Exploratory Factor Analysis for the Digital Divide: Evidence for the European Union - 27

Frederico Cruz-Jesus, Tiago Oliveira, and Fernando Bacao

ISEGI, Universidade Nova de Lisboa,
1500 Lisbon, Portugal

Abstract. Our research aims to analyze the digital divide within the European Union 27 (EU-27). Hence we used a multivariate approach, more specifically Factor Analysis, to study the digital disparities between European Countries. Two latent dimensions on this subject were found. We also found statistical evidence that one of the dimensions on digital development is higher in the original 15 European countries. Therefore, considerable disparities on the Information society were found.

Keywords: Digital Divide, Information Society, European Union.

1 Introduction

The attention given by leaders from all over the world, to the concept of information society and the potential for a digital divide, has, in the last years, risen significantly. At the World Summit on the Information Society, was declared that the global challenge for the new millennium is to build a society "where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life" [1, 2].

Moreover, the European Union (EU) has just released the Europe 2020 Strategy which has the objective of lead to "*a smart, sustainable and inclusive growth for European Economy*" [3] and "*to exit the crisis and prepare the EU economy for the challenges of the next decade*" [4]. This economic growth will be accomplished, among other factors, by developing an economy based on knowledge and innovation [3]. Included in the Europe 2020 Strategy, as one of the seven flagships of the Strategy, the Digital Agenda for Europe was developed and aims to define the central role that the use of information and communication technologies (ICTs) must play if Europe wants to materialize its ambitions for 2020 [4]. Therefore, relevant digital inequalities within 27 European Union countries (EU-27) must be detected and corrected so as not to jeopardize the objectives of Europe 2020.

To the best of our knowledge, until now, there is a lack of studies which address the situation regarding the digital disparities, especially including the whole EU-27. Considering the importance that the EU gives to a homogeneous digital development in all of its members, the first step to be taken towards this objective is to assess the current situation in all of its members. Therefore we hope that this research may fill this gap and shed some light on this issue, so that efficient policies may be deployed.

M.M. Cruz-Cunha et al. (Eds.): CENTERIS 2011, Part I, CCIS 219, pp. 44–53, 2011.

2 Digital Divide and Digital Development

The term digital divide was first used in the mid-90s by the former Assistant Secretary for Communications and Information of the United States Department of Commerce, Larry Irving Junior [5]. According to the Organization for Economic Co-operation and Development (OECD), "*the term digital divide refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access ICTs and to their use of the Internet for a wide variety of activities*" [6].

Firstly, the digital divide was understood in binary terms, which means the difference were in "has" or "has not" access to Information Technologies. Nowadays, however, this difference is considered narrow, since that other factors need to be considered. Therefore, digital divide is nowadays understood as a complex a multidimensional phenomenon. [7-9].

There are two types of digital divide. The first is located at an international level, which means, between different countries. The second one is located at an intra-national level, or within a country. In these types of digital divide gaps can occur in access to ICTs between regions, or groups of individuals, when characteristics of different nature are verified like, for example, socioeconomic, gender, ethnicity or even age [10, 11]. Hence, according to this definition, the digital divide can represent a threat for all the *e-strategies* spread all over the world, including the Digital Agenda for Europe [12, 13].

The development and usage of ICTs has had an exponential growth in the last decades. These technologies are playing a decisive role in improving almost every aspect of our societies, including business transactions, communications, politics and economy. Hence new types of interactions, or advanced services, are becoming more and more common like e-commerce, e-government, e-health, e-learning, e-banking or e-finance, among others [14-18]. Moreover, actions and technologies like Internet surfing, YouTube, email, wikis or access to online libraries are taking a part in our daily routines, improving the way people interact with each other's and have access to privileged information against those who has not [19]. Therefore, is consensual that ICTs positively affects economy and welfare in some dimensions [14, 20]. The ICTs creates competitive advantages in enterprises, improves national health systems [21], throw e-health, improves education systems as well [22], throw e-learning which creates a lot of opportunities reducing distances constraints between students and universities or colleges, and creates new employment sectors which decreases unemployment rates [23, 24]. Thus, in order to these benefits be accomplished some obstacles need to be overcome, particularly the inequalities both between and within countries, when it comes to the access to these technologies by population.

3 Measuring Digital Divide

3.1 Framework

In order to measure the level of ICTs in each of the target country for a posterior multiple comparison some obstacles needed to be overcome. Due to its unquestionable importance to improve economy and social care, the problem of how to measure it has been gained a growing attention [12, 13, 20, 25].

Firstly, there is not a single and standardized clear definition of digital development, information society or digital divide, since that, considerations about this subject differs from countries, geographical areas, organizations and information society models [23].

The second constraint is related to a lack of harmonized data available when considering analysis for multiple countries. Hence there is a "trade-off" between depth and width on the analysis. This means that, the more indicators we try to use, less are the countries able to be included in our analysis [13]. Yet this problem was mitigated by the fact that our analysis aims to European countries since that in the last years the EU, via Eurostat, has make an effort on offering harmonized and specific data about this subject on every one of the 27 European Countries. Therefore, all data used in the analysis is gathered from the Information Society Statistics Category in the Eurostat website and are concerned to the year of 2009.

According to the recommendations of the OECD, the variables which should be used to measure the digital divide varies along the objective of the research. For instance, if we want to measure the internal or domestic, digital divide we should "drill down" the ICTs level indicators by groups like gender, age, income, education, geographical place, and so on. To measure the digital divide between countries, the indicators should refer to the aggregated national reality. Since our objective is to analyze it within the European Union, we will follow the second one.

Recent studies concluded that the international digital divide is mainly a consequence of economic inequalities between countries. Besides economic development, countries with lower educational attainment also tend to present lower rates on the usage and adoption of ICTs [26-30].

On the other hand, some authors showed that the domestic digital divide is characterized by a higher risk of digital exclusion of the elderly, women, population with lower income, education attainment, with disabilities, living in rural areas or belonging to ethnic minorities [16, 31-38].

3.2 Data

To measure the different levels of information society across EU-27, we used 13 variables which are compatible with recommendations from OECD, EU and which were already used in prior researches. These indicators were selected by combining a mix of prior studies along with some recommendations from the referred organizations. The variables are the following (See Table 1).

The percentage of households having access to broadband connections (HsBro) and the percentage of e-government services available (egovsup) were used by Cuervo and Menéndez [13], among other indicators, to measure the digital divide within EU-15. Similar variables to the percentage of households having access to the Internet (HsInt) and to broadband connections (HsBro); percentage of population regularly using the Internet (IntPop); percentage of population regularly using the Internet for finding commercial information (IntSrc); percentage of population using the Internet to obtain information, and interact, with public authorities (egovInf and egovInt, respectively); and the percentage of population regularly using e-learning services (elearn), were used by Çilan, Bolat and Coskun [14], to analyze the digital

Table 1. Acronyms and Descriptions of Variables

Code	Variable
HsInt	% of households having access to the Internet at home
HsBro	% of households with broadband access
IntPop	% of population regularly using the Internet
IntSrc	% of population using Internet for finding commercial information
ebank	% of population using e-banking services
elearn	% of population using e-learning services
email	% of population using e-mail
ehealth	% of population using Internet for seeking health information
egovInf	% of population using Internet to obtain Information from public authorities
egovInt	% of population using Internet for interacting with public authorities
ecom	% of enterprises having received orders online over last year
esafe	% of enterprises selling online offering the capability of secure transactions
egovsup	% of government services available online

Table 2. Data Used

Country	HsInt	HsBro	IntPop	IntSrc	ebank	elearn	email	ehealth	egovInf	egovInt	ecom	esafe	egovsup
Austria	70	58	67	54	35	34	63	36	35	39	10	4	100
Belgium	67	63	70	59	46	35	68	33	27	31	16	6	70
Bulgaria	30	26	40	17	2	14	34	10	8	10	3	1	40
Cyprus	53	47	45	39	15	25	38	16	21	22	7	3	50
Czech Republic	54	49	54	50	18	27	55	20	23	24	15	7	60
Denmark	83	76	82	74	66	58	81	46	65	67	19	10	84
Estonia	63	62	67	54	62	31	62	33	43	44	11	3	90
Finland	78	74	79	73	72	69	75	56	45	53	15	7	89
France	63	57	65	60	42	55	60	37	36	39	12	5	80
Germany	79	65	71	69	41	40	70	48	35	37	18	6	74
Greece	38	33	38	33	5	26	31	15	11	12	6	3	45
Hungary	55	51	57	48	16	32	55	36	23	25	6	2	63
Ireland	67	54	60	54	30	40	56	24	23	28	21	9	83
Italy	53	39	42	33	16	35	39	21	15	17	4	2	70
Latvia	58	50	61	50	42	38	54	29	22	23	4	2	65
Lithuania	60	50	55	44	32	28	47	29	18	19	18	7	60
Luxembourg	87	71	83	75	54	66	81	54	44	54	9	3	68
Malta	64	63	55	48	32	39	51	30	23	24	12	6	100
Netherlands	90	77	86	79	73	34	85	50	50	55	22	8	79
Poland	59	51	52	29	21	33	45	22	16	18	5	2	53
Portugal	48	46	42	40	17	40	40	28	18	21	16	3	100
Romania	38	24	31	12	2	18	28	16	6	6	3	1	45
Slovakia	62	42	66	50	26	21	61	30	26	31	6	2	55
Slovenia	64	56	58	49	24	38	53	33	31	32	11	7	95
Spain	54	51	54	47	24	38	52	32	29	30	10	4	80
Sweden	86	79	86	77	71	45	83	36	48	57	21	9	95
United Kingdom	77	69	76	64	45	45	74	34	30	35	16	12	100

divide between member and candidate countries of the EU before the 2004 enlargement. Moreover, the EU, via Digital Agenda for Europe [4], emphasis the role of technologies like e-health, e-learning, e-banking and e-government. E-banking and e-health are considered to be *"some of the most innovative and advanced online services"* [4]; e-government services are also mentioned in the Digital Agenda, since

that *"despite a high level of availability of e-government services in Europe, differences still exist amongst Member States"* [4]; Therefore we found measures of these advanced services particularly relevant to our analysis. At our best knowledge, there is a lack of studies on this subject which already included the measurement of these services, reason why we found this inclusion particularly relevant.

We also consider that having retained this data from the Eurostat gives us the assurance that the result of the analysis is not compromised by the quality and adequacy of the data used. The data used can be seen on Table 2.

Table 2 expresses high disparities within EU-27 related to the ICTs. Bulgaria has 30% of households connected to Internet and the usage of e-banking by population is only 2%. On the other edge, we have Netherlands with 90% and 72% respectively. When analyzing the e-government supply availability we have four countries with 100% services available and three with less than 50%. These uneven distributions on the variables will not affect our analysis, since that factor analysis do not make any assumptions about variables´ distributions, but they can be very elucidative about the gap that exists between countries. Moreover, the dimensionality of the data used, with 13 dimensions, makes impossible to address the digital divide with simple univariate statistics, without lead to incomplete results.

4 Methodology

4.1 Factor Analysis

Factor Analysis uses the correlation between variables in order to find latent factors within them. In order to use a successful factor analysis some assumptions need to be confirmed. The usage of this technique depends on the correlation structure within the input data. Hence, we need to confirm that this correlation exists; otherwise factor analysis may bring weak results. Our analysis involved several steps. The first was to analyze the correlation structure of the data, by the correlation matrix. In second, the suitability of the data must be confirmed by the Kaiser-Mayer-Olkin (KMO). Third, we needed to choose the extraction method to be used. Fourth, the number of factors to be extracted was defined and then, finally, we had to interpret the factors based on its loadings.

The correlation matrix (see Table 3) shows that each variable has, at least, one absolute correlation coefficient of 0.67 with another variable. This fact ensures that the variables used concerns to the same phenomena. We noticed that one of the highest correlation level (0.99) exists between the percentage of population using Internet to obtain Information from public authorities (egovInf) and percentage of population regularly using Internet for interacting with public authorities (egovInt), which indicates that the search for government´s information online leads to online interaction with public authorities. On the other hand, the percentage of government services available online (egovsup) presents a correlation coefficient of 0.52 and 0.53

Table 3. Correlation Matrix

	HsInt	HsBro	IntPop	IntSrc	ebank	elearn	email	ehealth	egovInf	egovInt	ecom	esafe	egovsup
HsInt	1	0.94	0.94	0.93	0.88	0.69	0.94	0.86	0.86	0.89	0.67	0.66	0.58
HsBro		1	0.92	0.93	0.91	0.73	0.92	0.84	0.88	0.89	0.72	0.70	0.67
IntPop			1	**0.95**	0.92	0.66	**0.99**	0.85	0.89	0.92	0.62	0.62	0.51
IntSrc				1	0.89	0.73	**0.95**	0.87	0.89	0.91	0.72	0.67	0.58
Ebank					1	0.68	0.90	0.82	0.89	0.91	0.64	0.58	0.56
Elearn						1	0.66	0.79	0.69	0.72	0.42	0.45	0.56
Email							1	0.86	0.89	0.92	0.65	0.63	0.53
ehealth								1	0.83	0.85	0.52	0.43	0.53
egovInf									1	**0.98**	0.60	0.56	0.56
egovInt										1	0.60	0.56	0.56
Ecom											1	0.85	0.58
Esafe												1	0.58
egovsup													1

with the percentage of population regularly using the Internet (IntPop) and the percentage of population using email (email), respectively. These low correlations indicate that, apparently, in some countries the adoption of ICTs by population does not have a linear correlation to the efforts of policy makers to encourage the use of these technologies.

To confirm the suitability of the data for factor analysis, KMO was realized. It returned the value of 0.85, which expresses the good adequacy.

As extraction method we applied the Principal Components Factor Analysis. This is the most widely used in Marketing and Social Sciences [39]. Since that our aim is to reduce the complexity of the problem we had to decide how many factors we would extract from our analysis. There is not a straight rule to do it since that the nature of the problem in study is crucial. There are three main criteria for reaching the number of factors; Pearson´s, Kaiser´s and Scree Plot methods were taken in consideration [39]. All of them were unanimous; the optimal number of factors to be extracted is two. As showed on Table 4 the percent of variance retained in these two factors is 86.6%. This means that, even though, we have just changed the number of indicators to analyze from thirteen to two, only 13.4% of information was lost.

Considering that our objective is to reduce the complexity of the digital divide, we used the rotation of the factors in order to achieve a better split of the original indicators in only one Factor. Although there are several types of rotation, including orthogonal and oblique methods, the orthogonal ones seem to be the most widely used [40]. In particular we applied the Varimax rotation. Nevertheless, Varimax and Quartimax rotations led to similar results.

To measure the scale reliability of each factor, Cronbach´s Alpha Measure was also calculated. It measures the internal consistency of each factor within itself. Nunnally [41] suggests that a value over 0.7 is considered good. The values returned are 0.985 and 0.860 for factor 1 and factor 2, respectably, indicates that the factors are consistent, since that those values are considered high.

Table 4. Results of Factor Analysis and Cronbach´s Alpha

Factor Analysis	Factor 1	Factor 2
Ehealth	**0.909**	0.224
Egovint	**0.902**	0.347
IntPop	**0.884**	0.389
Egovinf	**0.877**	0.353
Email	**0.874**	0.414
ebank	**0.854**	0.397
IntSrc	**0.845**	0.479
HsInt	**0.836**	0.466
HsBro	**0.809**	0.540
elearn	**0.752**	0.248
esafe	0.278	**0.904**
ecom	0.326	**0.880**
egovsup	0.379	**0.655**
Percent of Variance Explained	59%	28%
Cumulative Variance Explained (%)	59%	87%
Cronbach´s Alpha	0.985	0.860

Factor 1 is characterized by high density of usage of ICTs by Individuals along with the availability of its Infra-Structure. Therefore, factor 1 expresses the *ICTs adoption and diffusion by Population.*

In factor 2 we have the capacity of enterprises to provide safe connections on e-commerce, the orders received on-line and the e-government services availability. Hence, factor 2 is related to the *e-commerce, e-safety and e-government.*

We computed the factor scores to each country for a comparison analysis (see Figure 1). The plot shows that Scandinavian Countries – Sweden, Netherlands, Denmark and Finland – are the ones with better position in both dimensions. Luxembourg is the country with better levels in *ICTs adoption and diffusion by Population* but is however, at the same time, one of the countries with lower *e-commerce, e-safety and e-government* levels. United Kingdom is the country with highest level on factor 2, which confirms the theory that is one of the countries in the

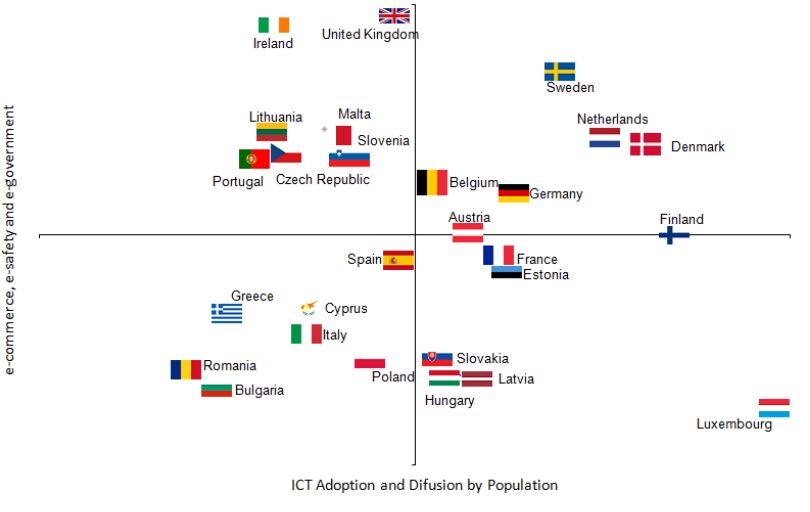

Fig. 1. Countries´ Coordinates on Extracted Factors

world with higher levels when it comes to availability of e-government services [42]. Austria has an average level regard to factor 2 and a slightly higher level than average in factor 1. Eastern Countries like Romania and Bulgaria are the ones in worst position considering the digital development.

Finally, we noticed some countries with very similar coordinates, or digital profiles, like the case of Romania and Bulgaria; Lithuania, Czech Republic and Portugal; Italy and Cyprus or France and Estonia. The fact that these pairs of countries are not necessarily close from the geographical or cultural point of view may bring us to other studies.

4.2 Mann-Whitney Test

After retaining the two dimensions with factor analysis we tested if the original EU-15 countries showed statistically different values on the factors against the countries which entered last. The Mann-Whitney Test showed that the original EU-15 countries tend to present higher levels on both factors for a confidence level of 10% since that p-value is 0.051 and 0.079, respectively for factor 1 and factor 2. However the results are not strong enough to apply a confidence level of 5%, especially for factor 2. Hence we tested the difference in the factors for three groups of countries, in pair with each other, which were formed by the original EU-15 countries, the 10 which entered in 2004 and the ones who entered last (2007). For a confidence interval of 95% both the original EU countries and the ones which entered in the 2004 presents higher levels on factor 1 against those which entered in 2007. Both factors have differences at a significance level of 10%. Moreover, for the same confidence level there are not significant differences between the original EU-15 countries and the ones which entered in 2004, which indicates that these are already mature and fitted to the EU when it comes to the Information Society policies.

5 Summary of Findings and Limitations of the Study

The digital divide appears to have two latent dimensions, which are the *ICT adoption and diffusion by Population* and the usage of *e-commerce, e-safety and e-government*. These two dimensions are independent considering that countries may have a top position in one dimension, and at the same time, a bottom position in the other. The Mann-Whitney Test showed that the statistical difference of the original 15 EU Countries against those which entered last is mainly due to the presence of Bulgaria and Romania in last group. Some policy actions might be proposed from our results: The high performance of some countries in just one dimension of digital divide, and low levels on the other has to be seen as a challenge. Like economic development the digital one needs to be harmonized and affect all dimensions; the worst ranked countries, especially Bulgaria and Romania, need to emphases their policies to the digital development towards the direction of Northern European Countries. This development may only be accomplished with a multifaceted strategy, stimulating both ICTs Infrastructure and adoption by Population with the development of e-commerce and e-government´s boosting policies. We also noticed that, in fact a gap in the digital development within EU exists and that this gap needs to be bridged to achieve the goals expressed by European Commission.

Even though our efforts to offer a complete and multidimensional analysis, some limitations must, however, be considered: First, our analysis refers to the digital divide at specific point of time, which is, the year of 2009. Therefore evolutions are likely to happen in just a few years; second, our empirical application consists of just 13 variables. Hence, some aspects of the information society may not be covered; third, we analyzed the digital divide within EU, with indicators related to aggregate national realities. This ways, internal gaps may not be covered.

References

1. WSIS, Tunis Commitment. In: Second Phase of the World Summit on the Information Society, Tunis, p. 5 (2005)
2. WSIS: World Summit on the Information Society: Declaration of Principles. In: World Summit on the Information Society, Geneva, p. 9 (2003)
3. European Comission: Europe 2020 - A strategy for smart, sustainable and inclusive growth, Brussels, p. 37 (2010)
4. European Comission: A Digital Agenda for Europe, Brussels, p. 42 (2010)
5. Dragulanescu, N.-G.: Social Impact of the "Digital Divide" in a Central-Eastern European Country. The International Information & Library Review 34(2), 139–151 (2002)
6. OECD, Understanding the Digital Divide, 32 (2001)
7. Okazaki, S.: What do we know about mobile Internet adopters? A cluster analysis. Information & Management 43(2), 127–141 (2006)
8. Warschauer, M.: Reconceptualizing the Digital Divide (2002)
9. Bertot, J.C.: The Multiple Dimensions of the Digital Divide: More than the Technology "Haves" and "Haves Nots". Government Information Quarterly 20, 191 (2003)
10. Ono, H., Zavodny, M.: Digital inequality: A five country comparison using microdata. Social Science Research 36(3), 1135–1155 (2007)
11. Unesco, I.f.S.: Measuring and monitoring the information and knowledge societies: a statistical challenge (2003)
12. OECD, Guide to Measuring the Information Society, Secretary-General of the OECD: Paris (2009)
13. Cuervo, M.R.V., Menéndez, A.J.L.: A multivariate framework for the analysis of the digital divide: Evidence for the European Union-15. Information & Management 43(6), 756–766 (2006)
14. Çilan, Ç.A., Bolat, B.A., Coskun, E.: Analyzing digital divide within and between member and candidate countries of European Union. Government Information Quarterly 26(1), 98–105 (2009)
15. Facer, N.S.K.: Beyond the digital divide: Rethinking digital inclusion for the 21st century, p. 40. Futurelab (2007)
16. Vicente, M.a.R.a., LÃpez, A.J.s.: A Multidimensional Analysis of the Disability Digital Divide: Some Evidence for Internet Use. The Information Society: An International Journal 26(1), 48–64
17. Vicente, M.R., Gil-de-Bernabé, F.: Assessing the broadband gap: From the penetration divide to the quality divide. Technological Forecasting and Social Change 77(5), 816–822
18. European Comission: Bridging the Broadband Gap, Brussels, p. 10 (2006)
19. Brooks, S., Donovan, P., Rumble, C.: Developing Nations, the Digital Divide and Research Databases. Serials Review 31(4), 270–278 (2005)

20. The World Bank, Information and Communications for Development: Global Trends and Policies. The World Bank, Washigton DC (2006)
21. Bakker, A.R.: Health care and ICT, partnership is a must. International Journal of Medical Informatics 66(1-3), 51–57 (2002)
22. Cukusic, M., et al.: e-Learning process management and the e-learning performance: Results of a European empirical study. Computers & Education 55(2), 554–565 (2010)
23. Castells, M., Himanen, P.: A Sociedade da Informação e o Estado Providência - O Modelo Finlandês, 1st edn., p. 287. Fundação Calouste Gulbenkian, Lisboa (2007)
24. Castells, M.: The Network Society Volume III, 1st edn., p. 287. Fundação Calouste Gulbenkian, Lisbon (2007)
25. Vehovar, V., et al.: Methodological Challenges of Digital Divide Measurements. The Information Society 22, 12 (2006)
26. Chinn, M.D., Fairlie, R.W.: The determinants of the global digital divide: a cross-country analysis of computer and internet penetration. Oxford Economic Papers-New Series 59(1), 16–44 (2007)
27. Hargittai, E.: Weaving the Western Web: explaining differences in Internet connectivity among OECD countries. Telecommunications Policy 23(10-11), 701–718 (1999)
28. Kiiski, S., Pohjola, M.: Cross-country diffusion of the Internet. Information Economics and Policy 14(2), 297–310 (2002)
29. Pohjola, M.: The Adoption and Diffusion of ICT Across Countries: Patterns and Determinants. In: The New Economy Handbook, pp. 230–247. Academic Press, London (2003)
30. Chinn, M.D., Fairlie, R.W.: ICT Use in the Developing World: An Analysis of Differences in Computer and Internet Penetration. Review of International Economics 18(1), 153–167 (2010)
31. US Department of Commerce, Falling through the Net I: A Survey of the 'Have-Nots' in Urban and Rural America, US Department of Commerce: Washington, D.C. (1995)
32. US Department of Commerce, Falling through the Net II: New Data on the Digital Divide, US Department of Commerce: Washington, D.C. (1998)
33. US Department of Commerce, Falling through the Net III: Defining the Digital Divide, US Department of Commerce: Washington, D.C. (1999)
34. US Department of Commerce, Falling through the Net IV: Toward Digital Inclusion, US Department of Commerce - Economic and Statistics Administration: Washington, D.C. (2000)
35. US Department of Commerce, A Nation Online: How Americans Are Expanding Their Use of the Internet, US Department of Commerce - Economics and Statistics Administration: Washington, D.C. (2002)
36. Vicente, M.R., López, A.J.: Patterns of ICT diffusion across the European Union. Economics Letters 93(1), 45–51 (2006)
37. Vicente, M.R., López, A.J.: Some empirical evidence on Internet diffusion in the New Member States and Candidate Countries of the European Union. Applied Economics Letters 15(13), 1015–1018 (2008)
38. Vicente, M.R., López, A.J.: What drives broadband diffusion? Evidence from Eastern Europe. Applied Economics Letters 17(1), 51–54
39. Peres-Neto, P.R., Jackson, D.A., Somers, K.M.: How many principal components? stopping rules for determining the number of non-trivial axes revisited. Computational Statistics & Data Analysis 49(4), 974–997 (2005)
40. Sharma, S.: Applied Multivariate Techniques. John Wiley & Sons, Inc., New York (1996)
41. Nunnaly, J.C.: Psychometric Theory. McGraw-Hill, New York (1978)
42. Unwin, T., de Bastion, G.: Digital Divide. In: Rob, K., Nigel, T. (eds.) International Encyclopedia of Human Geography, pp. 191–197. Elsevier, Oxford (2009)