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DIFFERENTIATION OF THE USE THE COMPUTERS AND INTERNET IN POLAND IN YEARS 2011-2015

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In the presented paper authors attempt to analyze the differences in the use of computers and the Internet in particular voivodships, places of residence and in different socio-economic groups in Poland in the years 2011, 2013 and 2015. To this purpose authors used data on the diagnosis of conditions and the quality of life of Polish people [8]. Gini's indicators and the Lorenz curve were used to visualize the differences in the use of computers and the Internet. The results showed that the greatest variation in the use of Internet and Computers was between students/learners, private entrepreneurs and the pensioners, annuitants and farmers. In the place of residence and the voivodeship, there were no significant differences in the use of these two above technologies.

Keywords: Internet use in Poland, Gini coefficient, Lorenz curve, differentiation methods

1. Introduction

"*It is not worthy of an educated man to waste his time working as a slave to the calculations that anybody could have done if the machines were used for that purpose*" said one of the informatics patrons - Gottfried Wilhelm Leibniz. This German scientist at the turn of the seventeenth and eighteenth centuries noticed the possibility of creating a machine that frees man from the need to make complex calculations. But only the twentieth century became an era of unbelievably fast growth in the production of computing machines, microprocessors, computers and the spread of the Internet [9].

Effective use of information and communication technologies by improving access to the Internet with the use of high-speed broadband is considered to be key to increasing productivity and stimulating innovation in Europe [6]. The era of technological progress and global informatization has resulted in a tremendous increase in business improvements, a change in the way we learn and the importance of international trade. Mechatronics, nanotechnologies, personal computers and the Internet are increasingly beginning to influence the shape of modern society, the so-called Information Society (ITC). This, among other things, contributes to improving work efficiency.

In 2014, 77.1 % of households were equipped with at least one computer. The percentage was increasing on a systematic basis in the recent years and was significantly higher in households with children. The number of regular computer users was also increasing over the period 2010-2014 [7].

2. Goal and research data source

The main goal of the study was to analyze the differences in the use of computers and the Internet in Polish households. Authors set three research hypothesis:

1st Main users of computers and Internet are young people and employers.
2nd In Mazowieckie, Dolonośląskie and Małopolskie voivodeships the concentration of computer and Internet use is much bigger than other voivodeships.
3rd Place of residence don't play significant role in variation in the use of Internet and Computers.

Table 1. Countability of research households and people in years 2011, 2013, 2015

	Year		
	2011	2013	2015
Number of households (including:)	19 346	18 773	16 778
Using a computer	7 982	7 660	7 327
Using the Internet	7 607	7 505	7 235
Number of people (including:)	25 767	25 248	21 808
Computer users	15 410	14 606	12 986
Internet users	14 582	14 281	12 816

Source: own preparation on the basis of Social diagnosis data

The comparative period taken to the study was three years 2011, 2013 and 2015. The data used in the study came from a statistical survey Social Diagnosis - conditions and quality of life of Polish people [8]. This scope of years was arbitrarily taken, because authors didn't had access to bigger sample of data.

The study was conducted for three variables separately for each year. The main factors that have been taken into account when analyzing the diversity of computer use and the Internet were: voivodeship (WOJ), class of residence (KLM) and socio-economic group (GSE).

Table 1 shows the number of households and individual persons in particular years. It is worthwhile to note that in Polish households still less than half of the surveyed households was using a computer, but year by year, a slow upward trend is visible. It is encouraging that in 2015, 99% of households and individuals who used a computer also used the Internet.

Table 2. Countability of research people in GSE in years 2011, 2013, 2015

	Year		
Socio-economic group (GSE)	2011	2013	2015
Employed	8 949	8 598	7 771
Private entrepreneur	994	978	846
Farmers	1 621	1 639	1 455
Annuitants	2 010	1 827	1 583
Pensioners	6 441	6 486	5 862
Students/learners	2 145	1 959	1 505
Unemployed and other professionally inactive	3 607	3 761	2 786

Source: own preparation on the basis of Social diagnosis data

Table 3. Countability of research people in KLM in years 2011, 2013, 2015

	Year		
Class of residence (KLM)	2011	2013	2015
>=500 thousands	1 975	1 823	1 478
200-500 thousands	2 205	2 053	1 678
100-200 thousands	1 660	1 604	1 372
20-100 thousands	4 769	4 625	3 875
<20 thousands	3 332	3 093	2 624
Village	11 826	12 050	10 781

Source: own preparation on the basis of Social diagnosis data

By analyzing the studied data, it can be observed that in the GSE the largest group are people employed, then retired people and the unemployed. In contrast, in KLM the most numerous group is by far for people from the village. Regarding the voivodeships, people from Mazowieckie and Śląskie dominate here (cf. Table 2, 3, 4).

Because of the uneven size of the surveyed individuals for particular variables, the Gini index and the Lorenz curves were calculated on the basis of percentage, ie:

$$\frac{\text{Number of people using the Computer/Internet for the variable}}{\text{Number of people for the variable}} = eg. \frac{\text{Number of employees using computers}}{\text{Number of employees}}$$

To this approach, the data has been more normalized and the comparison was more meaningful.

Table 4. Countability of research people in WOJ in years 2011, 2013, 2015

	Year		
Voivodeship (WOJ)	2011	2013	2015
Dolnośląskie	1 712	1 677	1 439
Kujawsko-pomorskie	1 427	1 396	1 126
Lubelskie	1 704	1 698	1 567
Lubuskie	794	796	657
Łódzkie	1 830	1 750	1 595
Małopolskie	1 880	1 782	1 560
Mazowieckie	3 053	3 086	2 738
Opolskie	799	774	687
Podkarpackie	1 614	1 544	1 378
Podlaskie	976	1 003	906
Pomorskie	1 448	1 417	1 232
Śląskie	2 705	2 672	2 201
Świętokrzyskie	1 288	1 337	1 130
Warmińsko - Mazurskie	1 199	1 238	1 185
Wielkopolskie	2 176	2 086	1 629
Zachodniopomorskie	1 162	992	778

Source: own preparation on the basis of Social diagnosis data

3. Methodology

Gini coefficients and the Lorenz concentration curve were used to test the variation in voivodships, places of residence classes and in different socio-economic groups. Concentration (unevenness) conveys an uneven distribution of the sum of the of the characteristic values between individual units of the population. The concentration curve is a special type of graph for a series of cumulative frequencies of two or more distributions. In the case of the spatial concentration research of phenomena on one of the two-dimensional axis of coordinate system, is designated the cumulative field to which the phenomenon relates. The total measured surface S is divided into k disjoint parts of any shape ($S = s_1 + s_2 + ... + s_i$). The number of objects in the i-th part is determined by m_i, hence:

$$M = \sum_{i=1}^{k} m_i \ , \qquad (1)$$

where: M is the total number of objects (the number of people using the computer and Internet in for eg. the place of residence class). In order to create a series of cumulative masses and previously mentioned fields, the number of objects per field and per mass is ordered in a non-decreasing manner. This gives the basis for extracting the individual expressions of the series:

$$z(x_i) = \sum_{j=1}^{i} m_i \quad \text{and} \quad x_i = \sum_{j=1}^{i} s_j, (i = 1,2,...,k) \ , \qquad (2)$$

The last expressions are equal to:

$$x_k = s_1 + s_2 + .. .+ s_k = S,$$
$$z(x_k) = m_1 + m_2 + ... + m_k = M, \qquad (3)$$

Such a combination allows finding for both sets of distribution series, the empirical distributions for empirical distribution (ie: the frequency distributions with which the number of observed persons using computers and the Internet falls, for example, for the chosen class of residence):

$$F(x_i) = \frac{Z(x_i)}{M} \quad \text{and} \quad G(x_i) = \frac{x_i}{S}, \qquad (4)$$

where $F(x_0) = 0$, $F(x_k) = 1$ and analogically $G(x_0) = 0$, $G(x_k) = 1$. By comparing pairs of numbers ($F(x_i)$, $G(x_i)$), (i = 1, 2, ... , k), they are taken as points on the plane of the rectangular coordinate system. After the points are merged, the concentration curve is obtained and, after smoothing - the Lorenz concentration curve is drawn [1, 2, 10].

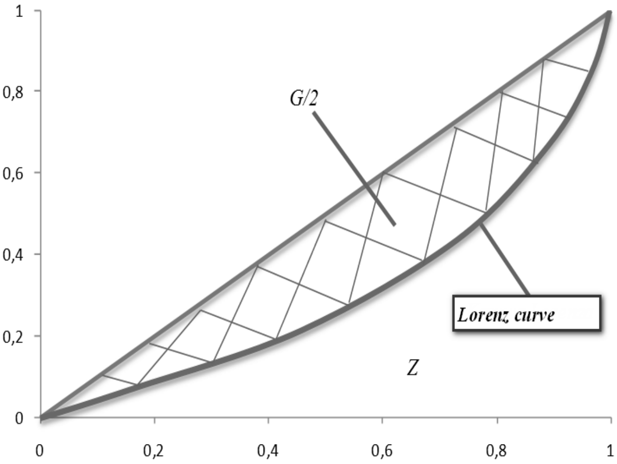

Figure 1. Example of Lorenz curve

In graphical terms, the Lorenz curve is a set of connected points forming a convex curve. It is located in a square with dimensions $1x1$ - unit square - (Figure 1). The diagonal of this square is called the equilibrium line (egalitarian line), and it represents an ideal uniformity in the distribution of a given phenomenon. In a perfectly proportional increase of the tested characteristics, the quotient of $F(x_i) / G(x_i)$ is always equal to 1. In this case, the concentration curve coincides with the uniform distribution line. This means that the researched phenomenon, in our case, the use of computers and the Internet is evenly distributed in relation to the characteristics in question. The concentration curve moves away from the even distribution line, the more unequal is the distribution of the value of the variable between units of the statistical community and there is a greater concentration [3].

The mathematical interpretation of the concentration of a given phenomenon is the index (index) of Gini G concentration (Figure 1). This parameter is the difference between a unit square and a doubled field between a concentration curve and a uniform distribution line. The area between the concentration curve and the equilibrium distribution line can be written as $0.5 - Z$ (where: Z is the area under the concentration curve), so the formula for the Gini concentration index is given by the following relation:

$$G = 1 - 2Z \tag{5}$$

In order to determine the numerical value of the Z field, the mathematical trapezoid method (so called numerical integration) is used [4]. Gini's concentration index takes values [0; 1], the closer to 1, the concentration is stronger, and the closer to 0, the weaker it is. If G is 0, then we have no concentration when 1, then we have so. Total concentration. In practice, it is rare for G to be 0 or 1, because even with extreme asymmetry there is a slight concentration [5, 11, 12].

3. Research results

In the case of two variables, WOJ and KLM, Gini coefficients were very similar for computer users as well as Internet users. The greatest diversity occurred in socio-economic groups. The two dominant user groups were students/learners and private entrepreneurs. These two groups concentrated over 40% of the population that was using computers and the Internet. In all tested years, the computer and the Internet was least often used by pensioners, annuitants and farmers, and these three groups had a slightly more than 20% share in the use of these two options. It is worth to point out that the concentration of computer use and the Internet in the considered period did not change significantly in socio-economic groups.

For the voivodships, Gini's coefficient were at the similar levels for all years taken into consideration. Gini's indices strongly confirmed the absence of any concentration in any of the voivodship. Most people admitted to use the computer and the Internet in the Pomorskie, Lubuskie, Wielkopolskie, Mazowieckie and Śląskie voivodships. They focused about 35% of the population. Households placed in farm area in the Świętokrzyskie and Podkarpackie voivodships were the worst among all, and together they represent just over 10% of the population. However, it is worth to add, that the distribution of the number of people using computers and the Internet in all voivodships was very similar.

Table 5. Gini index for individual years and variables

Specification	Year	Gini index for the number of people using computers	Gini index for the number of people using Internet
WOJ	2011	0.038	0.046
	2013	0.036	0.036
	2015	0.042	0.042
KLM	2011	0.065	0.074
	2013	0.073	0.075
	2015	0.069	0.071
GSE	2011	0.244	0.258
	2013	0.264	0.271
	2015	0.246	0.250

Source: own preparation on the basis of GUS data

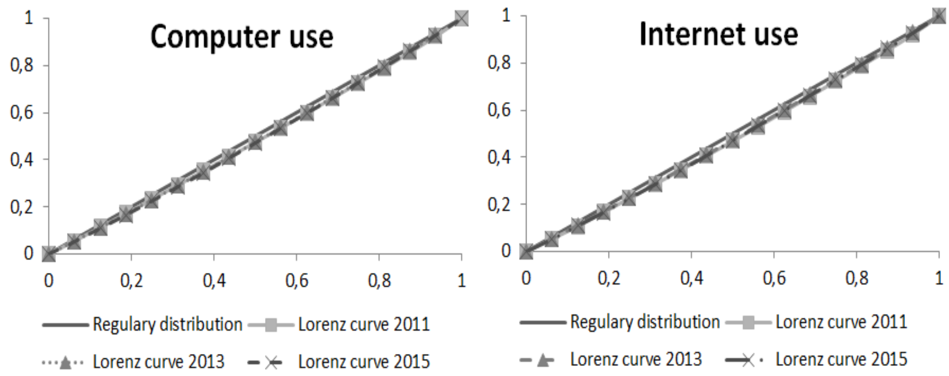

Figure 2. Lorenz cures of computer and Internet use in WOJ

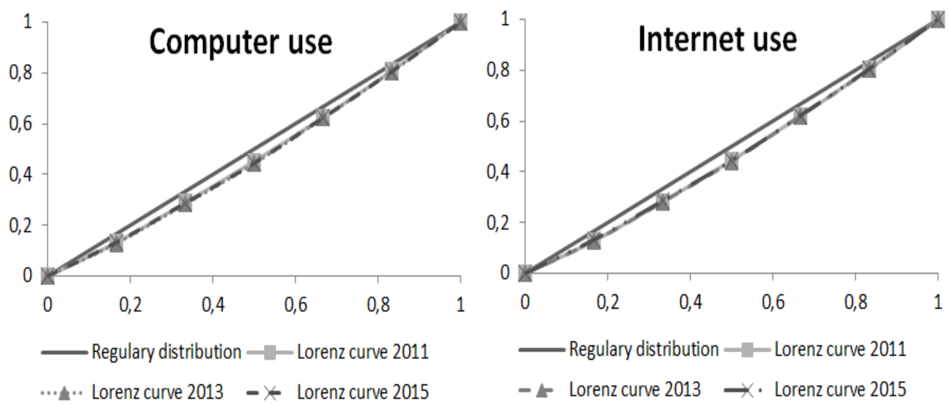

Figure 3. Lorenz cures of computer and Internet use in KLM

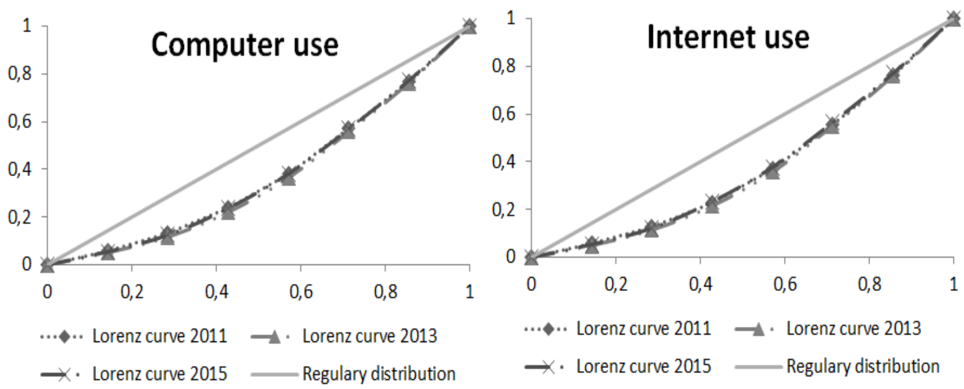

Figure 4. Lorenz cures of computer and Internet use in GSE

Very similar results to the results concerning voivodships was obtained for the variable: class of residence. Also in this case there was no significant difference between the individual classes of the place of residence, which could be proven by Gini's coefficients values close to zero.

The obtained results are also confirmed by the Lorenz curves, which in the case of voivodships and classes of residence almost collide with a uniform distribution line. Only in the case of socio-economic groups there was a more visible concentration.

4. Conclusion

Effective use of information and communication technologies by improving access to the Internet with the use of high-speed links is widely recognized as crucial for the development of today's living society. Also in Poland there is a noticeable improvement in access to computers and to the Internet by households. However, this is not yet a satisfactory level.

The study focused on visualization the differences between the use of personal computers and the Internet in the three years 2011, 2013 and 2015. The results showed that the greatest variation in the use of these two technical options is by far between students/learners, private entrepreneurs and the pensioners, annuitants and farmers. Referring to the first hypothesis, the results confirmed that young people and employers are mainly users of this new two technologies. Regarding the place of residence and the voivodship, there were no significant differences in the use of these two technologies. Those results have not confirmed hypotheses 2 and 3.

Dissemination of modern solutions enables the development of society to accelerate while at the same time reducing the inequalities in particular information society environments. E-commerce, e-learning, e-administration, e-tourism are some solutions chosen from many others that radically change the world economy. Fast information flow streamlines business processes and productivity. This is why it is imperative to continuously observe and monitor ITC development.

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