambridge Journal of Economics 19, 121.

Audretsch, D.B., Feldman, M.P., 1996. R&D spillovers and the geography of innovation and production. The American Economic Review 86, 630-640.

Barnard, H., Chaminade, C., 2011. GINs: what are they and where can we find them?(Conceptual and Empirical issues), CIRCLE Electronic Working Papers.

Bathelt, H., 2005. Geographies of production: growth regimes in spatial perspective (II) – knowledge creation and growth in clusters. Progress in Human Geography 29, 204-216.

Burt, R.S., 1992. Structural holes. Cambridge University Press, Cambridge.

Cantwell, J., Piscitello, L., 2002. The location of technological activities of MNCs in European regions: the role of spillovers and local competencies. Journal of International Management 8, 69-96.

Cantwell, J., Piscitello, L., 2005a. Competence-creating vs. Competence-exploiting Activities of Foreignowned MNCs: How Interaction with Local Networks Affects their Location, Annual Conference of the European International Business pp. 10-13.

Cantwell, J., Piscitello, L., 2005b. Recent Location of Foreign-owned Research and Development Activities by Large Multinational Corporations in the European Regions: The Role of Spillovers and Externalities. Regional Studies 39, 1-16.

Cantwell, J., Piscitello, L., 2007. Attraction and Deterrence in the Location of Foreign/owned R&D activities: the role of positive and negative spillovers. International Journal of Technological Learning, Innovation and Development 1, 83-111.

Chaminade, C., 2009. On the concept of GINs. CIRCLE Electronic Working paper 2009/05.

Coe N.M., H., M, Yeung, H.W., Dicken, P.H.J., 2004. Globalizing' regional development: a GPNs perspective. Transactions of the Institute of British Geographers 29, 468-484.

Dicken, P., Kelly, P.F., Olds, K., Wai‐Chung Yeung, H., 2001. Chains and networks, territories and scales: towards a relational framework for analysing the global economy. Global networks 1, 89-112.

Dicken, P., Malmberg, A., 2001. Firms in Territories: A Relational Perspective*. Economic Geography 77, 345-363.

Dickens, P., 2007. Global Shifts: mapping the changing contours of the world economy, 5th Edition ed. Guilford, New York.

Dunning, J.H., Lundan, S.M., 2009. The Internationalization of Corporate R&D: A Review of the Evidence and Some Policy Implications for Home Countries1. Review of Policy Research 26, 13-33.

Ernst, D., Kim, L., 2002. GPNs, knowledge diffusion and local capability formation, Research Policy, pp. 1417-1429.

Fifarek, B.J., Veloso, F.M., 2010. Offshoring and the global geography of innovation. Journal of Economic Geography 10, 559.

Gereffi, G., Humphrey, J., Sturgeon, T., 2005. The governance of global value chains. Review of International Political Economy 12, 78-104.

Giuliani, E., 2007. The selective nature of knowledge networks in clusters: evidence from the wine industry. Journal of Economic Geography 7, 139-168.

Giuliani, E., 2008. Multinational Corporations and Patterns of Local Knowledge Transfer in Costa Rican High‐Tech Industries. Development and Change 39, 385-407.

Giuliani, E., 2011. 12 Networks of innovation. Handbook of Regional Innovation and Growth, 155.

Giuliani, E., Bell, M., 2005. The micro-determinants of meso-level learning and innovation: evidence from a Chilean wine cluster. Research Policy 34, 47-68.

Giuliani, E., Bell, M., 2004. When micro shapes the meso: Learning networks in a Chilean wine cluster, SPRU Paper No. 115.

Giuliani, E., Pietrobelli, C., Rabellotti, R., 2005. Upgrading in Global Value Chains: Lessons from Latin American Clusters. World Development 33, 549-573.

Hamilton, B.A., 2006. Innovation: Is Global the Way forward?, in: Insead (Ed.).

Henderson, J., Dicken, P., Hess, M., Coe, N., Yeung, H.W.C., 2002. GPNs and the analysis of economic development. Review of International Political Economy 9, 436-464.

Hotz-Hart, B., 2003. Innovation Networks, Regions, and Globalisation, in: Press, O.U. (Ed.), The Oxford Handbook of Economic Geography (paperback edition 2003).

Ivarsson, I., Alvstam, C.G., 2009. Learning from foreign TNCs: a study of technology upgrading by local suppliers to AB Volvo in Asia and Latin America. Int. J. Technology Management 48, 2009.

Ivarsson, I., Göran Alvstam, C., 2004. International technology transfer through local business linkages: the case of Volvo Trucks and their domestic suppliers in India. Oxford Development Studies 32, 241-260.

Le Bas, C., Sierra, C., 2002. Location versus Home Country Advantages in R&D Activities: Some Further Results on Multinationals Locational Strategies. Research Policy 31, 589-609.

Mackinnon, D., 2012. Beyond strategic coupling: reassessing the firm-region nexus in GPNs. Journal of Economic Geography 12, 227-245.

Mariani, M., 2002. Next to Production or to Technological Clusters? The Economics and Management of R&D Location. Journal of Management and Governance 6, 131-152.

Maskell, P., Pedersen, T., Petersen, B. And Dick-Nielsen, J., 2006. Learning Paths to Offshore Outsourcing - From Cost Reduction to Knowledge Seeking, SMG Working

Paper No. 13/2006.

Powell, W.W., Grodal, S., 2004. Networks of innovators, in: Fagerberg, J., Mowery, D., Nelson, R. (Eds.), The Oxford handbook of innovation. OUP, Oxford, pp. 1-29.

Verspagen, B., Schoenmakers, W., 2004. The spatial dimension of patenting by multinational firms in europe. Journal of Economic Geography 4, 23-42.

Zanfei, A., 2000. Transnational firms and the changing organisation of innovative activities. Cambridge Journal of Economics 24, 515-542.

Kogut, B., and Kulatilaka, N. 1994. Operating flexibility, global manufacturing, and the option value of a multinational network. Management Science, 40: 123-139