THE MEASURING OF THE GINI, THEIL AND ATKINSON INDICES FOR GEORGIA REPUBLIC AND SOME OTHER COUNTRIES

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When studying the economic structure of society qualitative and quantitative methods are closely related to each other. In particular when analyzing the economic structure of society inequality indices such as the (generalized) Gini index, the Hoover index, the first and second Theil indices, the first and second Atkinson indices and others are used. In this article we investigate the relationship between these indices and in some cases prove that they can be calculated by different formulas. In addition these indices will be calculated for the following countries: Azerbaijan, Armenia, China, Estonia, France,Georgia, Germany, Greece, Iran, Israel, Italy, Japan, Latvia, Lithuania, Moldova, Russia, Turkey, Ukraine and the United States.

For the economic interpretation of these quantitative data, a conceptual, qualitative analysis of economic categories, such as a poverty, a middle class, an unemployment, an employment, a subsistence level, etc., is needed, without knowledge of which it is impossible to use these indicators wisely.

Consider, for example, the poverty and the socialexclusion. "The poverty" in the European Union in 1975 was defined [11] as follows:“*People are said to be living in poverty if their income and resources are so inadequate as to preclude them from having a standard of living considered acceptable in the society in which they live. Because of their poverty they may experience multiple disadvantages through unemployment, low income, poor housing, inadequate health care and barriers to lifelong learning, culture, sport and recreation. They are often excluded and marginalized from participating in activities (economic, social and cultural) that are the norm for other people and their access to fundamental rights may be restricted.”*

In 2002, Eurostat proposed a conceptual framework for measuring social exclusion (Eurostat, 2002), according to which income poverty is one aspect of social exclusion.

We believe that on the basis of calculated by us inequality indices we can better analyze the economic structure of the Georgian society.

Let us consider the classification of the inequality indices based on the axiomatic approach ([3], [10]). Not all inequality indices satisfy these axioms; therefore they must be considered as reasonable conditions, which must be satisfied by the quantitative characteristics under consideration.

1. The Pigou-Dalton principle of transfers: “Inequality indexes should fall with a progressive transfer, i.e., an income transfer from richer to poorer individuals; Inequality indexes should rise with a regressive transfer, i.e. an income transfer from poorer to richer individuals” [3].
2. Scale invariance: “Scale invariance requires the inequality index to be invariant to equi-proportional changes of the original incomes” [3].
3. Translation invariance: “Translation invariance requires the inequality index to be invariant to uniform additions or subtractions to original incomes” [3].
4. The principle of population: “The principle of population axiom requires the inequality index to be invariant to replications of the original population” [3].
5. Decomposability: “In any case, the decomposability axiom requires a consistent relation between overall inequality and its parts. If the original income distribution y is composed by, say, n groups, and has an overall inequality I(y) it must be that:

$$I(y)=\sum_{i=1}^{n} w_i I(y_i)+B ,$$

where w_i and the “between group” term B depend only on subgroup means and population sizes [10].

The Gini coefficient. The Gini coefficient was developed by the Italian statistician and sociologist Corrado Gini ([2], [4], [12]) in 1912. It measures income inequality in the society. In generally Gini coefficient is a macro economical statistical characteristic which shows the degree of stratification of society with respect to the distribution of some good and represents the ratio of the actual distribution of this good to an absolutely equality distribution. If the Gini coefficient is equal to 0, then the actual distribution is theperfect equality and if the Gini coefficient is equal to 1 then the inequality is maximal. The Gini coefficient multiplied on 100 is called The Gini index and it represents a measure of inequality by percents.

We consider two ways of describing the discrete Gini index:

1.Using the Lorentz curve;

2. With the help of a covariance.

In the first case the Gini indexis defined based on the Lorenz curve.Lorenz curve (the AB curve on the Diagram 1) plots the proportionof the total income of the population (y axis) that is cumulativelyearned by the bottom x% of the population(Diagram 1). The plot of the function y=x thus represents the equality of incomes. Thenthe Gini index is the ratio of the area of the figure between the line y=x and the Lorenz curve to the area under the line of equality y=x, i.e. $G = S_L / S_{\vee ABC} = 2S_L$ because $S_{\vee ABC} = 0.5$.

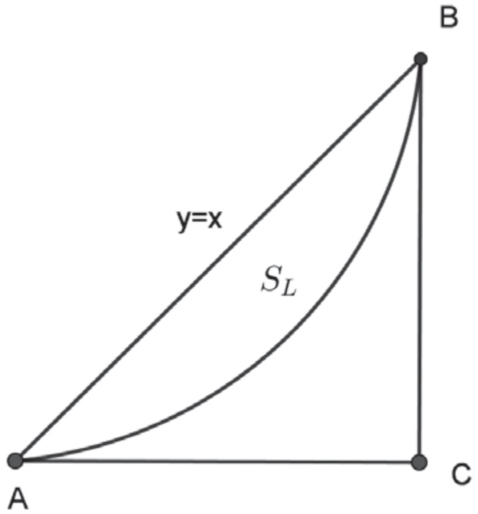

Diagram 1. Lorenz curve

Let $L(x)$ denotes the Lorenz curve and *S* an area of the figure under $L(x)$, then by Newton-Leibniz formula

$$S = \int_0^1 L(x)\,\mathrm{dx}$$

and consequently

$$G = 1 - 2\int_0^1 L(x)dx \ .$$

In the practice Lorenz curve often is an angled line and it is more convenient to calculate it without using the integral calculus. Namely let a p_i part of the society($i = 1,2,...,n$, $p_1 + p_2 + ... + p_n = 1$)uses a q_i part of some goods($i = 1,2,...,n$, $q_1 + q_2 + ... + q_n = 1$) or in cumulative form $r_i = p_1 + p_2 + ... + p_i$ part of society uses $s_i = q_1 + q_2 + ... + q_i$ part of goods, $i = 1,2,...,n$. Then [2]

$$G = 1 - \sum_{i=1}^{n} (\mathrm{r}_i - r_{i-1})(\mathrm{s}_i + s_{i-1}) \, .$$

It is easy to show that Gini coefficient satisfies 1, 2 and 4 axioms.

The Gini index can also be calculated using covariance. The covariance of two random values

$$X = \begin{pmatrix} x_1, & x_2, & ..., & x_n \\ p_1, & p_2, & ..., & p_n \end{pmatrix}, \quad Y = \begin{pmatrix} y_1, & y_2, & ..., & y_n \\ q_1, & q_2, & ..., & q_n \end{pmatrix},$$

is

$$\mathrm{cov}(\mathrm{X},\mathrm{Y}) = E[(X - E[X])(\mathrm{Y} - \mathrm{E}[\mathrm{Y}])] = E[\mathrm{XY}] - E[X]E[Y]$$

where $E[X]$ isan expected value.

Proposition1. Let

$p_1 = p_2 = ... = p_n = 1/n$, $q = (q_1, q_2, ..., q_n)$, $q_1 \le q_2 \le ... \le q_n$;

then Gini coefficient may be calculated by the formula

$$G = \frac{2}{E(q)} Cov(q, F(q))$$

where $F(q) = \left(\frac{1}{n}, \frac{2}{n}, ..., \frac{n}{n}\right)$.

Proof. By definition

$$q \cdot F(q) = \left(\frac{q_1}{n}, \frac{2q_2}{n}, ..., \frac{nq_n}{n}\right).$$

Therefore

$$E(q \cdot F(q)) = \frac{q_1/n + 2q_2/n + ... + nq_n/n}{n} = \frac{q_1 + 2q_2 + ... + nq_n}{n^2}.$$

Since $q_1 + q_2 + ... + q_n = 1$ therefore

$$E(q) = \frac{q_1 + q_2 + ... + q_n}{n} = \frac{1}{n},$$

$$E(F(q)) = \frac{1/n + 2/n + ... + n/n}{n} = \frac{1 + 2 + ... + n}{n^2} = \frac{n(n+1)}{2n^2} = \frac{n+1}{2n},$$

$$E(q \cdot F(q)) - E(q)E(F(q)) = \frac{q_1 + 2q_2 + ... + nq_n}{n^2} - \frac{q_1 + q_2 + ... + q_n}{n} \cdot \frac{n+1}{2n} = \frac{q_1 + 2q_2 + ... + nq_n}{n^2} - \frac{n+1}{2n^2}.$$

Since

$$\frac{2}{E(q)} = \frac{2n}{q_1 + q_2 + ... + q_n} = 2n,$$

therefore $G = \frac{2}{E(q)} \operatorname{cov}(q, F(q)) = 2n\left(\frac{q_1 + 2q_2 + ... + nq_n}{n^2} - \frac{n+1}{2n^2}\right) = \frac{2(q_1 + 2q_2 + ... + nq_n) - (n+1)}{n}$.

Let us calculate now the Gini coefficient by the Lorenz curve which is the angled line.The figure under Lorenz curve consists by one triangle and several trapezoids with the same heights. These heights are equal to $\frac{1}{n}$. Then an area of this figure is

$$\frac{1}{n}(q_1 + (q_1 + (q_1 + q_2)) + ((q_1 + q_2) + (q_1 + q_2 + q_3)) + ... +$$
$$+((q_1 + q_2 + ... + q_{n-1}) + (q_1 + q_2 + ... + q_{n-1} + q_n))) =$$
$$= \frac{1}{n}(q_1 + (2q_1 + q_2) + (2q_1 + 2q_2 + q_3) + ... + (2q_1 + 2q_2 + ... + 2q_{n-1} + q_n)) =$$
$$= \frac{1}{n}((1 + 2(n-1))q_1 + (1 + 2(n-2))q_2 + (1 + 2(n-3))q_3 + ... + (1 + 2(n-n))q_n) =$$
$$= \frac{1}{n}((q_1 + q_2 + ... + q_{n-1} + q_n) + 2((n-1)q_1 + (n-2)q_2 + (n-3)q_3 + ... + (n-n)q_n) =$$
$$= \frac{1}{n}(1 + 2(n(q_1 + q_2 + ... + q_{n-1}) - (q_1 + 2q_2 + ... + (n-1)q_{n-1})) =$$
$$= \frac{1}{n}(1 + 2n(1 - q_n) - 2(q_1 + 2q_2 + ... + (n-1)q_{n-1})) =$$
$$= \frac{1}{n}(1 + 2n - 2nq_n - 2(q_1 + 2q_2 + ... + (n-1)q_{n-1})) =$$
$$= \frac{1 + 2n - 2(q_1 + 2q_2 + ... + (n-1)q_{n-1} + nq_n)}{n}.$$

So

$$G = 1 - 2B = 1 - \frac{1 + 2n - 2(q_1 + 2q_2 + ... + (n-1)q_{n-1} + nq_n)}{n} =$$
$$= \frac{2(q_1 + 2q_2 + ... + (n-1)q_{n-1} + nq_n) - (n+1)}{n}.$$

Therefore calculating of the coefficient using the Lorenz curve and the variance gives the same results.We have four formulas for calculating Gini coefficient:

1) $G = \frac{2(q_1 + 2q_2 + ... + (n-1)q_{n-1} + nq_n) - (n+1)}{n}$ - by the parts;

2) $G = 1 - \sum_{i=1}^{n} (r_i - r_{i-1})(s_i + s_{i-1})$ - by the cumulative parts;

3) $G = \frac{2}{E(q)} Cov(q, F(q))$ - by the covariance;

4) $G = 1 - 2\int_0^1 L(x)dx$ - by the integral.

Since it is difficult to find examples of calculating the Gini coefficient in the Georgian economic literature, we calculated it for different countries by the distribution of GDP (Gross domestic product). We used World Bank data published in 2016 and in 2018 (see Table 1).Comparison of our calculations to the results of the World Bank, the Statistical Office of Georgian Republic (GeoStat) and the Central Intelligence Agency of the USA shows that the difference between them is palpable (see Table 2).

	r_1 =0.1	r_2 =0.2	r_3 =0.4	r_4 =0.6	r_5 =0.8	r_6 =0.9	r_7 =1
	s_1	s_2	s_3	s_4	s_5	s_6	s_7
Georgia 2013	0.021	0.056	0.161	0.315	0.54	0.701	1
Georgia 2016	0.026	0.067	0.182	0.342	0.564	0.719	1
USA 2013	0.018	0.052	0.155	0.309	0.536	0.698	1
USA 2016	0.016	0.05	0.152	0.305	0.53	0.694	1
Russia 2012	0.023	0.059	0.16	0.305	0.517	0.678	1
Russia 2015	0.028	0.069	0.18	0.332	0.547	0.703	1
Azerbaijan 2005	0.035	0.084	0.21	0.375	0.595	0.743	1
Armenia 2013	0.035	0.085	0.211	0.377	0.597	0.744	1
Armenia2016	0.033	0.079	0.2	0.37	0.598	0.747	1

Table 1. Distribution of GDP (World Bank)

	Our	GeoStat	World Bank	CIA of USA
Georgia 2013	38.6	39	40.0	46 (2011) 37.6 (1991)
Georgia 2016	35.2	39	36.5	40.1(2014)
USA, 2013	39.5		41.1	
USA, 2016	40.1		41.5	
Russia 2012	40.1		41.6	
Russia 2015	36.4		37.7	
Azerbaijan 2005	16.1		16.6	
Armenia 2013	30.4		31.5	
Armenia 2016	31.3		32.5	

Table 2. Gini coefficient: Our, Geostat, World Bank [7], CIA of USA [8]

The insignificant difference between the Gini coefficient of Georgia and developed countries is explained by the fact that the Gini coefficient satisfies the second Scale invariance axiom.

			Gini		General. Gini	
	Countries	Years	WB	Our	v=3	v=4
1	Azerbaij.	2005	16.6	16.1	19.8	21.4
2	Ukraine	2016	25	24.2	29.8	32.1
3	Moldova	2016	26.3	25.4	30.7	32.9
4	Belarus	2016	27	26.0	31.5	33.8
5	Norway	2015	27.5	26.5	32.7	35.4
6	Sweden	2015	29.2	28.1	34.8	37.8
7	Germany	2015	31.7	30.6	37.2	39.8
8	Poland	2015	31.8	30.8	37.2	39.6
9	Japan	2008	32.1	31.0	38.0	40.9
10	Armenia	2016	32.5	31.3	37.9	40.3
11	Switzerl.	2014	32.5	31.4	37.9	40.4
12	Estonia	2015	32.7	31.7	38.7	41.4
13	Unit. Kingdom	2015	33.2	31.9	38.8	41.5
14	Tajikistan	2015	34	32.9	39.5	42.0
15	Latvia	2015	34.2	32.9	39.9	42.7
16	Italy	2014	34.7	33.5	41.3	44.6
17	India	2011	35.1	33.6	38.7	40.3
18	Uzbekistan	2003	35.3	34.0	40.2	42.4
19	Greece	2015	36	34.7	42.7	45.9
20	Spain	2015	36.2	34.9	43.0	46.3
21	Georgia	2016	36.5	35.2	42.0	44.5
22	Lithuania	2015	37.4	36.2	43.4	46.1
23	Russian	2015	37.7	36.4	42.7	44.7
24	Iran	2014	38.8	37.4	44.1	46.4
25	Turkmen.	1998	40.8	39.4	45.9	47.8
26	Israel	2012	41.4	40.0	48.1	51.1
27	United States	2016	41.5	40.1	47.8	50.5
28	Turkey	2016	41.9	40.5	47.2	49.3
29	China	2010	42.6	40.7	48.8	51.6

Table 3. Thegeneralized Gini index

Table 3 shows the results of our calculations of the Gini index and the generalized Gini index of different World countries when $\nu = 3$ and $\nu = 4$. Let us remark that if $\nu = 2$, then the generalized Gini index coincides to Gini index.

The generalized Gini index[2] in the notations from 3) is calculated by the formula

$$G(\nu) = -\frac{\nu}{E(\mathrm{q})} Cov(\mathrm{q}, (1 - F(\mathrm{q}))^{\nu-1})$$

where ν is the coefficient of an inequalityaversion. Note that ifv=2, then the generalized Gini indexis equal to the standard Gini Index $G(2) = G$ because $\mathrm{cov}(x, 1-y) = -\mathrm{cov}(x, y)$. When the coefficient of inequality a version increases, the generalized Gini index increases too i.e. $G(\nu)$ is an increasing function of the variable ν.

The Hoover index [6] is equal to the portion of the total community income that would have to be redistributed (taken from the richer part of the population and given to the poorer part) for there to be income perfect equality.

The Hoover index is often called the Robin Hood index. Like the Gini coefficient the Hoover index may be calculated by the Lorenz curve. Therefore there exists a correlation between the Gini and Hoover indices. In particular the Hoover index as the Gini index satisfies first, second and fourth axioms.

Proposition 3. The Hoover index is calculated by the formula

$$H = \frac{1}{2} \sum_{i=1}^{n} \left| \frac{E_i}{E_t} - \frac{A_i}{A_t} \right|$$

where E_i is an income of i-th quantile, E_{total} is the sum of all E_i, A_i is the number of individuals in i-th quantile, A_{total} is the sum of all A_i. The Hoover index is equal to the maximum distance between the perfect equality distribution line and the Lorenz curve or to the maximum length of the vertical line segment which connects theperfect equalitydistribution line and the Lorenz curve.Then the income will be equalizedin the society if we redistribute the incomes corresponding to the figure that finds on the right of this vertical.

Remark.The Hoover index can be calculated also from formula

$$H = \frac{1}{2}\sum_{i=1}^{n}|q_i - p_i|$$

where the p_i part of the society uses the q_i part of the good.

Proof.Without loss of generality we may assume that the indices are ordered so that

$$\frac{E_1}{A_1} \lhd \frac{E_2}{A_2} \lhd \ldots \lhd \frac{E_N}{A_N}.$$

It is clear that if the distribution of the goods is the perfect equality then everyone will get $\frac{E_t}{A_t} = \frac{E_{total}}{A_{total}}$ good.Suppose i_0 is the index such that $\frac{E_t}{A_t} - \frac{E_{i_0}}{A_{i_0}} \geq 0$ and $\frac{E_t}{A_t} - \frac{E_{i_0+1}}{A_{i_0+1}} \lhd 0$.Therefore in order for the distribution to be made perfect equality $A_i, A_2, \ldots, A_{i_0}$ quantiles must be get

$$A_1(\frac{E_t}{A_t} - \frac{E_1}{A_1}) = \frac{A_1 E_t}{A_t} - E_1,\ A_2(\frac{E_t}{A_t} - \frac{E_2}{A_2}) = \frac{A_2 E_t}{A_t} - E_2, \ldots,\ A_{i_0}(\frac{E_t}{A_t} - \frac{E_{i_0}}{A_{i_0}}) = \frac{A_{i_0} E_t}{A_t} - E_{i_0}$$

good or totally

$$E_0 = (\frac{A_1 E_t}{A_t} - E_1) + (\frac{A_2 E_t}{A_t} - E_2) + \ldots + (\frac{A_{i_0} E_t}{A_t} - E_{i_0}).$$

Let us suppose $i > i_0$. Any person from the i-th quantile has $\frac{E_i}{A_i}$ good which is greater than $\frac{E_t}{A_t}$. After balancing each of them loses $\frac{E_i}{A_i} - \frac{E_t}{A_t}$ good, and whole quantile lose $A_i(\frac{E_i}{A_i} - \frac{E_t}{A_t}) = E_i - \frac{A_i E_t}{A_t}$ good.

So all "rich" persons lose

$$E_1 = (E_{i_0+1} - \frac{A_{i_0+1} E_t}{A_t}) + \ldots + (E_n - \frac{A_n E_t}{A_t}).$$

Since $E_0 = E_1$ therefore

$$E_0 = \frac{1}{2}(E_0 + E_1) = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{A_i E_t}{A_t} - E_i\right|.$$

Therefore the Hoover index is equal to

$$H = \frac{E_0}{E_t} = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{A_i}{A_t} - \frac{E_i}{E_t}\right|.$$

The second part of Proposition 3 is easy.

Using the resulting formula and based on World Bank data, we calculated the Hoover index for 22 countries (see Table 4).

			Gini WB	Gini our	Hoover	Teil 0	Teil 1	Atkins. 1	Atkins. 2
1	Azerbaij.	2005	16.6	16.1	11.7	0.042	0.043	0.042	0.041
2	Ukraine	2016	25	24.2	17.6	0.095	0.097	0.092	0.091
3	Moldova	2016	26.3	25.4	18.5	0.105	0.110	0.104	0.100
4	Belarus	2016	27	26.0	18.8	0.111	0.115	0.108	0.105
5	Norway	2015	27.5	26.5	19.2	0.119	0.117	0.110	0.112
6	Sweden	2015	29.2	28.1	20.3	0.137	0.132	0.123	0.128
7	Germany	2015	31.7	30.6	22.3	0.158	0.157	0.145	0.146
8	Poland	2015	31.8	30.8	22.6	0.157	0.158	0.147	0.145
9	Japan	2008	32.1	31.0	22.4	0.167	0.161	0.149	0.154
10	Armenia	2016	32.5	31.3	23	0.163	0.163	0.151	0.150
11	Switzerl.	2014	32.5	31.4	23.1	0.164	0.166	0.153	0.152
12	Estonia	2015	32.7	31.7	23.6	0.172	0.165	0.152	0.158
13	United Kingdom	2015	33.2	31.9	23.5	0.173	0.170	0.156	0.159
14	Tajikistan	2015	34	32.9	24.2	0.181	0.182	0.166	0.166
15	Latvia	2015	34.2	32.9	24.2	0.189	0.183	0.167	0.172
16	Italy	2014	34.7	33.5	24.3	0.207	0.188	0.171	0.187
17	India	2011	35.1	33.6	24.5	0.186	0.205	0.185	0.169
18	Uzbekistan	2003	35.3	34.0	24.8	0.194	0.201	0.182	0.176
19	Greece	2015	36	34.7	25.3	0.223	0.202	0.183	0.200
20	Spain	2015	36.2	34.9	25.5	0.226	0.204	0.184	0.202
21	Georgia	2016	36.5	35.2	25.8	0.211	0.211	0.190	0.190
22	Lithuania	2015	37.4	36.2	26.4	0.232	0.224	0.201	0.207
23	Russian	2015	37.7	36.4	26.8	0.221	0.229	0.205	0.199
24	Iran	2014	38.8	37.4	27.5	0.239	0.239	0.213	0.212
25	Turkmen.	1998	40.8	39.4	29.1	0.262	0.269	0.236	0.230
26	Israel	2012	41.4	40.0	29.6	0.294	0.268	0.235	0.255
27	United States	2016	41.5	40.1	29.5	0.295	0.274	0.240	0.255
28	Turkey	2016	41.9	40.5	29.9	0.281	0.283	0.246	0.245
29	China	2010	**42.6**	40.7	30.3	0.303	0.278	0.243	0.261

Table 4. Table of Gini, Hoover, Theil and Atkinson indices

It is believed that the normal value of index is 20 percent. This value is approximately equal to the indicators of Ukraine, Germany, Moldova, Japan. In Georgia there should be a redistribution of 28.5 percent of the good, in Russia 29.5, in the USA 29.2.

The Theil indexis used to measure income inequality, lack of diversity, isolation, segregation, non-randomness, compressibility, irrigation system, software metrics andother phenomena. It was introduced ([5], [9]) in 1967 by Dutch econometrician Henri Theil and is based on the concept ofthe information entropy.

Compared to the Gini index, the Theil index has the advantage – it is decomposable, i.e. the Theil index is a weighted average of inequality within subgroups, plus inequality among those subgroups i.e. it satisfies 5-th axiom.

There exist two Theil index. For the population of N persons with X_i as income of i-th person these indices calculated by formulas

$$T_1 = \frac{1}{N}\sum_{i=1}^{n}\left(\frac{X_i}{\overline{X}} \cdot \ln \frac{X_i}{\overline{X}}\right),$$

$$T_0 = \frac{1}{N}\sum_{i=1}^{n}\left(\ln \frac{\overline{X}}{X_i}\right)$$

where $\overline{X} = \frac{1}{N}\sum_{i=1}^{n} X_i$ is the mean income.If an income distribution is the perfect equality then the Theil index is equal to 0.If all incomes are concentrated in the hands of one person, then the Theil index is equal to $\ln N$. Sometimes T_1 is called the Theil index and T_0 is called the mean logarithmic deviation.

The Theil index is scale invariance also, i.e. it satisfies second axiom and therefore does not change during the time of the devaluation. The Theil index as the Gini index is not translation invariance, i.e. does not satisfies the fourth axiom. The Theil index satisfies decomposability axiom.

If the population is divided into J certain $G_1, G_2, ..., G_J$ subgroups, N_j is the number of persons in G_j, $\overline{x}$ (y_j) is the average income of the population(of the group j), $\omega_j = \frac{N_j}{N}\frac{y_j}{\overline{x}}$ is the income share of group i and $T(G_i)$ is the Theil index of the subgroup G_i then the Theil index of the population can be expressed by the formula

$$T = \sum_{j=1}^{J} \omega_j T(G_j) + \sum_{j=1}^{J} \omega_j \ln \frac{y_j}{\overline{x}}.$$

We calculated Theil index by Microsoft Excel for some countries based on World Bank data (see Table 4).

The Atkinson index was introduced in 1970 by British economist Anthony Atkinson [1]. It uses for example by United States Census Bureau. The index can be turned into a normative measure by imposing, as in the case of the Gini index a coefficient of inequality aversion $\varepsilon \in [0,1]$ to weight incomes. If $\varepsilon = 0$ then the society is indifferent to the inequality of the income distribution. If ε increases then we may conclude that the society is more concerned with the income inequality.

The Atkinson index is defined as:

$$A = \begin{cases} 1 - \frac{1}{\mu}\left(\frac{1}{N}\sum_{i=1}^{N} y_i^{1-\varepsilon}\right)^{1/(1-\varepsilon)} & , \ \varepsilon \in [0,1) \\ 1 - \frac{1}{\mu}\left(\sum_{i=1}^{N} y_i\right)^{N}, \ \varepsilon = 1 & \end{cases}$$

where y_i is i-th person's or group income, $i = 1, 2, ..., N$ and μ is a mean income of all agents: $\mu = \frac{1}{N}\sum_{i=1}^{N} y_i$.

The coefficient of the inequality a version represents both positive and negative side of the Atkinson index because it can not be formally defined, but it is necessary to be guided by general economic and political considerations.

The Atkinson index can be computed from the Theil index. If $\varepsilon = 1$ and T is the Theil index then $1 - e^{-T}$ would be the Atkinson index.

We hope that the values of the inequality indices computed by us will help to better understand the economic structure of the Georgian society.

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THE MEASURING OF THE GINI, THEIL AND ATKINSON INDICES FOR GEORGIA REPUBLIC AND SOME OTHER COUNTRIES

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SUMMARY

When studying the economic structure of society qualitative and quantitative methods are closely related to each other. In particular when analyzing the economic structure of society inequality indicessuch as the (generalized) Gini index, the Hoover index, the first and second Theil indices, the first and second Atkinson indicesand other are used. In this article, we investigate the relationship between these indices and in some cases prove that they can be calculated by different formulas. In addition these indices will be calculated for the following countries: Azerbaijan, Armenia, China, Estonia, France, Georgia, Germany, Greece, Iran, Israel, Italy, Japan, Latvia, Lithuania, Moldova, Russia, Turkey, Ukraine, United States.