SOCIAL CAPITAL IN A SOCIAL NETWORK FRAMEWORK:
AN ANALYSIS OF SOCIAL SPACES IN
REGION OF TARAPACA (CHILE)

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Regional Economics Applications Laboratory, University of Illinois, Urbana, IL 61801-3671, USA
lufin@uiuc.edu

Abstract

This paper uses Social Capital analysis, including Social Networks tools, to evaluate the participation levels in social organization as a context for social interactions. The social area under study includes 10 municipalities located in Region of Tarapaca in Chile, a region that presents some interesting cultural features that are expected to affect the levels of participation and the way in which the social connections are structured. A social capital framework including a network dimension was adopted, following a Position Generator spirit. The analytical network tool was used to describe the patterns of social interaction and to identify descriptive associated factors. The results revealed important differences between communities and some influence of potentially contact resources on the interactions patterns exhibited in each location. In terms of Social Organizations the evidence suggests that the structures of linkage between different organizations are similar in terms of density in any community, emerging a Core composed by 4 types of organizations. The patterns of participation are presenting some particularities in terms of people characteristics by ethnicity, gender and class. In the case of household by household matrix analysis, the correlational evidence is suggesting that the variable Sex is presenting a strong connection with the participation in social organization, similar results is found to some factors of social capital defined as "Household Assimilation" and "Labor Participation". Finally A second result suggests some differentiate effect between urban and rural communities, especially in terms of the Social Capital factors related with "Return of Human Capital" and "Household Assimilation".

1. Introduction: Why Social Capital is a Relevant Topic for Research

Analysis of the role and contribution of Social Capital (SC) has been an increasing area of research as well as an important focus for many international development agencies such as the World Bank, the Inter American Development Bank, and the United Nation Development Program. The international evidence reported, for example, in the National Economic and Social Forum (2003) suggests that local and regional communities, and even nations and States that enjoy a high level of SC, as associational life and civic participation, tend to sustain higher levels of cooperation and trust, less corruption and social exclusion levels, and higher efficiency in their Government functions.

Following Fukuyama (2002) a great area of interest, specially in the Latin American case, is how social capital is created and what influence it has in economic development process, that role seems to be particularly interesting in the context of convergence in regional incomes, considering the evidence of convergence at some levels while divergence exists at other levels. The social capital analysis offers the possibility to explore non-economic characteristics of the social structure of regional and sub-regional economies as sources of explanation for this hierarchical inconsistency in convergence processes, and to clarify how the institutional conditions are affecting in general the regional development. This paper will analyze the internal social structure of a region in Chile to explore the degree of which social network structure differences can be related to differences in individual economic conditions.

In the Chilean Case early SC studies have been developed, especially after the return to democracy in 1990. Drawing on these previous studies, it is possible to recognize some tension between the perceived individual levels of human welfare in the modern context, that process has been defined as "un-comfortable modernity," between the main causes of this tension, the individualization process has been signaled (UNDP, 1998, 2000). That tendency has been explained for the dramatic social changes introduced during Pinochet's Government that finally consolidated a neo-liberal capitalistic regime as model of society for that country (Silva, 1993, 1996). For Moulian (1997) the regime has been legitimized during the democrat period, increasing the tension in terms of "subjective un-comfortableness," that issue is associated in very crude way with a non-inclusive economic model that constrains the opportunities for consumption by some groups of population.

In terms of the Human Development Paradigm (UNDP, 1998, 2000) the Chilean case is showing important differences between objective development indicators, as literacy rates, life

expectation and income per capita, those that are significantly raising during the 90's, and the subjective indicators related how the people have perceived these economic transformations in terms of their own familiar welfare and how those favorable transformations do not have a uniform territorial distribution, being concentrated in urban areas.

These tendencies are dynamically affecting the social life introducing a new sense of social marginalization that is affecting the social cohesion, and undoubtedly it is eroding the social peace and the future of the new Chilean democracy. In that context has been indicated that to reinforce the social life, social organizations play a crucial role, providing social "spaces" where people can express some of their needs and in that way channel their suggestions. From this perspective, the social organizations are communitarian spaces where some of that "subjective un-comfortableness" could be abated and re-oriented in order to promote new creative solutions for some of the problems associated with that new Chilean social scenario.

Considering that historical situation research has been focused on social organization (UNDP, 2000), with the purpose to understand more about their role in economic development more broadly defined. Normally those approximations are been oriented to quantify the number and nature of these organizations, to define the ways that they organize their activities, to characterize people that are participating there, and to define some public strategies to strengthen them. Special attention has been directed to organizations that include important groups of volunteers. From a critical point of view, this perspective, even when seems to be a valid approach, is extremely simply because it ignores the obvious interconnections that underlie the set of organizations and thus may potentially ignore one of the major sources of social relevance of any organization as a SC creator.

The main objective of this paper is to explore the role of Chilean Social Capital using a social network (SN) analysis approach. From this perspective emerges the necessity to put the data actually available in Chile into the logic of an SN framework, in order to characterize the underlying pattern of relationship that is contained in the set of social organizations, normally studied in Chilean communities. A second particular purpose is to define some social resources that are potentially involved in these identified nets of organizations. The paper has been organized in 5 sections, first is offered a general theoretical discussion about social capital and how the volunteer activities can been considered as a sources of it, also in that section is included a discussion about Social Capital in a Social Network context. The next section contains the methodological issues, including a description of data and area of study. The third section

provides a discussion about the network tools applied in our analysis and their implications in terms of research results. The fifth section shows the main obtained results for the case of study and finally the last section introduces some final comments and contextual final evaluation.

2 General Theoretical Framework

2.1 Alternative General Approaches

Social Capital Theory could be conceived as a set of many different theoretical propositions and approaches about SC. In terms of relevance, some place in first place the role that social institutional conditions play in facilitating collective action. At the same time, these different theories about SC explore the way the institutions act in a social dynamic process, including many different social practices and structures, such as: *social networks, trust levels, norms and social sanctions*. Early users of these terms were mainly Bourdieu, Coleman, Fukuyama, and Putnam. In the case of Bourdieu (1986), he sees the capital in three guises as economic capital, as cultural capital, and as a social capital, where the last is made up of social obligations or connections. The Bourdieu' Social capital is the aggregation of actual or potential resources which are linked to possession of a durable network of institutionalized relationships of mutual acquaintance and recognition, where the group provides its members with the collectivity-owned capital. In this context capital is represented by the size of the networks and by the volume of capital (economic, cultural, or symbolic) possessed by those to whom a person is connected.

For Coleman (1994), social capital consists of two elements; one is an aspect of social structure that facilitates certain actions of individuals within the structure, the second dimension are the resources, real or potential, gained from relationships. Social actors exercise control over those resources, and in order to extent their control they engage in exchanges and transfers of resources. These social relationships serve important functions in facilitating the actions of individual actors, and the form the basis of social capital.

Fukuyama (1995), drawing on Coleman's ideas, extents his own principles in the concept of Trust, as a measure of social capital, argues that it is accumulated through norms of reciprocity and successful cooperation in networks of civil engagement. For Fukuyama, SC rests in cultural roots, that are defined as ethical and moral habits, whose elements configure a cultural dimension of economic life under the basic shape of institutions on which the whole social dynamic in a modern society operates.

Putman (1993) considers that the participation in voluntary organizations in democratic societies strongly reflects the existing levels of social capital. These associations and participations promote and enhance collective norms and trust, both elements that are essential to produce and maintenance the collective well-being. Putman can be considered as a "Neo-Tocquevillean" thinker, because in his idea of democracy in the United States the systematic study of the links between democracy and civil society has played a central role.   This perspective have yielded a wide range of empirical evidence about the links between the quality of public life and the performance of social institutions, and how these relationship have been influenced by norms and networks of civic engagement.

Many researchers in such fields as education, urban poverty, and unemployment, the control of crime and drug abuse, and even health have discovered that successful outcomes are more likely in civilly engaged communities (Paldam, 2001). These results have supported a systematic inquiry showed that the quality of governance was determined by longstanding traditions of civic engagement (or its absence).

For a SC perspective, the social life is easier in a community that has a substantial stock of social capital.   In the first place, networks of civic engagement foster robust norms of generalized reciprocity and stimulate the emergence of social trust. These institutions, like social networks, facilitate coordination and communication between social actors, and it is recognized that they have the capacity to amplify personal and organizational reputations, and enable some dilemmas of collective action to be resolved in a practical and non expensive way.

For a more general perspective, Putman (1995) noted that when the economic and political negotiations are embedded in a dense network of social interaction, the incentives for opportunism behavior are reduced. These structures built on past collaborative experiences, then serve as a cultural pattern for future collaboration. Another role of SC is related with the fact that these dense networks of interaction probably help to remake the image that those participants have about themselves, developing a sense of "we" in contrast to individualistic enunciation of "I;" this is a conceptual process that validate new collaborative practices that increase the level of social capital.

The most obvious manner in which social capital is recognized it is linked with presence of social groups as Church-groups, public-service groups, parent-teacher associations, etc. Other kinds of organizations, such as those that assume a more relaxing way to collaborate and to participate, for example Internet groups of discussion, are not considered as a priority expression

of social capital. These kinds of movement are classified as spaces of social connectedness, but not social capital directly. Putman (1995) called them "secondary associations" or even "tertiary associations."   Obviously this qualification could be considered arbitrary, but from Putman's perspective their kinds of ties are non stable and furthermore, their influence is often limited to common symbols, or common leaders, even common ideals, but they are not related with the idea of durable ties that is contained in the notion of social capital.

Another element that is related with SC is the presence of close correlation between social trust and associational membership. This relationship is considered fundamental across time and across individuals, and also across countries. Evidence from the OECD (2001) has demonstrated that in 35 countries included in a survey, the social trust and civic engagement levels were strongly correlated; those results included a positive correlation between the density of associational membership in a society and the trust levels of its citizens.

2.2 Volunteer Activities as Source of Social Capital

Following the perspectives of Wilson and Musick (2000) and Meier and Stutzer (2004), Group membership is directly linked with the function of associational activity. It has two functions for individual welfare. First, the networks of relationships improve the efficiency of society by facilitating the coordination of actions (referred to as Putman's effects), and secondly, its presence increases the effectiveness of regional governments and regional economic performance. The authors claim that in regions where social relationships are more horizontal, in the sense that social actors with different power levels are integrated in networks of relationship based on trust and shared values, the level of participation in social organizations is higher and, as a result, the social capital is higher too. They argue that regions in which the regional government is more successful and the economy is more efficient are characterized by horizontal relations that both favored and fostered greater networks of civic engagement and levels of organization in society (Annen, 2003).

Another recognized function of associational activity is closely related to the theory of networks and the advantages of being embedded in networks (Wollenbaek and Selle, 2002). From this perspective, there is some debate about the role of ties or participation in a network. For example, Coleman (1994) argues that closed networks may provide a better basis for co-operation, while Burt (1992) stresses cohesive ties as a source of rigidity. However, in both cases the core of the argument relates to the transfer of knowledge between actors. In Burt (1992), the

concept of "structural holes" recognizes the importance of sources of new information; in this sense, Burt's structural hole vision could be considered as a description of the "strength of weak ties" that allows access to new information through network structure as well as strengthening the connectivity of the network. The reasoning in this last perspective is based in how the information is shared within the local network, and how the configuration of ties in the structure can define redundant paths to transmit the information between social actors. Following these ideas, to participate participation in social organizations is provides an opportunity to create new ties with potentially useful connections, while the more diverse be the contacts that can be accessed by those participating in volunteer activities the greater will be the level of SC obtained.

To elaborate an explanation about how people decide to participate or not as volunteers, a decision model is required that represents that process as an exercise of deliberative rationality. Following Kolodinsky *et al.* (2003) is possible to include the volunteer activities in the original formulation of Becker's household production model (Becker, 1965). In this model the members of a household maximize their own utility over a set of commodities that are acquired in the market, some of those are used to 'produce' new goods in the household. This situation implies the use of hours of labor in domestic production; these hours have an opportunity cost derived from the fact that they could be offered in the labor market.

An extension of this approach, Becker's theory of social interactions (Becker, 1974), suggest that an individual's own utility is influenced by characteristics of other persons that affect the production of a range of commodities. Kolodinsky *et al.* (2003) extend the household production framework to conceptualize the relationship between volunteering, including two types of individual incentives for volunteering. The first type is "sociability incentives" that operate by recognizing the satisfaction from an individual's social presence or by interaction with others. The second type is called "purposive incentives" and those are derived from the volunteer experience itself; by linking with others, an individual is able to produces tangible benefits or advantages from volunteering (impure altruism).

2.3 Exploring a Social Network approach on Social Capital

From a network perspective, the core meaning of the volunteering seems to be focused in the potential positive value in a social networks context; it offers the possibility to study different kinds of potential relationships that could contains many manifestation of social capital. The volunteer activities open the possibility to recognize the existence of "bridging" social capital

displayed as links between people, groups, and groups-people, with different locations in the social structure.

Even when it is possible to recognize different intellectual traditions about social capital, in general terms SC as to be seen as a complementary conceptual tradition on which social network analysis is able to extend some ecological perspective, thereby linking the micro-level, individual analysis, with a meso-level or perspective associated with community conditions. In order to organize that transition from Micro to Meso analysis, Lin's perspective could prove useful. Lin's perspective introduces a notion of social resources in a SN context as valued goods, assuming that those values are consensually determined (Lin *et al*., 1981, and Lin, 1999a).

From a pragmatic perspective, these social values are normative judgments generated by these goods (examples of that kind of generic goods are wealth, status, and power). In a social network context, these valued resources are attached to occupied social positions. Given the complexity of the social system, these resources can be classified into two types: personal resources and social resources. Personal resources are possessed by the individuals, who can use and dispose them with freedom and without much concern for compensation. In contrast, Social resources are accessible through one's direct and indirect ties. The personal access and use of these resources is temporary and, in simple terms, it may be viewed as a "borrowed resource" from our contacts. For example, a friend's occupational or authority position that is used to improve the probability of an acquaintance being hired. The manner in which those "contacts" are activated or are used, depends of the network structure. This characteristic implies that the structure is the vehicle that is used to access these resources.

In the Chilean context, where the social life seems to be affected by individualistic tendencies, one might result reasonable assume that the produced relationships generated through participation in Social Organizations may have some important degree of impure altruism or that they are defined as a strategy to access social resources.

In order to contextualize some traditions of social capital with these ideas about social resources, it is necessary to remark that social capital refers primarily to resources accessed in social networks. In that way, the approach focuses on the instrumental utility of such resources (social capital seen as an investment or as a mobilized resource). For Lin (1999b), the convergence of the social resources and social capital theories is based on their ability to complement and to strengthen the development of a social theory focusing on the instrumental utility of accessed and mobilized resources embedded in social networks.

Many studies have explored ways of measuring social capital; typically, two methods have been applied. They are referred to as Name Generators and as Position Generators; both can be considered as classical categories (Van der Gaag *et al.*, 2004). The Name Generator method is probably the more common method and has been used extensively in the network literature. Basically, there the ego is anxious to reveal the ego's contacts in certain types of relationships: public social environments (e.g., neighborhood, work), content areas (e.g., work matters, household chores), or intimacy (e.g., confiding, most intimate, etc). That method produces a list of contacts ranking from three to five or as many as volunteered by ego (a Ego Centered Network). From these lists, relationships between ego and contacts and among contacts, as well as contacts' characteristics, are generated. Social capital measures are constructed to reflect the contacts' diversity and range in resources (education, occupation) as well as characteristics (gender, race, age).

In contrast, the second method or Position Generators, normally is based on samples of structural positions salient in a society (such as occupations, authorities, work units, class, or sectors) and it asks respondents to indicate contacts (for example those known on first-name basis), in each of the positions under study. In this way, the relationships between ego and contact for each position can be identified.

In practical terms, the network approach can take many operational positions; Erickson (2003) notes that the Position Generator applications normally reveals how a person is able to access to vacant occupational positions through social relationships. Even though this perspective has been applied to labor market situations (Lin and Dumin, 1986, and Lin and Bian. 1991), it could be used in a more general perspective to include situations where people, who know others in high status positions, have access to resources associated with those who are more powerful. In that sense, the configuration of relationships generates opportunities for these people, and it implies that diverse networks are able to develop advantages in a manner that higher prestige positions are very strongly correlated with structural locations that facilitate ties to other high prestige people and ties to people from top to bottom in prestige.

2.4 Communities and position generator idea

Even when most of the research using the position generator has focused on social capital for individuals, the position generator approach can also be used to assess the social capital of communities. Following Woolcock (1998), it can be argued that communities can prosper when

two kinds of critical Social Capital are acting. First, communities need extensive ties between people in the community, so that people can communicate their plans, and organize effectively around a common good. Secondly, to prosper, communities also need rich linkages to a variety of people outside the community, so as to have access to resources beyond those in the community alone.

Following the previous ideas, the original main objective will be to study the Chilean Social Capital using a (SN) analysis approach following Lin's Position Generator principles. In that way, it is expected that the network configuration will be dependent of some potential personal resources associated with the people that are occupying the networks positions. By adopting this approach, the social capital creation might reveal some instrumental or strategic underlying orientation compatible with the impure altruism notion.

3. Methodology.

3.1 About Area under study.

This paper focuses attention only on the Tarapaca region, since it presents some interesting social features. Using some descriptive data, presented in figure 1 and figure A1 in appendix 1, the rates of participation in social organizations were calculated for each region and the country as a whole, the average is around 36% exhibiting an important heterogeneity degree, considering that regional variations lie between 26% and 48%. The last value corresponds to the Tarapaca Region that was selected of unit of analysis because of its high rate of participation. Additionally, in this region it is possible to identify a dichotomy between rural and urban communities; further, the presence of a relatively important group of Amerindian people (Aymara people) introduces a cultural dichotomy among Chilean and Aymarean culture (see figure 2).

3.2 About the Raw Data.

The used data come from CASEN 2000, the Chilean Socioeconomic Characterization Survey[1], for the year 2000. The sample is statistically representative of the population down to the municipal level. The 2000 survey includes 10 municipalities for the Tarapaca region ($k = 10$). The main question used from this survey corresponds to question P-18 (do you participate in some social organization in your municipality?), that answer was categorized in 19 different

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[1] This survey was managed for "Ministerio de Planificacion (MIDEPLAN)", It is equivalent to a Secretary of National Planning, that is depending directly for the Chilean Presidential Office.

social organizations (*e*=19 categories of events). The survey includes additional information at a personal level (350 additional variables, *v*), that were used to define a set of personal resources potentially capable of moving through the network. It is important to note that the total sample of households (*h*) is 8,460, corresponding with 42,990 individuals (*i*). Given that the variable *participation* is recorde through self-classification answers (where people identified if they participated or not), the people that answer *no* were dropped from the final sample,; as consequence, the sample was reduced to approximate 1643 households (≈ 8175 persons).

3.3 About the social connections matrix

The sample was divided for each community *k*, to produce a social network matrix, where each person was linked with his/her Household (family) and with a unique social organization, in that way *K* Two-Modes matrices of social participation were defined:

D_{fXe}^{k} is a matrix for community *k*, that has values representing the number of persons *i* of family *h* that participate in social organization *e*.

Using Breiger's Dualism theorem (Breiger, 1974) two matrices can be produced:

1. Matrix of Organizations by Organizations: $E_{eXe}^{k} = (D_{fXe}^{k})^{T} D_{fXe}^{k}$

2. Matrix of Families by Families: $P_{fXf}^{k} = D_{fXe}^{k} (D_{fXe}^{k})^{T}$

Even when in terms of analytical possibilities of analysis many basic manners are available. The focus in this report was putting in Family by Family matrices, following the traditional Generator Position studies in which personal ties are the focus of analytical attention. However some descriptive explorations about organizations were introduced in order to illustrate differences between them in terms of personal attributes contained there.

4. Selected Tools of Analysis.

4.1 For Organization by Organization Matrices.

Each matrix E_{eXe}^{k} contains a valued relationship between organizations in community *K* that is measured as a number of members of families that are participating in some organization. The entry in the main diagonal shows the absolute number of families involved in each organization, and the numbers outside that diagonal represents families that have members participating in

different organization. In this way, it will be possible to identify an organization that is isolated; this will occur when the people participating in it come from the same family or when some families that have a specialized pattern of participation (they participate only in one kind of organization).

To describe the main characteristic of these matrices a set of **Network Diagrams (a)** were constructed, introducing attributes [2] for each organization (node) based on some selected attributed that was calculated using a family average[3].

By design, the structure of organization is exactly the same in each community; hence, it is possible to compare if communities present significant differences in terms of densities associated with the structure of participation in organizations. This was accomplished following Snijders and Borgatti (1999), by using a **Compared Paired Densities (b)** test it was calculated using UCINET version 6.0.

4.2 For Families by Families Matrices.

Each matrix P^k_{fXf} contains a valued relationship between families in community K, measuring the number of organizations in which the members of family h are participating. The number in the main diagonal shows the absolute number of organizations involved for each family, and the numbers outside that diagonal represents the number of shared organizations, because families have members participating there. In this context, one family will be isolated when its members are participating in some particular organization that is not selected by member of others families.

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[2] The basic attributes considering and their keys are:
- Strength ties = number of families interlinking organizations (5 categories).
- Nodes color = Sex of participating people, it is red when participating are mainly women (100%), and black when they are mainly men.
- Node Size = decil position in regional scale based in total familiar income, the categories go from size=2 when is member of decil 1 (poorest families) to size=20, when is members of decil 10 (richest families).
- Node Shape = Domain on second language, it is based in the average of that attribute, the associated keys are: Triangle when the proportion is between 80-100%, Square when the proportion is between 0.3-0.8, and circle when is lower than 0.3.

[3] That implies for a attribute X (example income) applying the following formula:

$$X^k_e = \left(\frac{1}{n_H}\right)\sum_{h=1}^{H}\left[\left(\frac{1}{n_I}\right)\sum_{i=1}^{I} X^k_{ihe}\right]$$

where: I represents the number of people "i" that is member of a family h, H is the total of families "h" that are participating in organization "e" in community "k", n_I is the total of member of family h, and nh is the total of families h that are participating in organization e.

4.3 About Network Resources.

Given that each community K has many households, it seems convenient to reduce the complexity of any structural analysis using some structural equivalent perspective based on a **Positional Analysis (*c*)**. Following Wasserman and Faust (1999, chapter 9), this can be done in the following way:

(c.1) define a measure of structural equivalence: as a measure of equivalence a Euclidian distance metric was used; it was only applied to a dichotomized Family by Family matrix (P_{fXf}^{kd}). These matrices were calculated using 1 as the minimum value; it can be interpreted to mean that two families appear linked when at least one organization is connecting them in a non-directional relationship.

(c.2.) select a method to represent it:

(c.2.1) Partitioning actors: As a method to represent these matrices as networks of positions, a hierarchical clustering method was used considering an average link option to partition the set of actors. During this procedure, the diagonal values were ignored and the transpose matrices were included. To select the numbers of clusters, a criterion of greater changes in level values was considered, under the practical constraint that the number of final groups has to be reasonable (a "rule of thumb" approach was used).

(c.2.2) Assigning actors to positions: To assign actors to positions, a block-modeling procedure was used in all cases.

 (c.2.3) Describing ties between and within positions: As a method to describe ties between positions (blocks), a **Density Matrix** was used for each community. Normally that kind of matrices are reduced using a binary approximation in which value greater than α, where the number $\alpha \in [0,1]$, are assumed as 1 and cero otherwise, that kind of simplified matrix is called **Image Matrix (**Wasserman and Faust, 1999). In our case we did not use image matrices, with the purpose to preserve the connection among the original blocks obtained in each Density Matrix. Finally for each community, a set of "**Reduced Graphs**" were elaborated,[4] using the densities

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[4] Additionally in that reduced graph some additional criteria were includes as attributes of nodes, the basic attributes considering and their keys are:
- **Strength ties** = It is depending of density strength between clusters (5 categories).
- **Nodes color** = It is based in proportion of poverty in household: blue implies poverty presence (from 1% to 99%), and red is indicating absent of poverty in 100 % of cases.
- **Node Size** = Number of cases included in each cluster (households).
- **Node Shape** = It is based in proportion of masculine head household, when it is greater than 50%. It was used a square (indicating Men Domain), otherwise was used a circle, indicating Female Domain.

matrices as inputs. To accomplish this task, ties were considered as values-ties using the density values as reference. In that way the reduce graph are showing connection between blocks and the graphical thickness of those ties are representing strength in the association between different blocks.

4.4 About Contact Resources.

Following Lin's perspective, the **Positional Analysis** is a key piece that contributes to an understanding of the social capital creation in a network context, but it is not a sufficient condition to understand the social capital functioning. In order to complete that perspective, some notion about the potential **Contact Resources** embedded in the network has to be included; this dimension was included using a set of aggregated personal resources associated with socio economic attributes of people that are member of families included in each network, in that way here is assumed that each personal attribute constitutes a potential contact resource that can be activated using the social connections that are defined in the social network.

(d) Contact Resources.

Taking the additional data available for each family, a set potential Contact Resources was defined considering the regular practices contained in Position Generator studies (Van der Gaag *et al.*, 2004). Initially, the selected indicators were organized into five thematic groups or ex-ante dimensions: Socio-Economic Status, Human Capital, Labor Market Connections, Family Structure, and Cultural Capital. To reduce the number of elements involved, a factor analysis was applied (for details see appendix 2).

The Factor Analysis was based on a principal component analysis with a classical varimax rotation on data. The data set included the whole sample (1,643 households), and finally 5 factors were defined using the classical criterion to select only the factors that had an eigenvalue equal to or greater than 1.0. These five factors explained 53% of the total variance. They are summarized as follows, with a descriptor of the main components of the variance explained

F1 "Returns on Human capital: It explains 24.36 % of total variance".

F2 "Household Assimilation: It explains 12.9 % of total variance".

F3 "Age maturity of household: It explains 8.45 % of total variance".

F4 "Household labor Participation: It explains 6.59 % of total variance".

F5 "Diversity Family Structure: It explains 5.89 % of total variance".

These factors represent the potential Contact Resources that are embedded in the network structure and they will be use to establish whether they affect the pattern of relationships, implying some network causality.

4.5 About interaction among Network and Contact Resources.

The interdependency between those both dimensions is an important point to understand the SC from a SN perspective and to be able to project on the "real" space, in which the communities under study are located, a distinctive description of social processes that constitute its Social Spaces.   The apparent dichotomy between located-space and socially configured-space is particularly interesting, since regional policy is designed with information derived from the first dimension only, when, paradoxically, the real effects of that policy probably depend critically on the social space (for complementary perspectives, see Kilkenny and Nalbarte, 2002; Carvalho, 2005).

To clarify the existence of some "topological" relationship between network resources (positions) and contact resources, a new set of network relational tools was explored.

(e) Random Categorical Test of Autocorrelation (RCT).

This tool is able to test whether the configuration of relationships contained in the networks structure could be predicted using a set of categorical variables, associated for example with the social actors that are located in specific position in the network. Following Borgatti *et al.* (2002) this test generates a contingency table using an empirical net based on a randomization process to test the level of significance for any association between both variables (the net and the categorical criterion).

(f) Geary's *C* as a test of Social network dependency

Geary's *C* test explores the configuration of relationships contained in the network structure to see whether it could be associated with a particular continuous variable that is associated with social actors located in specific positions in the network. The test is a covariance measure between values in variables associated with the connected nodes. This test examines whether one node with high/low levels in the variable of interest is surrounded by nodes with high/low level (the case of positive correlation) or if high/low values are associated with

Low/high values (negative correlation). The test uses a bootstrapping process that shows the empirical confidence level for the *C* value calculated.

(g) Quadratic Assignment Procedure (QAP)- Regression:

This tool is used to represent a social interaction matrix as a function of a set of other matrices through a causal correlation analysis, in which the dependent social matrix could be considered as explained by the independent matrices. Following Borgatti *et al*. (2002), a sequential algorithm is used. It starts with a measure of correlation, as for example Pearson's correlation estimator; using a synchronously random permutation of rows and columns among matrices, an empirical distribution of that coefficient is generated, in such a way that the level of significance of the original value can be tested.

To implement the QAP analysis a set of social interaction matrices were constructed considering the different factors elaborated as Contact Resources. Each factor was categorized in five ordered groups; if a tie between families located in the same group was observed, this was registered with value 1, and zero otherwise. Following this procedure, for each community a new set of five social matrices was generated, representing homogeneity in terms of contact resources. The hypotheses behind this design is that in an impure altruism, the structure social interaction has to be influenced by the possibility of a match with potential partners; in this fashion, the homogeneity in terms of contact resources could reinforce the nexus between families.

On the other hand, a control for weak or strength ties was introduced creating a new dependent matrix from the original social family by family interaction (P_{fXf}^{k}). The new matrix was created by dichotomizing *F*, using 1 when the relationship between two families is strictly greater than one. It implies that families are required to share more organizational spaces with each other to be considered as connected and thus reveals evidence of stronger ties among families. Both matrices (weak and strength) were explored using the last group of tools in order to evaluate the impact of tie-weakness on the social connections and in that manner on SC.

5.   Main Descriptive and Testing Results

In appendices 3 and 4, there is a set of tables and diagrams associated with the previously defined tools, and they are organized by type of actor involved in each relationship. In the case of Organization by Organization matrices (see appendix 3), the associated descriptive elements for

each network are revealing different qualitative elements. Table-1 summarizes some of these features.

Table-1: Qualitative Analysis organizations by organizations networks

All results are shown as proportions (e.g. 6/19)

Community	Description
Arica	• 6 cases from 19 organizations appear as isolated, • Those organizations are under a female domain are 13 from 19. • In terms of cultural domain the native people have a great influence in organizations that tends to be isolated, 3 from 6 cases in comparison with 1 from 13 cases in non isolated organizations. • The poor people have limited participation in all organizations being their value equal to 6 from 19.
Camarones	• 6 from 19 organizations appear as isolated, • the organization under a female domain are 8 from 19, • In terms of cultural domain the native people has domain in organizations that tends to be isolated, 5 cases from 6 organizations and in the connected cases the native domain is reduced to 2 cases from 13 organizations. • The poor people figures with a limited domain only 7 from 19 organizations, and in 5 organization form 6 cases in isolated organizations.
Camiña	• 11 from 19 organizations appear as isolated, • Organizations under a female domain are 9 from 19 cases and in the isolated group it is 7 from 9 cases. • In terms of cultural domain the native people has domain on 11 from 19 organizations, including 9 from 11 isolated cases. • The poor people figures with a domain in 9 from 19 organizations that proportion raises to 8 from 11 in the isolated cases.
Colchane	• 9 from 19 organizations appear as isolated, • Organizations under a female domain are 15 from 19 cases and in the isolated group it is 9 from 9 cases. • In terms of cultural domain the native people has domain on 10 from 19 organizations, including 0 from 9 isolated cases. • The poor people figures with a domain in 15 from 19 organizations, including 9 from 9 in the isolated cases.
General Lagos	• 14 from 19 organizations appear as isolated, • Organizations under a female domain are 15 from 19 cases and in the isolated group it is 13 from 14 cases. • In terms of cultural domain the native people has domain on 17 from 19 organizations, including 13 from 14 isolated cases. • The poor people figures with a domain in 15 from 19 organizations, including 13 from 14 in the isolated cases.
Huara	• 7 from 19 organizations appear as isolated, • Organizations under a female domain are 8 from 19 cases and in the isolated group it is 6 from 7 cases. • In terms of cultural domain the native people has domain on 8 from 19 organizations, including 6 from 7 isolated cases. • The poor people figures with a domain in 7 from 19 organizations, including 5 from 7 in the isolated cases.
Iquique	• Only 4 from 19 organizations appear as isolated, • Organizations under a female domain are 12 from 19 general cases and in the isolated group it is 2 from 4 cases. • In terms of cultural domain the native people has domain on 0 from 19 organizations.

Community	Description
	• The poor people figures with a domain in 4 from 19 organizations, including 3 from 14 in the non-isolated cases.
Pica	• Only 8 from 19 organizations appear as isolated, • Organizations under a female domain are 12 from 19 general cases and in the isolated group it is 7 from 8 cases. • In terms of cultural domain the native people has domain on 1 from 19 organizations. • The poor people figures with a domain in 6 from 19 organizations, including 4 from 8 in the isolated cases.
Pozo Almonte	• There 7 from 19 organizations appear as isolated, • Organizations under a female domain are 11 from 19 general cases and in the isolated group it is 5 from 7 cases. • In terms of cultural domain the native people has domain on 1 from 19 organizations. • The poor people figures with a domain in 14 from 19 organizations, including 7 from 9 in the isolated cases.
Putre	• There 9 from 19 organizations appear as isolated, • Organizations under a female domain are 15 from 19 general cases and in the isolated group it is 9 from 9 cases. • In terms of cultural domain the native people has domain on 7 from 19 organizations, including 1 from 9 in isolated cases, • the poor people figures with a domain in 14 from 19 organizations, including 7 from 9 in the isolated cases.

The previous pattern of qualitative relationship between organization by organization networks and some of the visible attributes of the participating people might be associated with a pattern of social exclusion, especially in rural areas. This finding may reflect a lower level of integration or social connections for organization associated with a gender dichotomy, further influenced by a class dichotomy (affecting poor people) and a racial-cultural process affecting that affects the indigenous people. Even though these propositions have not been tested in this application, the descriptive results are suggestive in that sense that the descriptive evidence is compatible with the idea that in this cases the network structure could be able to move different kind of organizational (or personal) resources, depending of which community is being considered, specially if those are rural or urban.

Finally, in table 1 in appendix 3, the results are reported for a paired densities test; in the examined cases, the evidence is not able to reject the null hypotheses that the revealed densities are equivalent. The result mean be interpreted to imply that even when the number of isolated organization is changing, the valued density among organizations remains constant probably because the isolated organization have low values. These results also indicate that it is not possible to find enough evidence to support the idea of there being dissimilar network densities among the communities, and it could be associated with the fact that the typically four types of associations (Neighbor Associations, Sports Groups, Religious Groups, and Parent and Teachers

associations) are systematically concentrating the higher levels of participation for people in different communities.

In appendix 4, the main results are presented for the Families by Families matrices, those initial descriptive results are derived from the positional analysis, where to generate a set of "reduced graphs" some contacts resources elements were introduced as included attributes in each group. For practical purposes, these analyses were unable to exhibit firm patterns of relationship between the network resources (positional dimension) and the contact resources or social capital factors.

In view of these results, it seems to be more appropriate to focus attention only on the descriptive evidence that shows how the contact resources are distributed among different communities including, as a filter, the partitions associated with the previous positional analysis. These results are shown in section 4.2 and in table 2 in appendix 4.

In terms of the first Contact Resource, "Return on Human Capital," the urban areas (Arica and Iquique) have greater average values (high community between effect) and greater internal volatility (high within effect); this last result is linked with positional group heterogeneity in the accessibility to contact resources in one community. On the other hand, the rural communities reveal less volatility, but lower average values, especially in communities with a relatively stronger Aymarean presence, such as Colchane, Camiña, Camarones, Putre, and G.Lagos.

For the second resource, "Household Assimilation," predictably, since this factor is linked in some way with cultural assimilation, the urban areas (Arica and Iquique) are have higher average values and less internal volatility, while rural communities have greater volatility and lower average values. This finding is very clear in the in Colchane, Camiña, Camarones, Putre, and G.Lagos.

In contrast, for the third resource, "Age Maturity of Household," it is the urban areas that have lower average values and less internal volatility, while rural communities present a more heterogeneous situation. Some of them have greater volatility and higher average values too, while others have less volatility and low averages values. The results may reflect complex migratory patterns among urban and rural areas, typically presented in less developed countries in which the males in rural areas typically leaving to work in nearby urban areas, returning to their original towns when they are not in active occupational categories, in that way the migratory process affects the household age composition introducing high variability in rural areas.

A similar situation is produced in terms of the fourth contact resource, "Household Labor Participation." Here the urban areas contain average values and some internal volatility, while rural communities have relatively greater volatility and diversity in terms of their average values, especially in rural communities such as Colchane, Putre, and Huara.

Finally, the fifth component, called "Diversity-Family Structure," presents a complex pattern that apparently is not associated with either the rural or urban condition. In fact, that heterogeneity might be operating in terms of between and within community effect levels, accounting for the high level of volatility found there in each community.

Given these results, it would be difficult to establish a general potential pattern of relationship between contact and networks resources. The evidence derived from the network correlation approaches might be the key to enhancing our understanding. The results are presented in section 4.3 in appendix 4, letters E, F, and G. The values for different tests applied in each community are presented; through them, it is possible to link some observable attributes (or contact resources) with the pattern of social interaction defined in our social network. Recall that two different matrices of interaction were used. While both contain the same information, they are different because distinctive criteria to dichotomize them were used. In one case, a less rigorous criteria was used producing a matrix associated with "weaker ties" while in the second case, a higher cut-off point was used producing a "stronger ties" matrix. Considering these elements for each community (K=10), the set of tests was applied twice, generating 20 cases. In order to simplify the testing of the results, a modified meta-analysis was used, comparing the number of times in which one result yielded the same conclusion over the total of 20 replications available. To be consistent in terms of the social matrices and community, the same result has to occur for each of the 20 repetitions; a summary of the findings is presented in where the values in that table show the proportion of the 20 replications (or cases) in which the same conclusion is produced by each test.

The most interesting results are associated with the variable sex, revealing that some interdependence between sex and co-participation is social organization is presented in a strong-ties context (80% of cases). That result might imply that sex homogeneity is a factor associated with strong relationships among families that participate in social organizations, that finding is compatible with homophily principles that establish that gender homogeneity is a factor typically present in social networks (see McPherson *et al.*, 2001).

The second contact resource that is exhibiting an interesting behavior is the factor "Household Assimilation,", that resource is linked with some variables associated with cultural profiles (for example, designated as a worker, not dependent on public subsidies, etc.), that variable is showing strong evidence rejecting the idea that the network structure is completely independent of that characteristic, especially in the strong-ties context (70% of cases). It implies that a factor of cultural homogeneity might be acting to reinforce the social connection between families through particular social organizations.

Table 2: Quantitative Summary of Testing Tools Families by Families networks

Test	Variable	"Weak Ties"	"Strong Ties"	Total cases	Meaning
RCT test	Sex	0.2	0.8	0.50	% municipalities + matrices in which independence is rejected
	Poverty	0.3	0.1	0.22	
Geary's C test Ho:independence or C = 1	Returns on Human Capital	0.2	0.5	0.35	% municipalities + matrices in which independence is not significant (or C≠0)
	Household Assimilation	0.4	0.7	0.55	
	Age Maturity of Household	0.3	0.4	0.35	
	Household Labor Participation	1.0	0.3	0.65	
	Diversity Family Structure	0.5	0.5	0.50	
QAP Ho: rho=0 (Net,Factor)	rho(Net,F1)	0.4	0.4	0.40	% municipalities + matrices in which non-correlation is rejected
	rho(Net,F2)	0.6	0.7	0.65	
	rho(Net,F3)	0.4	0.4	0.40	
	rho(Net,F4)	0.3	0.2	0.25	
	rho(Net,F5)	0.2	0.3	0.25	

The next factor is "Labor Participation;" in this case the weak-ties matrices are providing consistent evidence in order that exist some association between the social network under study and the factor of interest (in 100% of cases).   It might be associated with mutual dependence between the social network structure and the homogeneity in that factor, implying that similarities in labor participation factor could be associated with connections in terms of social

networks, in general that result that seems compatible with the Lin's ideas, who sustain that occupational status is associated with access to social resources, where those resources are contained into the social networks structures, in that way both elements occupational status and social network structure are not independent (Lin and Dumin, 1986).

The QAP results are again showing consistent evidence about dependency of the social connections on the second contact resource factor, "Household Assimilation," for both weak and strong ties. But at the same time, the factor 3, "Household Labor Participation", does not appear as a systematic correlated element. That result seems to be non intuitively given the C test results, being cautious both results are non exactly comparables, because the QAP is simultaneously trying to explain social connection using a set of independent social connection binary matrices that were elaborated using a homogeneity criterion in terms of possession of those factors, in that sense it is acting as a coefficient from a multivariate regression analysis. In contrast, in the C test, the included variables resources are assumed as continuous variables, acting that test as a measure of covariance between both elements.

6. Final Comments

This paper was oriented to analyze the internal social structure of Region of Tarapaca in Chile, with the purpose to explore the degree of which social network structure differences can be related to differences in individual socio economic conditions. The research was using an analytical perspective on a Complete Network derived using Breiger's Dual theorems from a Two-Modes Matrix data representing household participation in social organizations.   The research included 10 urban and rural communities located in the interest region. The analysis for each community included a description of the Social Organizations relationship through Households, and mainly the Household by Households relations through Social Organizations. In that last task a Positional Analysis based in Structural Equivalence was developed, comparing the relative situation of each group in terms of possession of a set of five Social Capital Factors, elaborated following a Positional Generator style, those comparisons are including a within and between communities analysis.

In terms of Social Organizations the evidence suggests that the structures of linkage between them are similar in any community, considering these linkages in terms of density. That results suggest that four particular organizations (Neighbor Associations, Sports Groups, Religious Groups, and Parent and Teachers associations) are systematically occupying central

places in the system of participation in social organizations, constituting a "Core" in terms of social space occupying by people. The other organizations, to despite that they could be isolated or not, are relegating to a most marginal positions. However, the composition of that participation flows is different, in terms of people characteristics, being prominent distinctive elements as race (Chilean/Aymarean), gender (Men/female), and class (poor/richer). That issue suggests that even when the patterns of participations in Organizations appear similar between different communities the potential resources that are being connected through these structures of participation are different, implying that there are not homogeneous levels of SC.

In terms of households by households interconnections in each community, the correlational evidence is suggesting that the variable Sex is presenting a strong connection with the participation in social organization, that results seems to imply that sex homogeneity is a factor that facilitates the existence of relations among families that participate in social organizations, and in that way the gender dimension is introduced as a factor that affects the pattern of social connection between families.

Considering all the indicators prepared to measure Social Capital the evidence is resulting particularly strong in the cases of "Household Assimilation" and "Labor Participation" factors. Particularly the results associated with "Household Assimilation" are exhibiting a regular association between homogeneity in that factor and the network structure, where that association appears regularly in any of the ten studied communities. That is an interesting result because that factor is related with variables associated with cultural profiles as a worker class member, that issue is suggesting that the network structure of participation and the linkage between families is not independent of that dimension of working class member. It results is consistent with another homophily factor, meaning that cultural homogeneity might be reinforcing the social connection between families through particular social organizations.

In the case of the factor leveled "Labor Participation" the evidence suggests, for the case of weak-ties matrices, some association between the social network structure and the homogeneity in that factor. Those results could imply that similarities in labor participation factor are associated with connections in terms of social networks. That implication is a common result in Position Generator studies and in that way it seems to be consistent Lin's findings about how the occupational status is associated with access to social resources contained in the social networks structures.

A second result associated with Households by Households social matrices emerges from the inter-communities comparison of contact resources (between-within analysis), in which the average levels of social capital factors were compared (between communities dimension) taking account the structural community heterogeneity, associated with the social capital factor distribution between different structural groups into each community (within community dimension or volatility).   In that analysis two factors of Social capital are showing some interesting behavior, that suggest some association with the categorical dichotomy urban-rural presents in that region, such is the case of the factors "Return of Human Capital" and "Household Assimilation" in which the urban areas are presented higher levels with great heterogeneity in the first and less heterogeneity in the second, in comparison with the rural communities. Both patterns could be considered as expected while the heterogeneity in the first issue could be associated with bigger labor market in which the heterogeneity could be associated with presence of internal segmentation and discrimination emerging of different market structure, and from a most diverse human capital distribution in urban areas. In opposition, the less variability for urban areas in the second factor could emerge form a most homogeneous cultural pattern in terms membership to the working class that issue is relatively most heterogeneous in rural areas in which some families are dedicated to self production in traditional farms, and because some rural areas are presented most native population, fact that is related with the deepest difference in terms of the cultural dichotomy Chilean-Aymarean.
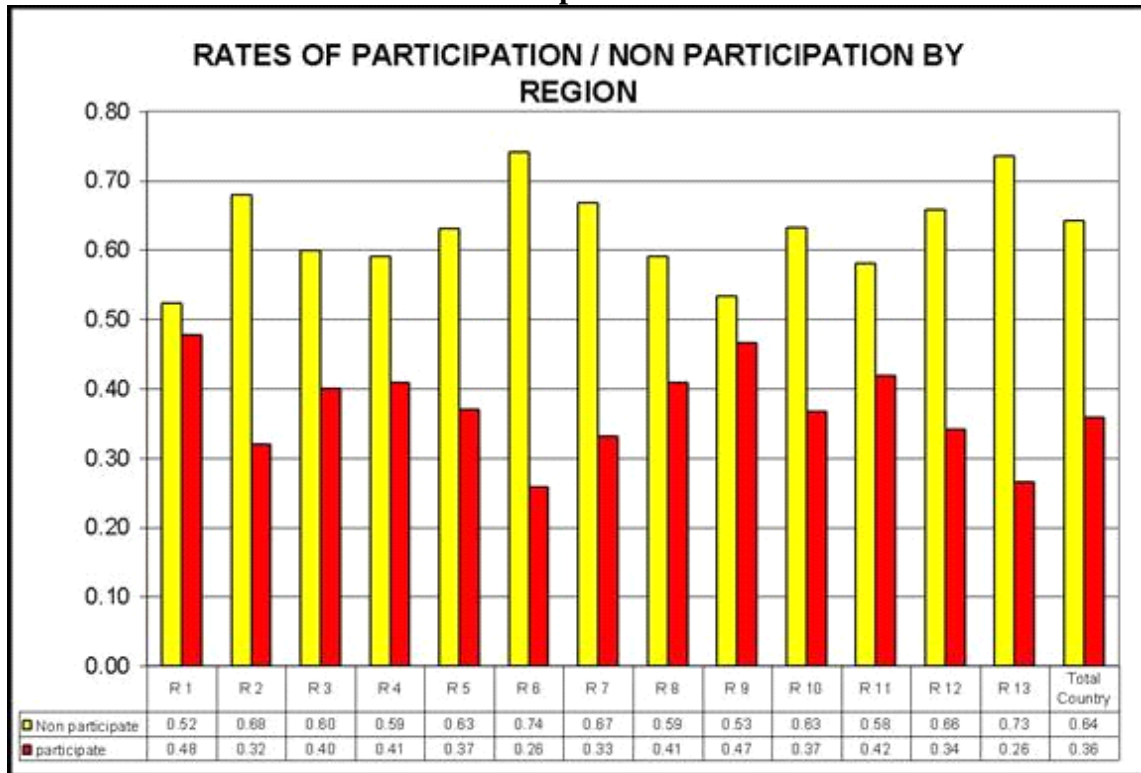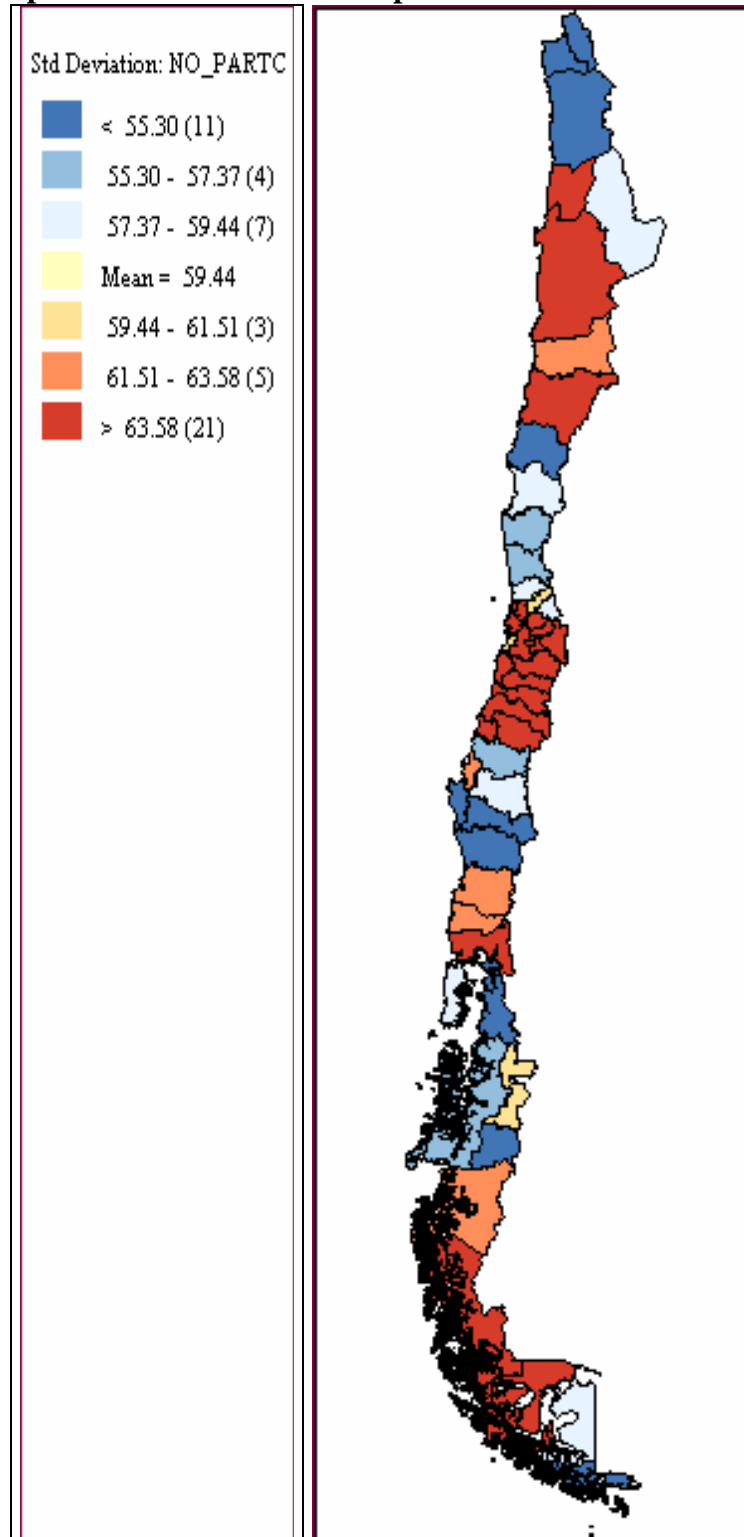
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Appendix 1
Descriptive Statistics and Maps

Graph N°1.

RATES OF PARTICIPATION / NON PARTICIPATION BY REGION

	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	R 12	R 13	Total Country
Non participate	0.52	0.68	0.60	0.59	0.63	0.74	0.67	0.59	0.53	0.63	0.58	0.66	0.73	0.64
participate	0.48	0.32	0.40	0.41	0.37	0.26	0.33	0.41	0.47	0.37	0.42	0.34	0.26	0.36

Map No1 : Rates of No Participation for Chilean Provinces

Std Deviation: NO_PARTC

- < 55.30 (11)
- 55.30 - 57.37 (4)
- 57.37 - 59.44 (7)
- Mean = 59.44
- 59.44 - 61.51 (3)
- 61.51 - 63.58 (5)
- > 63.58 (21)

Source: This map was preparing using GeoDA version 095i. The map represents the not participation rates by Chilean provinces using a deviation option centered in a mean = 59.44%.

Map No2
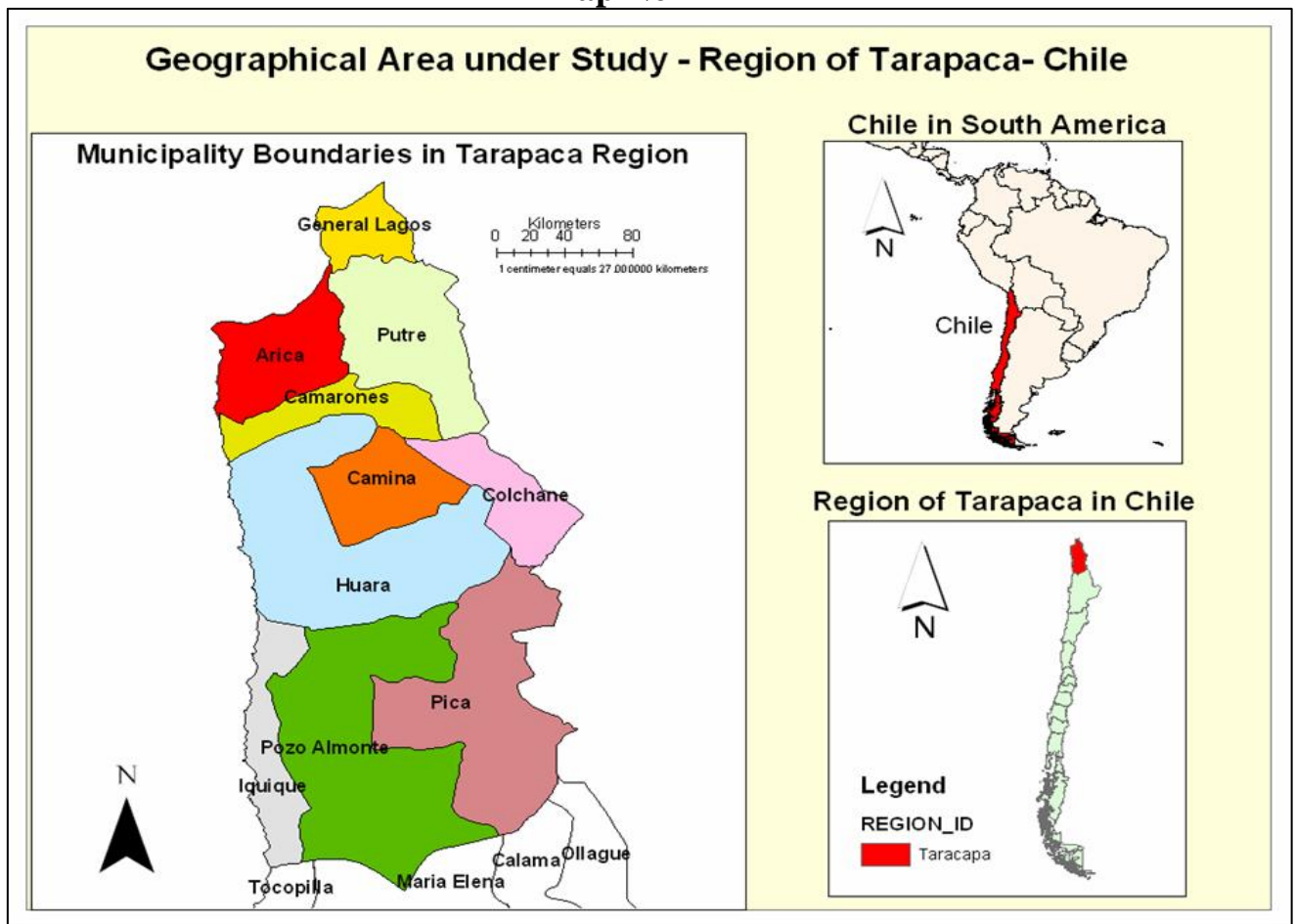
Source: This map was preparing using ARGIS version 8.1. The map represents the administrative political borders for the municipalities (communities) located in selected Region.

In Map No2 are showing the geographical distribution these communities: Urban areas are corresponding with Arica and Iquique, the rest could be considered as rural areas. In terms of Amerindian population a strong presence of them is found in: Colchane, Putre, Camarones, Camiña, General Lagos, and Arica.

Appendix No 2
Contact Resources and Factor analysis

Ex-ante categories and variables:

Group 1: Variables related with Socio-Economic Status category:

- Household is owner of property that they occupied
- Decil-Position in national income distribution
- Decil-Position in regional income distribution
- Total aggregated monetary income perceived by household
- Total aggregated monetary subsides perceived by household

Group 2: Variables related with Human Capital category:

- College education
- Average of schooling total population in household
- Average of schooling adult population in household (older that >15 years)
- Age average in household
- Age average adults in household (>15 years)
- Standard deviation of ages in household (as a measure of internal heterogeneity in household)

Group 3: Variables related with Labor market Connections category:

- Job as a formal worker
- Total household salary by hour
- Proportion of total household as occupied member of labor force
- Proportion of inactive people in household
- Aggregated household income that comes from salaries and wages

Group 4: Variables related with Family Structure category:

- Proportion of men in household
- Proportion of household people members of a nuclear family
- Number of people in household

Group 5: Variables related with Cultural Capital category:

- Proportion of people in household that are able to speak and/or understand a second language
- Proportion of people in household that have a negative opinion to participate in social organizations
- To have a computer connected to internet at home.
- Proportion of people in house that is considering him/herself as a internet user.
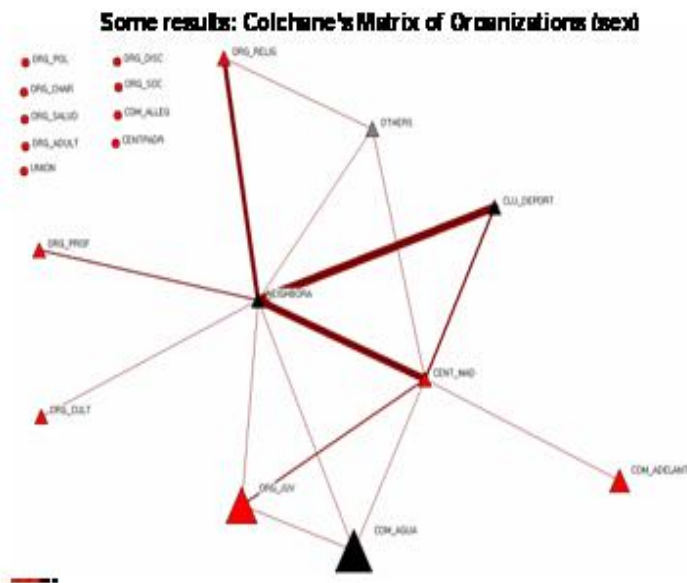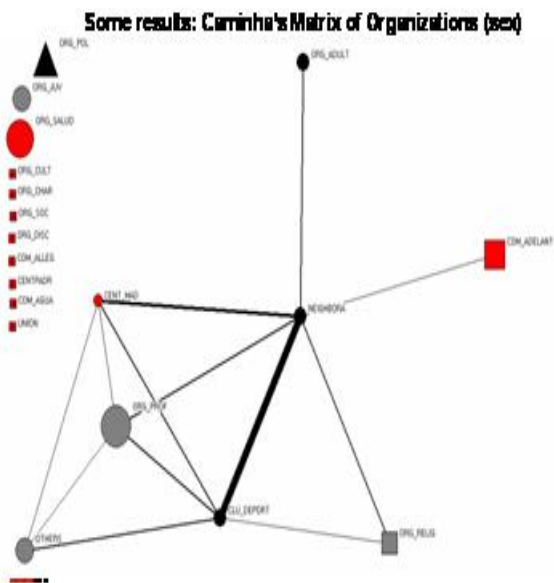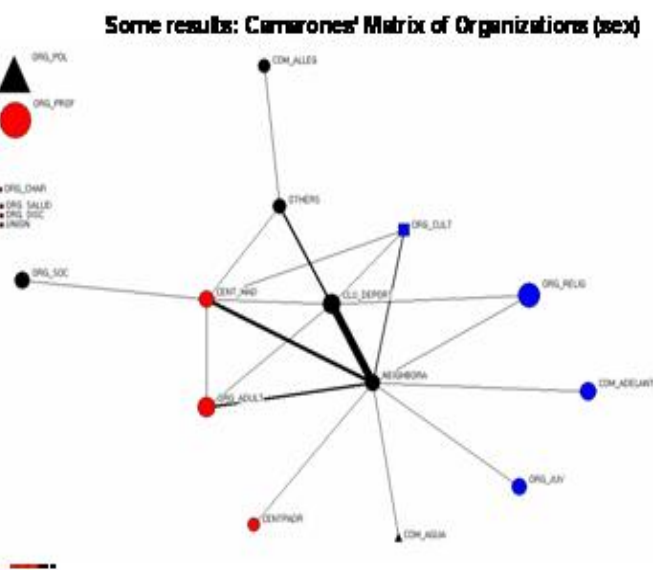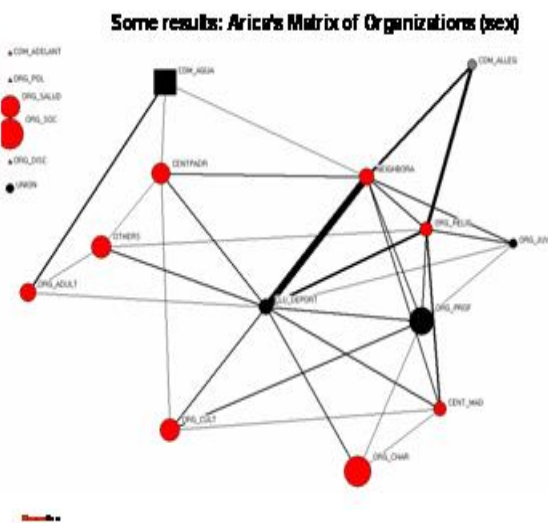
Ex-Post factor analysis: Main factors defined and loadings associated with the ex-ante variables:

Factor	Total explained variance	Loadings
F1 Returns on Human Capital	(24.36%)	
- Total aggregated monetary income perceived by household		(0.894)
- Aggregated household income that comes from salaries and wages		(0.873)
- Total household salary by hour		(0.651)
- College education		(0.619)
- Decil-Position in regional income distribution		(0.614)
- Decil-Position in national income distribution		(0.610)
- To have a computer connected to internet at home		(0.470)
- Average schooling total		(0.427)
- Years of schooling > 15 years		(0.420)
F2 Household Assimilation	(12.9%)	
- Proportion of household that is able to speak and/or to understand a second language		(0.682)
- Total aggregated monetary subsides perceived by household		(-0.542)
- Job as a formal worker		(0.467)
- Proportion of total household labor force unemployed		(0.293)
F3 Age Maturity of Household	(8.45%)	
- .Age average household		(0.902)
- Age average adults >15 years		(0.847)
- Number of people in household		(-0.723)
F4 Household Labor Participation	(6.59%)	
- Proportion of total household employed		(0.935)
- Proportion of inactive people in household		(-0.910)
- Proportion of men in household		(0.310)
F5 Diversity-Family Structure	(5.89%)	
- Proportion of household people members of a nuclear family		(-0.773)
- Standard deviation of ages in household		(0.634)
- Household is owner of property that they occupied		(0.387)
- Proportion of household that have a negative opinion to participate in social organizations		(0.128)
- To be a internet user		(0.080)

Appendix No 3
Results for Organization by Organization Matrices.

(a) Network Diagrams

Some results: Arica's Matrix of Organizations (sex)

Some results: Camarones' Matrix of Organizations (sex)

Some results: Caminha's Matrix of Organizations (sex)

Some results: Colchane's Matrix of Organizations (sex)
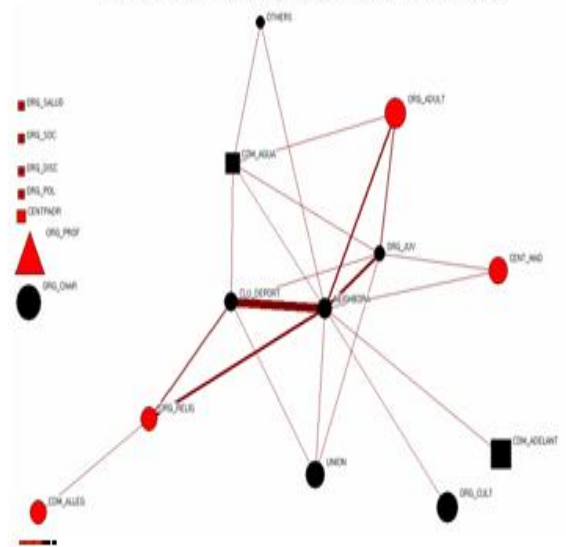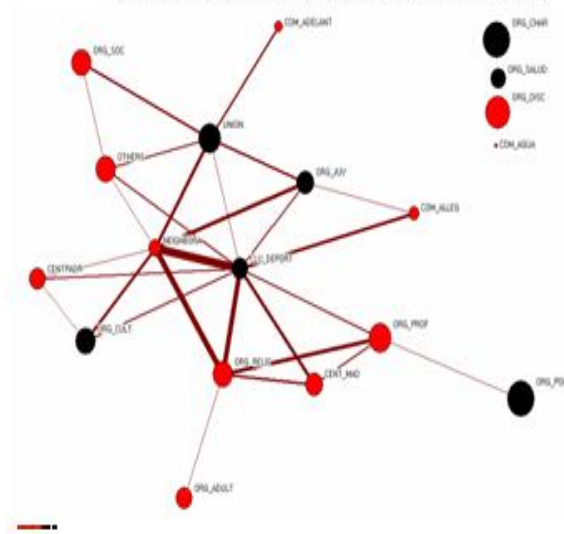
Some results: General Lagos' Matrix of Organizations (sex)
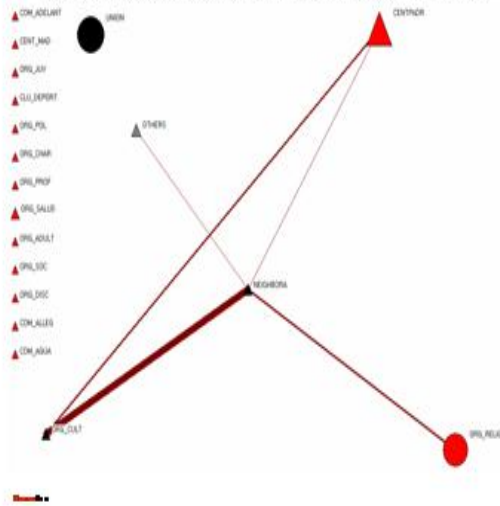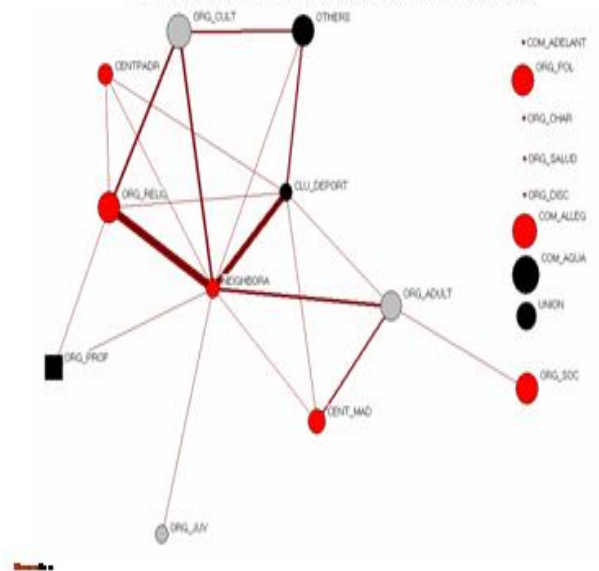

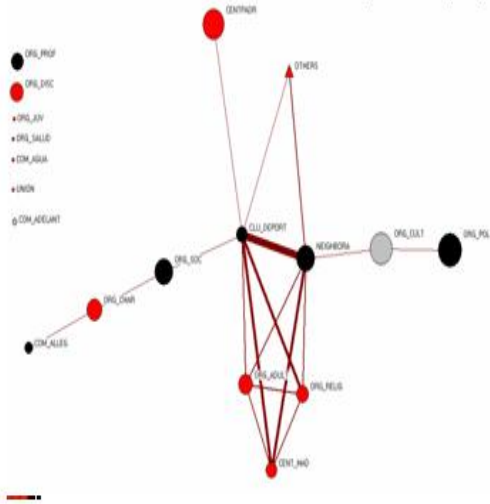Some results: Huara's Matrix of Organizations (sex)

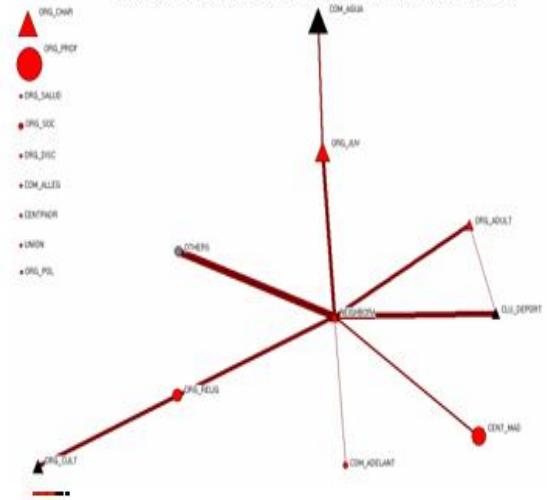Some results: Iquique's Matrix of Organizations (sex)

Some results: Pica's Matrix of Organizations (sex)

Some results: Pozo Almonte's Matrix of Organizations (sex)

Some results: Putre's Matrix of Organizations (sex)

(b) Compare Paired Densities

Table No1

Bootstrap T- Test on Differences in Densities between Two Networks of Organizations

	test (indep.samples)	Arica	Camarones	Camiña	Colchane	Gral. Lagos	Huara	Iquique	Pica	Pozo	Putre
Arica	Classical t-test	-	0.5269	0.7400	0.9936	5.4161	1.0176	-1.0119	2.4192	0.8049	2.7964
	Bootstrap t-test	-	0.0386	0.0588	0.0697	0.2740	0.0747	1.1155	0.2071	0.0794	0.1743
	t-statistic on bootstrap SE	-	0.0723	0.1075	0.1293	0.5180	0.1834	-0.2235	0.4927	0.2588	0.3976
Camarones	Classical t-test		-	0.2550	0.4017	3.3310	0.3234	-1.3380	1.3016	0.1852	1.6319
	Bootstrap t-test		-	0.0192	0.0273	0.1832	0.0225	-0.0953	0.0962	0.0153	0.1020
	t-statistic on bootstrap SE		-	0.2210	0.2681	0.9454	0.1022	-0.2035	0.1435	0.0239	0.4758
Camiña	Classical t-test			-	0.1024	2.3929	0.0000	-1.4486	0.7921	-0.1084	1.0820
	Bootstrap t-test			-	0.0075	0.1530	0.0000	-0.1105	0.0642	-0.0095	0.0755
	t-statistic on bootstrap SE			-	0.0723	0.6256	0.0000	-0.2395	0.0921	-0.0154	0.2846
Colchane	Classical t-test				-	2.7812	-0.1301	-1.7530	0.8009	-0.2481	1.1428
	Bootstrap t-test				-	0.1481	-0.0087	-0.1209	0.0562	-0.0196	0.0687
	t-statistic on bootstrap SE				-	0.7002	-0.0344	-0.2662	0.0819	-0.0293	0.3075
Gral. Lagos	Classical t-test					-	-3.8231	-5.3042	-3.5404	-3.6025	-2.6016
	Bootstrap t-test					-	-0.1853	-0.2949	-0.1508	-0.2301	-0.0936
	t-statistic on bootstrap SE					-	-1.0340	-0.5873	-0.2373	-0.3501	-0.6749
Huara	Classical t-test						-	-1.8537	1.1677	-0.1432	1.5707
	Bootstrap t-test						-	-0.1311	0.0870	-0.0125	0.0921
	t-statistic on bootstrap SE						-	-0.3234	0.1567	-0.0228	0.8955
Iquique	Classical t-test							-	1.5707	1.6388	3.3564
	Bootstrap t-test							-	0.0210	0.1401	0.2124
	t-statistic on bootstrap SE							-	0.8955	0.2619	0.5060
Pica	Classical t-test								-	-1.2352	0.5468
	Bootstrap t-test								-	-0.1417	0.0323
	t-statistic on bootstrap SE								-	-0.3777	0.0561
Pozo	Classical t-test									-	1.6072
	Bootstrap t-test									-	0.1215
	t-statistic on bootstrap SE									-	0.2054
Putre	Classical t-test										-
	Bootstrap t-test										-
	t-statistic on bootstrap SE										-

Dif. densities are significally different to zero. Bootstrapping with 5000 permutations.

Appendix No 4
Results for Families by Families Matrices.

4.1. About Network Resources.

C. Positional Analysis

c.2.1. Partitioning actors:

To describe the structural elements a block model procedure was done for each community (and for practical purposes). It was based in structurally equivalent principles, and it was done using a hierarchical cluster on dissimilarities based in Burt's Euclidean distances. A general summary of that procedure are presented in next table:

Table No1

Community	Final Clustering Groups	Original Numbers of Households
Arica	9 groups	from 170 households.
Camarones	7 groups	from 179 households
Camina	6 groups	from 177 households
Colchane	5 groups	from 174 households
Gral. Lagos	4 groups	from 107 households
Huara	7 groups	from 141 households
Iquique	8 groups	from 291 households
Pica	7groups	from 118 households
Pozo Almonte	5 groups	from 123 households
Putre	5 groups	from 155 households

The set of cut-off points and the column used to define each partition is presented in the following table:

Table No2

Community	Cut-off	Column	Group Number
Putre	3.948	11	5
Pozo Almonte	7.415	23	5
Pica	5.891	23	7
Iquique	8.444	30	8
Huara	4.425	12	7
General lagos	1.626	4	4
Colchane	4.795	15	5
Camina	4.094	14	6
Camarones	4.605	15	7
Arica	6.385	29	9

For each community a density matrix was elaborated based in the results of cluster analysis, that tables are presented in the next section:

c.2.2.1. Density Matrices for Defined Groups

Arica

	144	126	97	134	160	161	164
144	1.00000	1.00000	1.00000	1.00000	1.00000	0.00000	0.00000
126	1.00000	1.00000	1.00000	1.00000	0.01293	1.00000	0.03205
97	1.00000	1.00000	1.00000	0.00000	1.00000	1.00000	0.00000
134	1.00000	1.00000	0.00000	1.00000	0.01061	0.00343	0.04734
160	1.00000	0.01293	1.00000	0.01061	1.00000	0.00616	0.03006
161	0.00000	1.00000	1.00000	0.00343	0.00616	1.00000	0.01374
164	0.00000	0.03205	0.00000	0.04734	0.03006	0.01374	0.12281

Camarones

	138	33	146	180	147	108	127
138	1.00000	1.00000	1.00000	1.00000	0.00000	0.16071	0.06250
33	1.00000	1.00000	1.00000	0.02837	1.00000	0.00000	0.00000
146	1.00000	1.00000	1.00000	0.00000	0.00000	0.00000	0.00000
180	1.00000	0.02837	0.00000	1.00000	0.02837	0.08713	0.00887
147	0.00000	1.00000	0.00000	0.02837	1.00000	0.00000	0.00000
108	0.16071	0.00000	0.00000	0.08713	0.00000	1.00000	0.03571
127	0.06250	0.00000	0.00000	0.00887	0.00000	0.03571	0.07143

Camiña

	53.00000	146.00000	157.00000	137.00000	177.00000	170.00000
53.00000	1.00000	1.00000	1.00000	0.16667	0.16216	0.07692
146.00000	1.00000	1.00000	0.03333	0.22222	0.06194	0.02564
157.00000	1.00000	0.03333	1.00000	0.20000	0.10270	0.00000
137.00000	0.16667	0.22222	0.20000	1.00000	0.00676	0.05128
177.00000	0.16216	0.06194	0.10270	0.00676	1.00000	0.00728
170.00000	0.07692	0.02564	0.00000	0.05128	0.00728	0.10256

Colchane

	120	157	159	175	152
120	1.00000	0.14286	0.01587	0.02261	0.00000
157	0.14286	1.00000	0.11111	0.00719	0.00000
159	0.01587	0.11111	1.00000	0.10472	0.04762
175	0.02261	0.00719	0.10472	1.00000	0.01336
152	0.00000	0.00000	0.04762	0.01336	0.19780

General Lagos

	107	16	63	60
107	1.00000	0.01980	0.01485	0.00330
16	0.01980	1.00000	0.00000	0.00000
63	0.01485	0.00000	0.00000	0.00000
60	0.00330	0.00000	0.00000	0.00000

Huara

	48	106	70	93	141	121	140
48	1.00000	1.00000	1.00000	0.33333	1.00000	0.00000	0.00000
106	1.00000	1.00000	1.00000	0.00000	0.00000	0.00000	0.00000
70	1.00000	1.00000		1.00000	0.06667	0.00000	0.00000
93	0.33333	0.00000	1.00000	1.00000	0.06984	0.00000	0.00000
141	1.00000	0.00000	0.06667	0.06984	1.00000	0.04286	0.01392
121	0.00000	0.00000	0.00000	0.00000	0.04286	1.00000	0.03846
140	0.00000	0.00000	0.00000	0.00000	0.01392	0.03846	0.30769

Iquique

	252	261	287	260	286	285	278	291
252	1.00000	1.00000	1.00000	1.00000	0.00000	1.00000	0.00000	0.01493
261	1.00000	1.00000	1.00000	1.00000	1.00000	0.00000	0.00000	0.00995
287	1.00000	1.00000	1.00000	0.00000	1.00000	1.00000	0.00000	0.00000
260	1.00000	1.00000	0.00000	1.00000	0.00562	0.00186	0.03380	0.03890
286	0.00000	1.00000	1.00000	0.00562	1.00000	0.00000	0.07256	0.00862
285	1.00000	0.00000	1.00000	0.00186	0.00000	1.00000	0.00000	0.00366
278	0.00000	0.00000	0.00000	0.03380	0.07256	0.00000	1.00000	0.02411
291	0.01493	0.00995	0.00000	0.03890	0.00862	0.00366	0.02411	0.10131

Pica

	76	94	97	118	116	113	117
76	1.00000	1.00000	1.00000	1.00000	0.12766	0.00000	0.00000
94	1.00000	1.00000	1.00000	0.00513	0.00709	0.06667	0.04938
97	1.00000	1.00000	1.00000	0.00000	1.00000	0.00000	0.00000
118	1.00000	0.00513	0.00000	1.00000	0.13257	0.00699	0.01994
116	0.12766	0.00709	1.00000	0.13257	1.00000	0.02515	0.02600
113	0.00000	0.06667	0.00000	0.00699	0.02515	1.00000	0.00337
117	0.00000	0.04938	0.00000	0.01994	0.02600	0.00337	0.17379

Pozo Almonte

	73	35	83	123	120
73	1.00000	1.00000	1.00000	0.07979	1.00000
35	1.00000	1.00000	1.00000	0.61702	0.12195
83	1.00000	1.00000	1.00000	0.03846	0.01126
123	0.07979	0.61702	0.03846	0.16281	0.02906
120	1.00000	0.12195	0.01126	0.02906	1.00000

Putre

	91	138	155	153	149
91	1.00000	1.00000	1.00000	0.00000	0.00000
138	1.00000	1.00000	0.00000	0.00000	0.01111
155	1.00000	0.00000	1.00000	0.03333	0.01111
153	0.00000	0.00000	0.03333	1.00000	0.00000
149	0.00000	0.01111	0.01111	0.00000	0.13333

c.2.2.2 "Reduced Graph".

Arica
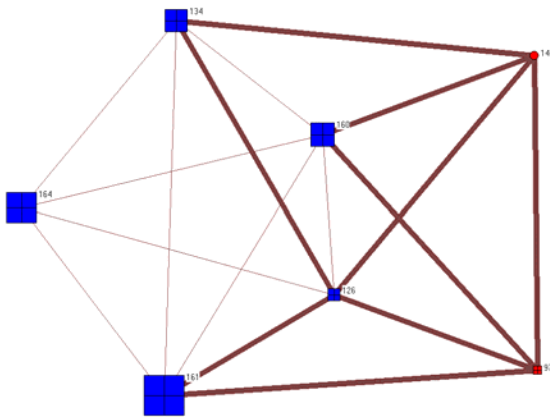
Camarones
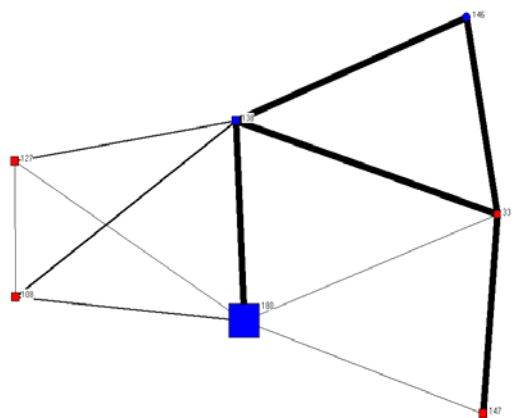
Camiña
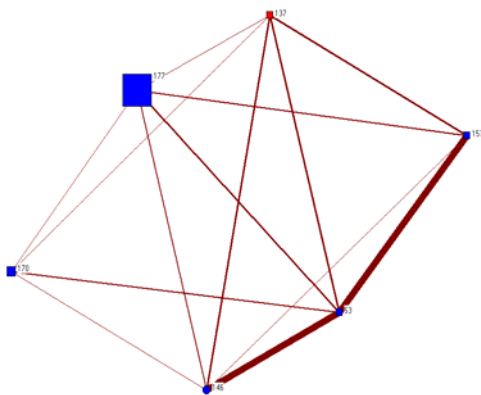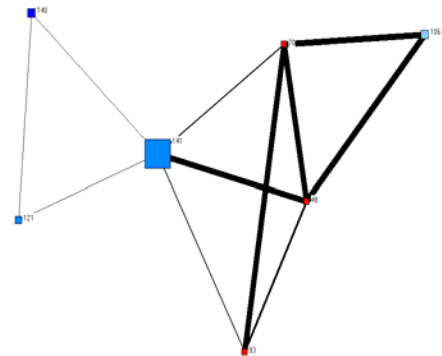

Colchane
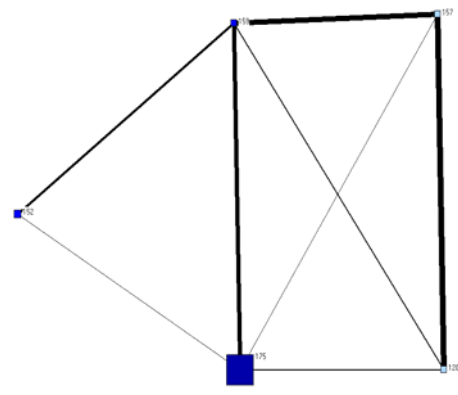
General Lagos
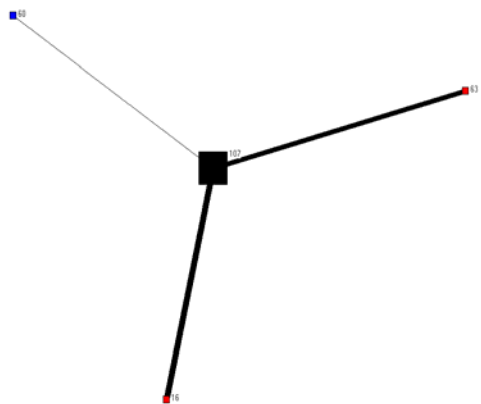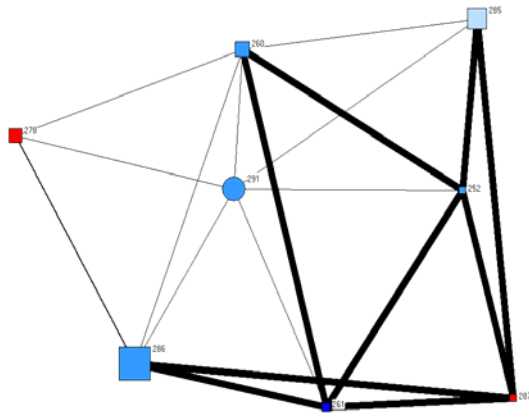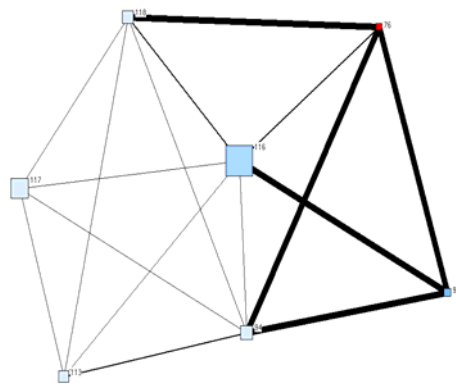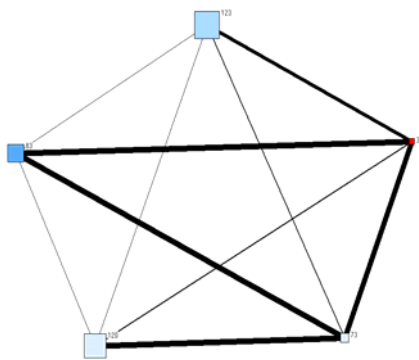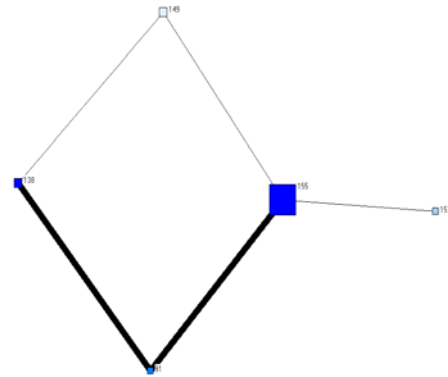

Huara

Iquique

Pica

Pozo Almonte

Putre

4.2. About Contact Resources by positional groups

In order to simplify the information that comes from Factor Analysis for each factor, a set of new summary measures was developed following a K-means logic. It is considering the average that each cluster group is presenting of each factor in each community and the within dispersion of these results.

Including the following indicators:

X^k_g is the average of factor X in group G, it is composed only by structurally equivalent actors (net effect) in Community K. It is calculated using:

$$X^k_g = \frac{\sum_{i \in G}^{N^k_g} x^k_i}{N^k_g}$$

Where: xki   is the value of factor X that is possessed by family i that was classified in group g in community k. and N_g^k is the total number of families included in group G in community K.

$\alpha^K_X = X_k$ It is the average for a factor X in each community k, it is defined as:

$$X_k = \sum_{g \in K}^{N_k} X^k_g * \left(\frac{N^k_g}{\sum_{g \in K} N^k_g} \right)$$

Volatility (β) is defined as a variance measure between the averages of groups G (centroids) in reference with the average for the community K where they are located.

$$\beta^k_X = \sum_{g \in K}^{N_k} \left[\left(X^k_g - X_k \right)^2 * \left(\frac{N^k_g}{N_k} \right) \right]$$

An alternative method to measure volatility could be calculated putting the attention in which is the degree of internal variance of each group G in reference with its own average (centroid). The index γ^g_{kX} is showing the heterogeneity in possession of factor X that is presented in a group G of structurally equivalent actors in community K.

$$\gamma^g_{kX} = \sum_{i \in G} \left[\left(X^k_i - X^k_g \right)^2 * \left(\frac{1}{N^k_g} \right) \right]$$

Using the index γ the volatility or within community heterogeneity can be represented as a weighted average of these indexes following the next proposed formulation.
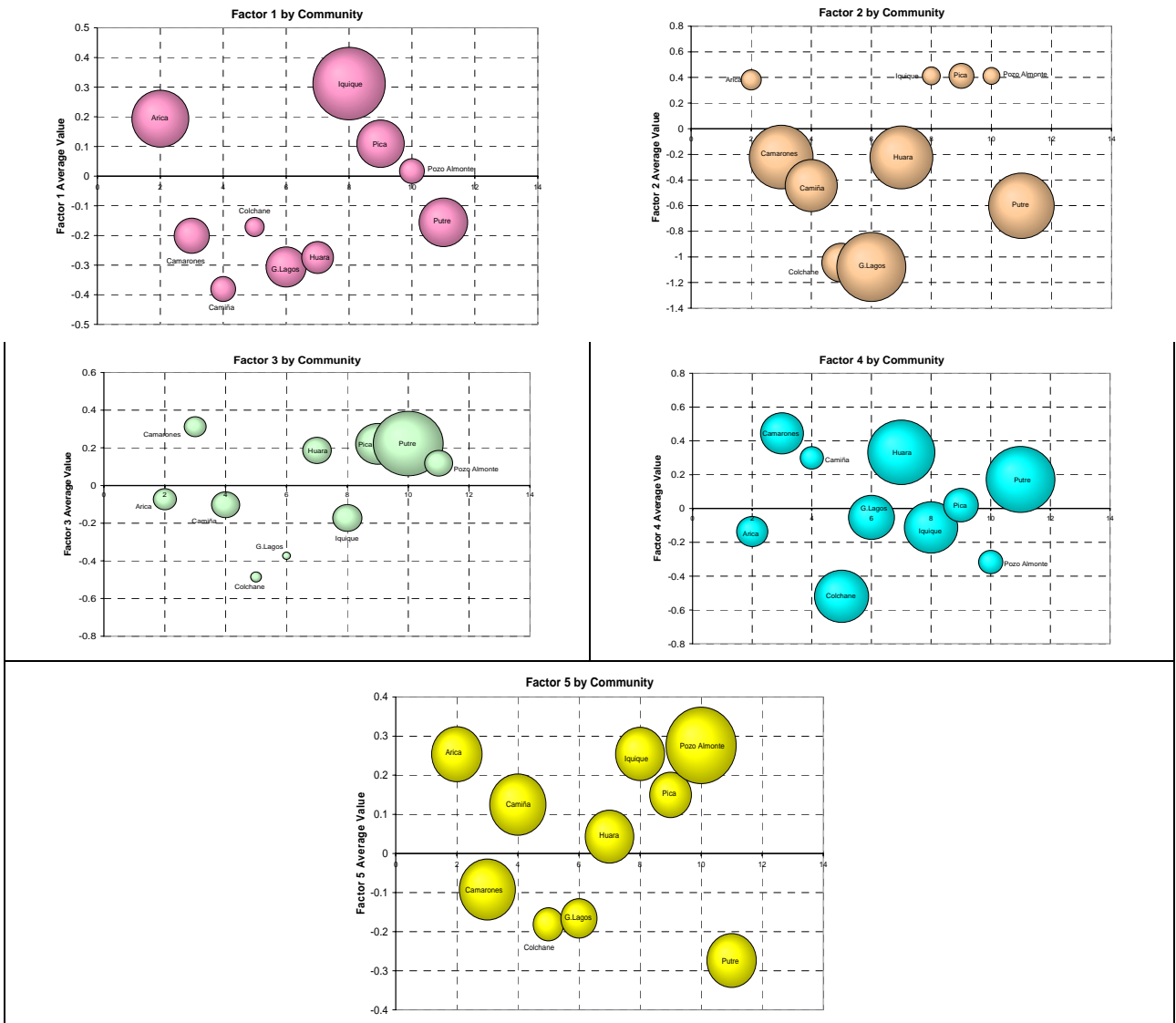
$$\varphi_X^k = \sum_{g \in K}^{N_k} \left[\gamma_{kX}^g * \left(N_g^k \middle/ N_k \right) \right]$$

In the next table is presented the Average Value for each factor in each location, indicating differences between communities, at the same time a Volatility type β measure is included, indicating the heterogeneity existing among cluster-groups inside each community K.

<div align="center">

Table No3
Between and Within Differences in communities in terms of Availability of Contact Resources

</div>

Community	Average FACTOR1	Average FACTOR2	Average FACTOR3	Average FACTOR4	Average FACTOR5	Volatility F1	Volatility F2	Volatility F3	Volatility F4	Volatility F5
Arica	0.19383	0.38169	-0.07278	-0.13621	0.25362	0.10544	0.01579	0.03141	0.01894	0.03574
Camarones	-0.20093	-0.22017	0.31234	0.44457	-0.09240	0.04025	0.15751	0.02797	0.03542	0.04372
Camiña	-0.38065	-0.44305	-0.10220	0.29935	0.12467	0.02025	0.10487	0.04621	0.01049	0.04432
Colchane	-0.17135	-1.04407	-0.48502	-0.51943	-0.18141	0.01185	0.05824	0.00702	0.05669	0.01295
G.Lagos	-0.30612	-1.07804	-0.37288	-0.05264	-0.16610	0.05234	0.18398	0.00387	0.04065	0.01838
Huara	-0.27433	-0.22358	0.18667	0.33217	0.04295	0.03325	0.15314	0.04809	0.08677	0.03311
Iquique	0.31196	0.41249	-0.17237	-0.11150	0.25435	0.16949	0.01251	0.05013	0.05500	0.03358
Pica	0.10930	0.41273	0.22130	0.01962	0.14980	0.07325	0.02434	0.11561	0.02331	0.02430
Pozo Almonte	0.01727	0.41192	0.22253	-0.31663	0.27622	0.01986	0.01122	0.28734	0.01134	0.06877
Putre	-0.15579	-0.60075	0.11833	0.17176	-0.27372	0.07652	0.16567	0.04617	0.09055	0.03409

In graphical terms and using the Volatility β index as size weight (radius) the next plots can represent the relative positions for each community.

Factor 1 by Community

Factor 2 by Community

Factor 3 by Community

Factor 4 by Community

Factor 5 by Community

4.3. About interaction among Network and Contact Resources.

E. Random Categorical Test of Autocorrelation (RCT).

Table No4

municipaly	Matrix Complexity GT	Sexo Head Household		Poverty condition	
		Observed Chi2	p-value	Observed Chi2	p-value
ARICA	0	7.516	0.778	10.419	0.635
	1	56.096	0.102	54.179	0.108
CAMARONES	0	22.512	0.345	119.955	0.017
	1	562.074	0.000	18.192	0.534
CAMINA	0	4099.550	0.000	158.615	0.006
	1	270.341	0.009	142.279	0.069
COLCHANE	0	216.678	0.004	26.804	0.299
	1	373.149	0.003	72.408	0.198
GRAL. LAGOS	0	7.301	0.415	5.687	0.658
	1	141.878	0.033	14.792	0.527
HUARA	0	53.446	0.952	2.710	0.929
	1	119.044	0.066	41.077	0.273
IQUIQUE	0	9.651	0.789	68.160	0.164
	1	216.390	0.011	15.122	0.690
PICA	0	25.404	0.271	42.214	0.128
	1	22.724	0.385	9.348	0.927
POZO ALMONTE	0	56.911	0.057	47.451	0.086
	1	116.033	0.006	30.011	0.232
PUTRE	0	22.512	0.344	52.705	0.118
	1	182.567	0.020	152.312	0.032

Autocorrelation RCT Analysis for Adjacency Matrices and Binary Factors

10000 randomisations. Ho variables are independent

Independent hip. is Rejected

F. Geary's C as a test of Social network dependency

Table No5

municipaly	Matrix Complexity GT	F1: Returns on Human Capital		F2: Household Assimilation		F3: Age Maturity of Household		F4: Household Labor Participation		F5: Diversity Family Struture	
		Geary's C	p-value	geary	p-value	geary	p-value	geary	p-value	geary	p-value
ARICA	0	0.674	0.092	0.938	0.271	0.854	0.027	0.936	0.115	1.000	0.299
	1	0.363	0.045	1.000	0.392	0.830	0.170	0.986	0.451	1.000	0.032
CAMARONES	0	0.789	0.002	0.891	0.026	1.000	0.001	1.000	0.264	1.000	0.025
	1	0.677	0.054	0.739	0.054	1.000	0.460	0.805	0.076	1.000	0.013
CAMINA	0	0.826	0.006	0.863	0.070	1.000	0.353	0.994	0.405	1.000	0.055
	1	1.000	0.467	1.000	0.410	0.698	0.001	0.803	0.049	1.000	0.015
COLCHANE	0	0.807	0.083	0.890	0.019	1.000	0.100	0.958	0.176	0.903	0.060
	1	0.565	0.050	0.788	0.029	0.858	0.045	0.846	0.048	0.954	0.362
GRAL. LAGOS	0	0.727	0.010	0.852	0.000	1.000	0.065	0.976	0.160	0.976	0.151
	1	0.451	0.001	0.699	0.002	0.888	0.136	0.844	0.021	0.844	0.022
HUARA	0	0.686	0.001	0.823	0.005	1.000	0.102	0.985	0.370	0.992	0.434
	1	0.761	0.168	0.826	0.120	0.979	0.414	0.724	0.012	0.976	0.440
IQUIQUE	0	0.726	0.015	0.976	0.383	0.913	0.069	0.948	0.143	0.893	0.022
	1	0.595	0.066	0.815	0.111	0.680	0.004	0.721	0.002	0.888	0.168
PICA	0	0.816	0.120	0.925	0.253	0.820	0.005	0.953	0.274	0.951	0.270
	1	0.642	0.198	1.000	0.433	0.686	0.049	1.000	0.210	1.000	0.332
POZO ALMONTE	0	0.687	0.081	0.843	0.137	0.752	0.000	1.000	0.221	1.000	0.031
	1	0.948	0.545	1.000	0.418	0.544	0.000	0.774	0.400	1.000	0.004
PUTRE	0	0.768	0.390	0.872	0.013	0.954	0.139	0.940	0.106	0.987	0.401
	1	1.000	0.477	0.705	0.300	0.563	0.000	0.587	0.001	1.000	0.120

Autocorrelation Geary's Test for Adjacency Matrices and Factors

5000 randomisations, C =1 perfect independence

Significatelly more social independent

Significatelly less social independent

G. Quadratic Assignment Procedure (QAP)- Regression:

Table No6

| QAP REGRESSION ADJACENCY MATRICES AND MATRICES OF FACTORS | | | | | | | | | | | | |
| municipaly | Matrix Complexity GT | F1: Returns on Human Capital | | F2: Household Assimilation | | F3: Age Maturity of Household | | F4: Household Labor Participation | | F5: Diversity Family Struture | | intercept | |
		Best	p-value	Best	p-value	Best	p-value	Best	p-value	Best	p-value	Best	R-adj
ARICA	0	-0.007	0.138	0.003	0.304	0.004	0.259	-0.003	0.537	0.001	0.376	0.275	0.000
	1	-0.006	0.055	0.003	0.222	0.004	0.179	0.000	0.525	-0.001	0.463	0.046	0.000
CAMARONES	0	0.001	0.340	0.042	0.000	0.010	0.026	0.013	0.099	-0.001	0.546	0.673	0.002
	1	-0.003	0.241	0.035	0.000	-0.002	0.393	-0.012	0.019	0.010	0.031	0.122	0.004
CAMINA	0	0.013	0.006	0.023	0.000	0.011	0.015	0.001	0.439	0.002	0.275	0.706	0.001
	1	0.008	0.079	0.018	0.010	0.010	0.051	0.001	0.340	0.011	0.033	0.178	0.001
COLCHANE	0	-0.003	0.246	0.011	0.023	-0.010	0.000	0.010	0.030	-0.004	0.225	0.649	0.000
	1	-0.003	0.362	0.003	0.224	0.004	0.213	0.006	0.123	-0.004	0.275	0.226	0.000
GRAL. LAGOS	0	0.005	0.032	0.012	0.000	-0.002	0.151	-0.077	0.153	0.000	0.437	0.934	0.003
	1	0.028	0.007	0.028	0.005	0.000	0.406	-0.061	0.298	0.026	0.100	0.410	0.002
HUARA	0	0.010	0.071	0.066	0.000	0.001	0.396	0.006	0.163	0.013	0.036	0.590	0.003
	1	0.008	0.120	0.034	0.001	0.002	0.337	0.000	0.423	0.008	0.120	0.166	0.001
IQUIQUE	0	0.034	0.000	0.002	0.296	-0.006	0.101	0.007	0.396	0.007	0.062	0.234	0.001
	1	0.007	0.008	-0.001	0.302	-0.004	0.018	0.000	0.378	0.002	0.205	0.051	0.001
PICA	0	0.013	0.125	-0.007	0.266	0.027	0.019	0.006	0.291	-0.013	0.170	0.262	0.001
	1	0.001	0.340	0.011	0.018	0.001	0.366	-0.003	0.197	-0.001	0.484	0.019	0.001
POZO ALMONTE	0	0.015	0.104	0.005	0.285	0.068	0.000	-0.004	0.301	0.008	0.167	0.256	0.004
	1	-0.002	0.401	0.010	0.073	0.034	0.000	-0.011	0.005	0.005	0.231	0.059	0.007
PUTRE	0	0.020	0.002	0.025	0.001	0.002	0.312	0.016	0.009	0.005	0.147	0.629	0.001
	1	-0.002	0.437	0.008	0.074	0.024	0.001	0.005	0.148	-0.002	0.373	0.092	0.001

2000 Permutations, unstandardized coefficients

Significatelly social correlated

Significatelly social inverse correlated