TRENDS IN INCOME DISTRIBUTION

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Abstract: In modern society the income distribution is one of the major problems. Usually, it is considered that a severe polarisation in matter of income per capita could have a major negative impact on the general process of economic development. This study is focussing on estimating dynamics of some concentration indicators in Romania for the last period. We are using available data at two levels, namely income distribution by deciles and by regions, respectively (NUTS 2, according to the EU classification). The results show different trends in the two cases. Moreover, the impact of the crisis on the income distribution is evaluated and some conclusions are derived from the study.

Keywords: income distribution, Lorenz curve, Gini coefficient, lognormal distribution

JEL Classification: C82, E25, O15

1. Introduction

There are many studies trying to estimate changes in income distribution and trends in the concentration of population. An increase in concentration degree means a convergence process in matter of income and a decrease means a divergence process. Today it is accepted that economic growth has a direct impact on income level and on its distribution among different groups of households (deciles, for example), but this type of correlation is not a simple one.

Thus, inequality in matter of income per person tends to increase over time while a country is in a developing stage, and to decrease after a critical average income is obtained. This trend is usually called the Kuznets curve. However, many economists, based on some empirical evidence, contest this long-term trend,

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considering that inequality is increasing continuously as a country develops. As example, a recent report by OECD shows that the gap between the rich and the poor within member countries "has reached its highest level for over 30 years, and governments must act quickly to tackle inequality" (OECD, 2011). More precisely, in 17 OECD countries an increasing inequality was registered between 1985 and 2008, in three countries (France, Hungary, Belgium) there was little change in inequity, and only in Greece and Turkey there was a decreasing inequity. Moreover, at the global level, Nolan (2009), using Gini coefficients (for income data in PPP exchange rate, unweighted by population) concluded that the income inequality increased from 0.20 in 1820 to 0.52 in 1980.

Depending on data and methodology used, some estimating results show that income inequality has increased (Milanovic, 2011) but according to other authors it remained relatively stable (Bourguignon and Morrison 2002), or decreased (Sala-i-Martin, 2002) since 1980. Such contradicting results are explained by Milanovic (2005) by using the same data on Gini coefficients from 1950 to 2000 and showing that when GDP per capita of countries are unweighted by population the income inequality increases, but when they are weighted inequality decreases.

Our approach is dedicated to identifying discrepancies in income among different groups of population and at regional level in the last years, and to analysing how differences have evolved, especially after the global economic crisis hit Romania, and its impact on the poverty.

2. Income distribution by deciles

According to available published data, the average monthly income per person in households (expressed in constant prices of the year 2000) increased from about 125 lei to 254 lei (103.4%). Although the share of the poorest people in the first deciles (deciles 1-4) decreased from 46.8% in 2000 to 46.6% in 2011, however, overall, there is some tendency to mitigate the polarization, reflected by the fact that the average monthly income in deciles 1-4, compared to the national average increased from 54.8% in 2000 to 57.3% in 2011 (when considering deciles 1-5, the increase was from 60.4% to 63.0%). Favorable is the situation of the poorest decile, D1, the share of which increased from 14.4% in 2000 to 14.6% in 2011, while average income was growing, if compared to the national average, from 32.8 % in 2000 to 35.6% in 2011. Positive in terms of reducing disparities in income, the average income is the reduction of the richest decile, D10, if compared to the national average, from 265.9% in 2000 to 257.1% in 2011.

Basic data we used for the study of income distribution are presented in Table 1 – population distribution by deciles and in Table 2, respectively – income distribution by deciles for the period 2000-2011. A graphical representation of the correlation between the two variables is shown in Figure 1 (where v is income in lei, in constant prices of the year 2000, by person and by month, in deciles and p% is the share of deciles in total population).

Table 1

- % -

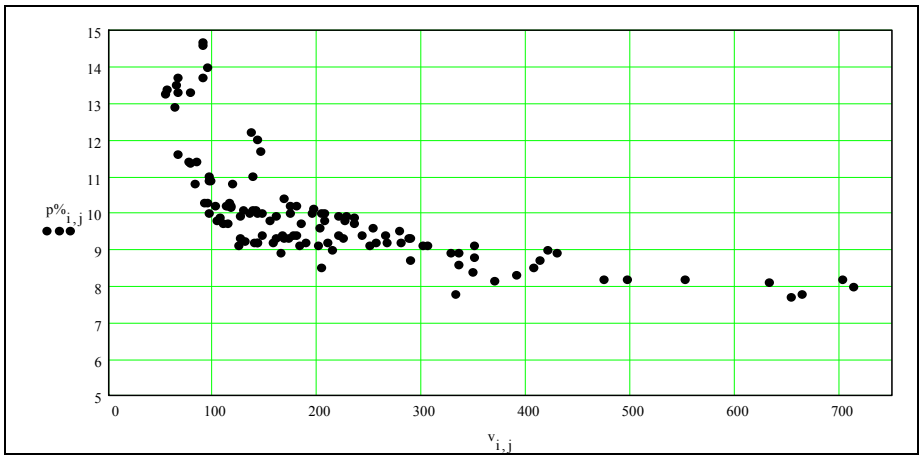
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
D1	14.4	13.4	13.3	12.9	13.7	13.5	13.3	13.3	13.7	14.0	14.7	14.6
D2	11.6	11.4	11.4	11.4	11.0	10.9	10.9	10.8	11.0	11.7	12.2	12.0
D3	10.8	10.3	10.3	10.2	10.3	10.2	10.2	10.1	10.4	10.2	10.2	10.0
D4	10.0	9.8	9.9	10.2	10.0	10.1	10.1	9.9	10.0	10.0	10.1	10.0
D5	9.7	9.7	10.1	9.9	10.0	10.0	9.8	9.7	9.9	9.9	9.8	9.9
D6	9.1	9.3	9.3	9.2	9.3	9.3	9.4	9.8	9.6	9.4	9.2	9.1
D7	9.2	9.2	9.4	9.2	9.1	9.2	9.6	9.7	9.3	9.1	8.7	9.3
D8	8.9	9.4	9.3	9.4	9.2	9.4	9.4	9.5	8.9	8.8	8.6	8.9
D9	8.5	9.1	9.0	9.3	9.2	9.2	9.1	9.1	9.0	8.9	8.7	8.5
D10	7.8	8.4	8.1	8.3	8.2	8.2	8.2	8.1	8.2	8.0	7.8	7.7

Table 2

- % -

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
D1	3.0	3.9	3.6	4.0	3.6	3.4	3.2	3.3	3.2	3.2	3.2	3.3
D2	4.9	5.3	5.2	5.3	5.2	5.0	4.7	4.9	4.9	5.0	4.9	5.1
D3	6.0	6.4	6.4	6.5	6.3	5.9	5.7	5.9	6.0	6.1	6.2	6.3
D4	7.0	7.2	7.2	7.2	7.3	6.8	6.7	6.7	6.9	7.1	7.0	7.4
D5	8.0	8.0	7.9	8.0	7.7	7.7	7.6	7.7	7.8	8.0	8.1	8.2
D6	9.1	8.8	8.8	8.8	8.7	8.8	8.6	8.6	9.0	9.1	9.2	9.1
D7	10.5	10.0	9.9	9.9	9.9	9.9	9.9	9.9	10.2	10.3	10.4	10.4
D8	12.1	11.6	11.6	11.4	11.3	11.6	11.8	11.7	12.0	12.0	12.1	11.9
D9	15.0	14.1	14.4	14.2	14.4	14.7	14.9	14.7	15.0	14.7	14.9	14.7
D10	24.4	24.5	25.0	24.7	25.7	26.2	26.9	26.5	25.0	24.5	23.9	23.6

Figure 1



In order to study the income distribution we started from a standard lognormal function, f, estimated for the period 2000-2011, as follows:

$$f(x) := \frac{1}{x \cdot \sqrt{2 \cdot \pi \cdot \sigma_j}} \cdot e^{-\frac{1}{2} \cdot \frac{\left(x - \mu_j\right)^2}{\left(\sigma_j\right)^2}} \tag{1}$$

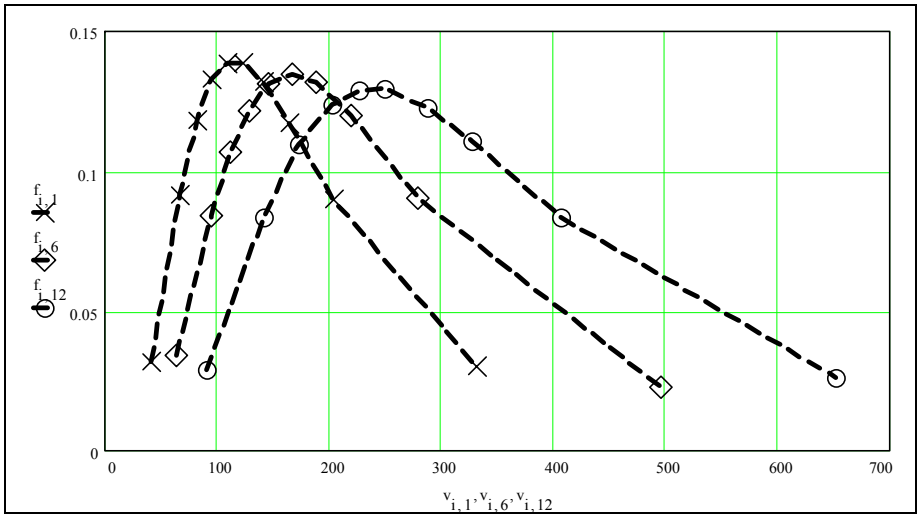
where: x = ln (v), v beeing the income per person in household; m = ln (M), M beeing the average level monthly income per person; and σ is the variance (dispersion).

$$\sigma_j := \sqrt{\sum_{i=1}^{D} \left(x_{i,j} - \mu_j\right)^2 \cdot n_{i,j}} \tag{2}$$

where: n is the share of deciles in total number of population; π is pi constant; e is the base of natural logharitms; and i = 1,...,D (D=10) are deciles and j = 1,...,12 are years of the period (1 = 2000, up to 12 = 2011).

The simulation results of lognormal function f for three years of the analised period (2000, 2005, and 2011) are presented in Figure 2.

Figure 2



Currently, in literature there are many attempts to estimate the income concentration by using various indicators. In the case of this study, given the available data, we estimated a limited number of indicators, which then were compared to see if the results on convergence are comparable, at least as a trend.

The first indicator we used for the convergence assessment, otherwise commonly used for dynamic series, is the coefficient of variation, σ, the formula of which for a specific variable intensity, v (income per capita), is consistent with the following relationship:

$$\sigma v = \Sigma \, Wv \, P / V \tag{3}$$

where: σv is variation coefficient for income, v; Wy is deviation from the average level, in module; P is number of population; and V is total income.

In order to estimate the variation coefficient for the 2000-2011 period we used the following relations:

- for weighted average of income

$$vm_t := \frac{\sum_{i=1}^{n} v_{i,t} \cdot N_{i,t}}{\sum_{i=1}^{n} N_{i,t}} \quad (4)$$

- for the deviation from the average

$$Wv_{i,t} := \left| v_{i,t} - vm_t \right| \quad (5)$$

- for the coefficient of variation

$$\sigma\_v_t := \frac{\sum_{i=1}^{n} Wv_{i,t} \cdot N_{i,t}}{\sum_{i=1}^{n} N_{i,t} \cdot vm_t} \cdot 100 \quad (6)$$

where: i = 1, 2,..., n (n=10) are deciles and t = 1, 2,..., T (T=12) are the years of 2000-2011 period.

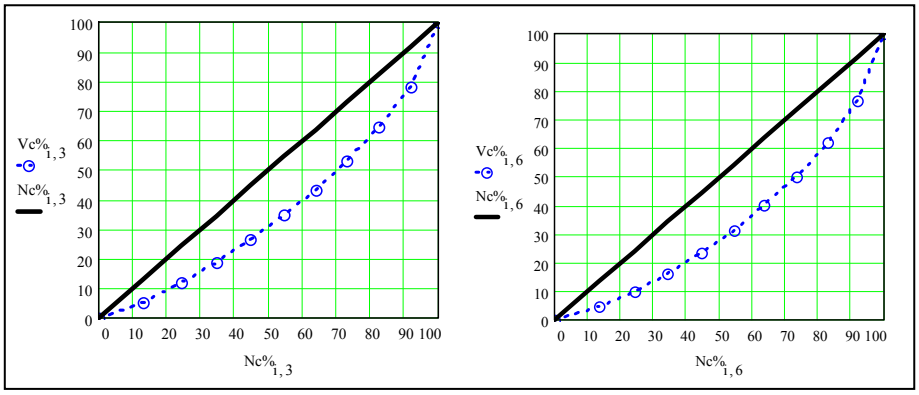
According to resulted estimation, there is a trend of convergence over the analysed period, the variation coefficient, σ_v, decreasing from 45.0% in 2000 to 42.1% in 2011. The minimum value of the coefficient was reached in 2003 (40.7%) and the maximum value in 2006 (47.4%).

Usually, to analyse income distribution the so-called Lorenz curve is used. Changes in concentration degree could be a measure of the convergence in income distribution. The Lorenz curve expresses the distribution of a certain indicator of interest within a certain population. As a rule, on the abscissa the cumulative share of population from lowest to highest income per person is shown and on the vertical axe the corresponding cumulative share of total

income. The line passing through all points (x,y) in plane is the resulted Lorenz curve. The diagonal line of the unit square thus formed means the average per capita income and area bounded by the Lorenz curve and this diagonal, denoted as A, represents a global measure of gaps or the concentration degree of population. The diagonal line corresponds to the so-called line of perfect equality (all levels of income per person are equal; by contrast, the line of perfect inequality is represented by the horizontal line, y=0 for all x smaller than 100%, continuing with the vertical line y=100% when x=100%).

For example, we present in Figure 3 the Lorenz curve for years 2003 (denoted here by 3) and 2006 (denoted here by 6), respectively. In this Figure the cumulated weights of income, Vc%, on the vertical axis and those of population, Nc%, on horizontal axis, are expressed in percentage). We can see an increase in the area bounded by the Lorenz curve and the diagonal line in 2006, compared with 2003, which signifies a process of divergence. For instance, the Lorenz curve for 2006 shows that 44.5% of the total population (the poorest four deciles) had only 23.5% of the total income, and 54.3% of the total population (the poorest five deciles) covered only 31.4% of the total income.

Figure 3



Based on the Lorenz curve we estimate the Gini coefficient, which is defined as the ratio of surface area A (bounded by the Lorenz curve and the diagonal line) and the entire area below the diagonal line, denoted by A+B, B being the area under the Lorenz curve. We may write the relation for computing the Gini coefficient, G, as G=A/(A + B), or, taking into account that the denominator is equivalent to half of the unit, as twice A (G=2A), A being equal to 0.5-B.

Theoretically, the Gini coefficient can range from 0 (perfect equality) to 1 (perfect inequality). Expressed as percentage, the Gini coefficient is called the Gini index. For applications, there are different methods to estimate the Gini coefficient, which usually involve a large amount of calculation.

A method which we used for estimating the Gini coefficient is one of interpolation (the so-called method of trapezoids), as follows:

$$G := 1 - \sum_{i=1}^{n} \left(\frac{X_i - X_{i-1}}{100} \right) \cdot \left(\frac{Y_i + Y_{i-1}}{100} \right) \quad (7)$$

where: X=Nc% and Y=Vc%.

According to the resulted estimation, there is a trend of convergence over the analysed period, the Gini coefficient decreasing from 31.4% in 2000 to 29.7% in 2011. The minimum value of the coefficient was reached in 2003 (28.3%) and the maximum value in 2006 (32.7%).

Another indicator derived from the Lorenz curve is the maximum vertical distance between the curve and the line of perfect equality (diagonal line). It can be considered that the amount is equal to the proportion of total income that should be transferred from the richer half of the population to the poorest half of the population (this indicator is sometimes called the Robin Hood coefficient or the RH index, when it is expressed as percentage). In the case of the income distribution the RH index can be estimated as follows:

$$RH = \max (Nc\% - Vc\%) \quad (8)$$

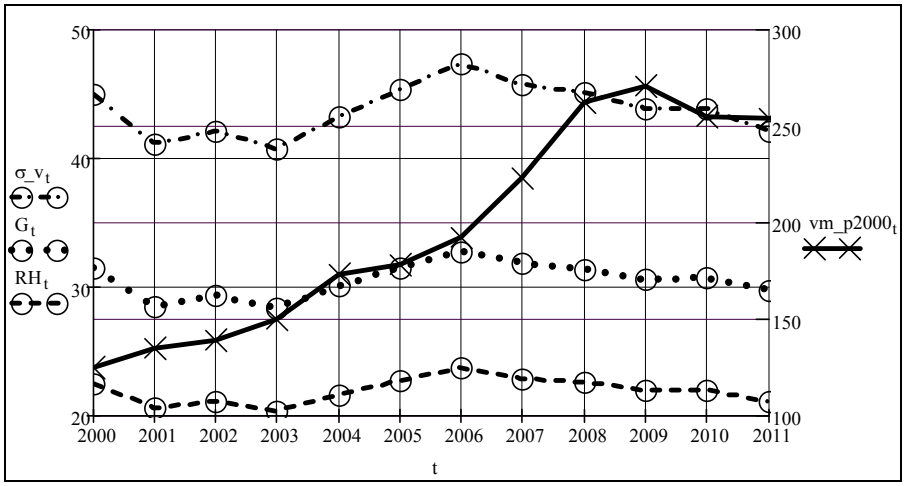
where: Nc% is the cumulative share of deciles in total population and Vc% is the cumulative share of deciles in total income. The estimated results show again a convergence in matter of income during the analysed period, expressed by a decrease in the RH index (from 22.5% in 2000 to 21.1% in 2011).

Synthetically, the results of our estimations for the three concentration indicators in the 2000-2011 period are presented in Table 3 and in Figure 4.

Table 3

	Variation Coefficient	Gini Coefficient	RH Coefficient	Income per capita (in lei, pct 2000)
	- in % -			
2000	45.0	31.4	22.5	124.7
2001	41.0	28.5	20.5	134.5
2002	42.1	29.4	21.0	138.9
2003	40.7	28.3	20.4	149.4
2004	43.2	30.1	21.6	173.1
2005	45.4	31.5	22.7	178.1
2006	47.4	32.7	23.7	191.7
2007	45.7	31.8	22.8	223.1
2008	45.1	31.3	22.5	262.0
2009	43.8	30.6	21.9	270.4
2010	43.8	30.7	21.9	254.3
2011	42.1	29.7	21.1	253.8

Figure 4



Generally, we can see from the distribution of income by deciles that the convergence trend was favorably influenced by the increase in the average level of income per person. At the level of the entire period the values of the correlation coefficient between the concentration indicators and the average income per person ranged between +0.275 and +0.330. After 2006 the value of

the concentration indicators decreased continuously, but, however, during the last years of crisis in Romania (2010 and 2011) the average income also decreased.

3. Income distribution by regions

In Romania, there are eight development regions (as in NUTS2 EU classification). In the context of the EU convergence programme, in Romania diminishing disparities among regions continues to be an important goal. In order to analyse the dynamics of the income distribution by regions we used a similar methodology as in the case of the distribution by deciles.

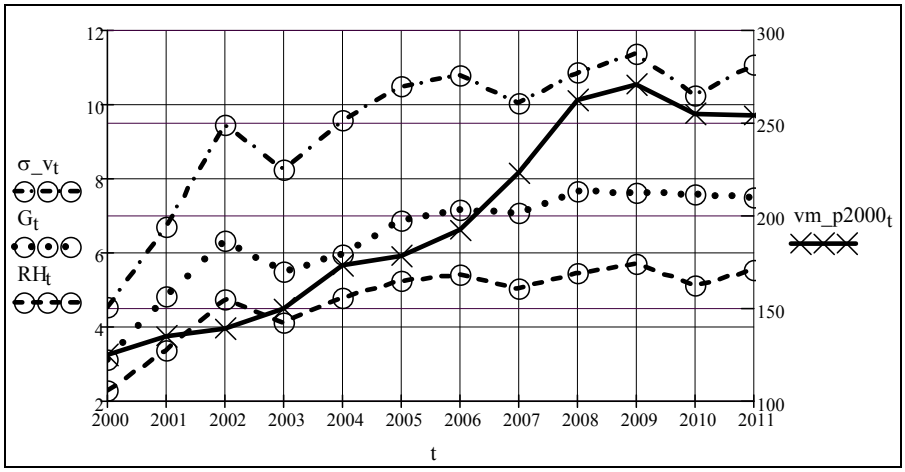
In the case of the distribution by regions, the results of our estimations for the three concentration indicators in period 2000-2011 are synthetically presented in Table 4 and in Figure 5.

Table 4

	Variation Coefficient	Gini Coefficient	RH Coefficient	Income per capita (in lei, pct 2000)
	- in % -			
2000	4.5	3.1	2.3	124.7
2001	6.7	4.8	3.3	134.5
2002	9.4	6.3	4.7	138.9
2003	8.3	5.5	4.1	149.4
2004	9.6	5.9	4.8	173.1
2005	10.5	6.8	5.2	178.1
2006	10.8	7.1	5.4	191.7
2007	10.0	7.0	5.0	223.1
2008	10.9	7.7	5.4	262.0
2009	11.4	7.6	5.7	270.4
2010	10.2	7.6	5.1	254.3
2011	11.1	7.5	5.5	253.8

Although in absolute terms the concentration is higher in the case of the distribution by regions than in case of the distribution by deciles, we can see for the territorial distribution a significant divergence reflected by an accelerated increase in value of the concentration indicators. In the 2000-2011 period the values of the correlation coefficient between the concentration indicators and the average income per person were highly positive between +0.776 and +0.844.

Figure 5



4. Conclusions

The Lorenz curve model and its derived Gini coefficients together with other indicators could be useful to evaluate the intensity of convergence in matter of income.

During the 2000-2011 period, the concentration degree in absolute terms was higher in the case of the income distribution by regions than in case of the distribution by deciles.

However, in dynamics, there are two opposite trends: while by deciles there was a weak convergence process, by regions there was a strong divergence process.

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