Voluntary Participation and Social Capital in France: Local Effects of Social Determinants ⋆

Katia Melnik *,1 and Marie Lebreton **,1

Abstract

In the majority of studies devoted to social capital issues little attention has been paid to questions of parameter heterogeneity (Durlauf and Fafchamps, 2003) and local effects of determinants. To cope with this, we study the determinants of social capital using individual data and allowing for parameter heterogeneity. The model used in this paper is an Artificial Neural Network (ANN) one which uses the Neuro-Coefficient Smooth Transition Auto-Regressive (NCSTAR) model as latent regression. It will give a vector of estimates for each observation of the sample as a nonlinear function of its geographical position and other variables. Its outputs could be considered as the posterior probabilities associated to each modality of the dependent. We showed that allowing for parameter heterogeneity improves considerably the fit of the estimated model relatively to the multinomial logit model which gives global parameter estimates. Moreover, a regional pattern emerges for the estimated coefficients which encourages the public action at this level. Conversely to the Knack and Keefer (1997)'s findings, we find empirical evidences of significant positive direct or indirect effects of active membership in groups on the individual's disposition toward public good provision, and on the individual positive expectations concerning others'behaviors. This result supports the vision of nonprofits as bearing the values of cooperation and positive tendency toward public issues.

Key words: social capital, parameter heterogeneity, neural network models
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* GREQAM, Université de la Méditerranée, Centre de la Vieille Charité,
2, rue de la Charité, F-13236 Marseille cedex 02, France. melnik@ehess.univ−mrs.fr
**GREQAM, Université de la Méditerranée, Centre de la Vieille Charité,
2, rue de la Charité, F-13236 Marseille cedex 02, France. egen_us@yahoo.com
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1 Introduction

The research on voluntary organizations and participation has stayed a long time in the field of sociology and political science. Membership in voluntary associations was typically considered in political science as important determinant of political participation and political efficiency, which are crucial for democracy (Knoke, 1981). However, in the last two decades economists started to pay more attention to nonprofit sector and voluntary activities to better understand the foundations of collective action, notably the provision of collective goods. In fact voluntary organizations are recognized as alternative mechanisms (besides market and public sector) of private provision of collective-type goods (Weisbrod, 1977), namely impure public goods. In other words, nonprofits provide more or less excludable goods or services to their members or to external populations. The "private provision "means here that the public good is provided on a voluntary basis and without any centralized taxation. While the non-profit activities are much diversified, non-profits are typically very representative in the cultural sphere, social action or charitable activities. The impure public goods delivered by nonprofits may take very different forms, for instance defending members common values or interests or merely practices of joint leisure activities.

Voluntary organizations are more likely to attract private monetary and labor donations than firms or governmental agencies (Rose-Ackerman, 1996). Thus, in the context of private provision of public or collective goods, nonprofits may be more efficient than market or government. However the existence of a common objective across rational individuals is not sufficient to permit them to successfully attain it (Olson, 1966). Thus a number of determinants must be considered for better understanding of collective action, and particularly the voluntary participation. This leads economists to re-examine the grounds of individual utility function admitting its link with social interactions and social structure.

Voluntary participation is the essential resource of voluntary organizations. According to Salamon et al (2000), in 22 countries under study an average of 28 percent of the population reported contributing their time to nonprofit organizations. In France, the value of volunteering is relatively high and it attained 2,66 percent of GDP in 1995-2000 (Salamon and al, 2004). The French nonprofit sector counts more than 700 thousands of non-profits, with about 1.3 millions of workers and more than 7 millions of volunteers. According to the French National Institute of Statistics (Febvre and Muller, 2003), 55 percent of members merely benefit of common activities, 29 percent pay fees without participate while 17 percent exert responsibilities and 9 percent take part in organization. The French non-profit sector is characterized by prevailing public resources, notably in the fields of health, education and social services. The social services and education are dominant in the expenditures of the nonprofit sector in France. The prevailing fields of activity in the French non-profit

sector are recreation, sport, and culture, which represent about 60 percent of the total number of non-profits. Nonprofits are largely characterized by the need of fund-raising on a basis of voluntary contributions, even if the part of their public resources may be important. As a whole, the majority of French non-profits are represented by small organizations with annual budgets of less than 7500 euros. These nonprofits rely mainly on the voluntary participation and private fees (Tchernonog, 2000).

In the recent years, the membership in nonprofits has been associated to the notion of social capital. This term has been introduced by Bourdieu (1980) in France, and by Coleman (1988) in the English-speaking literature. It highlights the benefits that can be obtained from membership in more or less dense social networks or groups. Social networks and membership in groups are part of the definition of social capital. In fact the social capital term reflects a double level of benefits that can be obtained throught social networks and membership in groups. The first one refers to the individual-level outcomes facilitated by social ties and the individual's position in the social structure. The second aspect is a more complex one, and it refers to the collectivity-level benefits assessed in the literature as trust and cooperation, or civic norms. It is difficult to generalize the causes and the effects of voluntary participation across countries because of the internal diversity of the nonprofit sector in each state, but also for the reason of different institutional and cultural environments. Curtis et al (1992) compare voluntary participation in associations in fifteen countries by studying effect of country on membership odds. They find that the country of residence is an important predictor of voluntary association joining. However cross-country studies cannot assess what is reflected by voluntary participation. For instance some authors argue that voluntary participation is higher in countries where individuals are more individualistic (Curtis and al, 1992), while others assume that voluntary participation reflects the peoples' greater community orientation (Knoke, 1981). Because of country specificities, it is more justified to focus on only one country (Durlauf, 2002). Moreover, the effects of determinants and explanations may well not be the same aross countries. For instance, Brock and Durlauf (2001), according to Durlauf and Fafchamps, (2003) allowed for parameter heterogeneity in their empirical study of relationship between ethnolinguistic diversity and growth in Africa. According to their finding, the variable of ethnolinguistic diversity was only helpful to explain growth patterns in Sub-Saharian Africa, but not in the rest of the world. Generally, in the empirical works of social capital with individual data, the geographical space is either ignored (as in Brehm and Rahn (1997))or used as proxy of country-specific features (Renno (2000),Curtis et al (1992)). In the empirical studies mentioned above, it is implicitly assumed that the relationship between trust or civic participation and their determinants is stable over space. However parameter estimates can exhibit significant spatial variations. According to Fotheringham A.S., Charlton M.E., Brunsdon C. (1997), the observed spatial heterogeneity could be the consequence of measurement errors and/or a real variation of the relationship

over space and/or a misspecification in the model. This paper is an attempt to study the relationships between some measures of social capital (as in Knack and Keefer, 1997) and voluntary participation in groups taking into account of spatial instability via parameters heterogeneity. The model developed in this paper is supported by the following arguments. Durlauf and Fafchamps (2003) point out that in most empirical studies of social capital including several geographical area, it is assumed that the errors can not be identified as far as their distribution is concerned. Whereas geographical space cannot necessarily be neutral. They also mention that if the distribution of a given error depends on its associated geographical area then there is heterogeneity in parameters estimates. The model proposed here gives a vector of parameter estimates for each observation of the sample according to its geographical coordinates among other variables.

To deal with spatial heterogeneity defined as the lack of stability over space of the studied relationship (Anselin, 1988), Casetti (1972) introduces the spatial expansion model. McMillen (1996) develops the Geographically Weighted Regression (GWR) model. However, none of these models can be applied to a relationship with categorical dependent variable.

After a brief review of the social capital conception in section two, an ANN model with the NCSTAR model as latent regression allowing for parameter heterogeneity when the dependent variable can take K values (with $K > 2$) is presented. Section four is devoted to the estimation of the spatial stability of the relationship between the social capital measures and their determinants. The results follow in section five. Section six concludes.

2 Social Capital and Voluntary Participation

The notion of social capital is supposed to take into account some advantages which may be obtained through social relations. However, there is no consensus concerning its action levels and its outcomes. Bourdieu's social capital is a means of individual action, since Coleman's definition stresses the outcomes of social interactions on the community level. As showed Portes (1998) and Durlauf (2002), the widely adopted Coleman's definition of social capital may introduce some difficulties in empirical studies. This is particularly due to the lack of explicit models and mixing of the concept and of its effects. In fact, some studies equalize the stock of social capital to the level of associational involvement and participatory behavior or use them as proxies of social capital (Glaeser et al., 2002). Others consider associative memberships as determinants of social capital measured as levels of trust and of civic cooperation (Knack and Keefer, 1997).

In their empirical investigation, Knack and Keefer (1997) use the variables of trust and civic norms to measure country-level social capital. They define

country-level index of trust as the percentage of people who expect that most others will act cooperatively in prisoner dilemma context. For instance, their trust indicator is the percentage of respondents of the World Values Surveys who replied that "most people can be trusted". To measure the variable of civic norms, Knack and Keefer used a large range of responses to questions supposed to reflect the willingness to cooperate with anonymous individuals when faced with various issues, for instance public good ones (e.g. cheating on taxes or avoiding a fare on public transport). They tested the impact of trust on economic growth and found a strong significant relationship. Concerning voluntary membership, their empirical investigation of the effects of social capital on economic payoffs concludes that "promoting horizontal associations through encouraging the formation and participation in groups may be counterproductive"as "membership in group...is unrelated to trust, to civic norms, and to economic performance". However, the measures of group membership indicated merely the average number of groups cited per respondent in each country and did not reflect the intensity of participation. Whereas, there are important reasons for not confounding active and passive memberships which will be explained hereafter. Following Durlauf and Fafchamps (2003), this study focuses on two specific phenomena often placed under the label of social capital, namely interpersonal and generalized trust and civic participation. One can consider social capital as a positive externality of social interactions taking the form of either interpersonal or generalized trust. Trust reflects the individuals expectation of the likelihood of non-negative outcome in situations characterized by uncertainty, notably in economic exchanges (Bhattacharya and al, 1998). The generalized trust is based on the general knowledge of an agent concerning his social environment, while the interpersonal one is an outcome of individual experiences of repeated social interactions with peers. The two forms of trust are supposed to facilitate economic exchanges, cooperation and coordination in the provision of public good. Generally the formal institutions based on laws are considered as more efficient in building generalized trust than repeated interactions.[2] However social networks including voluntary organizations may be necessary to support these institutions (public action). Voluntary participation can either contribute to provide necessary support to public provision of public good, or be a "second best solution ". In both cases, voluntary organizations and social networks are crucial for higher involvement in decision-making process and for the better understanding of public policy, and its legitimization.

[2] In fact, for each pair of newly matched agents, the interpersonal trust takes time and effort to establish while the generalized trust is instantaneous (Durlauf and Fafchamp, 2003).

3 The model

Hereafter the method used for the empirical investigation is presented. When the dependent is categorical, y_i can take $K+1$ levels. Let p_{ik} be the probability that $y_i = k, k = 0, ...K$. Usually, a multinomial logit or a multinomial probit models is performed to determine the p_{ik}'s. In this case, it is assumed that the functional form of the latent regression is linear and that the errors follow a logistic distribution in the multinomial logit case or a cumulative normal distribution in the multinomial probit case. However, these hypothesis are not always met in practice. As ANN models are universal approximator, they have been used to approximate the linear latent regression as in Schumacher, Roßner, Vach (1995), Zeng (1999). Here we propose to use the Neuro-Coefficient Smooth-Transition Auto-Regressive (NCSTAR) model developed by Medeiros and Veiga (2000) to approximate the latent regression.

3.1 The original model

The NCSTAR model has been originally written as:

$$y_i = \Theta_i^{'}\widetilde{x}_i + e_i, \quad i = 1, .., n, \tag{1}$$

where y_i is the ith element of the dependent variable, $\widetilde{x}_i = [1, x_i^{'}]$ is a $(p+1)\times 1$ vector of explanatory variables and Θ_i is a $(p+1)\times 1$ vector of real coefficients with $\Theta_i = [\Theta_i^{(0)}, \Theta_i^{(1)}, ..., \Theta_i^{(p)}]'$. More specifically, each output of the multi-layers feed-forward neural network with H units in the hidden layer is given by:

$$\Theta_i^{(j)} = \sum_{h=1}^{H} \beta_{jh}\Lambda(w_h s_i - c_h) - \beta_{j0}, \tag{2}$$

for j = 0,...,p and i = 1,...,n, where β_{jh} and β_{j0} are real coefficients. $\Lambda(w_h s_i - c_h)$ is the logistic activation function with s_i, a $(q\times 1)$ vector of transition variables, $w_h = [w_{1h}, ..., w_{qh}]'$, and c_h are real parameters. As in Medeiros and Veiga (2000), it is assumed that s consists of elements belonging to x and also other variables. However, the approach is still valid if s is only composed by elements of x, as in Medeiros, Veiga and Pedreira (2001) or if s=x, as in Medeiros and Veiga (2000). The logistic activation function is defined as:

$$\Lambda(w_h s_i - c_h) = \frac{1}{1 + \exp\left(-\left(w_h s_i - c_h\right)\right)}. \tag{3}$$

Putting (2) in (1) and reparametrizing leads to:

$$y_i = G(\widetilde{x}_i, \widetilde{s}_i, \Psi) = \alpha'\widetilde{x}_i + \sum_{h=1}^{H} \beta_h \widetilde{x}_i \Lambda\left[\gamma_h\left(\widetilde{\delta}_h' \widetilde{s}_i\right)\right] + e_i, \tag{4}$$

where $G(\widetilde{x}_i, \widetilde{s}_i, \Psi)$ is a nonlinear function of the variables $\widetilde{x}_i$ and $\widetilde{s}_i$ with $\widetilde{s}_i = [1, s_i^{'}]$ and $\Psi = [\alpha', \beta_1', ..., \beta_H', w_1', ..., w_H', c_1, ...c_H]'$, the $(p+1)\times(H+1)+(q+1)\times h$ vector of parameters with elements $\alpha = [\alpha_0, ..., \alpha_p]' = [-\beta_{00}, ..., -\beta_{p0}]'$ and $\beta_h = [\beta_{0k}, ..., \beta_{ph}]'$. Moreover γ is a $(H \times 1)$ vector of slope parameters with $\gamma_h = \| \widetilde{w}_h \|$ and $\widetilde{\delta}_h^{'} = \left[-\widetilde{c}_h, \widetilde{w}_h^{'}\right]$ with $\widetilde{w}_h^{'} = \frac{w_h}{\gamma_h}$ and $\widetilde{c}_h = \frac{c_h}{\gamma_h}$ for $h = 1, ..., H$.
To sum up, the NCSTAR network contains three layers: an input layer which contains the transition variables, an hidden layer and an output layer. The inputs are sent via weights noted $\widetilde{\delta}$ to the hidden layer. The latter forms a linear combination of inputs and these weights and it applies a logistic activation function to this combination. Then the results are convey to the output layer via the β weights. When they arrived to the output unit they are linearly combined and transformed via the identity output activation function to give the ouputs of the network. As the identity function return exactly what comes from lower layer, it as been omitted in (4) [3].
The architecture of the network is based on: Rech et al (1999) to select variables i.e the x_i's and the s_i's, Luukkonen et al (1988) and Terasvirta et al (1993) to determine h, the number of hidden unit. When the set of parameters Ψ has been estimated, the corresponding Θ_i in (2) are calculated. The former are global parameters whereas the latter are the local ones.

3.2 The NCSTAR model as an approximation of the latent regression when the dependent variable is categorical

ANN models have already been used to approximate the linear latent regression as in Schumacher, Roßner, Vach (1995), Zeng (1999), Bourgeois (2002). When the dependent is categorical, y_i can take $K + 1$ levels. Let p_{ij} be the probability that $y_i = j, j = 0, ...K$. These probabilities are the output of the preceding network (4) if the softmax function is used as output activation function instead of the identity one. It produces valid posterior probability estimates (see McCullach and Nelder, 1989, Finke and Muller, 1994) that sum to one. It is defined by Bridle (1990) and it is written for $j = 1, ..., K$ as:

$$p_{ij} = \frac{exp(G(\widetilde{x}_i, \widetilde{s}_i, \Psi_j))}{1 + \sum_{k=1}^{K} exp(G(\widetilde{x}_i, \widetilde{s}_i, \Psi_j))}. \tag{5}$$

In (5), each j modality is associated to a set of parameters Ψ_j common to all individuals. However, all these Ψ_j are not identified so the class probability associated to $j = 0$ is constrained to be null and becomes the reference outcome. Now, $K \times ((p + 1) \times (h + 1) + (q + 1) \times h)$ parameters have to be estimate by maximizing the following log-likelihood function(which is equal

[3] With the identity output function explicitly written, (4) becomes:
$y_i = I(G(\widetilde{x}_i, \widetilde{s}_i, \Psi)) = G(\widetilde{x}_i, \widetilde{s}_i, \Psi)$.

to minimize the cross-entropy function):

$$lnL = \sum_{i=1}^{n} \sum_{k=1}^{K} t_{ik} logp_{ik}, \tag{6}$$

where y_{ik} is the value of the target variable for the ith observation and the kth category.

4 The data

In this empirical investigation we seek to show the extent to that trust, shared norms, and civic participation as proxies of social capital are achieved via social interaction based on voluntary groups and associations (Durlauf and Fafchamps, 2003.) To do this we study the relationship between social capital and its determinants allowing for parameter heterogeneity. The data used in the study are individual and subjective, and they are supposed to provide coherent information about respondents probabilistic expectations concerning others' behaviour (variables TRUST), shared norms, and civic participation (variables CIVIC). Mansky (2000) and Durlauf (2002) encourage the use of surveys as providers of coherent information on people's characteristics and expectations. The dataset comes from the ISSP survey "Social Network 2" held in 2001 and which includes 1398 individuals for France. Because we study the spatial heterogeneity of the relationship between trust and its determinants, only one observation per department is used. Thus to determine the more representative individual per department, the following procedure has been applied. For each department, the middle individual is found by averaging all observations relative to the department (this is what is usually known as the barycentre). Then the euclidian distances between individuals of the department and the corresponding middle individual are calculated. The individual with the lowest distance is selected as the representative of the department. Tarn et Garonne, Vaucluse, Territoire de Belfort, Seine Saint Denis and Val d'Oise are missing. Thus only 89 individuals (one per department) constituted the sample. The missing departments are colored in white in all the graphs. Moreover the Corse region has been deleted from the sample as it does not share a common border with another French department.

4.1 The dependent variables

Two distinct variables reflecting individual expectations about behaviors of other people are studied.

- The first one, named TRUST59, is supposed to reflect the level of interpersonal trust, and the proxy used is the individual's responses to the question: To what extent do you agree or disagree with the statement "There are only a few people I can trust completely". This variable is coded as following:
  · TRUST59=0 for "Neither agree nor disagree ",
  · TRUST59=1 for "Agree "and "Agree strongly ",
  · TRUST59=2 for "Disagree "or "Disagree strongly ".
  This variable reflects positive expectations toward people and the frequency of contacts with people.
- The second variable supposed to proxy the level of generalized trust. TRUST61 describes the individuals agreement or disagreement with the following statement"If you are not careful, other people will take advantage of you ". This variable is supposed to show how an individual assesses the likelihood that other people will behavior opportunistically. It is coded as:
  · TRUST61=0 for "Neither agree nor disagree ",
  · TRUST61=1 for "Agree "and "Agree strongly ",
  · TRUST61=2 for "Disagree "or "Disagree strongly ".
- The variable CIVIC56 was assessed from the responses to the question: "On the whole, do you think it should or it should not be the governments responsibility to provide a decent standard of living for the old persons? "It was coded as following:
  · CIVIC56=0 for responses "Cannot choose ",
  · CIVIC56=1 for responses "Probably should not be"or "Definitely should not be",
  · CIVIC56=2 for "Definitely should be"or "Probably should be".
- The variable CIVIC63 was measured on the base of responses to the question: "Suppose you wanted the local government to bring some improvement to your community life. How likely is it that you will be able to influence it? "
  · The responses "Do not know"were coded as CIVIC63=0,
  · "Not at all likely"and "Not very likely"as CIVIC63=1,
  · "Very likely"and "Somewhat likely"as CIVIC63=2.

These two variables CIVIC are supposed to assess the individual's disposition toward public good issues. The variable CIVIC56 focuses on the altruistic tendency and shared norms, since the second one highlights the individual's ability to influence a public good. These dependent variables are mapped in figure 1 to figure 4. Figure 1 and 2 show respectively the people'degrees of interpersonal and generalized trust. There are quite different, therefore they cannot be mixed. Concerning CIVIC56, people with positive tendency to public good issue are prevailing. As to CIVIC63, 20 percents estimate that with a high probability that they could influence their local government's decisions. They are partly localized in the south-east of France, in the Provence Alpes

Côte d'Azur region [4] .

Fig. 1. **A map of the actual TRUST59 dependent variable and its associated histogram legend**

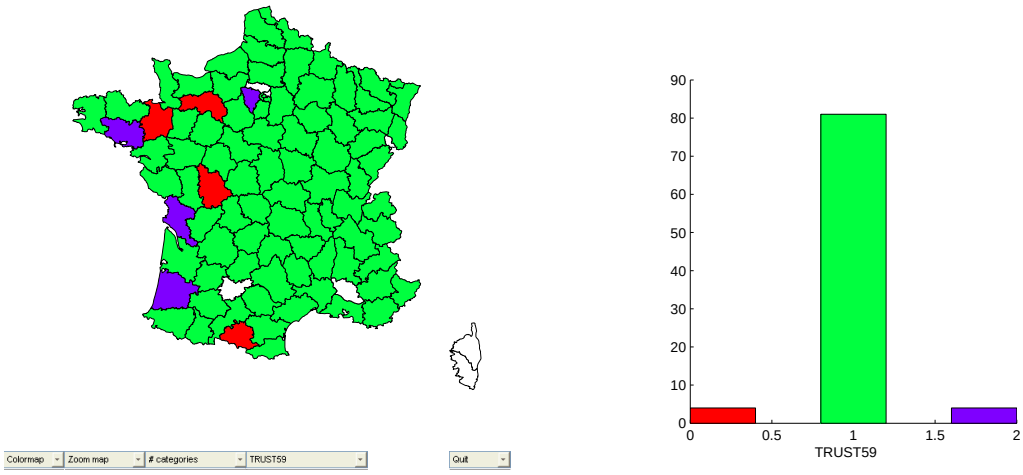
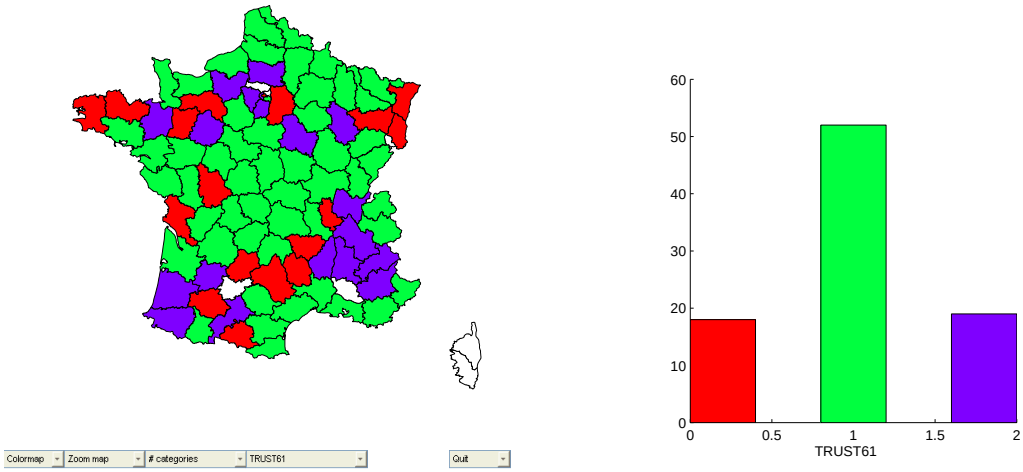


Fig. 2. **A map of the actual TRUST61 dependent variable and its associated histogram legend**



[4] The list of the french departments as well as the corresponding regions is in Appendix A. The associated map is in Appendix B.

Fig. 3. **A map of the actual CIVIC56 dependent variable and its associated histogram legend**

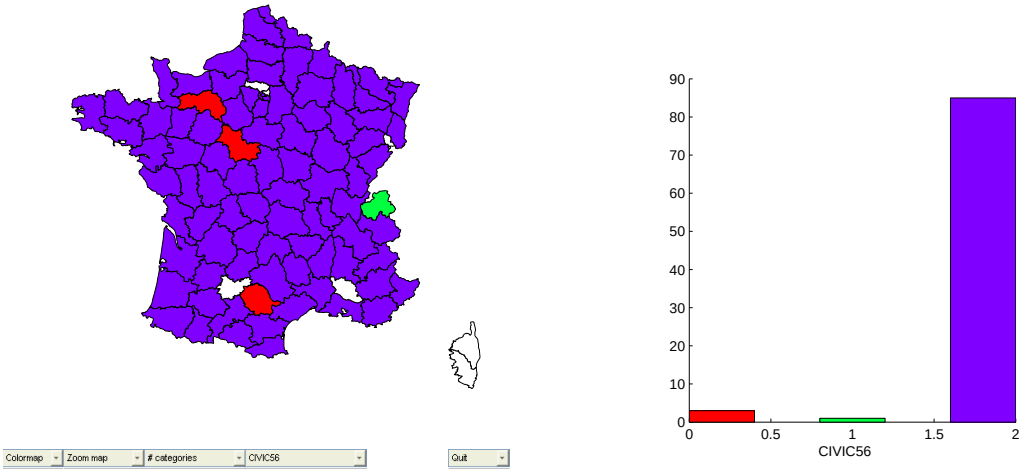
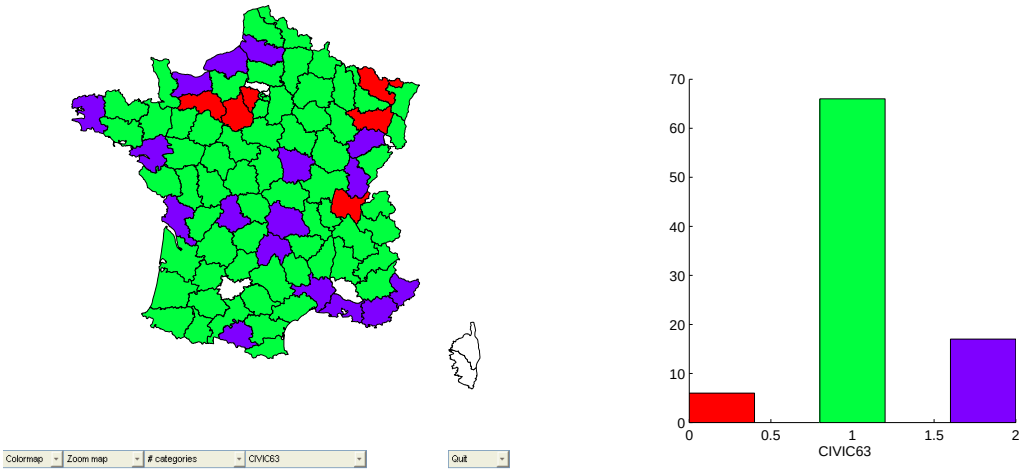


Fig. 4. **A map of the actual CIVIC63 dependent variable and its associated histogram legend**



4.2 The explanatory variables

This study focuses on the relation between memberships in groups, namely voluntary organizations, and measures of generalized trust and civic norms. Thus, the explanatory variable GROUP has been constructed on the basis of responses concerning individuals active or passive memberships in very different organizations, such as political parties, professional, charitable, leisure,

neighborhood, or other associations. GROUP is coded as 1 if people respond that they participate at least once per year in a group and 0 otherwise.
Contrary to many studies, the GROUP variable used in this paper permits to distinguish active and passive memberships. This seems to us important for the following reasons. Firstly, voluntary associations are generally considered as organizations which are characterized by the following key aspects: the conformity of members to common objectives, the formation of values expressed by participants, and the self-regulation (Knoke, 1981). Thus, the active membership better reflects participant commitment to the common norm linking the individual to the association than the passive one. Secondly, the role of socializing, namely of direct contacts with leaders, facilitate the coordination in the provision of collective good. Indeed, according to numerous experimental results, communication and social relations between actors, absence of anonymity, and identification as a member of group, positively affect agents contributions to public good. Finally, active members are able to influence the provision of public good, whereas passive ones can merely consume the services or goods provided by the organization.
The choice of other explanatory variables was based on the assumption that generalized trust, civic norms, and individual ability to influence a public good depend not only on the social network in which the individual is involved, but also on the individual position in the largest social system, and on his or her individual characteristics (Knoke, 1981, Costa and Kahn, 2002). Unfortunately, the number of explanatory variables had to be limited due to the small sample size available here. Consequently only the INCOME and EDUCATION variables have been kept to account for individual characteristics.
The INCOME variable takes values from 0 if people do not answer to 9 [5] . The value of 3 corresponds to a family income per month equals to the guaranteed minimum wage.
EDUCATION is the variable which indicates the degree of education of respondent. It can take 8 values from 3 to 10. A value of 3 corresponds to the elementary level; 4 to the grammar school level, 5 and 6 refer to the professional training level after the grammar school, 7 and 8 to high school level, 9 to the ordinary degree and 10 to post graduate degree. Values 5 and 6 correspond to the middle class in terms of familial income. A strong heterogeneity in the geographical distribution of the EDUCATION variable can be seen ion figure 6. People with higher education level represent less than 25 percents of the sample. concerning the GROUP variable, two third of the respondent declare being active members of an association, a club or a group. No participants are concentrated in the center of France.

[5] if the income family par month is less than 457 euros, INCOME is coded 1 and if it is between 4573 and 6898 it is coded 9. 2 corresponds to a income range of $[457, 762]$; 3 of $[763, 1067]$; 4 of $[1068, 1500]$; 5 of $[1501, 2287]$; 6 of $[2288, 3049]$; 7 of $[3050, 3811]$; 8 of $[3812, 4572]$

Fig. 5. **A map of the INCOME variable and its associated histogram legend**

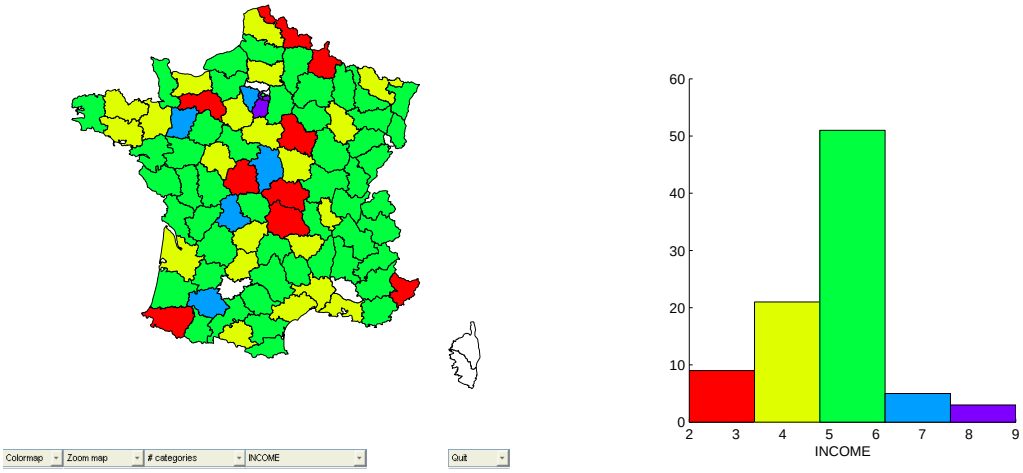


Fig. 6. **A map of the EDUCATION variable and its associated histogram legend**

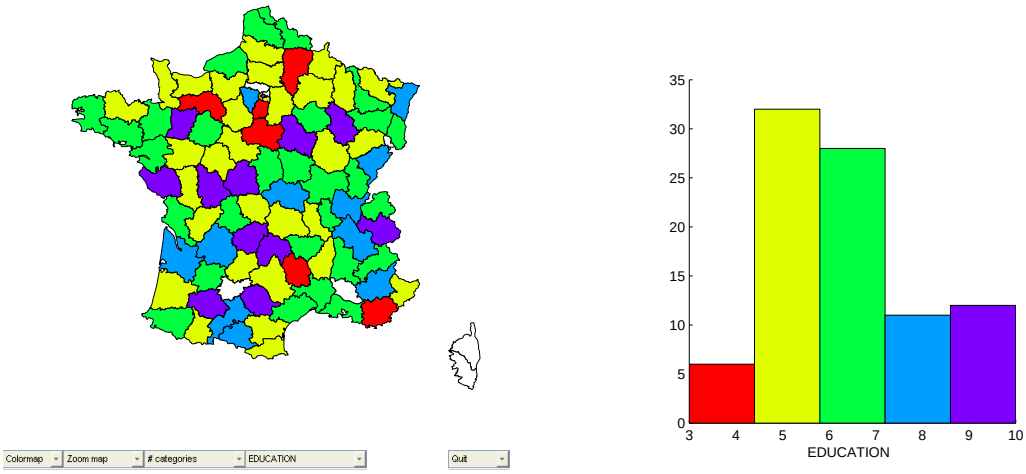
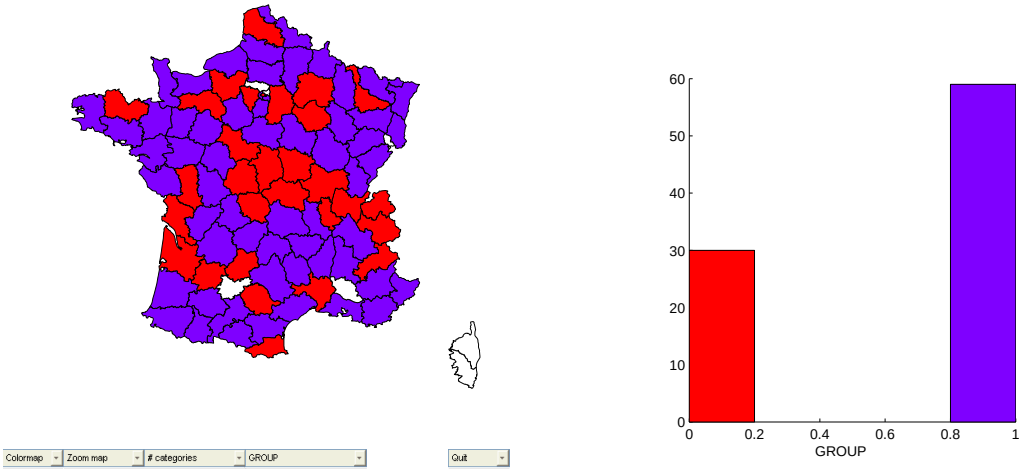


Fig. 7. **A map of the GROUP variable and its associated histogram legend**



5 The results

5.1 A standard (linear) multinomial logit model: global parameters

According to the number of category which equals 3 for each dependent variable, a multinomial logit model can be performed for each dependent with X=[1,INCOME,EDUCATION,GROUP] as explanatory variables. The McFadden R^2 [6] associated to the TRUST59 dependent variable equals 0.076. No parameter estimates are significative except for the one of income when TRUST59 = 2. The LR ratio test [7] with a p-value of 0.55 cannot reject the following null hypothesis: the appropriate model is a one with only a constant term as regressor. In the TRUST61 case, the McFadden R^2 equals 0.036, the null hypothesis cannot be rejected according to the LR ratio test and no estimated coefficients are significative. When the dependent variable is CIVIC56, the McFadden R^2 equals 0.3, the LR ratio test rejects the null hypothesis at the 10 percents level. Unfortunately, there is no significative coefficients. Finally, for the CIVIC63 dependent, the Mcfadden measure of fit is 0.037, the LR p-value equals 0.58 and the coefficients are not significative except for

[6] The MacFadden R^2 is also known as the likelihood-ratio index. It compares the likelihood for a model with only an intercept to a model with the set of explanatory variables. It is defined as: $1 - \frac{\text{non restricted likelihood}}{\text{restricted likelihood}}$.

[7] The Likelihood Ratio (LR) test considers the null hypothesis that the appropriate model contains only a constant term. If the LR p-value is less than 5 percents, the null hypothesis is rejected.

$GROUP$ at the 13 percents level when CIVIC63 = 2. Even if these results are poor, they succeed quite well to found the values of the dependent: in 81 cases over 89 for TRUST59, in 48 cases for TRUST61, in 86 cases for CIVIC56 and in 66 cases for CIVIC63. However, one has to note that there is a predominant value in the TRUST59 case (respectively in the CIVIC56 case) of 1 (respectively of 2). This is the results of the sample selection procedure of the observation which uses the nearest individual of the middle one, leading to a standardized sample.

5.2 A modified NCSTAR model

5.2.1 "Interpersonal trust".

Figures 8 to 10 map the posterior probabilities associated the categories of TRUST59. The NCSTAR model has selected INCOME as input variable. This means that INCOME enters linearly the model ($\widetilde{x} = [1 \quad INCOME]$). Moreover, the transition variables (the $\widetilde{s}$'s) are constituted as follows: $[1 \quad INCOME \quad EDUCATION \quad GROUP \quad LONGITUDE \quad LATITUDE]$. The McFadden R^2 equals 0.439, the null hypothesis can be rejected according to the LR ratio test and the network detects well 84 observations over 89. The estimated global coefficients are given in tables 1 and 2. The corresponding local estimates are in figures 11 and 12. One can note the following regional pattern. While a strong posterior probability of $TRUST59 = 1$ is uniformly distributed (see figure 9), the coefficients of INCOME are negative in the south of France and positive in the north (figure 11). The limited number of $TRUST59 = 2$ do not allow us to consider the effects of INCOME (figure 10)on this category as relevant.

Fig. 8. **TRUST59 Posterior probabilities: p_{io} for i=1:89 and r=0**

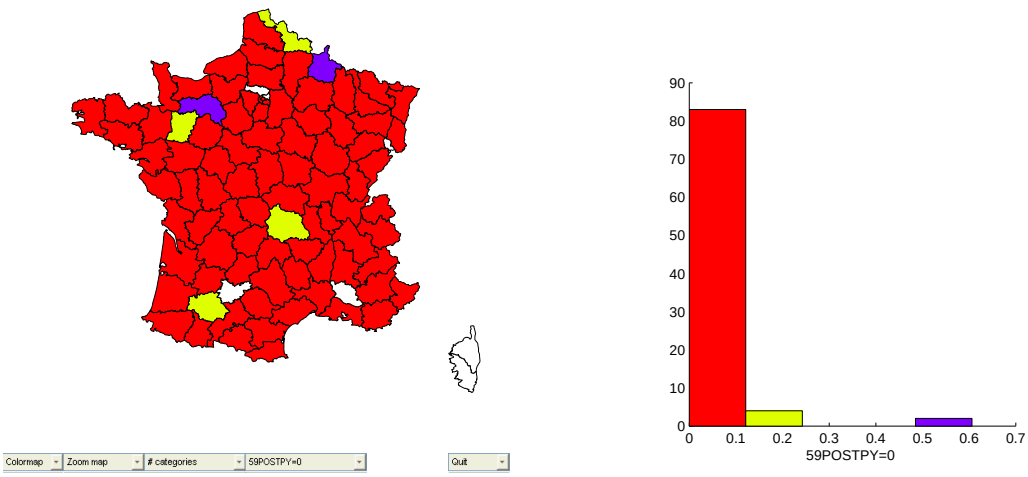


Fig. 9. **TRUST59 Posterior probabilities:** p_{io} **for i=1:89 and r=1**

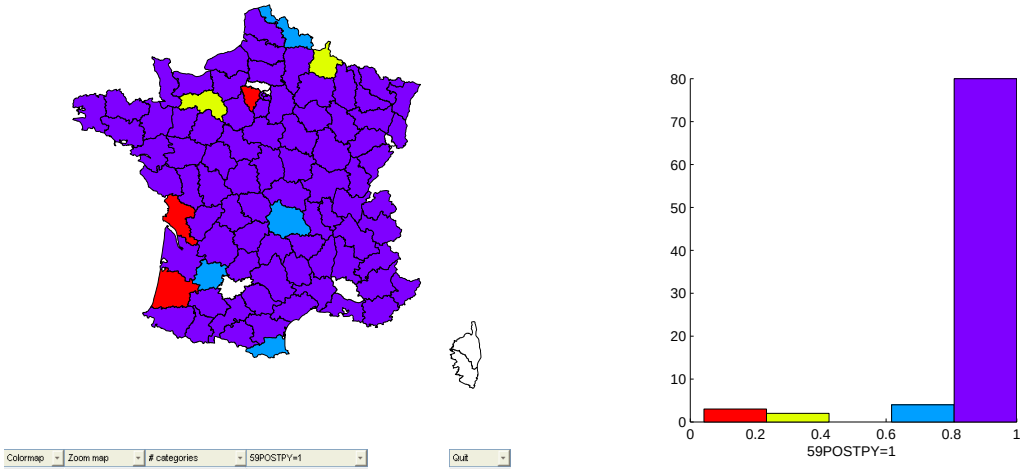


Fig. 10. **TRUST59 Posterior probabilities:** p_{io} **for i=1:89 and r=2**

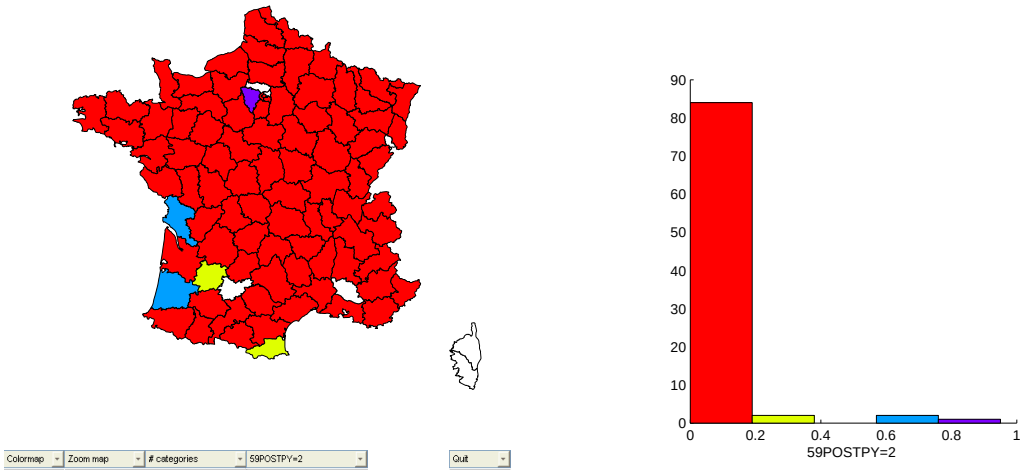


Fig. 11. **The INCOME parameter estimates for TRUST59=1**

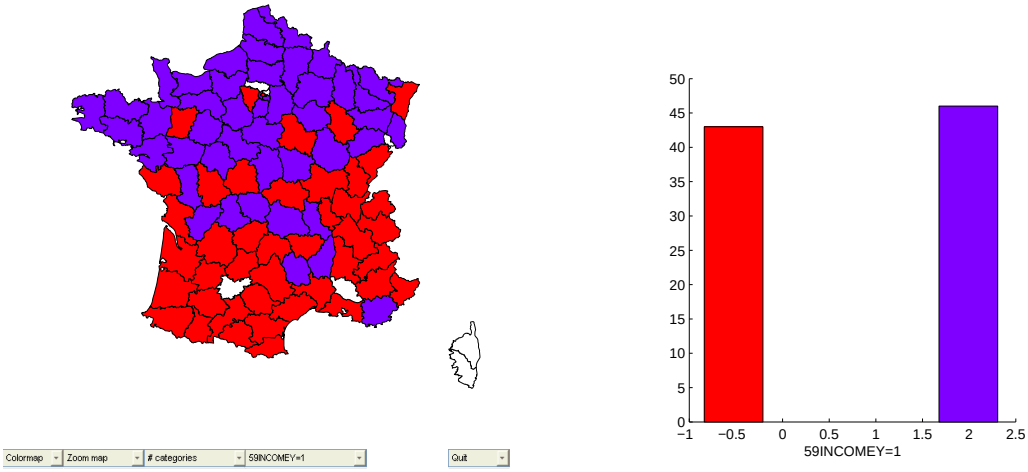
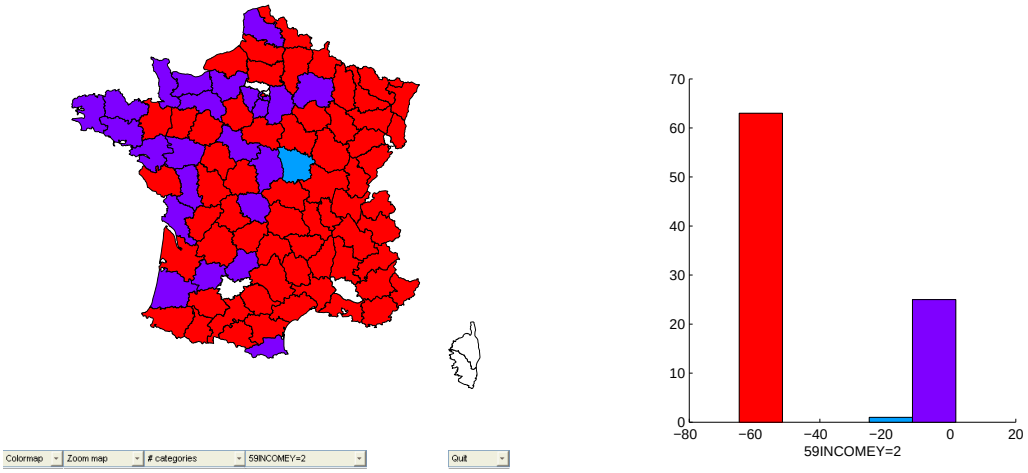


Fig. 12. **The INCOME parameter estimates for TRUST59=2**



5.2.2 "Generalized trust"

Figures 13 to 15 map the posterior probabilities associated the categories of TRUST61. The optimal architecture of the network for this dependent variable is given by tables 3 and 4. They show that GROUP enters linearly and nonlinearly the model. The McFadden R^2 equals 0.204, the null hypothesis can be rejected according to the LR ratio test and the network detects well 59 observations over 89. The comparison of the figures 14 and 16 sheds some light on the instability of the relationship i.e the inability to found a generalized rule linking the value of the GROUP variable and the posterior probability of

$TRUST61 = 1$. For $TRUST61 = 2$, greater coefficients of GROUP (in figure 17) are associated to greater posterior probability.

Fig. 13. **TRUST61 Posterior probabilities: p_{io} for i=1:89 and r=0**

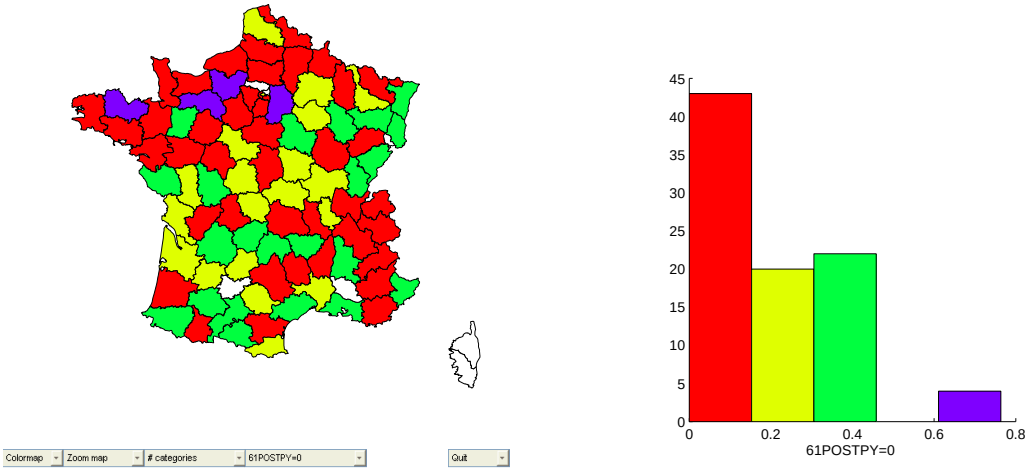


Fig. 14. **TRUST61 Posterior probabilities: p_{io} for i=1:89 and r=1**

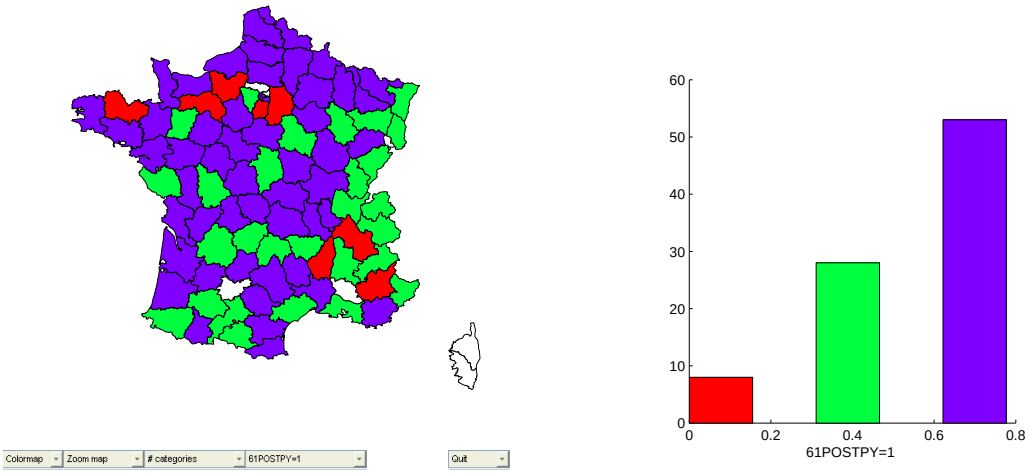


Fig. 15. **TRUST61 Posterior probabilities: p_{io} for i=1:89 and r=2**

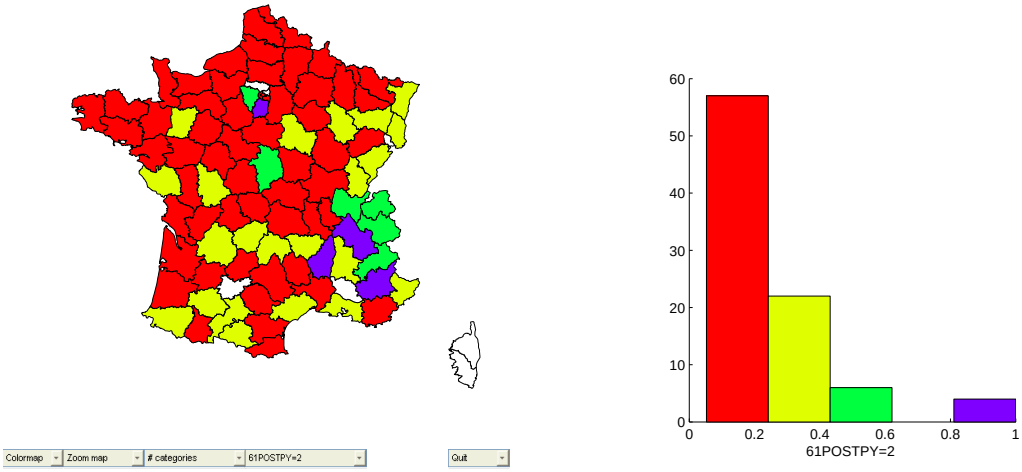


Fig. 16. **The GROUP parameter estimates for TRUST61=1**

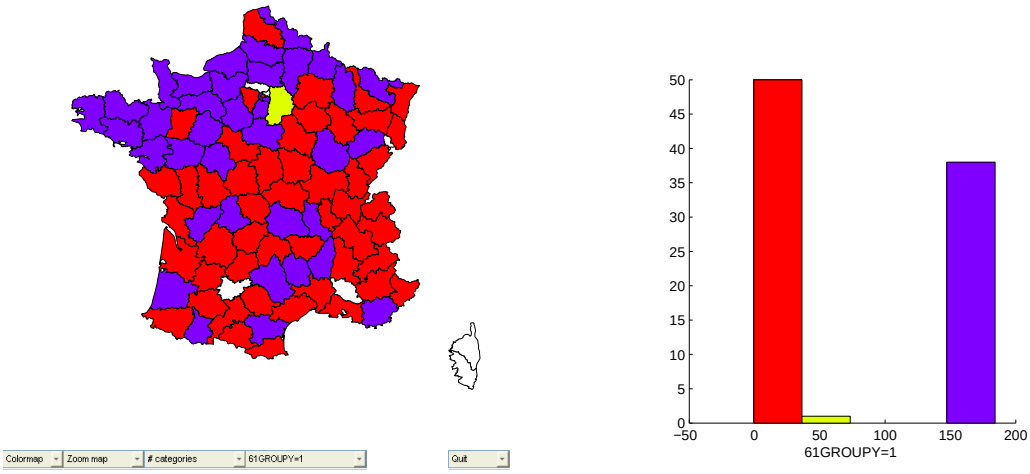
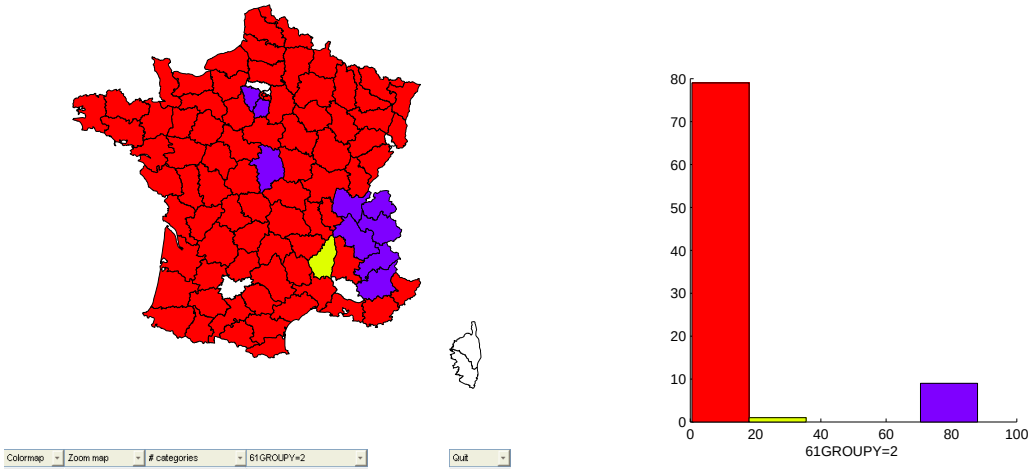


Fig. 17. **The GROUP parameter estimates for TRUST61=2**



5.2.3 Disposition toward public good issues: altruistic tendency

Figures 18 to 20 map the posterior probabilities associated the categories of CIVIC56. GROUP has been selected by the statistical tests to enter linearly and non linearly the model.The McFadden R^2 equals 0.62, the null hypothesis can be rejected according to the LR ratio test and the network detects well 87 observations over 89. All the coefficients assigned to GROUP for CIVIC56 = 2 are positive. The heterogeneity in the parameter appears in figure 22 as the number of values taken by estimates is rather important. Concerning CIVIC56 = 1, the insufficient number of observations explain the poor results in table 3.

Fig. 18. **CIVIC56 Posterior probabilities: p_{io} for i=1:89 and r=0**

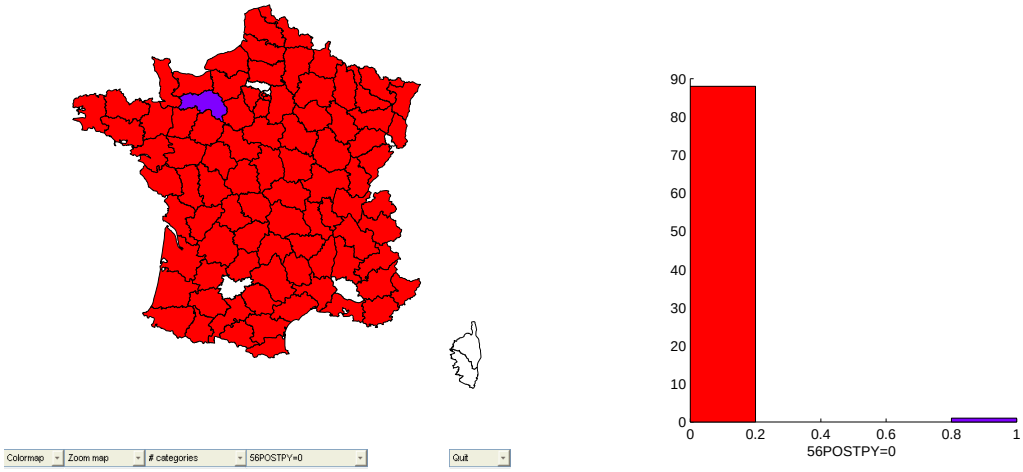


Fig. 19. **CIVIC56 Posterior probabilities: p_{io} for i=1:89 and r=1**

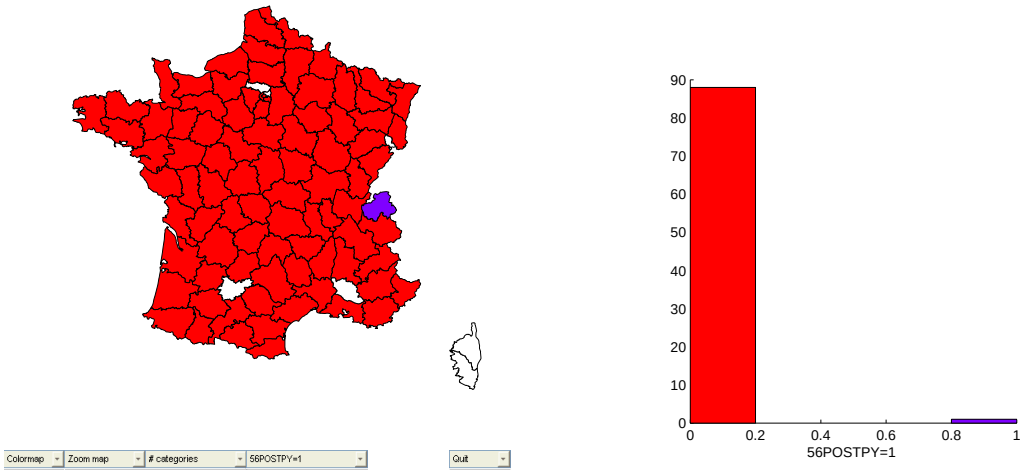


Fig. 20. **CIVIC56 Posterior probabilities: p_{io} for i=1:89 and r=2**

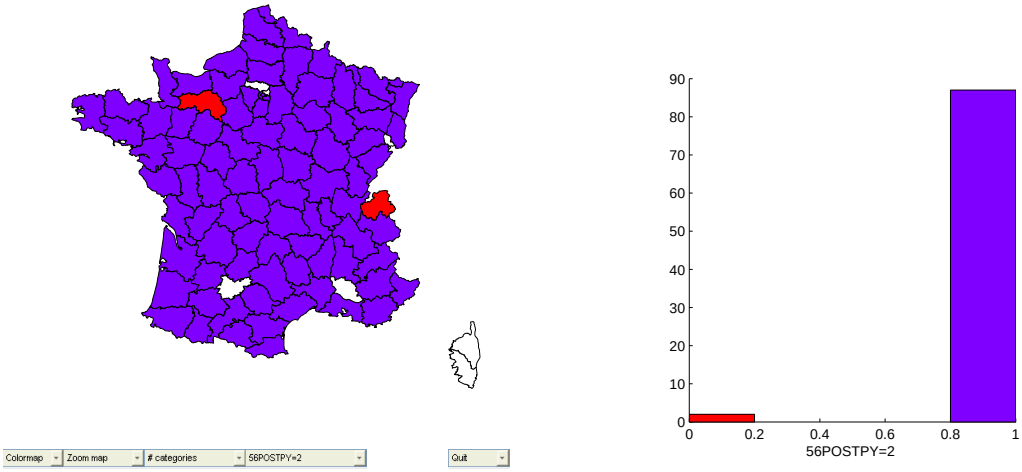


Fig. 21. **The GROUP parameter estimates for CIVIC56=1**

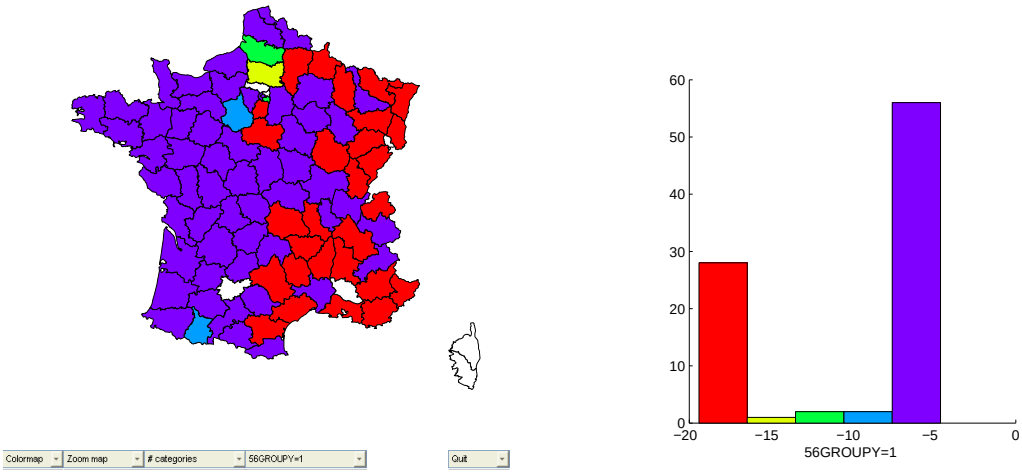
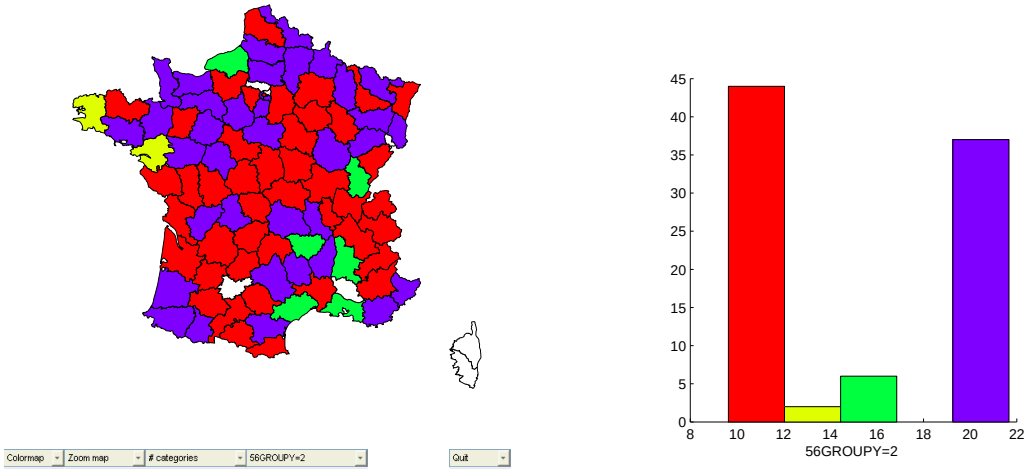


Fig. 22. **The GROUP parameter estimates for CIVIC56=2**



5.2.4 Disposition toward public good issues: individual ability to influence public good

Figures 23 to 25 map the posterior probabilities associated the categories of CIVIC63. The architecture of the model is the same as for the two dependent variables mentioned above. The McFadden R^2 equals 0.221, the null hypothesis can be rejected according to the LR ratio test and the network detects well 71 observations over 89.When figures 24 and 26 are compared, one can see that the increase in the estimated coefficients are related to a decrease in the posterior probability of CIVIC63 = 1. Moreover, a higher posterior probability of CIVIC63 = 2 (in the south-east of France, see figure 25) is related to a positive coefficient for GROUP.

Fig. 23. **CIVIC63 Posterior probabilities: p_{io} for i=1:89 and r=0**

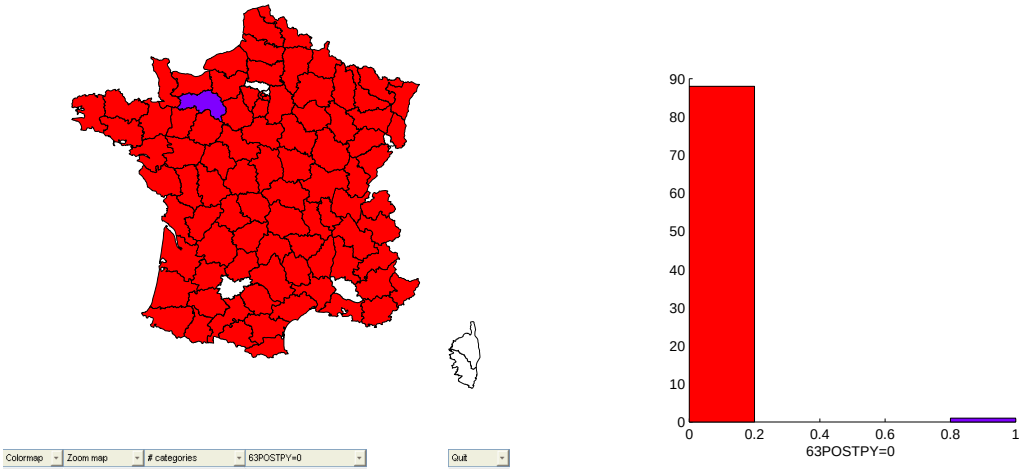


Fig. 24. **CIVIC63 Posterior probabilities: p_{io} for i=1:89 and r=1**

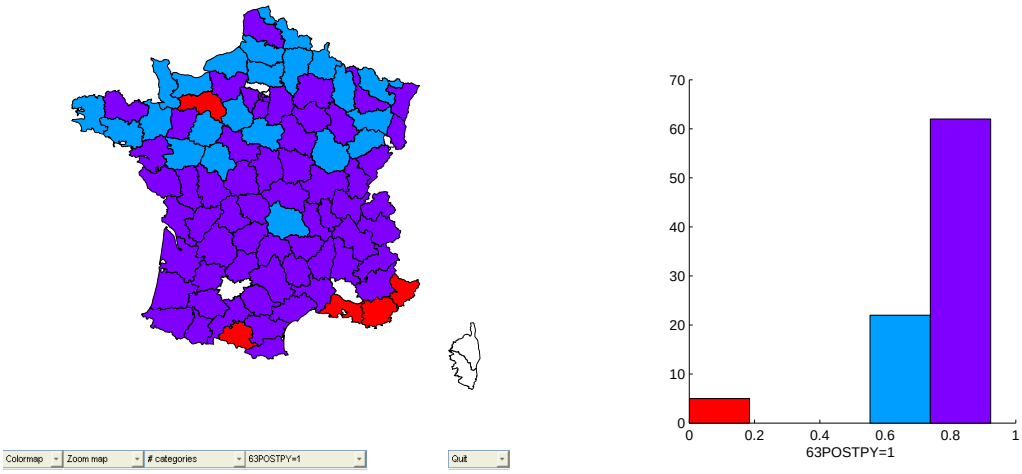


Fig. 25. **CIVIC63 Posterior probabilities: p_{io} for i=1:89 and r=2**

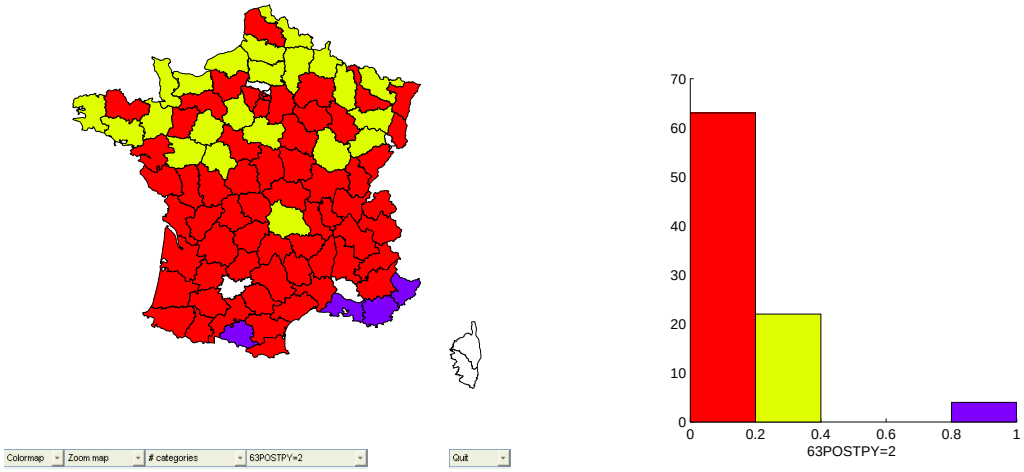


Fig. 26. **The GROUP parameter estimates for CIVIC63=1**

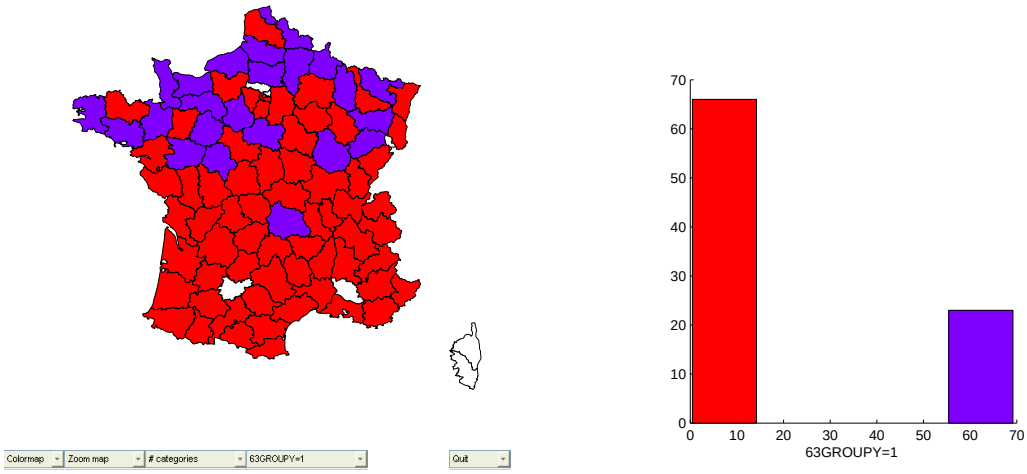
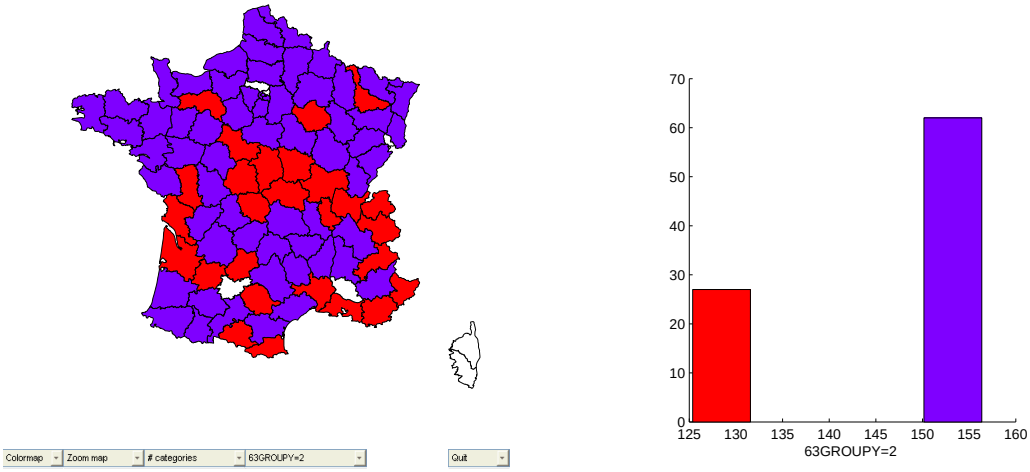


Fig. 27. **The GROUP parameter estimates for CIVIC63=2**



6 Conclusion

This study estimates the local effects of voluntary participation on some social capital measures by taking into account the geographical position of each observation and by allowing for parameter heterogeneity. The results obtained without allowing for spatial heterogeneity in the parameters through estimation of a global model assume that the differences in outcome are only the consequence of differences in the levels of the explanatory variables. However, this assumption is generally not met in practice. Moreover the existence of spillovers across neighboring units, due to social interactions may cause the absence of independency among observations. The administrative division of the territory and the geographic localization may introduce some interdependencies in patterns of agents'behavior. Even if social interactions are irreducible to the geographical proximity, the latter supports them.
The following aspects have been highlighted in the present paper. Firstly, we showed that allowing for parameter heterogeneity improves considerably the fit of the estimated model relatively to the models with global parameters. Secondly, contrary to other empirical studies of social capital and voluntary participation, we do not make any assumption concerning which explanatory variables enter linearly and non linearly the model. The optimal architecture of the NCSTAR model i.e. the number of hidden units, the variables included in the $\widetilde{x}$ and the ones included in the $\widetilde{s}$ are determined via simple statistical tests. Moreover a linearity test is performed to determine the relevance of a hidden unit before the construction of the network. This means that as a NCSTAR model has been constructed for each dependent variable, non linearity

in the data has been detected.
Conversely to the Knack and Keefers findings, we find empirical evidences of positive direct and indirect effects of active membership in groups on the individuals disposition toward public good provision (variable civic), and on the individual positive expectations concerning others behaviors (generalized trust). According to our results, generalized trust, shared norms, and civic participation can be achieved via social interactions in voluntary groups and associations. We are aware of limits of the present study which are particularly due the lack of more detailed data set. A greater data set would enable us to take more explanatory variables and to better control relationship under study. Though considering of spatial parameter heterogeneity is an emerging practice in regional science, the surveys often ignore more detailed information concerning geographical respondents'localizations, for instance respondents'zip codes. Emphasizing the spatial non stationarity of a relation is helpful for better oriented economical and political decisions on the appropriate levels. The analysis presented in this paper can be extended to the most of European countries provided availability of adequate data.

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Appendix A: The French departments and regions with Corse excluded and missing value in black

number	department	region
D67	Bas-Rhin	Alsace
D68	Haut-Rhin	
D24	Dordogne	Acquitaine
D33	Gironde	
D40	Landes	
D47	Lot et Garonne	
D64	Pyrénées Atlantiques	
D3	Allier	Auvergne
D15	Cantal	
D43	Haute Loire	
D63	Puy de dôme	
D14	Calvados	Basse Normandie
D50	Manche	
D61	Orne	
D21	Côte d'Or	Bourgogne
D58	Nièvre	
D71	Saône et Loire	
D89	Yonne	
D22	Côtes d'Armor	Bretagne
D29	Finistère	
D35	Ile et Vilaine	
D56	Morbihan	

number	department	region
D18	Cher	Centre
D28	Eure et Loire	
D36	Indre	
D37	Indre et Loire	
D41	Loir et Cher	
D45	Loiret	
D08	Ardennes	Champagne Ardennes
D10	Aube	
D51	Marne	
D52	Haute Marne	
D25	Doubs	Franche Conté
D39	Jura	
D70	Haute Saône	
D90	**Terrotoire de Belfort**	
D27	Eure	Haute Normandie
D76	Seine maritime	
D75	Paris	Île de France
D77	Seine et Marne	
D78	Yvelines	
D91	Essonne	
D92	Hauts de Seine	
D93	**Seine saint denis**	
D94	Val de Marne	
D95	**Val d'oise**	

number	department	region
D11	Aude	Languedon Roussillon
D30	Gard	
D34	Hérault	
D48	Lozère	
D66	Pyrénèes Orientales	
D19	Corrèze	Limousin
D23	Creuse	
D87	Haute Vienne	
D54	Meurthe et Moselle	Lorraine
D55	Meuse	
D57	Moselle	
D88	Vosges	
D09	Ariège	Midi Pyrénées
D12	Aveyron	
D31	Haute Garonne	
D32	Gers	
D46	Lot	
D65	Hautes Pyrénées	
D81	Tarn	
D82	**Tarn et Garonne**	
D44	Loire Atlantique	Pays de la Loire
D49	Maine et Loire	
D53	Mayenne	
D72	Sarthe	
D85	Vendée	
D02	Aisne	Picardie
D60	Oise	
D80	Somme	

number	department	region
D16	Charente	Poitou Charentes
D17	Charente Maritime	
D79	Deux Sèvres	
D86	Vienne	
D04	Alpes de Haute Provence	Provence Alpes Côte d'Azur
D05	Hautes Alpes	
D06	Alpes Maritimes	
D13	Bouches du Rhônes	
D83	Var	
D84	**Vaucluse**	
D01	Ain	Rhône Alpes
D07	Ardèche	
D26	Drôme	
D38	Isère	
D42	Loire	
D69	Rhône	
D73	Savoie	
D74	Haute Savoie	

Appendix B: Map of the french departments

Fig. 28. **A map of the french departments**

The NCSTAR parameter estimates when the dependent variable is TRUST59

Table 1
TRUST59=1

explanatory variables	associated parameters	trust59
$\widetilde{x}_1 =$ constant term	α_{11}	4.79***
$\widetilde{x}_2 =$ INCOME	α_{12}	2.31***
$\widetilde{x}_1 =$ constant term	β_{11}	-1.72***
$\widetilde{x}_2 =$ INCOME	β_{12}	-3.15***
$\widetilde{s}_1 =$ constant term	c_{11}	-4.14
$\widetilde{s}_2 =$ INCOME	w_{11}	-16.04
$\widetilde{s}_3 =$ EDUCATION	w_{12}	144.0
$\widetilde{s}_4 =$ GROUP	w_{13}	-11.04
$\widetilde{s}_5 =$ LONGITUDE	w_{14}	10.68
$\widetilde{s}_6 =$ LATITUDE	w_{15}	-121.88

Table 2
TRUST59=2

$\widetilde{x}_1 =$ constant term	α_{21}	2.08***
$\widetilde{x}_2 =$ INCOME	α_{22}	1.64***
$\widetilde{x}_1 =$ constant term	β_{21}	-197.13
$\widetilde{x}_2 =$ INCOME	β_{22}	-66.34
$\widetilde{s}_1 =$ constant term	c_{21}	-79.79
$\widetilde{s}_2 =$ INCOME	w_{21}	-50.57
$\widetilde{s}_3 =$ EDUCATION	w_{22}	86.87
$\widetilde{s}_4 =$ GROUP	w_{23}	80.56
$\widetilde{s}_5 =$ LONGITUDE	w_{24}	78.17
$\widetilde{s}_6 =$ LATITUDE	w_{25}	-27.02

Notes:* denotes significance at 10 percent level and ** significance at 5 percent level.

The NCSTAR parameter estimates for TRUST61, CIVIC56 and CIVIC63

Table 3
When the dependent variable equals 1

explanatory variables	associated parameters	TRUST61	CIVIC56	CIVIC63
$\widetilde{x}_1 =$ constant term	α_{11}	-128.83***	0.75	3.12***
$\widetilde{x}_2 =$ GROUP	α_{12}	184.22***	-19.4	0.46***
$\widetilde{x}_1 =$ constant term	β_{11}	129.53***	-19.52	-50.34***
$\widetilde{x}_2 =$ GROUP	β_{12}	-184.8***	14.79	68.72***
$\widetilde{s}_1 =$ constant term	c_{11}	-118.91***	-8.28	155.10***
$\widetilde{s}_2 =$ GROUP	w_{11}	-201.07***	-9.0	158.88***
$\widetilde{s}_3 =$ INCOME	w_{12}	-111.03***	1.40	-82.22***
$\widetilde{s}_4 =$ EDUCATION	w_{13}	291.97***	12.45	-70.0***
$\widetilde{s}_5 =$ LONGITUDE	w_{14}	137.54***	-14.93	-30.89***
$\widetilde{s}_6 =$ LATITUDE	w_{15}	-86.12***	3.83	125.06***

Table 4
When the dependent variable equals 2

$\widetilde{x}_1 =$ constant term	α_{21}	124.43***	16.36***	175.54***
$\widetilde{x}_2 =$ GROUP	α_{22}	88.0***	9.64***	125.37***
$\widetilde{x}_1 =$ constant term	β_{21}	-124.89***	4.98***	-285.20***
$\widetilde{x}_2 =$ GROUP	β_{22}	-87.49***	12.03***	30.99***
$\widetilde{s}_1 =$ constant term	c_{21}	-479.68***	0.81	-176.36***
$\widetilde{s}_2 =$ GROUP	w_{21}	123.43***	8.56	251.90***
$\widetilde{s}_3 =$ INCOME	w_{22}	-293.98***	-0.70	20.72***
$\widetilde{s}_4 =$ EDUCATION	w_{23}	-31.36***	-13.35	-9.24***
$\widetilde{s}_5 =$ LONGITUDE	w_{24}	-279.25***	0.39	-33.57***
$\widetilde{s}_6 =$ LATITUDE	w_{25}	131.60***	0.43	198.27***

Notes:* denotes significance at 10 percent level and ** significance at 5 percent level.