Original scientific paper

Two Statistical Models on European and Croatian

Metadata, citation and similar papers a
ozitorij Filozofskog fakulteta u Zagrebu' at University of Zagreb

Božidar Tepeš
Department of Information Sciences
Faculty of Humanities and Social Sciences, University of Zagreb
Ivana Lučića 3, 10 000 Zagreb, Croatia
btepes@ffzg.hr

Ivan Mijić
Diplomatic Academy, Ministry of Foreign Affairs and European Integration
Zagreb, Croatia
Ivan.Mijic@mvpei.hr

Krunoslav Tepeš
City Office for Transport Planning, City of Zagreb
Zagreb, Croatia
krunoslav.tepes@zagreb.hr

Summary

The Council of the European Union (EU) defined information society (IS) with new Strategy i2010 for information and communication technology (ICT). Eurostat has European statistics for EU countries. Central bureau of statistics of Croatia and IDC Adriatics have numerical data benchmark indicators for information society for Croatia as candidate country. In our paper we use eight numerical data variables in two statistical models. Factor analysis model looks for the most important variables for information society. Causal structure model defines causal relation between these variables for development of information society in EU and Croatia.

Key words: Information society, benchmark indicators, factor analysis and causal model.

Information society

Among numerous attempts to define Information society (IS), we will use one which defines it as a society in which the creation, distribution, integration and manipulation of information is a significant economic, political, and cultural activity.[1] The knowledge economy represents its economic counterpart, where

[1] http://en.wikipedia.org/wiki/Information_society

wealth is created through the economic exploitation of knowledge.[2] Specific to this kind of society is the central position ICT has for production and economy.[3] Information society can be seen as the successor of industrial society.[4] The aim of the information society is to ensure the access to information to everyone. Bearing in mind the ever growing amount of information accessible in digital shape, it is important that each and every citizen is provided with an equal access to information, i.e. create the conditions in which the knowledge society benefits all, regardless of geographic, social, age or any other factor. The key activities to meet this goal are enabling equal access to the information society technologies to all social groups and continuous efforts of business sector and academic community to foster information knowledge throughout the entire population. From statistical point of view, IS is connected with ICT. In Guide to measuring IS, 2009. Organisation for economic and co-operation and development (OECD) presented possible conceptual model of IS.[5] Main elements of this model are ICT supply, ICT demand, ICT infrastructure, ICT products and content. ICT supplies are producers and production ICT goods and services. ICT demands are users and uses, households, individuals, and businesses. ICT infrastructures are investments and services. ICT products are price and quality. Content or flows of information are production, publishing, and electronic distributions. ICT demand and ICT infrastructure as part of IS are electronic commerce (e-commerce).

In EU the i2010 strategy is the EU policy framework for the IS and media. Presented it in June 2005 by the European Commission as the new initiative, it promotes the positive contribution that ICT can make to the economy and society,[6] The i2010 strategy has three main aims: to create a single European IS which promotes internal market for IS and media services, to strengthen investment and innovation in ICT research, and to support better public services and quality of life through the use of ICT.[7]

Benchmark indicators

The eEurope is a political initiative that emerged to ensure that future EU generations maximize the changes the IS brings. These changes affect a vast array of factors and agents, create prosperity and share knowledge. That is why they have an enormous potential for enrichment. The good management of this trans-

[2] http://Ibid.

[3] http://www.it.iitb.ac.in/~prathabk/pages/tech_archives/global/post_industrial_society.pdf

[4] Ibid.

[5] http://www.oecd.org/dataoecd/25/52/43281062.pdf

[6] http://ec.europa.eu/information_society/eeurope/i2010/index_en.htm

[7] http://ec.europa.eu/information_society/eeurope/i2010/strategy/index_en.htm

formation represents the main economic and social challenge, since it also involves serious repercussions for employment, growth and the greater integration of EU.8

In May 2002, the Commission (in view of the Seville European Council) presented the eEurope 2005 Action Plan. This provides policy actions for European institutions and member states to accelerate the development of the IS in Europe. In order to monitor progress of the Action Plan, it also contained proposals for a benchmarking exercise. They were based on a set of indicators which would be proposed by the Commission and endorsed by the Council.9

The Eurobarometer surveys used for several eEurope 2002 indicators provided rapid results (within 6 weeks of survey) and used a single methodology for all member states of the European Union. Greater use should be made of surveys undertaken by National Statistical Institutes (NSIs) and Eurostat, and additional ad hoc surveys. It should be stressed that candidate countries were invited to participate in Eurostat surveys from 2003 and additional surveys run by the Commission will be extended to candidate countries as soon as possible.10

The Commission proposes fourteen policy indicators and twenty two supplementary indicators (with their sources and frequency of collection).11 In addition, one policy and tree supplementary indicators are proposed for which pilot studies need to be carried out.

The following eight basic benchmarks were used in this article:

Percentage of households or individuals having access to the Internet at home (A1)

Percentage of individuals regularly using the Internet (A2)

Percentage of persons employed using computers connected to the Internet (B1)

Number of basic public services fully available6 on-line (D1)

Percentage of population using Internet to seek health (F1)

Percentage of enterprises total turnover from e-commerce (G1)

Percentage of enterprises with broadband access (J1)

Percentage of households or individuals with broadband access (J2)

Factor analysis

Main idea of factor analysis method [1], [6] is to find smaller dimension space to analyze multi dimensional space of measured stochastic variables [6]. In IS we are looking at eight measured variables for EU countries from 2003 to 2008. Our measured variables are eight basic benchmarks (A1, A2, B1, D1, F1, G1,

[8] http://www.ine.es/en/docutrab/tic/inventario_in05_en.pdf

[9] http://ec.europa.eu/information_society/eeurope/2002/news_library/documents/benchmarking05_en.pdf

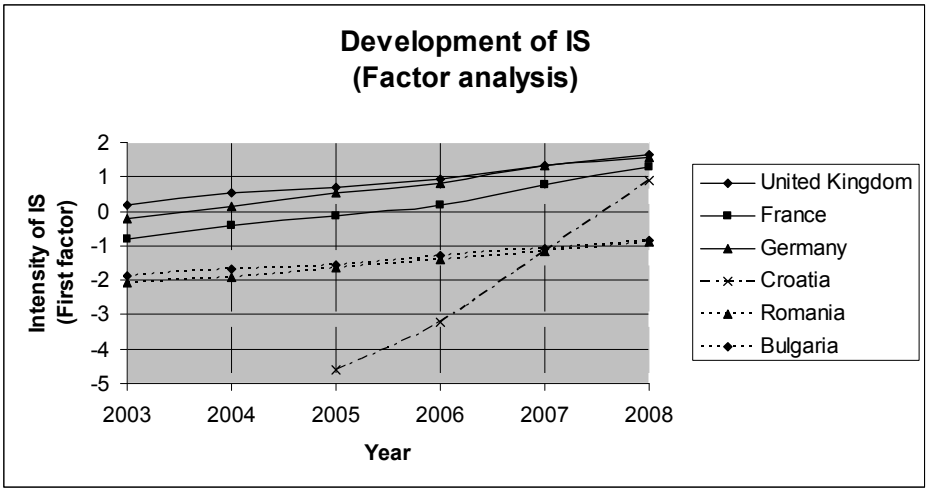
[10] Ibid.

[11] Ibid.

J1, J2). From Eurostat statistics, we are observing this eight measured variables for twenty seven EU countries for six years. We are using principle component method [1] for finding factors for describing IS. Using statistical software Statistica first factor or principle component describe 75%,of total variance of all measured variables. We named this first factor Intensity of IS (Y). The relation between first factor and measured variables is:

$$Y = 0{,}947A1 + 0{,}933A2 + 0{,}886B1 + 0{,}756D1 + 0{,}871F1 + 0{,}879G1 + 0{,}834J1 + 0{,}916J2$$

Software Statistica found factor score for every EU country in years we were observing. Scores for United Kingdom, France, Germany, Romania and Bulgaria are in Picture 1. Central bureau of statistics of Croatia and IDC Adriatics have numerical data benchmark indicators for IS for Croatia. We used this data for 2005, 2006, 2007 and 2008 with normalization and relation first factor and measured variables as before, and we found score for Croatia. You can see the results in Picture 1.



Picture 1. Development of IS (Factor analysis)

From factor analysis we can say that in 2005 IS in Croatia was far from IS in EU countries, in 2007 we were at level of negative development of IS countries Romania and Bulgaria, but in 2008 we were near development of IS countries United Kingdom, France and Germany.

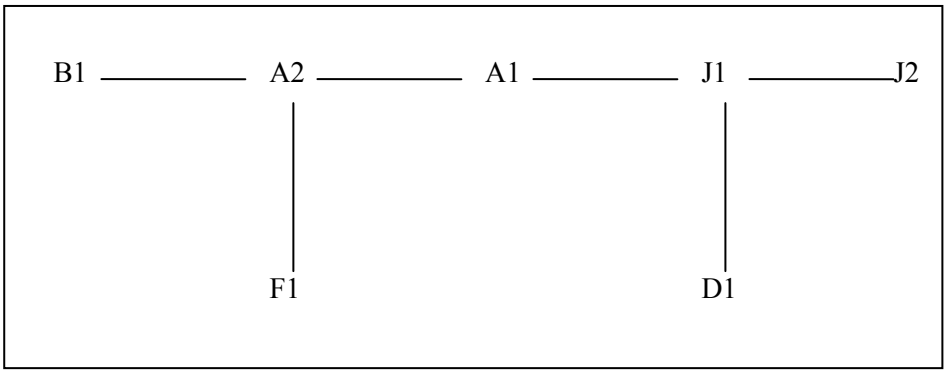
Causal model

Causal statistical model [2], [3], [4], [5] use same measured data or eight benchmarks. In analyzing causal structure we are looking for partial correlation coefficients between measured variables. In first step we are looking for partial correlation coefficients between two measured variables and all others or $\rho_{ij\cdot kl\ldots s}$ where two variables are ij and all other variables are $kl\ldots s \neq ij$ Results are in the following Table 1.

Table 1. Partial correlation coefficients

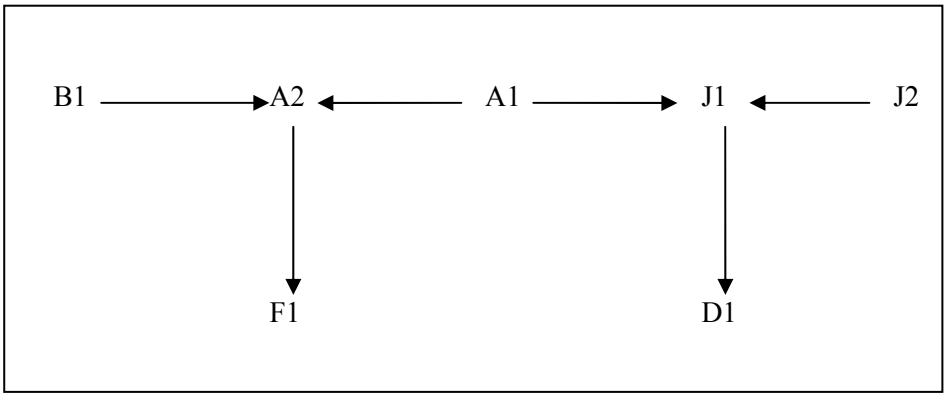
Variable	A1	A2	B1	D1	F1	G1	J1	J2
A1	-	0,510	0,213	0,126	0,112	0,283	-0,800	0,160
A2		-	0,312	-0,184	0,345	-0,159	0,067	0,275
B1			-	0,154	0,075	0,237	0,152	-0,288
D1				-	-0,077	0,231	0,401	0,110
F1					-	-0,028	-0,077	0,212
G1						-	-0,121	-0,148
J1							-	0,467
J2								-

We are looking for six bold partial coefficients in Table 1. absolutely greater than $0{,}3$ or $\left|\rho_{ij\cdot kl\ldots s}\right| \geq 0{,}3$ and find causal structure [7], [8], [9] in Picture 2.



Picture 2. Causal structure IS

With more analysis [2], [3], [4], [5] we can find causal V structures $A1 \rightarrow A2 \leftarrow B1$ and $A1 \rightarrow J1 \leftarrow J2$ together with causal connections $A2 \rightarrow F1$, and $J1 \rightarrow D1$. Final causal model of IS for EU countries is in Picture 3.



Picture 3. Causal model IS

From causal model of IS we can see three most important causal measure variables for development of IS. These three variables are percentage of households or individuals having access to the Internet at home (A1), percentage of persons employed using computers connected to the Internet (B1) and percentage of households or individuals with broadband access (J2). It means that Internet at home and working place, together with broadband access at home, are the most important for IS. Second level for IS developments are two variables: percentage of individuals regularly using the Internet (A2), and percentage of enterprises with broadband access (J1). It means that second level is Internet for individuals research and enterprise with broadband access. At the third level there are two variables: IS percentage of population using Internet to seek health (F1), and number of basic public services fully available on-line (D1). They relate to public services and health, as one of the most important goals of public services. As we can see variable percentage of enterprises’ total turnover from e-commerce (G1) is not in causal model because e-commerce is ICT demand and ICT infrastructure as part of IS.

Conclusion

Our research of IS form statistical point of view or statistical modeling of IS. Model show causal structure of IS and the most important goals for development of IS. Also, we can see position of Croatia in development of IS or knowledge society. Our model have only eight measured variables, and more realistic model of IS must have more variables. At the same time, period of research was only six year. Development of IS is connected with globalization and model of IS must include more countries than EU countries.

References

[1] Hill, T., Lewicki, P., STATISTICS: Methods and Applications, StatSoft, 2005
[2] Pearl, J., Causal Diagrams for Empirical Research, Biometricka, 82(4), 669-710, 1995
[3] Pearl, J., The logic of counterfactuals in causal inference, Journal of American Statistical Associations, 95(450), 428-435, 2000
[4] Pearl, J., Causality, CAUSALITY: Models,Reasoning, and Inference, Cambridge University Press, 2001
[5] Pearl, J., Statistics and Causal Inference: A review, Test Journal, 12(2), 281-345, 2003
[6] Tepeš, B., Skripte iz statistike, Zagreb, 2009 (http://www.ffzg.hr)
[7] Tepeš, B., Predavanja iz statističkih modela na grafovima, Zagreb, 2009 (http://www.ffzg.hr)
[8] Tepeš, B., Predavanja i vježbe iz kombinatorike i grafova, Zagreb, 2009 (http://www.ffzg.hr)
[9] Veljan, D., Kombinatorika I diskretna matematika, Algoritam, Zagreb, 2001