SOCIAL CAPITAL FORMATION: DO ICT MATTER FOR EUROPE?

Emiliano Colantonio, Daniela Cialfi
Department of Philosophical, Pedagogical and Economic-Quantitative Sciences, University of Chieti-Pescara, Italy
colantonio@unich.it
daniela.cialfi@unich.it

Abstract: *Information and Communication Technologies (ICTs) have impacted the way in which individuals, government and society interact each other. As a consequence, ICTs represent a dynamic and new way by which it could be possible to explain the countries' development into the Knowledge-Based Society. Why is it possible to consider ICTs as a dynamic instrument for explaining this phenomenon? ICT can create networking, to connect learning experience and innovation to each other. Alongside the growing increase in ICTs, the concept of social capital in the twenty years has found interest in all sectors due to the rise of the concept of virtual community. In this context, researchers have focused on the role it could play in building communities, increasing economic productivity and contributing to country development. In this sense, ICT and social capital concepts interlink with each other in a variety of ways: social capital could contribute to the diffusion of ICT but, at the same time, ICTs could have a role in the social capital formation. Given the possible interactions between the two concepts, this paper aims to map out the relationship between ICT and social capital studying the related variables' disparities among European countries. This paper shows evidence of the geography of this relationship in Europe. For the statistical and geographical analysis, we used a non-linear cluster neural network, the Self-Organizing Map (SOM). This tool was used to analyse the performance of European countries in 2015. The properties of the algorithm lead the SOM map to be a representation of the statistical property of the original dataset used to create it thanking the learning nature of the algorithm; the statistical dissimilarity is translated into space distance and vice versa. Also, it was possible because the dataset has been mapped onto the surface of the SOM by adding each neuron up to colour gradient. The results show the isolation of Balkan and Eastern European countries. In particular, we found that ICT may promote social capital, that is, ICT could play a decisive role in creating and developing social capital. These results prompt the formulation of new policies for European countries.*

Keywords: *social capital; ICT; neural networks; country performance.*

JEL Classification: *A13; O18; O33; R11; R12.*

1. Introduction

It is known that innovation plays a vital role in economic growth and development. However, participation in cultural activities in different countries fails to yield similar results. ICT and social capital are themselves two concepts interlinked with each other in a wide variety of ways. At the same time, this relationship could be considered more ambivalent: ICTs could help the formation of social capital within local communities, but ICTs could be seen as new opportunities to create new social linkages and, as a consequence, expanding the formation of social capital.

Understanding this possible relationship between ICT and social capital is useful for at least two reasons: first, as much empirical evidence affirms, social capital could play an essential role in the realisation of economic opportunities. Secondly, new ICT devices, like the Internet of Things (IoT), could be used to understand their impact in the society in which we live, including social capital issues. This paper aims to map out the relationship between ICT and social capital through the study of the relative disparities among European countries. The analytical tool employed for the analysis is the Self-Organizing Map (SOM hereafter), an unsupervised computational neural network. This tool is helpful for highlighting, from a topological perspective, the patterns of the proxies used and for better understanding if ICT could play a determinant role in building social capital in Europe.

This paper is structured as follow. The second section gives a literature review about the relationship between ICT and social capital. The third section reports the variables used for the construction of the database evaluated in the analysis. The following part details the measures and the results of the Self-Organizing Map. The study ends with a part where we present the implication regarding the findings.

2. The potential relationship between ICT and social capital: A literature review

The social capital concept has reflected the diversity of disciplines and research's contributions to the debate on it. In this context, it is possible to say that social capital could have a positive relationship with, as Parissaki and Humphreys (2005) said in their work, "not only on those who 'own' it, but also the community (region) at large" (Parissaki and Humphreys, 2005). This effect could be explained by the externalities that are generated by network spillovers.

To have a better comprehension of the possible positive or negative relationships, first, it is necessary to make a distinction between the various type of social linkages, like strong and weak ties. As suggested by Granovetter (1973), the strength and the increasing importance of the weak ties are important factors for having success in the economic field. Regarding the term "weak ties" O'Brien et al. affirm that "The essential characteristic of [types of] social capital is not its weakness or strength but rather its extensiveness and inclusiveness" (O'Brien et al., 2005:1046). Subsequently, it was introduced by Woolcock in 2001 three different categories of social capital:

> 1) Bonding social capital, defined as strong ties between like people;
> 2) Bridging social capital, defined as more distant or "weak ties" of like persons;
> 3) Linking social capital, defined as weak ties that reach out to, unlike people/ organisations.

In this theoretical framework, in which way ICT interact with social capital. A firm answer to this question it is not possible, but some more general dynamics and patterns could be identified. Recent empirical studies, like Benkler (2006), have found that ICT could enable individuals to thicken existing ties and generate new ones. For example, mobile phone and email are used to be in touch with family and friends. Together with that, ICT considered as an online interest-oriented dimension helps to develop new ties between like-minded people for a variety of purposes, like tools for communication and collaborative information sharing or creation of meeting spaces where like-minded people can gather and socialise.

3. Data

This empirical study investigates the patterns of the relationship between ICT and social capital in Europe in 2015, using data from Eurostat's database. During the study, we have chosen the variables in the following Table 1 and 2015, as a period of analysis, because we needed to cope with three main restrictions. The first and second restrictions regard the data availability by European countries. Longtime series data were available, for the 20 European countries, only for ICT and economic variables, instead of the social capital proxies' data were available only for 2015. Consequently, we have decided to restrict the period of analysis to 2015 only. The third restriction was about the choice of aggregate proxies for social capital because the different conceptualisations of social capital might lead to ambiguities at the operational level. It will imply the selection of different research strategy: during this study, social capital is considered to be an attribute of networks (or societies, countries).

Following this approach, the choice of country-level indicators derived from some empirical literature like Andriani and Karyampas (2009), Degli Antoni (2006). After choosing the variables, indicators are divided into three macro-categories linked to European experience: Social capital, ICT use and Economy. These categories reflect the different but interwoven structures of the relationship between ICT and social capital at the country level, as could be observed from Table 1 below.

Table 1: List of performance indicators from Eurostat (year: 2015)

Function	Indicator
Social capital	Participation in any cultural activities in the last 12 months
	Participation in informal voluntary activities
ICT use	Households – the level of internet access
	Households – broadband connection to the Internet
Economy	GDP per capita
	Total R&D Expenditure

Source: Authors' representation

The first set of indicators considered by this research concerns social capital. We have used, as social capital proxies, variables related to the associative world because, according to Putnam (2010), the associational activities are an essential framework where social capital could occur and grow. If we refer to this Putnam approach, social capital could be considered under functional aspects. Information and trust are vital for a network because they represent most of the network's 'intangible' resources, which help the society to achieve either economic and social outcomes (like well-being and higher employment rate) or uncertain outcomes (such as a sense of social security). All of these aspects occur if information represents the primary resource that individuals or groups want to achieve through the availability of social connections.

Following this approach, the 'Participation in any cultural activities in the last 12 months (percentage values)' (variable: Participation in any cultural activities in the last 12 months) and the 'Participation in informal voluntary activities (percentage values)' (variable: Participation in informal voluntary activities) are used as indicators for social capital.

The second set of indicators we used is related to the use of ICT. Information and Communication Technologies (ICTs) have impacted the way in which individuals, government and society interact each other. As a consequence, the evolution of social capital within or outside of geographical boundaries may depend on several elements, especially the availability and practical use of broadband connectivity. All of those elements – together with the issues of online trust – determine the frequency of interactions. Following this idea, the 'Households – level of internet access (percentage of households)' (variable: 'Households – level of internet access) and the 'Households – broadband connection to the Internet (percentage of households) (variable: Households – broadband connection to the Internet) are chosen as proxies of the ICT usage level in a European countries.

The last set refers to the economic performance of the European countries at an aggregate level. We have used this kind of variables as a proxy of the ability of networks and social capital interactions to be translated into economic assets and, subsequently, into economic 'capital', used to achieve their economic standing. To become economic capital, it is necessary that social capital move from private goods into a public one causing the rising of collective and cumulative economic benefits. Based on this approach, the 'GDP per capita (PPS_EU28)' (variable: GDP per capita) and the 'Total R&D expenditure (percentage of GDP)' (variable: Total R&D Expenditure) are used as indicators for the economic performance level of the European countries.

4. Patterns of European countries in 2015

In this empirical study, we have performed a non-linear clustering analysis with the Self-Organizing Map, one of the most essential and widely used neural network architecture. This type of architecture was developed by Kohonen (2001). We have used the SOM approach to provide a year evaluation of the structure of this relationship. We choose this tool, at least, two reasons: first, instead of multidimensional scaling approach, its input observations are not categorised a priori and, as a consequence, the structure is unknown. The output network can be considered as a sort of statistical space or virtual topology in which the spatial configuration is closely linked to the spatial properties of the dataset. Secondly, this tool could understandably show complex entities. This property is particularly crucial at policy support level, where the understanding of such relationships is crucial for appropriate decision-making.

For studying the relationship between ICT and social capital, we have divided the analysis into two steps: in the first step, we have considered the evolution of the European countries in 2015. In the second, we have analysed the relationship more deeply through the study of the Feature Maps of the six variables that we used.

Regarding the first step, the following Figure 1 shows the location of European countries in 2015: a mass of European countries is located in the centre of the SOM map.
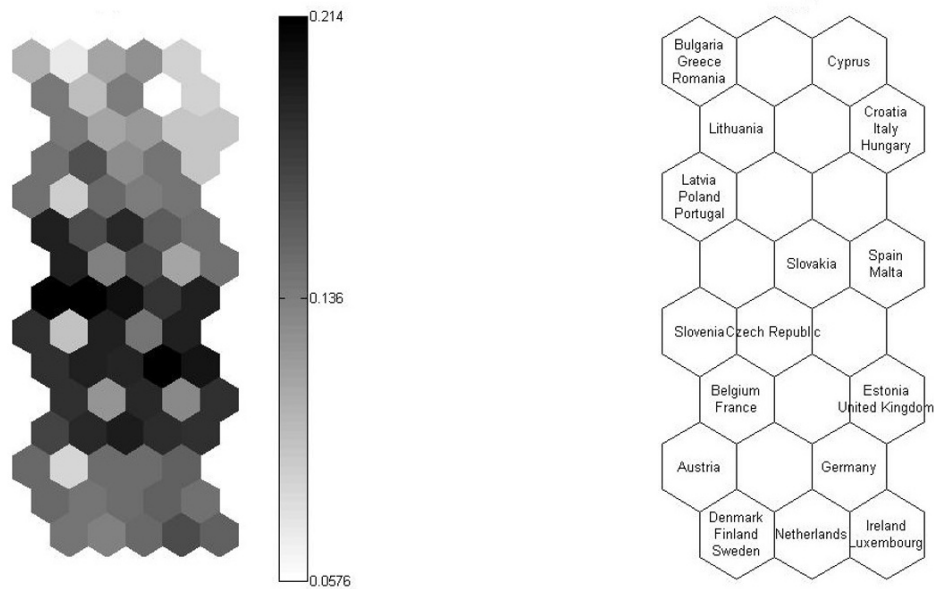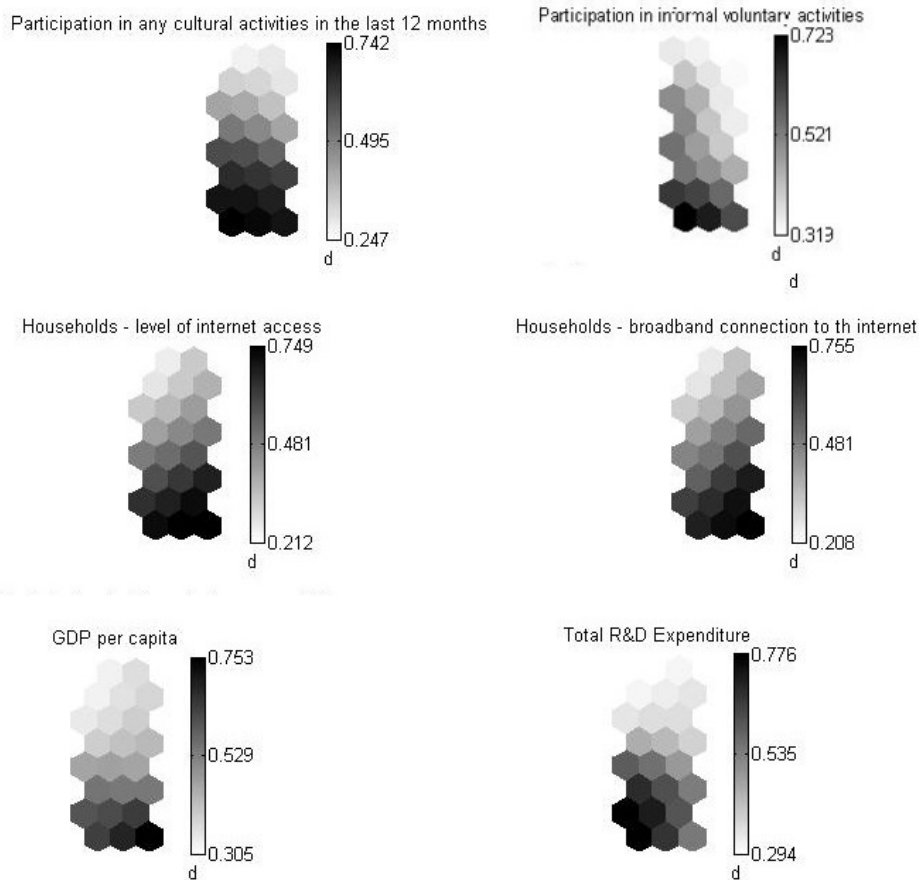
Figure 1: U-Matrix
Source: Authors' computation and representation

This position has the effect of isolating the Balkan, the Eastern and part of the Mediterranean countries from the Northern ones which remain, respectively, at the upper and bottom part of the map. Consequently, it creates a gap between them and the rest of the sample. In this case, the black – and – white of the cells constitute the intracluster homogeneity degree: the light colours reveal high intra-cluster homogeneity, while the dark colours represent a lack of homogeneity.

Following, we have analysed 2015 through the use of its Feature Maps. Figure 2 shows the feature maps for each of six variables that we used. The values are displayed on a gradient colour range, from white (the lowest) to black (the highest). This tool permits:

- To obtain different profiles for the regions of the SOM;
- To discover in which socio-economic aspects the EU countries are strong or weak;
- To understand by which means the feature maps drive the final result.

It is possible to observe that the Northern European countries, located at the bottom of the maps, excel in nearly all considered variables. As profiled be profiled before into the Figure 1, the Balkan, Eastern and part of Mediterranean countries, clustered in the upper part of the maps, show low values in all considered variables. In contrast, Northern countries, such as Denmark, Finland and Sweden; and some Centre European countries, like Belgium, France and Germany, obtain similar results due to the high score in 'Total R&D Expenditure' and 'Households-broadband connection to the Internet'.

Participation in any cultural activities in the last 12 months
0.742
0.495
0.247
d

Participation in informal voluntary activities
0.723
0.521
0.313
d
d

Households - level of internet access
0.749
0.481
0.212
d

Households - broadband connection to th internet
0.755
0.481
0.208
d

GDP per capita
0.753
0.529
0.305
d

Total R&D Expenditure
0.776
0.535
0.294
d

Figure 2: Feature maps of the variables
Source: Authors' computation and representation

From this analysis, it emerges that in Europe ICT may promote social capital formation, as we have previously highlighted in the literature review.

Growing empirical evidence suggests that Internet makes more natural and useful to be active within the local communities' initiatives and, at the same time, it contributes to reinforcing social belonging to members. Furthermore, Internet, as Katz and Rice affirm in their work (2002), can build a new form of social capital being "in many ways different and more powerful than the local, physical means of earlier areas" (Katz and Rice, 2002: 332).

5. Conclusions

This paper has the scope to study the possible existence of a positive relationship between ICTs and social capital in Europe. Considerations in the previous section indicate the presence of a possible positive relationship between the two concepts. However, little doubts remain if ICT could play a strategic role in the communities

and social capital formation processes; because the degree use of ICT could create a strongly differences among social capital, especially between strong and weak ties:

> 1) ICT is unlikely to create bonding social capital due to the difficulties to build trust within virtual communities; while, as we have highlighted in the literature review, ICT could receive benefits from the existence of substantial social capital ties;
>
> 2) ICTs are unable to originate bridging and linking social capital because of the incapacity to identified and interact with people having similar interests.

To sum up, ICT could open a variety of ways to empower the countries' development in the modern society. With ICT, social capital could have essential importance for the countries' ability to achieve social and economic development in the society.

All of these perspectives on the potential benefits of ICTs, provide a possible focus for future researchers. Methodologically, we will improve the time-level of the analysis using a more extensive time series, moving from a short-term analysis to a long one. After, we will also set up an analysis on the dynamics of phenomena through the analysis of variations between the ICT and social capital variables because other external factors could interfere this relationship.

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