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Differences in technology transfer between regional innovation systems of developed and developing countries

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Diferencias en la transferencia de tecnología entre sistemas regionales de innovación de países desarrollados y en desarrollo

Diferenças na transferência de tecnologia entre sistemas regionais de inovação de países desenvolvidos e desenvolventes

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This document's purpose is, by using the social network method (SNA), to establish the differences between the process of technology transfer among regional innovation systems (SRI) of developed regions and developing regions, in order to derive policy implications for the regions of lower innovation capacity. As such, the goals of the present document are: to characterize developed and developing regions' innovation systems. Secondly, to propose a battery of policy instruments that stimulate networks and spillovers in order for developing regions to strengthen their systems of innovations.

El propósito de este artículo es utilizar el método análisis de redes sociales (SNA) para establecer las diferencias entre el proceso de transferencia de tecnología entre los Sistemas Regionales de Innovación (SRI) de regiones desarrolladas y de regiones en desarrollo, con el fin de derivar implicaciones políticas para las regiones de menor capacidad de innovación. Como tal, los objetivos del presente artículo son: caracterizar los sistemas de innovación de las regiones desarrolladas y en desarrollo. En segundo lugar, proponer una batería de instrumentos de política que estimulen las redes y los efectos indirectos para que las regiones en desarrollo fortalezcan sus sistemas de innovación.

O objetivo deste documento é utilizar o método de análise de redes sociais (SNA) para estabelecer as diferenças entre o processo de transferência de tecnologia entre os Sistemas Regionais de Inovação (SRI) das regiões desenvolvidas e das regiões em desenvolvimento, a fim de derivar implicações políticas para as regiões com menor capacidade de inovação. Assim, os objetivos deste artigo são: caracterizar os sistemas de inovação das regiões desenvolvidas e em desenvolvimento. Em segundo lugar, propor uma bateria de instrumentos de política que estimulem redes e efeitos indiretos para regiões em desenvolvimento para fortalecer seus sistemas de inovação.

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1. Introduction

The accelerated globalization and technological changes rates, initiated in the nineties decade, has set forth that regions are vital players in coordinating economical life and that companies and regions are not self-sufficient in order to generate all the knowledge and technology to produce (Gertler & Levitte, 2003; Del Giudice, Carayannis & Maggioni, 2017). From here, two phenomena has gained renowned attention: administrative decentralization, which is why regions have been granted more powers and competencies (Herrschel & Tallberg, 2011), and the transformation of the international technology process, ITP, determined by the forming of networks and utilization of spillovers driven by the presence of universities (Bradley, Hayter & Link, 2013; Dau, 2018).

These two phenomena complement each other in the importance of the localization of multinational companies, MNC (Dunning, 2013). These engage in direct foreign investment, DFI, in those places where they find natural resources, markets o knowledge (Cantwall & Glac, 2004; Del Giuduce et al., 2017). In any case, the ITP is executed among MNC and agents located in specific regions, which has led to the forming of global value chains (Gereffi, Humphrey & Sturgeon, 2005).

Under these circumstance, the ITP takes place between two alternative forms: the first, and more traditional one, is the transferring of technology from MNC to the region of reception (Dunning, 1993), where a lineal ITP is set, LITP, in which local agents are passive receptors of unilateral and partial spillovers, UPS (Caves, 1974). The second alternative is that of an ITP where MNC, through their subsidiaries or company-university relationships, absorb technology and knowledge from the territories where they are located (Bradley et al., 2013). This is non-lineal interactive ITP, NLITP, where local and international agents are active receptors and issuers in exploiting multilateral reciprocal spillovers, MRS (Driffield & Love, 2006; Schmidt & Sofka, 2009).

Recognizing the alternatives to carry out ITP has boosted the construction of regional competitiveness policies based of exploiting networks and spillovers (Schmidt & Sofka, 2009) and their impact of Regional Innovation systems (Pitelis & Teece, 2018). Due to the enforcement of such policies, via MNC and regions relationships, the ITP occurs among developed and industrialized countries, and among these and developing recently industrialized countries (Narula & Michel, 2009).

The document is organized in six sections: after this introduction, the second section describes the ITP and identifies its agents, object, environmental changes and the means of technology transferring. The third section puts forward an ITP simulation in presence of networks and spillovers using the SNA method. The fourth section deducts the differences between LITP and NLITP. The fifth section derives some policy implications based on the instruments that promote networks and spillovers, and their impact on RIS. Finally, there will be a set of conclusions and recommendations.

Key words
Technology transfer, Regional Innovation Systems, Innovation Networks, externalities, multinational companies.

Palabras clave
Transferencia de tecnología, Sistemas regionales de innovación, Redes de innovación, externalidades, empresas multinacionales.

Palavras-chave
Transferência de tecnologia, Sistemas regionais de inovação, Redes de inovação, Externalidades, Empresas multinacionais.

JEL Codes:
O32, O38, F23

2. Networks and spillovers within the International Technology Transferring Process

In this model, the objects of the ITP are: the generation of products and processes of high, medium and low technological content; the production of patents, licenses, blueprints, maps and codified knowledge in publications and manuals, and the mobility of human capital (Dunning, 1993).

The channel through which the ITP and DFI (Dunning, 1993) are also part of the model, the environment and the means of technology transfer. While participating agents are at least two:

Firstly, the transmitters are MNC. A company acquires such status when engaging in DFI equal or higher than 10% of the effective value in another company in a country different from its headquarters' (UNCTAD, 2011). The second kind of agents are the receiving regions or companies of the DFI (Cantner, Meder & Wal, 2008). Years later, Bozeman and Boardman (2014) acknowledge that contingent effectiveness model has experimented some changes. One of high significance is the inclusion of technology's public value as an important variable to the model. This one is concerned with the impact that the technology transferred has on the micro and macro levels of knowledge, equity and sustainability of the place where ITP takes place. Parallel to this, there are changes in the environment worth researching.

Just as the environment has experimented changes, transformations have also taken place in transmission means. They are described next on.

Spillovers are a kind of indirect economic externality which is boosted by the proximity of agents in short distances (Balland, Boschma & Frenken, 2015). These are classified in two types, unilateral and partial, and reciprocal multilateral.

1. Unilateral and partial spillovers, UPS, have been a subject of study since the sixties decade, and constitute the technological externalities poured by MNC in the place where their subsidiaries are located. Authors propose that the source of their origin and generation are at least three: workforce mobility between companies, the generation of spin-off in the region and the learning effect. (Poetzsch, 2017).
2. Reciprocal multilateral spillovers, RMS, are externalities received by MNC through the knowledge absorbed by its subsidiaries from the places where they are placed (Schmidt & Sofka, 2009). Was perhaps one of the first to detect this sort of externality and denominated it inverse technology transferring, a term appropriated by authors such as Driffield and Love (2005), and Narula and Michel (2009). The sources of these externalities are: the limitation of successful practices, attaining of local patents, acknowledgement of ancestral flavors, etc. (Driffield & Love, 2005; Bozeman & Boardman, 2014). MNC may also take advantage of the quality of the products, the competence between suppliers, research infrastructure, R+D expenses, among others (Driffield & Love, 2005).

One of the most outstanding traits of the current ITP is that MNC, like local agents grouped in RIS, organize themselves into networks to exchange knowledge and technology (Narula & Michel, 2009). The links between agents configure social networks where knowledge flows (Casas et al., 2013; Carayannis & Campbell, 2005; Cantner et al., 2008).

Under this logic of interaction, the link or relations among agents are the agreements which regulate the transmitting of technology (Bozeman & Boardman, 2014). According to the links' nature, the networks of knowledge configured in the ITP move in two extremes:

They may be strong and dense if agents are highly involved and relationships reciprocal; typical in the transferring of technology between developed countries' regions (Chaminade & Plechero, 2012; Boschma, Frenken, Bathelt, Feldman & Kogler, 2012; Gertler & Levitte, 2003; Hurtado-Torres, Aragón-Correa, & Ortiz-de-Mandojana, 2018). Likewise, they may be weak and fragmented when links are one-way and agents bear a hierarchical relationship where MNC are dominant, while the regions and its companies are dominated; typical ITP phenomenon in less developed countries (Casas et al., 2013; Caicedo, 2012).

In order to understand this logic within ITP, social networks analysis, SNA, may be of great use given that it is applied where networks' information is confirmed (Hanneman, 2000). According to the SNA, every social network has a set of properties that allow evaluating its attributes and strengths (Hanneman, 2000). This works extracts the density, centrality, closeness and dimensionality properties of the network to identify the differences in the ITP.

In this respect, the school of proximity proposes that innovation occurs where the knowledge network is denser; reciprocity is greater, non-linearity and interactivity among agents in the exchange of knowledge (Balland et al., 2015). Likewise, the lower the distance and amplitude of the network, the greater the proximity is, the interactivity among agents (Boschma et al., 2012). On the other hand, the degree of closeness property, which measures the capacity an agent has to reach all the rest, guarantees cognitive proximity (Balland et al., 2015); in whose case what is attempted is to minimize the network's structural gaps to increase the possibility of knowledge transferring (Gertler & Levitte, 2003). Finally, the index of centrality describes the capacity of an agent to centralize information. The literature has shown that the lower the index of concentration, the greater the interactivity, reciprocity and the non-linearity in technology transferring will be (Bradley et al., 2013).

Researches carried out mainly in developing and belated industrialization countries and regions have shown that this is an outstanding ITP trait and the innovation of these countries (Casas et al., 2013; Caicedo, 2012; Albornoz & López, 2015). At this point of the analysis, the hypothesis of the present work is proposed: if patent request are taken as channels of technology transferring:

> H_1: under the conditions of an ITP in presence of networks and spillovers among MNC of the most competitive regions and the RIS of the least competitive ones, it's stated that there is an inverse relationship in the percentage of patent requests carried out with foreign regions, between the most competitive regions and less competitive regions. Similarly, there is also an inverse relationship between national ownership of foreign patents of the least competitive regions and foreign ownership of national patents of the most competitive regions. This serves as evidence of a lineal and weak process of technology transferring since networks have low density and spillovers are unilateral.
>
> H_2: Likewise, in conditions of technology transferring founded in networks and spillovers between MNC and RIS of the most competitive regions, a positive relationship is present between the percentage of patent requests carries out with foreign regions, as well as a positive relationship between national ownership of foreign patents and foreign ownership of national patents in this kind of regions. This serves as evidence of a more iterative and non-lineal ITP due to networks being denser and spillovers multilateral.

3. Methodology

In order to prove the hypothesis, a methodology combining the qualitative of SNA and the quantitative of the data is applied.

3.1. Identifying of Regions

The territories under analysis are those of the second level of administrative decision-making in the countries, qualified as TL2 by the OECD o NUTS 2 by the European Union. In order to evaluate the most competitive regions, the following rankings were taken: WKCI of 2008, which identified 145 regions as more competitive in the knowledge, the GaWC from 2010, which rated 298 territorial units as global. The OECD's study (2012) *Promoting Growth in all Regions* assessed 23 cities as innovative. The ECLAC's book entitled *Economy and Territory in Latin America and the Caribbean* (Ramírez, Silva & Cuervo, 2009), identifies 32 territories as winners. And the study *Regional innovation Systems in Latin America* (Llisterri, Pietrobelli & Larsson, 2011) by the BID identified 9 regions with sound systems of innovation.

These data were taken in February of 2017 and regions qualifying in at least three of the five ranking were selected. To that end, a matrix of coincidences was built. The results are compiled in **Chart 1**.

Chart 1. Sample of the main RGBC of the world based on the OECD's TL2.

Source of information	*Identified winning regions*	*Classified Regions*	*Results from the Matrix of Coincidences*	*Number of coinciding regions*
WKCI	145	108	WKCI/GaWC/OCDE	108
GaWC	298	116		
OECD	23	23		
ECLAC	182	32	BID/CEPAL/OCDE	32
BID	9	9		
Total	514	288	Total	140

Note: of the regions classified in WKCI, GaWC and OECD, 108 are incorporated to the present study, while the OECD, ECLAC and BID incorporate 32 regions, mainly Latin American

Source: author's own elaboration

Chart 1 shows that 140 territories classify as object of analysis, out of which 108 coincide with the rankings from WKCI, the GaWC and OECD and 32 appear on the rakings of the OECD, the BID, the GaWC and the ECLAC.

From that chart, the most competitive regions were attained, both for their capacity to bind with the rest of the world as well as their capacity to compete in the economy of knowledge. The next step was to classify them from higher to lower level of competitiveness. To this end, the *per capita* GDP level of 2015

calculated at constant 2010 prices taken from the OECD was taken as a discriminating variable, see table number 2. To that end, the GDP level *per capita* was taken as discriminant variable. Territories of medium and medium-high rent, between $3150 and $24907, were defined as less competitive or class 3, RC3, regions; also classified as gamma or sufficient in the GaWC, and as in transition or lagging in the KWCI.

Meanwhile, regions with a rent rate between $24907 up to $46194 were classified as Class 2, RC2, in competitiveness, which were rated as beta or alpha in the GaWC, and as followers or emergent in the KWCI. Finally, the regions defined as Class 1, RC1, in competitiveness are those who have over $46194 of income per capita; classified as alpha or beta in the GaWC, and as leaders or followers in the KWCI.

Chart 2. Description of the analysis regions.

	Interval	*Rank*	*Mean*
Class 1 regions	more than 46 194 $ per capita income	46 194 $ +	57 354 $
Class 2 regions	From 24 907 $ to 46 194 $ per capita income	21 287 $	37 107 $
Class 3 regions	From 3150 $ to 24,907 $ per capita income	21 757 $	17 713 $

Note: The regions corresponding to each class with their respective GDP per capita, is specified in Annex 1

Source: author's own elaboration.

Chart 2 shows the rank and mean corresponding to each class. The regions included in class number 1, which have more than 46 194 $ per capita income, have an average of 57 354 $ where the countries are: United States, Germany, China, Austria, Canada, Luxembourg, Belgium, France, Slovak Republic, Switzerland, United Kingdom, Norway, Sweden, Republic of Singapore, Ireland and Australia. Having greater participation United States. For class 2, being those regions with a per capita income between $ 24,907 and $ 46,194, they have an average of $ 37,107 and are made up of the following countries: China, Chile, Lithuania, Estonia, United Kingdom, Mexico, Spain, France, Finland, Israel, Japan, New Zealand, Korea, Germany, Canada, Brazil, Hungary, Sweden, Italy, United States, Australia, Belgium, Iceland and Denmark. In class 3 are the regions with a per capita income ranging from $ 3,150 to $ 24,907, these have an average of $ 17,713 and is made up of: India, Argentina, Colombia, Brazil, the Netherlands, Mexico, Chile, Peru, China, Latvia and Spain.

3.2. Simulation of an ITP through SNA

In order to design the simulation, it was proposed that two regions exist; a type RC1 or RC2 more competitive region where the MNC's headquarters reside, and type RC2 or RC3 less competitive region receiving the FDI and where the subsidiaries are located. To describe both kinds of ITP, two hypothetical networks were designed.

As ties, the relationship derived from the localization of FDI is assumed and the collaboration among companies to generate and exploit knowledge. The difference between networks lays in the directionality of its ties. In the network simulating LITP, its arrows' direction goes from MNCs to local clusters. While in the NLITP, the arrows' direction goes both ways between MNCs and local clusters.

Once the networks were built, the Ucinet software was asked to display indicators of density, geodesic distance, centrality and degree of closeness.

3.3. An empirical approximation

In order to empirically approach the simulation of networks, RC1 and RC2 were taken as proxies of the agents in the case of the issuers, and RC2 and RC3 as receptors of technology. Likewise, as proxies of the ties the percentage of patents requests carried out with foreign regions (%PRFR), the national ownership of foreign patents (NOFP) and the foreign ownership of national patents (FONP) were taken. These variables are used because they represent the efforts taken on by multinational companies when patenting with foreign regions, as well as the efforts taken on by other kind of institutions such as universities when they patent in collaboration with other foreign institutions (Hurtado-Torres, Aragón-Correa, & Ortiz-de-Mandojana, 2018).

The variables were taken from the OECD's 2012 base because it is the year in which data for all regions is available; tis guarantees a comparison as approximated as possible of the collaboration and technology transferring processes.

The regions' data was introduced in Excel; it was requested to calculate the Pearson correlation between: the %PRFR of the RC1s with the RC2s, of the RC1s with the RC3s and the RC3s with the RC2s. It also calculated the correlation between NOFP of the RC1s with the FONP of the RC3s, between the NOFP of the RC1s with FONP of the RC2s and between NOFP of the RC3s with the NOFP of the RC2s.

4. Results analysis: ITP's characteristics among regions

Before presenting our results, the characteristics of the regions object of analysis will be described in regard to their degree of globalization, competitiveness in the knowledge economy and localization.

Of the RC1s or more competitive regions, fifteen are located in the United States, three in Germany, two in Canada and one in every one of the following countries: China, Austria, Czech Republic, Switzerland, Norway, France, Australia, The Republic of Singapore, The Republic of Slovakia, the United Kingdom, Belgium and Luxembourg. Regarding the degree of globalization of RC1s, eight qualify as alpha, six as alpha+, ten as beta, three as gamma, five as sufficient and one as non-globalized. Finally, according to their competitiveness in the knowledge economy, nine RC1s are leaders, twelve are followers, nine are in transition and three are emergent.

Now, of the RC2s identified, Germany and Sweden count with four each; the United Kingdom, Finland and Japan with three; Australia, Canada and the United States with two and Israel, France, Hungary, Iceland, Brazil, Denmark, Italy, South Korea, Austria and the Netherlands count with one each. Regarding their degree of globalization, one is alpha, another one's alpha+, nine are beta, three gamma, seven sufficient and twelve non-globalized. With respect to the knowledge economy, one RC2 is leader, eleven are followers, six emergent, eleven are in transition and three are lagging.

Lastly, with regard to their localization, we have that eight of RC3s are in Mexico, six in Brazil, five in China, four in Colombia, two in India, two in Chile and one in Argentina, Peru, Latvia, Lithuania, Estonia and Spain. Meanwhile, in relation to their degree of globalization five are alpha, one is alpha+, five are beta, and another five are gammas, nine are sufficient and eight are non-globalized. Regarding RC3s' knowledge degree, twenty-three are lagging, nine are emergent, one is in transition and none is neither follower nor leader.

From here we have that RC1s are located in the United States and the most competitive countries of Europe. By their degree of globalization, they are alpha and beta, leaders and followers in knowledge. RC2s are European, followers and emergent, betas and gammas. Finally, RC3s are located in South America and China, they are lagging and it's worth noting that they have a sound degree of globalization.

4.1. Differences in the ITP

Just as it was expected, there two well-differentiated types of relationships in the ITP, one is lineal and the other one is non-lineal. The results from applying SNA and the calculation of the correlations are grouped in **Charts 2 and 3**. Next on, the findings will be described.

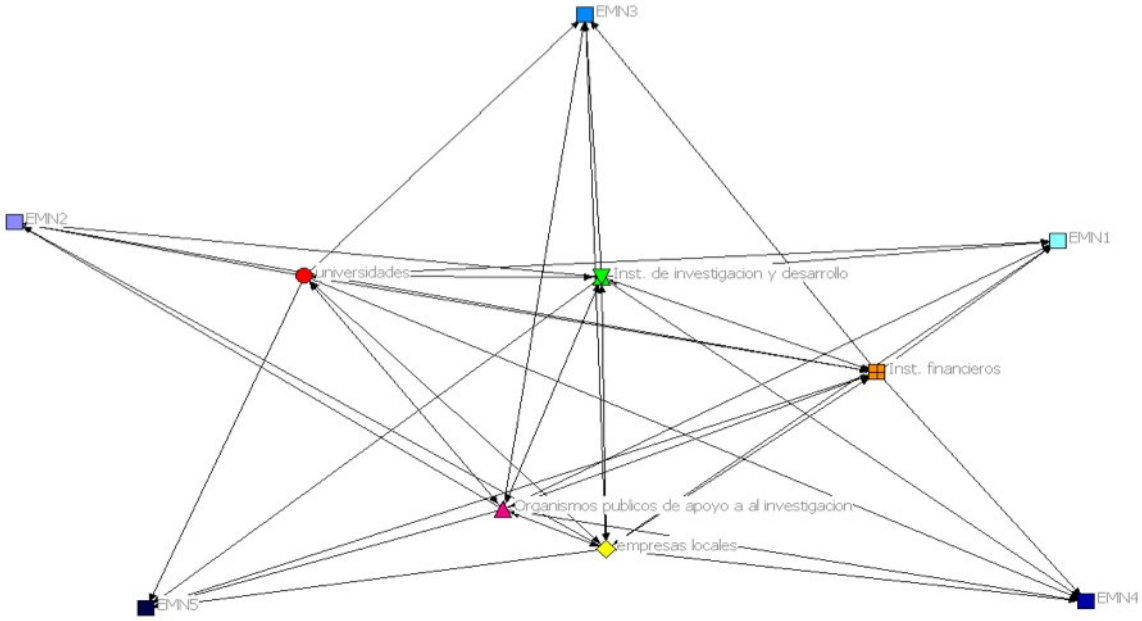
1. Lineal ITP's characteristics. LITP's traits are illustrated in **Graph 1**. This graph shows that between RIS's agents and MNCs one-way links between MNCs' subsidiaries and headquarters are configured; this is the traditional manner in which technology is transferred to developing countries and regions (Narula, 2010). This is a lineal process because knowledge's flow is one-way. A review of **Chart 2's** first line, which collects the data on the network's properties, permits to infer this process's characteristics.

Here, regarding density, it is observed that the network reaches up to 50% of relations, which indicates that the LITP is asymmetrical because the links go from MNCs to the RISs.

In turn, the analysis of distance displays a value of 1, meaning that a MNC only requires of one step to connect with a RIS actor. However, the network's amplitude is 0.5, which is an indicator of fragility related to the link's probability of occurrence (Hanneman, 2000).

Regarding the degree of closeness, the chart's values indicate that the network has a fragile structure due to the severability of the network into two sub-networks, which permit to identify the presence of structural holes (Hanneman, 2000). Here, it's clear that a network is made up by RIS's agents and ach MNC, a fact that limits the transferring of knowledge and technology. Lastly, the concentration index or the power of an actor is positive, 17.12%, which is evidence of hierarchy and power borne by the MNCs over RIS's agents.

Graph 1. Technology transferring with unilateral and partial spillovers.



Source: author's own elaboration.

LITP occurs between preferably gamma, sufficient and not-very-globalized regions with MNCs located where they may find natural resources and markets; therefore, FDI is localized in lower proportion since the RIS tends to be weak, fragmented and disarticulated (Caicedo, 2012).

This result is corroborated by those obtained in **Chart 3**.

Here, we see that for the %PRFR the correlation between RC1s and RC3s is −0,23666233 and between RC2s and RC3s is −0,20603009. Besides, the correlation between the NOFP of RC3 with RC2s' FONP is −0,1332358. Likewise, the relation between RC1s' NOFP and RC3s' FONP, which is −0,043908852, is also negative. These result show that RC3s are net consumers of technology and are little sough after to create new patents.

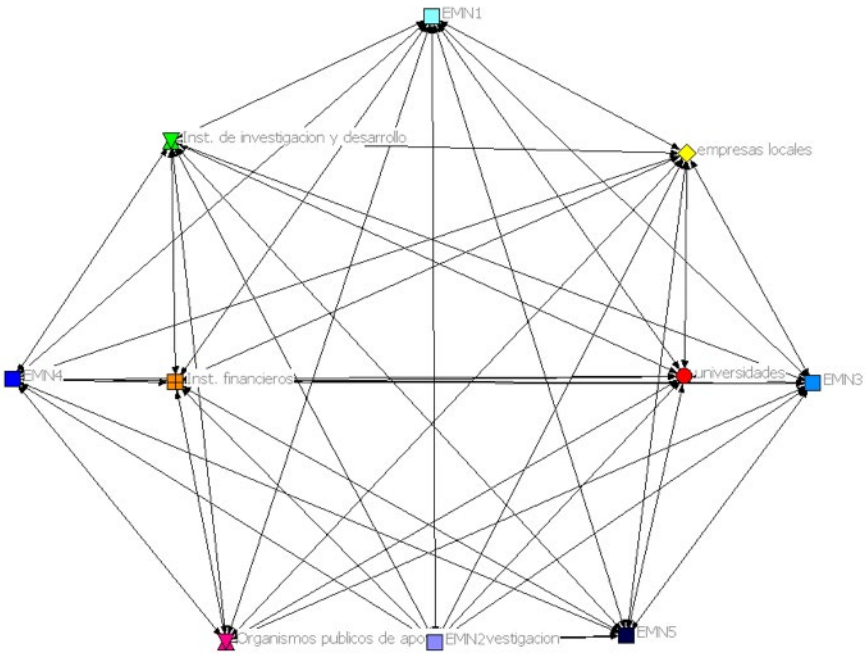
In practical LITP terms, the UPSs that stay in each region are forms of administrative organization, suppliers formed around some specific technologies, facilities and some infrastructure; spillovers which in many cases do not increase the PTF and, contrary to the expected, deepen social inequalities (Suanes & Roca-Sagalés, 2014).

In this kind of ITP, local companies would weakly hook up to global value chains and when they participate; they do so as suppliers of raw materials, thus competing with suppliers from other parts of the world, with scarce profitability on its products (Pietrobelli & Rabelloti, 2011).

In the LITP, the networks tend to be simpler with one-way links, wide opened and with several holes that provoke leaks of information and knowledge (Casas et al., 2013; Caicedo, 2012). The process experiments lags in the flowing of FDI as well as in the collaboration of relationships for knowledge creation and exploitation and cooperation.

2. Characteristics of NLITP. Just as **Graph 2** shows, relationships go both ways. In terms of Graph Theory, this is a close, complete and finite graph in which all actors have access to one any one other (Hanneman, 2000). This network shows that the NLITP is interactive and little hierarchical. An analysis of the network's properties would help to understand this phenomenon.

Graph 2. Technology transferring with reciprocal multilateral spillovers.



Source: Author's own elaboration.

Chart 2's second row shows that the density is of 100%, which indicates that in this type of ITP there's a tendency to reach all possible relationships and links. This makes the NLITP a dynamic and non-lineal process in which the agents are receptors and transmitters of technology and knowledge.

On the other hand, the distance between the network's agents is 1 and the amplitude is 0, meaning that it is probable to perform all possible connections and that an gent does not need intermediaries to reach another one, due to low transaction costs of transferring technology (Balland et al., 2015).

Now, it is worth highlighting that the network tends to be complete and reciprocal, and totally accessible, without structural holes, which is ITP is a fluid process with few barriers or agents stopping it; this guarantees cognitive proximity (Balland et al., 2015). Lastly, we have a concentration index equal to 0, which

implies that agents compete freely for access to information and knowledge. This is important because in these conditions it's guaranteed that the network be flexible, autonomous and of hierarchy 0; this is ideal for any network, especially those of knowledge transferring (Chaminade & Plechero, 2012).

The results on **Chart 3** confirm the hypothesis of a NLITP as proposed in the network. Regarding the relation and exchange of knowledge, it's evidenced that RC1 and RC2 %PRFR has a value of 0,28266148. At the same time, the correlation between RC1 FONP and RC2 NOFP equals 0,02539978. The complementarity becomes more evident in the relationship between RC1s' NOFP with RC2s' FONP. This relationship expresses the interactivity of the most competitive regions' collaboration.

The spillovers generated in this relationship are RMS (Schmidt & Sofka, 2009). These are evidenced in more patents in collaboration between companies and universities and research centers among countries and regions, which represents more processes of learning and, with it, a greater capacity of absorption by the agents. In this context, global value chains configured between RC1 and RC2 regions tend to be more intense, bearing a higher level of competitiveness where companies and regions are suppliers of knowledge (Gereffi et al., 2005).

Chart 3. Results of the Hypothetical networks' priorities.

NETWORK	*DENSITY*	*DISTANCE*			*CLOSENESS*		*NETWORK CENTRALIZATION INDEX*
		Average	*Compactness*	*Breadth*	*inCloseness*	*outCloseness*	
With unilateral partial spillovers	50%	1	0.5	0.5	EMN:20 SRI'S:16.667	EMN:10 SRI'S:100	17,12%
With multilateral reciprocal spillovers	100%	1	1	0	Closeness 100		0,00%

Source: author's own elaboration from the results of UCINET.

Chart 4. Correlation of technology transferring proxies.

		%PRFR %PRFR	*NOFP-FONP*
Group 3-> Group 2	CC	−0,20603009	−0,133235803
	PV	0,08888776	0,148710682
Group 1-> Group 3	CC	−0,23666233	−0,043908852
	PV	0,15626991	0,028924864
Group 1-> Group 2	CC	0,28266148	0,025399782
	PV	0,77449842	0,465219922

Note: CC stands for Pearson's Correlation coefficient and PV stands for p value

Source: author's own elaboration.

4.2. Policy implication of technology transferring

Acknowledging the need to formulate policies to stimulate innovation based of technology transferring and attracting FDI has marched on different paths. Yet, it's possible to combine the instruments to attain a superior result to that attained by working policies separately.

Here, we propose a set of elements to be taken into account in order to design competitiveness policy instruments and incentives, combined with attracting FDI so as to seize UPS and MRS generated with the forming of global value chains.

4.2.1. Incentives to the entry of more agents

An RC3 needing to be competitive must take on prodigious efforts to promote itself as an optimal place to attract FDI. It is imperative to augment the number of local agents grouped in RIS (Caicedo, 2012; Casas et al., 2013; Albornoz & López, 2015). Parallel to it, the entrance of the highest possible number of MNCs must be facilitated.

The instruments helping the forming of research centers, stimuli to universities' participation in joint projects with MNCs and the region's promoting, may build a proper environment to generate a climate of competence and innovation. Such climate, aside from the externalities in product quality and project's results, generates reciprocal multilateral spillovers, and unilateral and partial ones in the form of production factors' mobility.

4.2.2. Organizational autonomy policies

Such policy must create instruments which do not hinder agent's freedom of decision to participate in as much projects as possible according to resources and organization capacity. With respect to the subsidiaries' autonomy, regional governments have a low capacity to intervene; but the creation of bridges between subsidiaries and institutions, and of the former with local businessmen might constitute elements which influence an MNC's decision to choose a region as a place to undertake research projects.

4.2.3. Minimizing the specificity of assets

In this regard, regions must design policies that lessen localization barriers and stimulate agent's mobility. The lessening of barriers to trade, stablishing safeguards and regulations when drawing contracts of projects are useful instruments that the policy may use to stimulate the entrance and exit of MNCs, and the free circulation of knowledge incorporated and unincorporated into the region of arrival's RIS.

4.2.4. Low Hierarchy

From the competitiveness policy standpoint, local and international agents must perceive whether there are privileges or special treatments to a particular agent.

Instruments such us anti-monopoly laws and competence defense, public regulations on the allocation of subsidies and sponsorships to innovation may help to promote low hierarchy and the power of an actor or actors over others. So, the policy may help to lessen MNC's risks of entrance at the same time that it guarantees a proper environment to carry out innovation activities.

4.2.5. Stimulating reciprocity

Instruments such as awards to the best projects derived from the relationship between MNCs and RIS agents, subsidies to local companies that manage to attract a MNC's project, and promoting foreign technology transferring, among others, could perform as guarantors in creating an atmosphere of cooperation so as to attract FDI; through this path reciprocity among agents is stimulated.

5. Conclusions and Recommendations

It's possible to acknowledge that regions configure an international process of technology based on the forming of networks and seizing of spillovers, which may permit the evolution of Regional Innovation Systems (RIS) generated from the processes of technology transferring that might be studied from the Social Network Analysis.

In this research, the differences in ITP have been evidenced. Supported by SNA, it has been shown that this process moves in two extremes, a lineal and hierarchical one and a non-lineal and iterative one. The first operates when the relationship between MNCs and RISs' agents is fit for natural resources and local markets exploitation; while quite different is the process in which MNCs and RISs' actors establish a strategy to exchange useful knowledge. This finding permits to identify elements makers of regional policies, so as to generate instruments and make of regions attractive places for foreign investment.

Hence, the usefulness of this document lays on its power to provide elements and tools in order to deepen into the studying of ITP in the era of globalization.

This document pretends to put forth the importance of using social networks as a methodological strategy to analyze technology and knowledge transferring. Even though hypothetical networks were designed here, conclusions similar to those already attained by works of a similar theoretical traditions were drawn. Therefore, the usefulness of using SNA lays in having been able to provide elements and tools to deepen into the studying of ITP in the era of globalization.

However, this kind of works face several limitations: information availability on spillovers, since the literature has shown to stumble on problems when capturing this kind of externalities is required. Another limitation of this kind of research is associated to the analysis of links and therefore to the forming of a network. As it is known, relationships between MNCs and agents of the RIS are carried out though projects, specific contracts, exchanging of services, etc. The issue lays on the comparability of all these alternative forms of relationship and its homogenization.

Here, it's been advanced up to identifying policy implications borne by the network, spillovers and space relationship. It is possible to propose that it's required for scientific and technology policies to move towards the construction of instruments that strengthen the forming of innovation networks. This

implies deepening into the study of these organizational forms: understanding its properties, the logic of its links, the role of distance and stimuli to associating since by understanding the networks' functioning wide, inclusive, global and collaborative policies could be designed.

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Annexes

Annex 1

CLASS 1 REGIONS		
Country	Region	2015
United States	Indiana	46715
United States	Louisiana	47147
United States	Kansas	47293
United States	Wisconsin	48164
United States	Ohio	48408
United States	Rhode Island	48830
Germany	Baden-Württemberg	48974
Germany	Hesse	49292
Germany	Bavaria	49377
United States	Oregon	49706
China	HongKong	50095
United States	Pennsylvania	51016
Austria	Vienna	51776
United States	Virginia	52809
United States	Colorado	52911
Glen	Saskatchewan	53515
Germany	Bremen	54392
United States	Texas	54607
United States	Minnesota	55039
United States	Illinois	55590
United States	Maryland	55974
United States	Washington	57162
Ireland	Ireland	58284
United States	California	58331
Republic of Singapure	Singapure	59334
Glen	Alberta	59589
Australia	Western Australia	60257
France	Île-de-France	61319
Sweden	Stockholm	62181
Norway	Oslo and Akershus	64021
Reino Unido	Greater London	64756
United States	Connecticut	64816
United States	Massachusetts	65679
Switzerland	Zürich	66459
United States	New York	66638
Slovak Republic	Bratislava Region	68424
Belgium	Brussels Capital Region	70047
Germany	Hamburg	70662
Luxembourg	Luxembourg	87202

CLASS 2 REGIONS		
Country	Region	2015
China	Shanghai	25507
Chile	Santiago Metropolitan	25693
Lithuania	Lithuania	25768
Estonia	Estonia	25986
United Kingdom	Northern Ireland	27593
Mexico	Nuevo Leon	27750
China	Beijing	27890
United Kingdom	North East England	28074
Spain	Valencia	28108
France	Nord-Pas-de-Calais	30031
China	Tianjin	30310
Finland	Eastern and Northern Finland	31108
Israel	Israel	31279
Japón	Chubu (Hokuriku)	31895
United Kingdom	North West England	32498
Finland	Southern Finland	33576
Nueva Zelanda		33926
Finland	Western Finland	34020
United Kingdom	South West England	34240
Korea	Capital Region (KR)	34357
Germany	Schleswig-Holstein	34545
Japan	Chugoku	34851
Glen	Quebec	35193
United Kingdom	Scotland	35232
México	Federal District (MX)	35408
United Kingdom	East of England	35620
Japón	Kansai region	35802
Brazil	Distrito Federal (BR)	35853
Korea	Gyeongnam Region	35967
France	Rhône-Alpes	36734
Hungary	Central Hungary	36899
Sweden	Småland with Islands	37079
Sweden	South Sweden	37273
Germany	Lower Saxony	37677
Spain	Catalonia	37754
Sweden	East Middle Sweden	37793
Italy	Lazio	37971
Austria	Styria	38411
Glen	Manitoba	38775
United States	Arizona	39205
United States	Oklahoma	39467
United States	Kentucky	40192
United States	Florida	40314
Germany	Saarland	40521
Glen	British Columbia	40642
Germany	Berlin	40781
Australia	Victoria	41062
Italy	Emilia-Romagna	41155
Belgium	Flemish Region	41635
Iceland	Iceland	41664
Germany	Rhineland-Palatinate	41747
España	Basque Country	42084
Glen	Ontario	42210
Japan	Southern-Kanto	42541
Sweden	West Sweden	43238
España	Madrid	43374
United States	Michigan	43433
China	Taiwan	43530
Italy	Lombardy	43720
United States	Tennessee	44036
United States	Nevada	44477
Denmark	Denmark	44537
United States	Missouri	44544
United States	Georgia	44857
United States	Utah	45306
United States	North Carolina	45393
Australia	New South Wales	46030

CLASS 3 REGIONS		
Country	Region	2015
India	Estado de Karnataka	4199
India	Maharashtra	5975
Argentina	Buenos Aires	8787
Colombia	Atllantic	10243
Colombia	Valle del Cauca	12690
Colombia	Antioquia	13032
Brazil	Minas Gerais	14805
Netherlands	North Netherlands	15993
Mexico	Tamaulipas	16176
Mexico	Baja California Norte	16231
Netherlands	East Netherlands	17222
Chile	Valparaiso	17913
México	Aguascalientes	18498
Netherlands	West Netherlands	18673
Mexico	Sonora	18912
Brazil	Rio Grande Do Sul	19064
Brazil	Paraná	19107
Peru	Lima	19619
Mexico	Quintana Roo	19691
Colombia	Bogotá Capital District	19694
China	Zhejiang	20170
Brazil	Santa Catarina	20196
Mexico	Queretaro	21953
Latvia	Latvia	22224
Mexico	Coahuila	22473
China	Jiangsu	22809
Netherlands	South Netherlands	23166
Spain	Andalusia	23433
Brazil	São Paulo	24082
Brazil	Rio De Janeiro	24352