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INTERNATIONAL TELECOMMUNICATION ACADEMY

ITA–GIS Recommendation

A.6

(01/05)

Measuring the Digital Divide in the Information Society

NOTES

ITA-GIS Recommendation A.6 had been prepared to be used by international organizations (UN and its structural bodies, including ECOSOC, DPI, UNDP, ITU and others), by governments of countries-members of the World Community, by banks and financial structures (World Bank, International Bank for Reconstruction and Development and others), by companies-suppliers of the infocommunication equipment, by operators and infocommunication services providers, by Academicians of ITA and other scientific Academies in order to promote and assist the development of the Information Society and its components – Information Societies of countries-members of the World Community.

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Measuring the Digital Divide in the Information Society

International Telecommunication Academy

notes that

a) fundamental documents ***"Declaration of Principles"*** and ***"Plan of Actions"***, adopted in December 2003 in Geneva on the World Summit on the Information Society (WSIS), where the results of the work of the first phase of the World Summit were summarized and it was declared the beginning of the preparation for the second phase, which would be concluded by the final session of the World Summit on the Information Society in 2005 in Tunis,

b) the significance of successful conducting the first phase and finale session of the World Summit on the Information Society in 2005;

supporting

a) the value of these documents by ITU Secretary General Mr. Y. Utsumi according to which "in the Declaration of Principles and Plan of Action first of the ICT prospects and not the problems arisen thereupon are under consideration",

b) an active and multiscaled work of the UN structure organizations (ITU, ECOSOC, UN ICT Task Force, UNDP, UNIDO, UNESCO, International banking group) in this field,

understanding

under the Digital Divide significant differences in the development and ICT introduction levels in developing and developed countries as well as in countries with transition economy,

taking into consideration

a) three methods of the comparative digital analysis of countries development UNDP, ITU and ITA methods,

admitting further

a) the significance of the harmonization of the infocommunication and social-economic relation development in the civil society,

b) a profound impact of information, knowledge, infocommunication technologies and services on a political, economic and social life;

c) considerably uneven distribution of incomes, technologies and services between world countries, between the rich and poor;

d) necessary prevention of further increasing the digital and economic divide for harmonization of social-economic relations,

e) the necessity of rendering the economic and infocommunication (technological) assistance by developed countries and business companies (donors) to developing countries (recipients) as an essential condition of the harmonization of social-economic relations in the epoch of Information Society,

recommends

heads of international, state-operated, public and private infocommunication organizations for using in the world statistics the developed ***method of measuring the Digital Divide*** between different groups of world countries (Appendix 1 – 5), based on indicators of the Digital and Economic Divide.

APPENDIX 1/A.6

ITA Method of Measuring the Digital Divide

The basic features of the International Telecommunication Academy (ITA) method of measuring the inequality between groups of countries including the Digital Divide are developed in the book [1] and in ITA Recommendations on the Global Information Society [2]. The more detailed description of the ITA method of measuring the Digital Divide is presented in the book [3]. Comparing the ITA method with the UNDP and ITU methods and numerous examples of measuring the Digital and Economic Divide are also brought in the book [3]. That is why the presentation of the ITA method corresponds to materials of the book [3].

The ITA method of measuring the Digital Divide can be applied for measuring it between groups of countries as well between particular countries. As any other measuring method the present method is based on the fact that the Digital Divide must be evaluated (in a form of a digit) on the purpose to characterize the condition of a country or a group of countries in a form of one digit – Digital Divide Indicator (DDI).

The ITA method is focused on using adequate to the considering task mathematical methods implying the application of statistic data on the development of countries of the World Community (information resources, incomes, etc.). As a result the ITA method provides *statistic values* of the DDI.

The ITA method of measuring the Digital Divide means a subsequent implementation of the following operations:

1. Determination of the Infocommunication Vector (ICV);
2. Plotting the ICV dispersion curve;
3. Determination of the Digital Divide Indicator (DDI).

1.1. Determination of the Infocommunication Vector

Infocommunication technologies (ICT) in any countries are a set of various technologies including telephony (fixed and mobile telephones), data communication (Internet), computers, broadband links, etc. That is why the ICT set is multiparametric because every ICT is a parameter, which characterizes the development level of infocommunication resources in a country. Each technology or parameter is specified by its density (or penetration) that determines the number of subscribers terminals per 100 inhabitants and that is measured in percentage or in decimal fractions.

Among various ICT those are considered that are widely applied and that have the data in reports (reference books) of the International Telecommunication Union (ITU), World Bank and other internationally accepted organizations. In this case under ICT parameters are meant the following:

- fixed telephone density – TD,
- mobile telephone density – MD,

- Internet-users density – IUD,
- Personal computers density – PCD,
- Broadband access subscriber terminals density – BD.

The concept of the *Infocommunication Vector* (ICV) and its length (module or norm) in n-dimensional space is introduced for the purpose to characterize the set of ICT *n* parameters by one digit. Let us denote through a_{ij} – *i*-parameter of *j*-country, where the number of parameters *i* experiences changes from 1 till *n*, and the number of countries *j* - from 1 till *N*. In this case the ICV length is determined according to the following formula

$$A_j = \sqrt{\frac{1}{n}\sum_{i=1}^{n} a_{ij}^2}\,. \tag{1}$$

The ICV length determines the rank of the *j*-country: the more A_j is, the higher the rank is. The highest rank equal to 1 is given to the country with the highest possible ICV length $A_{j\,max}$. The distance between the ICV of two countries

$$C_{jk} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} \left(a_{ij} - a_{ik}\right)^2}\,, \tag{2}$$

gives a digital value distinguishing the ICV level in these countries.

Thus formulas (1) and (2) allow to bring the set of parameters to figures A_j or C_{jK}, which are enough to plot dispersion curves, i.e. to determine the ICV distribution among the World Community.

1.2. Plotting the Dispersion Curve

Dispersion curves (Lorenz Curves or Kendall-Stuart Curves) were introduced for characterizing the parameter distribution (income, ICT, etc.) inside a particular country or in the World Community [1, 3].

Fig. 1*a* provides a typical dispersion curve *Q*(*F*) – curve *OCA* of a parameter *Q* (ICV, incomes, etc.) from the share of countries (or population) *F*. And the abscissa *F*, and ordinate *Q* are normalized *cumulative* (total, accumulative, integral) quantities. That is why they experience changes from 0 till 1. Lines *OC* and *CA* are a polygonal (rough) approximation of the dispersion curve. The dispersion curve can be placed between the two limiting positions:

- line *OA* – a line of an absolute equality AE, when all countries have an equal value of the parameter (ICT, income, etc.) and
- lines *OB* and *BA* – lines of an absolute inequality AI, when the majority of countries has nothing or the least share of the parameter and its absolute value is one or several countries.

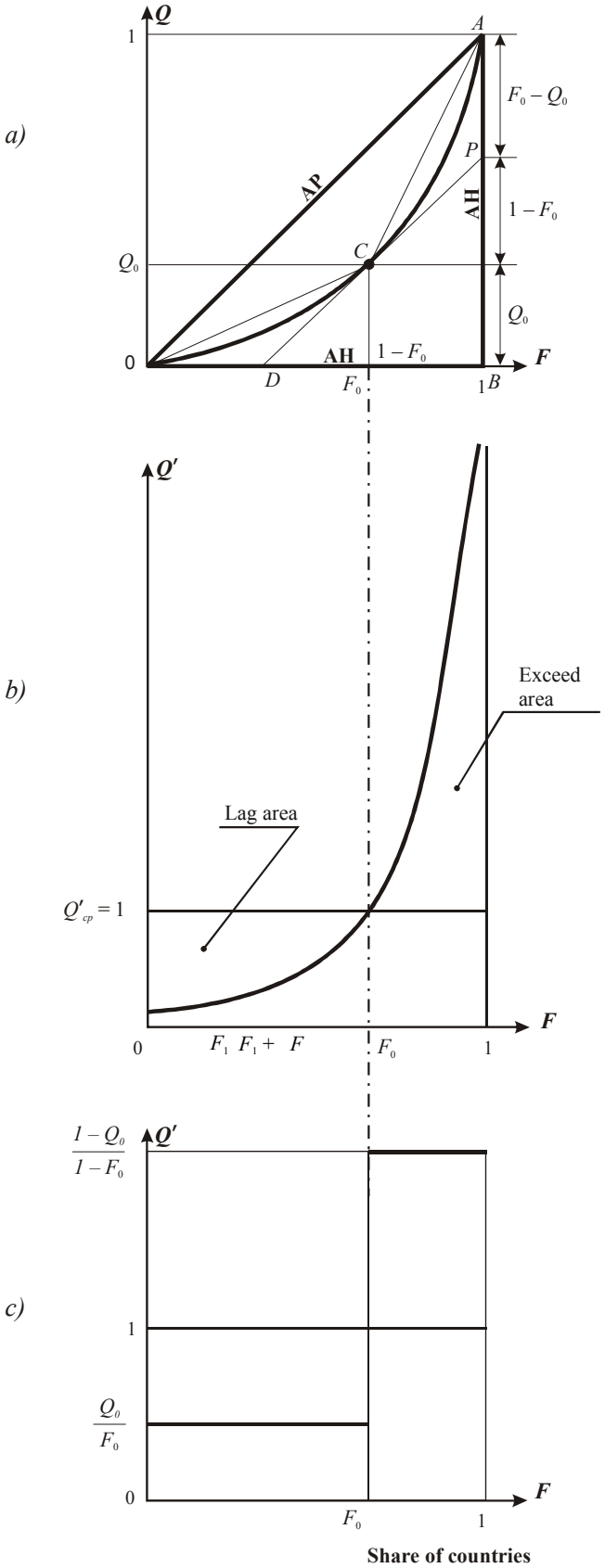

Fig. 1. Dispersion curve (*a*), the first derivative of dispersion curve – parameter density (*b*), approximation of parameter density (*c*).

The dispersion curve should be plotted the following way:

1. Making up a table of ranged ICV values A_j, starting with the country with the maximal value of the parameter and finishing with the country with the minimal value of the parameter. This table represents discrete values of the non-normalized first derivative of the dispersion curve. Dividing all the values by the maximal value we will get the value of the normalized first derivative of the dispersion curve. Let us express them through $V'_j,\ j = \overline{1, N}$.
2. Making up the table of the dispersion curve according to the next formula:

$$V(k) = \sum_{i=1}^{k} V'_i , \tag{3}$$

when $V'_i > V'_{i-1}$ and $k = \overline{1, N}$. The dispersion curve $V(k)$ is a non-normalized function with the maximal value

$$V_{\max} = V(N) = \sum_{i=1}^{N} V'_i . \tag{4}$$

3. Normalizing the dispersion curve $Q(k) = V(k)/V_{\max}$, $k = \overline{1, N}$, and introducing a new normalized variable

$$F = k / N , \tag{5}$$

we will get a normalized dispersion curve $Q(F) = V(F)/V_{\max}$.

4. Plotting a graph of the dispersion curve $Q(F)$ and its first derivative $Q'(F)$.

1.3. Determination of the Digital Divide Indicator

Determination of the DDI is based on the analysis of the dispersion curve $Q(F)$ and its first derivative $Q'(F)$.

The dispersion curve has an interesting point C, which tangent is parallel to the line OA. The parameter density in this point equals the average value. Fig. 1*b* displays the first derivative of the dispersion curve $Q'(F)$, which coincides in form with the parameter distribution among countries. In the point C with coordinates (Q_0, F_0) the first derivative of the dispersion curve $Q'(F) = Q'_{cp} = 1$. This point C or *the division point* divides community of countries into two groups:

- Group H (the first one) or Group with the high development level ($F_0 \le F \le 1$);
- Group L (the second one) or Group with the high development level ($0 \le F < F_0$).

For Group H the parameter density is $Q' > 1$, and for Group L the parameter density is $Q' < 1$.

That is why Group H is in the area of the exceeding parameter Q', and group L – in the area of the lagging parameter Q'.

Fig. 1*c* pictures the approximation of the parameter density with its average values for both groups:

- for Group *H* the average value of the parameter density is

$$Q'_1 = \frac{1 - Q_0}{1 - F_0}, \tag{6}$$

- for Group *L* the average value of the parameter density is

$$Q'_2 = \frac{Q_0}{F_0}. \tag{7}$$

The Digital Divide Indicator (DDI) for two groups of countries *H* and *L* equals the ratio

$$\Delta_1 = \frac{Q'_1}{Q'_2}. \tag{8}$$

If there is no divide, then $\Delta_1 = 1$. If there is any divide, then $\Delta_1 > 1$.

But dividing the community of countries into two groups does not emphasize the divide between countries with a very high or very low development level sufficiently. For this purpose let us introduce four groups: *H* – Group with the High Level; *UM* – Group with the Upper Middle Level; *LM* – Group with the Low Middle Level; *L* – Group with the Low Level. Dividing the community of countries into four groups with the help of tangents is pictured in Fig. 2.

Straight lines *ST* || *CA* and *PR* || *OC*. As a result the four groups are determined the following way:

- Group *H*: $F_1 \le F \le 1$;
- Group *UM*: $F_0 \le F < F_1$;
- Group *LM*: $F_2 \le F < F_0$;
- Group *L*: $0 \le F \le F_2$.

The average value of the parameter density in Group *H* correspondingly makes up:

$$Q'_1 = \frac{1 - Q_1}{1 - F_1}, \tag{9}$$

and for Group *L* makes up:

$$Q'_4 = \frac{Q_2}{F_2}. \tag{10}$$

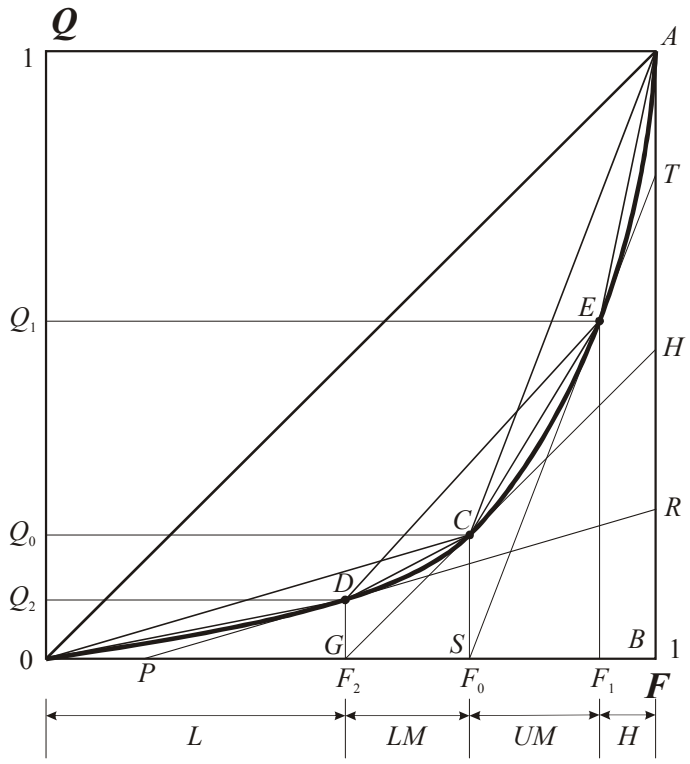

Fig.2. Dividing the community of countries into four groups: *H*, *UM*, *LM*, *L*

That is why the DDI for the four groups makes up

$$\Delta_2 = \frac{Q'_1}{Q'_4}. \tag{11}$$

Formulas (8) and (11) determine the Digital Divide Indicator. Let us consider concrete examples.

APPENDIX 2/A.6

Measuring the Digital Divide based on the Infocommunication Vector

Tab. 1 provides values of the ICV length *A* for 182 countries. The basic data on the ICV are brought in the ITU materials [4], the corresponding calculations in [3]. Ranking the countries as it as mentioned in the previous Appendix was accomplished in accordance with the values *A*: the higher it is, the lower the number of a country is. The leading place is taken by Luxemburg with an absolute value $A = 0{,}75$ and with the relative value (maximal) equal to 1. In Tab. 1 countries are divided into four groups *H*, *UM*, *LM* and *L*. The first group includes industrially developed countries (countries of Group 7, EU countries), a number of small and insular countries, countries of the Central Europe with the transition economy; the second Group is comprised of countries of the Eastern Europe with the transition economy and developing countries.

Table 1. Value of ICV length *A*, length of differential vector *C* and their distribution among 182 countries in 2003
Statistic data source: ITU [7] Calculations: ITA

	Country	*A*	*C*	*F*
High ICV Level (H)				
1	Luxembourg	0,750	0,000	1,000
2	Sweden	0,715	0,137	0,995
3	Iceland	0,712	0,188	0,989
4	Norway	0,689	0,110	0,984
5	Switzerland	0,688	0,126	0,978
6	Taiwan, China	0,686	0,146	0,973
7	Denmark	0,677	0,129	0,967
8	Hong Kong, China	0,675	0,156	0,962
9	Finland	0,613	0,202	0,956
10	Singapore	0,610	0,224	0,951
11	Germany	0,604	0,182	0,945
12	Netherlands	0,603	0,199	0,940
13	Italy	0,599	0,241	0,934
14	United States	0,596	0,290	0,929
15	United Kingdom	0,591	0,180	0,923
16	Korea (Rep.)	0,586	0,272	0,918
17	Australia	0,584	0,220	0,912
18	Austria	0,582	0,218	0,907
19	Israel	0,563	0,254	0,901
20	Ireland	0,553	0,210	0,896
21	Czech Republic	0,539	0,310	0,890
22	Slovenia	0,537	0,262	0,885
23	Japan	0,529	0,252	0,879
24	Spain	0,529	0,288	0,874
25	Canada	0,517	0,344	0,868

	Country	*A*	*C*	*F*
26	New Zealand	0,517	0,295	0,863
27	France	0,514	0,249	0,857
28	Portugal	0,511	0,321	0,852
29	Belgium	0,507	0,271	0,846
30	Cyprus	0,493	0,296	0,841
31	Malta	0,488	0,278	0,835
32	Macao, China	0,483	0,310	0,830
Upper Middle ICV Level (UM)				
33	Greece	0,459	0,356	0,824
34	United Arab Emirates	0,421	0,389	0,819
35	Estonia	0,418	0,359	0,813
36	Barbados	0,408	0,395	0,808
37	Slovak Republic	0,395	0,398	0,802
38	Hungary	0,395	0,393	0,797
39	Croatia	0,387	0,377	0,791
40	Seychelles	0,382	0,406	0,786
41	Bahrain	0,382	0,405	0,780
42	Lithuania	0,376	0,421	0,775
43	Latvia	0,372	0,426	0,769
44	Qatar	0,354	0,413	0,764
45	Antigua & Barbuda	0,352	0,456	0,758
46	Kuwait	0,332	0,457	0,753
47	Bahamas	0,314	0,490	0,747
48	Poland	0,304	0,463	0,742
49	Malaysia	0,304	0,490	0,736
50	Jamaica	0,303	0,496	0,731
51	St. Kitts and Nevis	0,293	0,544	0,725
52	Chile	0,277	0,491	0,720
53	French Polynesia	0,271	0,486	0,714
54	Mauritius	0,256	0,497	0,709
55	Bulgaria	0,253	0,522	0,703
56	Turkey	0,251	0,520	0,698
57	New Caledonia	0,250	0,543	0,692
58	Brunei Darussalam	0,246	0,517	0,687
59	Romania	0,220	0,543	0,681
60	Serbia and Montenegro	0,212	0,556	0,676
Lower Middle ICV Level (LM)				
61	Trinidad & Tobago	0,198	0,558	0,670
62	South Africa	0,196	0,576	0,665
63	Costa Rica	0,194	0,589	0,659
64	Saudi Arabia	0,194	0,561	0,654
65	Grenada	0,189	0,607	0,648
66	Uruguay	0,188	0,574	0,643
67	Dominica	0,187	0,597	0,637
68	St. Lucia	0,187	0,602	0,632
69	Bosnia	0,184	0,590	0,626
70	Albania	0,184	0,607	0,621
71	Brazil	0,181	0,574	0,615
72	Belarus	0,180	0,620	0,610

	Country	*A*	*C*	*F*
73	Suriname	0,180	0,586	0,604
74	Lebanon	0,167	0,587	0,599
75	TFYR Macedonia	0,164	0,615	0,593
76	Mexico	0,160	0,593	0,588
77	Argentina	0,157	0,601	0,582
78	China	0,154	0,608	0,577
79	Paraguay	0,152	0,628	0,571
80	Panama	0,151	0,611	0,566
81	Dominican Rep.	0,151	0,619	0,560
82	Thailand	0,150	0,612	0,555
83	Venezuela	0,146	0,613	0,549
84	Russia	0,144	0,624	0,544
85	Belize	0,144	0,610	0,538
86	Jordan	0,141	0,618	0,533
87	St. Vincent	0,141	0,630	0,527
88	Botswana	0,136	0,629	0,522
89	Colombia	0,129	0,631	0,516
90	Morocco	0,124	0,649	0,511
91	Iran (I.R.)	0,123	0,655	0,505
92	Tunisia	0,119	0,636	0,500
93	Ukraine	0,117	0,661	0,495
94	Gabon	0,114	0,658	0,489
95	El Salvador	0,114	0,642	0,484
96	Ecuador	0,113	0,642	0,478
97	Oman	0,110	0,645	0,473
98	Cape Verde	0,107	0,647	0,467
99	Philippines	0,101	0,662	0,462
100	Maldives	0,101	0,649	0,456
101	Fiji	0,100	0,652	0,451
102	Guyana	0,099	0,670	0,445
103	Bolivia	0,093	0,664	0,440
104	Moldova	0,091	0,674	0,434
105	Georgia	0,088	0,667	0,429
106	Namibia	0,085	0,668	0,423
107	Peru	0,084	0,674	0,418
108	Palestine	0,084	0,668	0,412
109	Azerbaijan	0,080	0,678	0,407
110	Egypt	0,080	0,678	0,401
111	Armenia	0,078	0,694	0,396
112	Guatemala	0,077	0,678	0,390
Low ICV Level (L)				
113	Kazakhstan	0,073	0,692	0,385
114	Libya	0,071	0,701	0,379
115	Syria	0,064	0,705	0,374
116	Tonga	0,062	0,701	0,368
117	S. Tome & Principe	0,057	0,716	0,363
118	Mauritania	0,055	0,706	0,357
119	Mongolia	0,055	0,696	0,352
120	Marshall Islands	0,052	0,710	0,346

	Country	*A*	*C*	*F*
121	Swaziland	0,051	0,700	0,341
122	Congo	0,047	0,715	0,335
123	Algeria	0,042	0,712	0,330
124	Kyrgyzstan	0,042	0,720	0,324
125	Gambia	0,042	0,711	0,319
126	Zimbabwe	0,040	0,716	0,313
127	Equatorial Guinea	0,039	0,717	0,308
128	Cote d'Ivoire	0,039	0,716	0,302
129	Viet Nam	0,039	0,717	0,297
130	Turkmenistan	0,039	0,729	0,291
131	Indonesia	0,039	0,714	0,286
132	Honduras	0,037	0,714	0,280
133	Samoa	0,035	0,724	0,275
134	Uzbekistan	0,035	0,726	0,269
135	Togo	0,035	0,720	0,264
136	Sri Lanka	0,035	0,716	0,258
137	Senegal	0,034	0,718	0,253
138	Cameroon	0,033	0,723	0,247
139	Vanuatu	0,031	0,721	0,242
140	Papua New Guinea	0,031	0,733	0,236
141	Cuba	0,031	0,728	0,231
142	Nicaragua	0,030	0,720	0,225
143	India	0,028	0,725	0,220
144	Kenya	0,027	0,727	0,214
145	Lesotho	0,024	0,730	0,209
146	Bhutan	0,023	0,731	0,203
147	Djibouti	0,022	0,729	0,198
148	Solomon Islands	0,022	0,737	0,192
149	Ghana	0,020	0,732	0,187
150	Tajikistan	0,019	0,738	0,181
151	Benin	0,018	0,734	0,176
152	Yemen	0,018	0,733	0,170
153	Sudan	0,018	0,734	0,165
154	Pakistan	0,017	0,735	0,159
155	Uganda	0,016	0,737	0,154
156	Nigeria	0,014	0,737	0,148
157	Cambodia	0,014	0,739	0,143
158	Tanzania	0,014	0,738	0,137
159	Zambia	0,013	0,738	0,132
160	Haiti	0,013	0,739	0,126
161	Mozambique	0,012	0,739	0,121
162	Mali	0,012	0,740	0,115
163	Burkina Faso	0,010	0,741	0,110
164	D.R. Congo	0,009	0,743	0,104
165	Comoros	0,009	0,743	0,099
166	Madagascar	0,009	0,741	0,093
167	Guinea-Bissau	0,008	0,746	0,088
168	Nepal	0,008	0,744	0,082
169	Guinea	0,008	0,742	0,077

	Country	*A*	*C*	*F*
170	Rwanda	0,008	0,743	0,071
171	Malawi	0,008	0,742	0,066
172	Lao P.D.R.	0,008	0,742	0,060
173	Sierra Leone	0,007	0,744	0,055
174	Bangladesh	0,006	0,744	0,049
175	Angola	0,006	0,744	0,044
176	Burundi	0,005	0,745	0,038
177	Eritrea	0,005	0,747	0,033
178	Myanmar	0,004	0,746	0,027
179	Chad	0,004	0,746	0,022
180	Ethiopia	0,003	0,747	0,016
181	Central African Rep.	0,002	0,748	0,011
182	Niger	0,002	0,748	0,005

ICV calculations are made according to the ITU data by using four parameters: TD, MD, IUD, PCD. The similar calculations are made according to the 1999 data. Fig. 3 provides ICV dispersion curves in 1999 and 2003, plotted in accordance with the methodology, give in the previous Appendix.

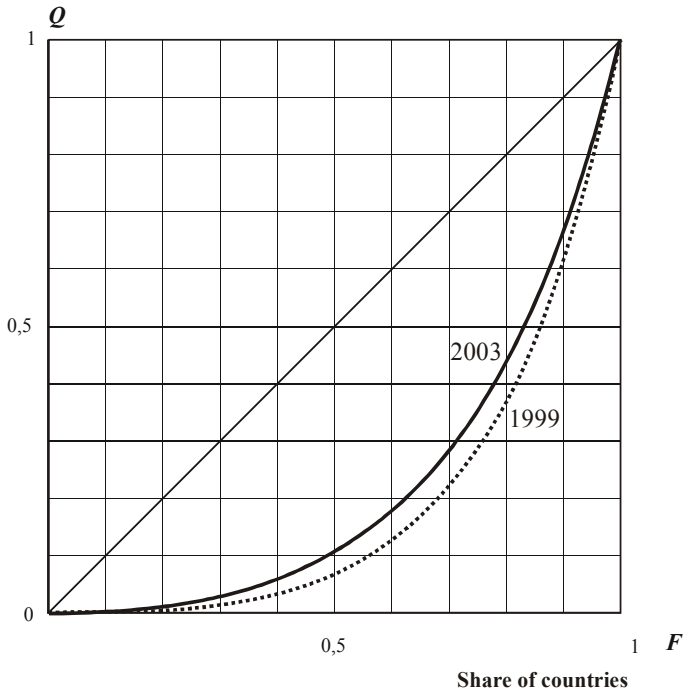

Fig. 3. Infocommunication Vector distribution (ICD) (dispersion curve) $Q(F)$ in 1999 and 2003

As it appears from Tab. 1 during the four years - from 1999 till 2003 – the ICV level has been increasing 1,33 times (as the ratio $A = 0,75/0,565$), i.e. the ICV increase makes up about 7% a year. Luxembourg's leading position was mainly promoted by two parameters: a very high mobile density MD = 1,061 or 106% and a high fixed telephone density TD = 0,797 or 80%. It is also to note, that Luxemburg takes the first place in the world according to the

GNP per capita, equal to 42,3 thousand US dollars. At the same time it is to stress that Luxembourg is a small country with a little territory; it is an advantage in comparison with big countries.

Tab. 2 provides numerical values of main parameters of dispersion curves, characterizing the values of the Digital Divide calculated in accordance with the described above methodology.

Table 2. ICV dispersion curves figures in 1999 and 2003

Years	1999	2003	Changes, %
Digital Divide Indicator, Δ_1	8,1	6,4	26
Divide between limiting groups – Digital Divide Indicator, Δ_2	38,9	22,8	71
Gini coefficient, K_G	0,59	0,55	7

Comparing the ICV dispersion curves in 1999 and 2003 (Fig. 3), it is to emphasize, that during the four years there has been a little improvement of the ICT distribution among countries of the World Community, that is illustrated in Tab.2. The divide estimation according to the levels of limiting Groups *H* and *L* (for "the very rich" and "the very poor") by dividing countries into four groups leads to essentially high values of the DDI in comparison with the two-group division of countries.

APPENDIX 3/A.6

ICT and ICV Distribution

Fig. 4 provides the estimated ICV dispersion curve and dispersion curves of its parameter components during 2003. It is to underline, that Fig. 4 also pictures the GNP per capita dispersion curves during the same year.

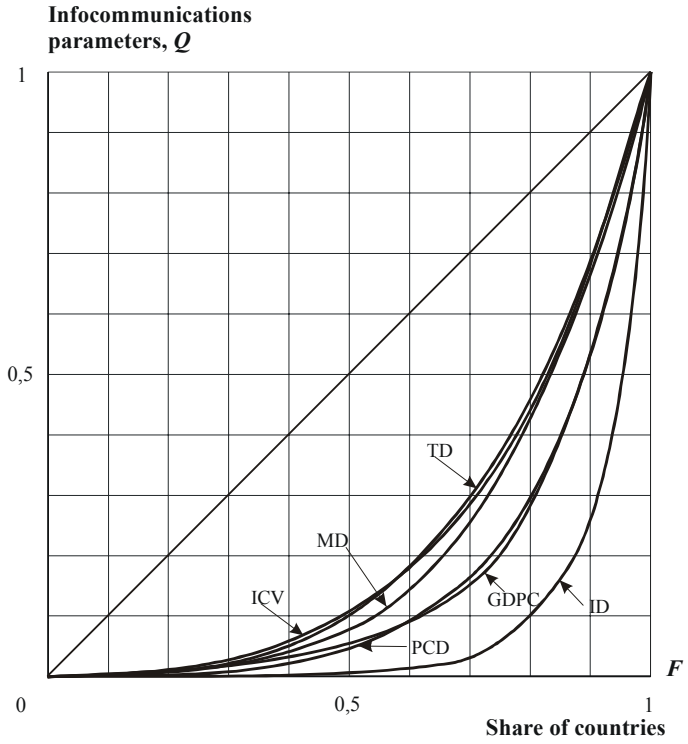

Fig. 4. ICT, ICV and GNP per capita dispersion curves2003 г.

Fig. 4 stresses, that the higher technologies are the more uneven they are distributed among countries.

APPENDIX 4/A.6

Digital Divide in Telephone Communication

Under *telephone communication* it is meant such communication, which is accomplished by fixed telephones (FT) as well as by mobile (cellular) telephones (MT), i.e. telephone communication – it is a set (for calculations only) of fixed and mobile telephone communication FMT. Let us consider that the number of subscriber terminals (or the number of users) FMT is equal to the total number of FT+MT. Such an approach has been used in ITU reports (reference books) recently.

Basing on the ITU data [5] a table for 206 countries was charted, which comprised of the following indices: the number of fixed telephones (FT), the number of mobile telephones (MT), the total number of telephones (FMT), the total density of telephones (FMD). The list was ranged according to the total density of telephones FMD. The normalized density of telephones (norm. FMD) V', non-normalized dispersion V and dispersion curve Q were evaluated in compliance with the posed above methodology. The interval between the neighboring countries makes up 1 / 206 = 0,0049. The derivative of the dispersion curve Q' is evaluated in accordance with the common rules of differentiation from Q.

Fig. 5 provides a plotted according to the given methodology graph, which represents a dispersion curve of the telephone communication distribution in 2002, plotted in compliance with the data.

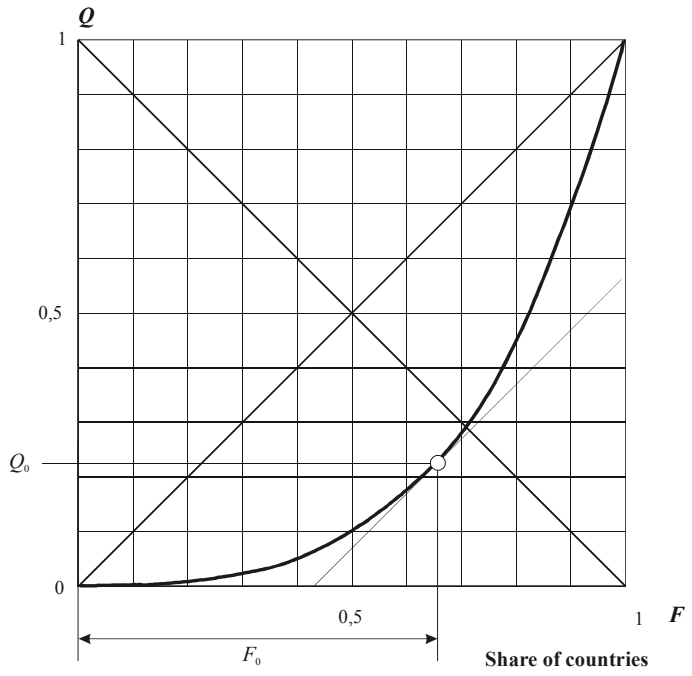

Fig. 5. Dispersion curve of telephone communication distribution (fixed and mobile telephones FMT) in the world in 2003

Fig. 5 detects, that by the two-group model of an analyzing group of countries the Digital Divide Indicator between the first and the second group is $\Delta_1 = Q'_1 / Q'_2 = 7$, the Gini coefficient is $K_G = 0{,}56$.

For the four-group models from parameters of two other tangency points it can be determined that the coefficient of divide makes up $\Delta_2 = 35$.

Fig. 6 pictures graphs of six dispersion functions of the following time periods 1982, 1992, 1996, 1999, 2002 and 2003, i.e. there is a period of 20 years, beginning with the Maitland Commission report [6] up to the ITU reports [4, 5, 7]. Tab. 3 provides digital characteristics of the dispersion curves represented in Fig. 6. Tab. 3 makes evident, that the Digital Divide Δ_1 estimated by the telephone communication has been decreasing during 20 years from 14,6 (1999) up to 7 (2003), i.e. there was a 2,1 decrease in the period.

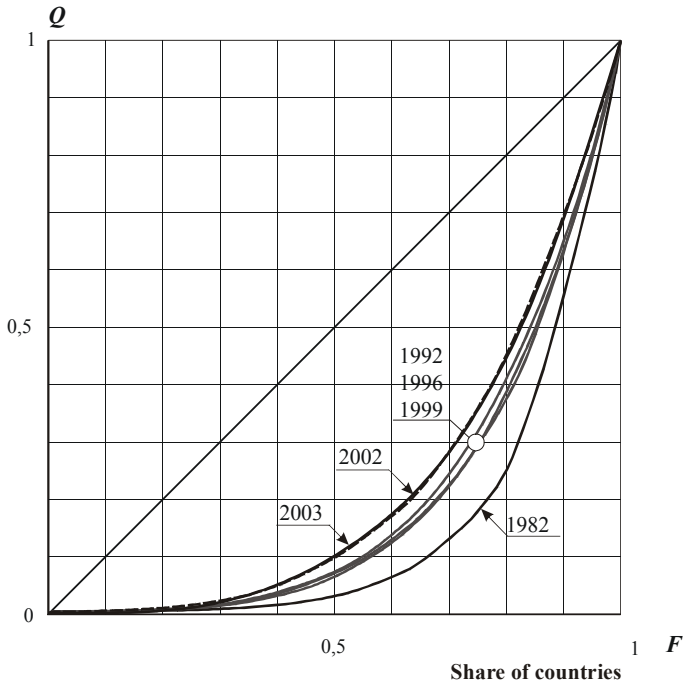

Fig. 6. Telephone communication dispersion curve (fixed and mobile telephones FMT) in the world during the period of 1982 - 2003

Table 3. Characteristics of telephone communication dispersion curves during the period of 1982–2002

Years	1982	1992	1996	1999	2002	2003
Number of countries	111	202	206	168	206	182
Digital Divide Indicator, Δ_1	14,5	9,3	8,5	9,1	7	6,4
Gini coefficient, K_G	0,71	0,62	0,6	0,62	0,56	0,55

It should be certainly mentioned, that such a result was the consequence of a long work carried out by governments of countries and by the International Telecommunication Union. Besides, a great contribution was made by the Maitland Commission report, which drew attention of governments and the international community on the misery of the telephone communication situation in developing countries.

APPENDIX 5/A.6

Digital and Economic Divide

Admitting the existence of the Digital Divide between developing and developed countries and the necessity of its reduction it is to emphasize that the *Digital Divide* is first of all a consequence of an *Economic Divide* [1, 2, 3]. Applying the developed ITU and World Bank methodology and data let us determine the Economic Divide

Fig. 7 provides a graph of the dispersion curve of the GNP per capita in 2003 plotted according with the developed method and the data provided in [3]. The number of countries makes up 182. The inequality (divide) coefficient $\Delta_1 = 12{,}3$, the Gini coefficient is $K_G = 0{,}68$. As it is evident from Fig. 7, the GNP per capita distribution is very uneven.

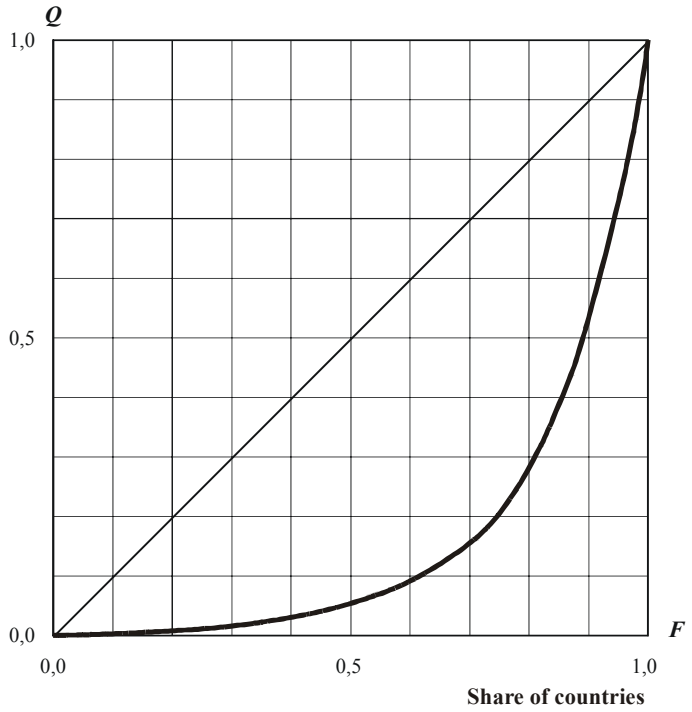

Fig. 7. Dispersion curve of Gross domestic product per capita (GNP per capita) in 2003
Statistic data source: ITU [7]. Calculation: ITA

Tab. 4 provides the distribution of 182 countries regarding to the level of the GNP per capita. There is also a four-group division *H*, *UM*, *LM*, *L*.

Tab. 4. GNP per capita distribution in 2003
Statistic data source: ITU [7] Calculations: ITA

	Country	GDP per capita (US$)	*Q*(*F*)	*F*
High GDP per capita Level (H)				
1	Luxembourg	47 255	1,000	1,000
2	Norway	42 149	0,959	0,995
3	Switzerland	36 738	0,923	0,989
4	United States	36 223	0,891	0,984
5	Denmark	32 033	0,860	0,978
6	Japan	31 324	0,832	0,973
7	Ireland	31 041	0,805	0,967
8	Qatar	28 295	0,778	0,962
9	Sweden	26 864	0,753	0,956
10	Iceland	26 617	0,730	0,951
11	United Kingdom	26 369	0,707	0,945
12	Netherlands	25 866	0,684	0,940
13	Austria	25 393	0,662	0,934
14	Finland	25 314	0,640	0,929
15	Germany	24 122	0,618	0,923
16	France	24 057	0,597	0,918
17	Hong Kong, China	24 014	0,576	0,912
18	Belgium	23 681	0,556	0,907
19	Canada	23 417	0,535	0,901
20	Italy	21 024	0,515	0,896
21	Singapore	20 894	0,497	0,890
22	Australia	20 230	0,479	0,885
Upper Middle GDP per capita Level (UM)				
23	United Arab Emirates	18 919	0,461	0,879
24	French Polynesia	16 613	0,445	0,874
25	Spain	16 091	0,430	0,868
26	Israel	15 619	0,416	0,863
27	Bahamas	15 442	0,403	0,857
28	Macao, China	15 249	0,390	0,852
29	Kuwait	15 140	0,376	0,846
30	New Zealand	14 820	0,363	0,841
31	Cyprus	14 194	0,350	0,835
32	New Caledonia	13 940	0,338	0,830
33	Taiwan, China	12 471	0,326	0,824
34	Brunei Darussalam	12 447	0,315	0,819
35	Greece	12 084	0,305	0,813
36	Portugal	11 800	0,294	0,808
37	Bahrain	11 312	0,284	0,802
38	Argentina	11 180	0,274	0,797
39	Slovenia	11 020	0,264	0,791
40	Korea (Rep.)	10 014	0,255	0,786
41	Malta	9 839	0,246	0,780
42	Barbados	9 500	0,238	0,775
43	Antigua & Barbuda	9 103	0,230	0,769

	Country	GDP per capita (US$)	*Q*(*F*)	*F*
44	Seychelles	8 647	0,222	0,764
45	Saudi Arabia	8 571	0,214	0,758
46	Oman	8 097	0,207	0,753
47	St. Kitts and Nevis	7 450	0,200	0,747
48	Trinidad & Tobago	7 166	0,193	0,742
49	Czech Republic	6 852	0,187	0,736
50	Hungary	6 486	0,181	0,731
Lower Middle GDP per capita Level (LM)				
51	Mexico	6 252	0,176	0,725
52	Iran (I.R.)	5 876	0,170	0,720
53	Croatia	5 125	0,165	0,714
54	Venezuela	5 105	0,161	0,709
55	Lebanon	4 988	0,156	0,703
56	Poland	4 902	0,152	0,698
57	Estonia	4 732	0,148	0,692
58	Chile	4 413	0,144	0,687
59	Slovak Republic	4 404	0,140	0,681
60	Grenada	4 348	0,136	0,676
61	Equatorial Guinea	4 289	0,132	0,670
62	St. Lucia	4 201	0,128	0,665
63	Costa Rica	4 064	0,125	0,659
64	Lithuania	3 977	0,121	0,654
65	Mauritius	3 957	0,118	0,648
66	Malaysia	3 870	0,114	0,643
67	Panama	3 812	0,111	0,637
68	Uruguay	3 640	0,108	0,632
69	Gabon	3 611	0,105	0,626
70	Latvia	3 597	0,102	0,621
71	Libya	3 484	0,098	0,615
72	Dominica	3 256	0,095	0,610
73	Jamaica	3 206	0,093	0,604
74	Belize	3 128	0,090	0,599
75	St. Vincent	3 028	0,087	0,593
76	Botswana	2 939	0,085	0,588
77	Turkey	2 722	0,082	0,582
78	Brazil	2 603	0,080	0,577
79	Dominican Rep.	2 586	0,077	0,571
80	Russia	2 370	0,075	0,566
81	South Africa	2 293	0,073	0,560
82	Maldives	2 258	0,071	0,555
83	El Salvador	2 203	0,069	0,549
84	Tunisia	2 152	0,067	0,544
85	Peru	2 124	0,065	0,538
86	Romania	2 107	0,064	0,533
87	Fiji	2 068	0,062	0,527
88	Thailand	2 044	0,060	0,522
89	Bulgaria	1 992	0,058	0,516

	Country	GDP per capita (US$)	$Q(F)$	F
90	Guatemala	1 939	0,056	0,511
91	Marshall Islands	1 893	0,055	0,505
92	Colombia	1 874	0,053	0,500
93	Suriname	1 860	0,051	0,495
94	Algeria	1 787	0,050	0,489
95	Jordan	1 742	0,048	0,484
96	TFYR Macedonia	1 705	0,047	0,478
	Low GDP per capita Level (L)			
97	Namibia	1 523	0,045	0,473
98	Cuba	1 518	0,044	0,467
99	Kazakhstan	1 485	0,043	0,462
100	Serbia and Montenegro	1 451	0,041	0,456
101	Belarus	1 438	0,040	0,451
102	Samoa	1 428	0,039	0,445
103	Cape Verde	1 407	0,038	0,440
104	Albania	1 332	0,036	0,434
105	Tonga	1 322	0,035	0,429
106	Egypt	1 260	0,034	0,423
107	Bosnia	1 232	0,033	0,418
108	Morocco	1 218	0,032	0,412
109	Syria	1 185	0,031	0,407
110	Swaziland	1 130	0,030	0,401
111	Vanuatu	1 113	0,029	0,396
112	Ecuador	1 076	0,028	0,390
113	Turkmenistan	988	0,027	0,385
114	Honduras	980	0,026	0,379
115	Philippines	969	0,025	0,374
116	Paraguay	967	0,025	0,368
117	Congo	967	0,024	0,363
118	China	963	0,023	0,357
119	Bolivia	935	0,022	0,352
120	Djibouti	894	0,021	0,346
121	Palestine	873	0,020	0,341
122	Sri Lanka	863	0,020	0,335
123	Indonesia	860	0,019	0,330
124	Guyana	828	0,018	0,324
125	Ukraine	827	0,017	0,319
126	Bhutan	734	0,017	0,313
127	Angola	715	0,016	0,308
128	Cote d'Ivoire	711	0,016	0,302
129	Georgia	673	0,015	0,297
130	Cameroon	670	0,014	0,291
131	Armenia	623	0,014	0,286
132	Solomon Islands	611	0,013	0,280
133	Yemen	513	0,013	0,275
134	Senegal	506	0,012	0,269
135	Azerbaijan	497	0,012	0,264

	Country	GDP per capita (US$)	$Q(F)$	F
136	India	494	0,011	0,258
137	Nicaragua	470	0,011	0,253
138	Mongolia	439	0,011	0,247
139	Viet Nam	429	0,010	0,242
140	Pakistan	428	0,010	0,236
141	Sudan	426	0,009	0,231
142	Benin	413	0,009	0,225
143	Nigeria	409	0,009	0,220
144	Kenya	391	0,008	0,214
145	Guinea	381	0,008	0,209
146	Haiti	380	0,008	0,203
147	Mauritania	365	0,007	0,198
148	Bangladesh	352	0,007	0,192
149	Zambia	338	0,007	0,187
150	Moldova	337	0,006	0,181
151	S. Tome & Principe	331	0,006	0,176
152	Lesotho	330	0,006	0,170
153	Lao P.D.R.	328	0,006	0,165
154	Mali	318	0,005	0,159
155	Kyrgyzstan	315	0,005	0,154
156	Comoros	303	0,005	0,148
157	Togo	301	0,004	0,143
158	Tanzania	282	0,004	0,137
159	Madagascar	277	0,004	0,132
160	Gambia	270	0,004	0,126
161	Central African Rep.	265	0,003	0,121
162	Uzbekistan	257	0,003	0,115
163	Cambodia	254	0,003	0,110
164	Uganda	243	0,003	0,104
165	Nepal	237	0,003	0,099
166	Burkina Faso	220	0,002	0,093
167	Mozambique	217	0,002	0,088
168	Chad	212	0,002	0,082
169	Rwanda	210	0,002	0,077
170	Ghana	209	0,002	0,071
171	Sierra Leone	199	0,001	0,066
172	Malawi	192	0,001	0,060
173	Tajikistan	188	0,001	0,055
174	Guinea-Bissau	173	0,001	0,049
175	Niger	165	0,001	0,044
176	Myanmar	148	0,001	0,038
177	Eritrea	146	0,001	0,033
178	D.R. Congo	143	0,000	0,027
179	Papua New Guinea	111	0,000	0,022
180	Ethiopia	96	0,000	0,016
181	Burundi	89	0,000	0,011
182	Zimbabwe	65	0,000	0,005

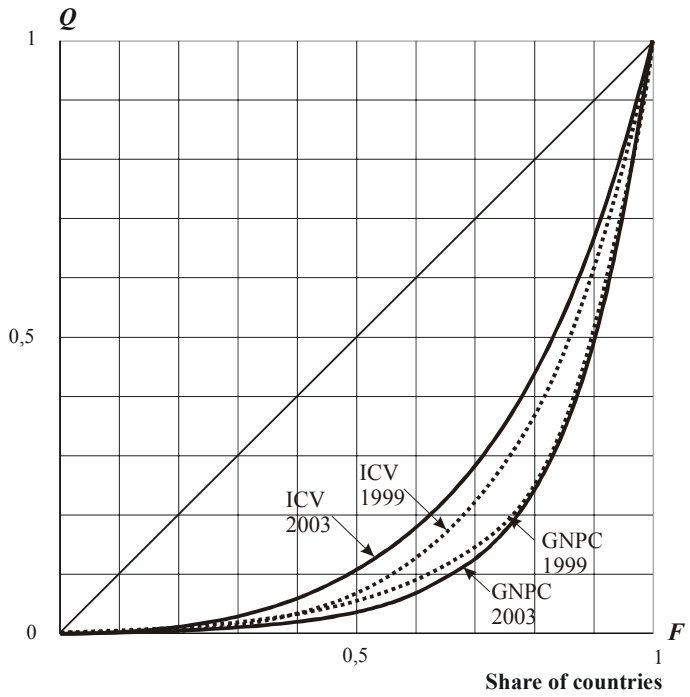

Fig. 8. Dispersion curve of infocommunication vector (ICV)
and Gross national product per capita during the time period of 1999 and 2003
1999
2003

Fig. 8 illustrates graphs of GNP per capita dispersion curves during the time periods of 1999 and 2003 plotted according to [3]. Practically all the curves overlap, i.e. during 4 years the Economic Divide hasn't changed practically. Tab. 5 provides characteristics of dispersion curves (Fig. 7). Comparing the data on the Divide of Tab. 3 and Tab. 5, it is evident, that the Digital Divide has been decreasing 1,5 times from 9,3 up to 6,4 during 12 years, and the Economic Divide is twice more than the Digital Divide by 2003 .

Table 5. Characteristics
of GNP per capita dispersion curves

Year	1992	1996	1999	2002	2003
Divide between groups, Δ_0	14,1	15,1	13.3	13,4	12,3
Gini coefficient, K_G	0,71	0,72	0,69	0,69	0,68

Fig. 8 provides graphs of ICV as well GNP per capita dispersion curves during the period of 1999 and 2003. As it is evident from Fig. 8, the ICV dispersion curves have been removing to the diagonal during three years, and the GNP per capita dispersion curves have practically remained unchanged. It also follows from Fig. 8, that the ICV distribution is more even (more democratic) than the GNP per capita distribution, i.e. ICT are more available in developing countries than economic resources. It can be explained by the fact that the equipment prices and service tariffs are reducing with time. It leads to the deeper ICV distribution.

Table 6. Digital and Economic Divide

Years		**1999**	**2003**
Digital Divide,	Δ_1	8,1	6,4
	K_G	0,59	0,55
Economic Divide,	Δ_1	13,3	12,3
	K_G	0,69	0,68

For the purpose of obviousness Tab. 6 provides main parameters of the Digital and Economic Divide – Divide Δ_1 and Gini coefficient K_G plotted in accordance with the data of Tab. 3 and 5. Tab. 6 asserts that the Economic Divide is deeper than the Digital Divide. Furthermore, the reduction of the Digital Divide, as it was already mentioned above, made up 29%, while the economic Divide remained practically unchanged.

Thus, the represented methodology of measuring the Digital Divide based on applying of mathematical instruments namely dispersion curves, practically made it possible to determine (measure) the Digital as well as Economic Divide.

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