Equity of Health Care Financing: An Application to Iran

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Abstract
This paper analyzes inequality in Iran's health system from a financing perspective. Through grouped data of household budget published by Iran Statistic Center (ISC) and Beta Lorenz curve introduced in Kakwani (1980), it has been tried to extract Beta Lorenz curve and Kakwani progressivity index in each individual rural and urban district, and also to obtain other inequality measure in (1997-2007) Period.Then to study health inequality for the given period, we divided it into two sub-periods: (1997-2001) and (2002-2007) and finally to compare health inequality, using Bootstrap technique, we made a pseudo statistical population. Results show a degree of descending progressively in urban areas while in rural areas it has witnessed a slight improvement. However as the results show in both rural and urban areas, because of the negativity of Kakwani's index of the household expenditure which is financed by themselves is not progressive at all. Also the ratio of share richest quintile to poorest quintile for health care in urban and rural areas are 8.79 and 8.01 respectively.

JEL codes: D31, D63, I18, P43.

Key Words: Equity, Health care financing, Kakwani progressivity index, Iran.

1 Introduction

The Economist Nobel Prize winner, Amartya Sen, in his book "Inequality Reexamined" argues that presently justice theory is imperceptible in some spaces,

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unless we can realize the worth of equity. A person who believes in income equality, a supporter of democracy and a liberal, in their political philosophy may believe in some equalities, but non of them may have common grounds. The first person may emphasize the equality of income distribution, the second one equal political rights and the last one equal freedom for all. Though these subjects are equally important and equality based on any of these variables could be the basis of a theory on justice, yet equality is an absolute idea and the prospect of a comprehensive social and economic equality is not so bright. However Health is a major concern for social justice. Health and getting to it are important to the economists due to the fact that health expenditures are sort of human capital and its improvement can bring about labor productivity and consequently economic growth. Even indices such as health expenditure value - either total or per capita expenditure - are indicators of the health care condition in a country, however the way these expenditure are distributed is very important because it has strong ties with social justice. This reason has made the health ministry officials of Iran to compile a strategic plan for equality distribution of health care.

2 Methodological issues

2.1 Measuring progressivity in financing

The progressivity of a health financing system refers to the extent to which payments for health care rise as a proportion of a household's income when his income rises. There are different ways to obtain this progressivity, one approach, that we adopted in this paper, is to estimate progressivity index. Already, the literature on tax progressivity has proposed a variety of such indices, but in this study, we employ index health care financing, namely that of Kakwani Index (KI).Π_k is as the Kakwani's Index (KI) of health care payments on gross income (expenditure), which is defined by twice the area between the Lorenz curve for gross income (expenditure), $Ł_{EX}(p)$, and the concentration curve for health care payments, $Ł_{HE}(p)$, and the (p) indicates the population's rank in the gross income (expenditure) distribution. $Ł_{EX}(p)$, shows relationship between the cumulative proportion of population of income and the cumulative percentage of the population, where the population is ranked according to its income (expenditure), whilst $Ł_{EX}(p)$, is formed by plotting the cumulative proportion of the population (ranked by income) against the cumulative share of payments. Thus we have :

$$\Pi_k = 2\int_0^1 (Ł_{EX}(p) - Ł_{HE}(p))\, dp$$

$$\Pi_k = (1 - 2\int_0^1 Ł_{HE}(p)\, dp) - (1 - 2\int_0^1 Ł_{EX}(p)\, dp))$$

$$\Pi_k = CI - Gini \qquad (1)$$

The degree of progressivity of the health care financing system can be assessed by calculating the difference between the concentration coefficient of payments, CI, and the Gini coefficient of gross income, Gini. A positive Kakwani Index ($\Pi_k > 0$), indicates that the system is progressive, so that the Lorenz curve of income lies above the concentration curve of payments, and vice versa it is regressive when ($\Pi_k < 0$); a zero value of (Π_k) indicates proportionality of the payments, and therefore the Lorenz and concentration curves are coincident. A progressive system is one in which health care payments rise as a proportion of income as income rises, whilst a regressivity system is one in which payments fall as a proportion of income as income rises. A proportion system is one in which health care payments account for the same proportion of income for everyone, irrespective of their income.

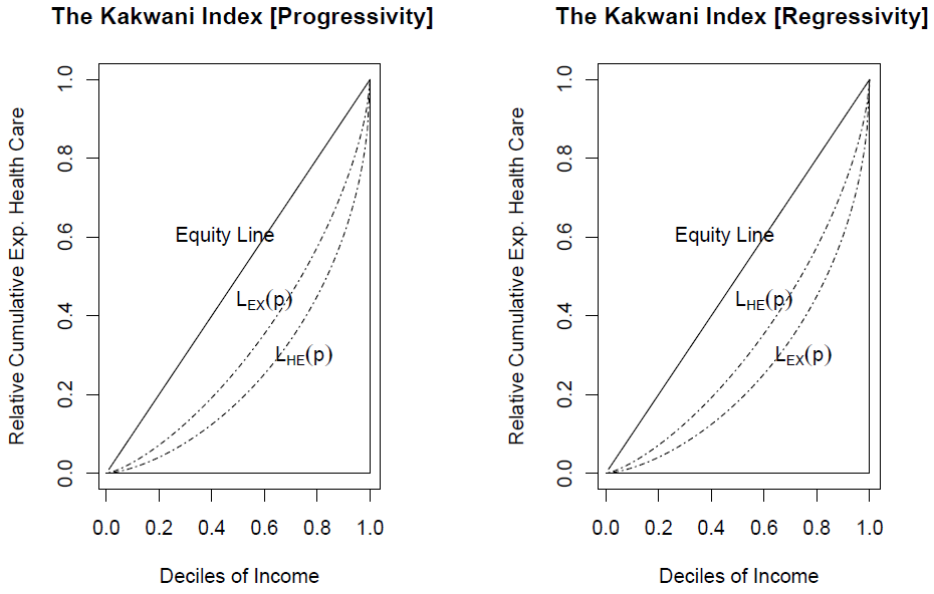

Figure 1: The Kakwani Progressivity Index

The kakwani index (KI) values range between -2 and +1 and is equal to the difference between the Health care concentration index and Gini coefficient for income (Expenditure). In this Paper, we estimate Gini coefficient for income (expenditure), and Concentration index for health care financing with Beta lorenz curve. We do this by estimating Kakwani progressivity indices, which can be used to quantify the progressivity or regressivity of health care financing using the available data. This approach, which has been used in health economics (Wagstaff and van Doorslaer 2000) is superior to the use of alternatives such as the Fairness of Financial Contributions (FFC) index (Murray et al. 1989; World Health Organization 2000) which as Wagstaff (2002) has established, cannot distinguish between the progressivity or regressivity of health care financing.

2.2 Beta Lorenz curve

The literature on the estimation of Lorenz curves provides a number of different functional forms. One of the best performers among them is the Beta Lorenz curve (Kakwani 1980). The Lorenz function for Beta Lorenz curve specification is given in following. Equation of Lorenz curve L(p) is:

$$L(p) = p - \theta p^{\gamma}.(1-p)^{\delta}, \tag{2}$$

We can write equation (1) in Log form :

$$Ln(p-L) = Ln(\theta) + \gamma.Ln(p) + \delta.Ln(1-p), \tag{3}$$

Then we have Equation (3) in stochastic form:

$$\underbrace{Ln(p-L)}_{Y} = \underbrace{Ln(\theta)}_{\lambda} + \gamma.\underbrace{Ln(p)}_{X_2} + \delta.\underbrace{Ln(1-p)}_{X_3} + \varepsilon, \tag{4}$$

Equation (4) can be readily estimated using ordinary least squares (OLS) routine (the estimation of the Beta Lorenz curve parameters requires the inclusion of the intercept term) then we have : $\widehat{\theta} = exp(\widehat{\lambda}), \widehat{\gamma}, \widehat{\delta}$ Kakwani (1980) indicated that Gini index equals with:

$$Gini = 2.\theta.B(1+\gamma, 1+\delta), \tag{5}$$

we know that, $B(\underbrace{1+\gamma}_{\alpha}, \underbrace{1+\delta}_{\beta})$ is Beta density function :

$$B(x;\alpha,\beta) = \frac{1}{B(\alpha,\beta)}.\int_0^x Ł^{\alpha-1}.(1-L)^{\beta-1}\,dp$$

$0 \leq x \leq 1$, $\alpha > 0$, $\beta > 0$.
and we know the Beta density function related with Gamma density function:

$$B(x;\alpha,\beta) = \frac{\Gamma(\alpha)\Gamma(\beta)}{\Gamma(\alpha+\beta)}$$

Then fitted lorenz curve L(p) equals with:

$$Ł(p) = \frac{1}{B(\widehat{\alpha},\widehat{\beta})}.\int_0^x Ł^{\widehat{\alpha}-1}.(1-L)^{\widehat{\beta}-1}\,dp$$

Once the Beta lorenz curve have been estimated, we can estimated share of k^{th} decile :

$$SH_k = \frac{\frac{1}{B(\widehat{\alpha},\widehat{\beta})}.\int_{k-1}^{k} Ł^{\widehat{\alpha}-1}.(1-L)^{\widehat{\beta}-1}\,dp}{\frac{1}{B(\widehat{\alpha},\widehat{\beta})}.\int_0^1 Ł^{\widehat{\alpha}-1}.(1-L)^{\widehat{\beta}-1}\,dp}, \tag{6}$$

Note, in above equations : $\boldsymbol{p}$, is cumulative proportion of population, $\boldsymbol{L}$ is cumulative proportion of expenditure if we obtain inequality in income, $L = L_{EX}(p)$ and $\boldsymbol{L}$ cumulative share of payments for health care if we obtain inequality in health care financing, $L = L_{HE}(p)$. For estimates Gini coefficient, Beta Lorenz curve function and calculating share of deciles, we have used EViews programming facilities. It is worth noting that we have been using version (7.1). Our calculations are once for income and once for health expenses.[1]

3 Data

We use private expenditure data on health care financed by the households. These data are collected and published annually by the Iran Statistic Center (ISC) in rural and urban areas. In this paper, used data are during 1997-2007. Fortunately these data are high quality but unfortunately reliable data on public health expenditure do not exist. The data include measures of household income and detailed disaggregation of household expenditure data on a variety of goods and services, including health care.

4 Results for areas

4.1 Results for urban areas

In this subsection we present the estimated Gini coefficients for income, health expenditure concentration indices and KIs household co-payments. The results are presented for urban areas of Iran, for the years 1997 to 2007. Table 1 presents the Gini coefficient, concentration index of health care and Kakwani's index (KI). Considering the results of table 1, the mean of Kakwani's index in total period in urban areas has been negative and equals with (-0.022), This indicates that Health care financing in this area is descending. In addition, ratio of share richest quintile to poorest quintile for Health care is (8.79). Numbers listed in Column Kakwani's index (KI) are obtained from subtract numbers listed in column (CI) from column (GINI). The following Figure (figure 3) show Lorenz curves for Income and health care expenditure in urban areas in 2007.

4.2 Results for Rural areas

In this subsection we present the estimated Gini coefficients for income, health expenditure concentration indices and KIs household co-payments. The results are presented for rural areas of Iran, for the years 1997 to 2007. Table 2 presents the Gini coefficient, concentration index of health care and Kakwani's index (KI). Similar to the results in urban areas for rural areas, we've provided a similar table. In table (2) you can see that the mean of Kakwani's index in total period in rural areas has been negative and equals with (-0.107), This indicates

[1] Those interested in recreating results of this paper, can request EViews commands and data from the author.

Table 1: Findings for urban areas: gini coefficient (Gini), concentration index of health care (CI), Kakwani progressivity Index (Π_k).

Year	Gini	CI	Π_k	$\frac{Richest\ Quantile}{Poorest\ Quantile}$ in Health Care
1997	0.399886	0.360251	-0.039635	8.225477
1998	0.394658	0.425048	0.030390	9.443766
1999	0.399145	0.223239	-0.175906	6.191092
2000	0.401198	0.437459	0.036261	9.699424
2001	0.393432	0.450145	0.056713	11.145775
2002	0.384205	0.275671	-0.108534	6.893041
2003	0.401039	0.391689	-0.009350	8.793063
2004	0.407243	0.446630	0.039387	9.893297
2005	0.406566	0.272431	-0.134135	6.847109
2006	0.411564	0.453520	0.041956	10.04177
2007	0.404977	0.424210	0.019233	9.542637
Mean	0.400356	0.378208	-0.022147	8.7924023

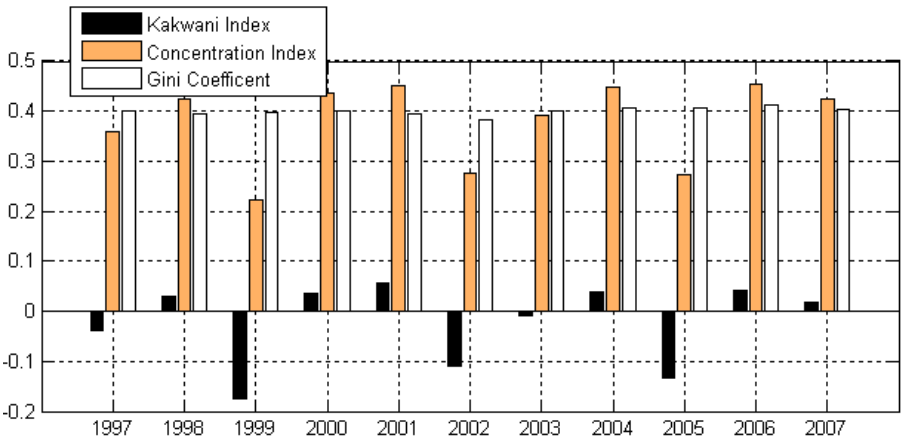

Figure 2: Gini coefficient, Kakwani index and concentration index [Urban]

that Health care financing in this area is descending. In addition, ratio of share richest quintile to poorest quintile for Health care is (8.01). Numbers listed in column Kakwani's index (KI) are obtained from subtract numbers listed in column (CI) from column (GINI). The following Figure (figure 5) show Lorenz curves for Income and health care expenditure in rural areas in 2007.

4.3 Bootstrap results for urban and rural areas

In this section, we provide evidence for changes in the Kakwani's indices during 1997-2007 period in urban and rural areas. For this purpose, as we already said,

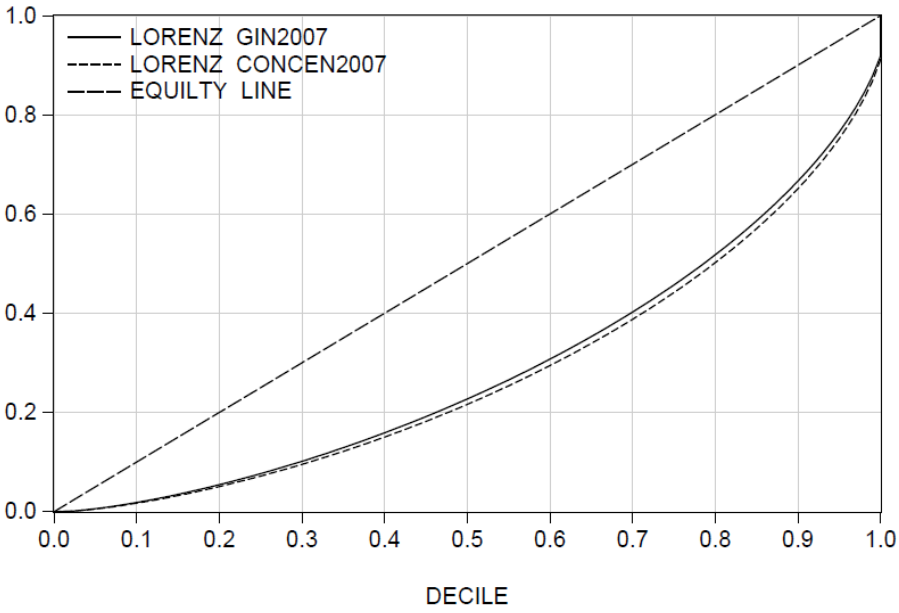

Figure 3: Lorenz curves for income and health expenditure 2007 [Urban]

Table 2: Findings for rural areas: gini coefficient (Gini), concentration index of health care (CI),Kakwani progressivity Index (Π_k).

Year	Gini	CI	Π_k	$\frac{Richest\ Quantile}{Poorest\ Quantile}$ in Health Care
1997	0.422666	-0.1180	-0.21455	6.004113
1998	0.444711	-0.0991	-0.01104	10.96286
1999	0.430977	0.0189	0.03162	11.30913
2000	0.427509	0.0189	-0.19778	6.273398
2001	0.411402	0.0189	-0.19991	6.045475
2002	0.411408	0.0189	0.06201	10.48473
2003	0.390743	0.0189	-0.16231	6.256828
2004	0.410273	0.0189	0.00708	10.54111
2005	0.411684	0.0189	-0.18088	6.287153
2006	0.422348	0.0189	-0.17175	6.546559
2007	0.437263	0.0189	-0.14313	7.412589
Mean	0.420089	0.312761	-0.10733	8.011267

we divided the sample into two sub-period 1997-2001 and 2002-2007 and finally

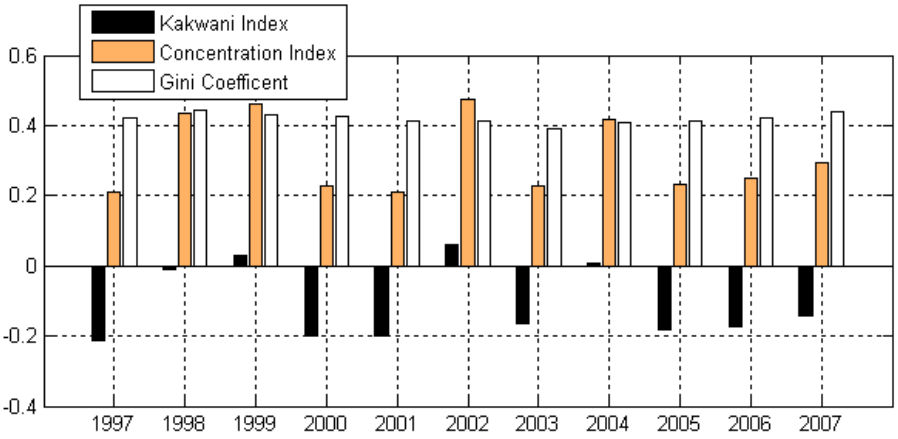

Figure 4: Gini coefficient, Kakwani index and concentration index [Rural]

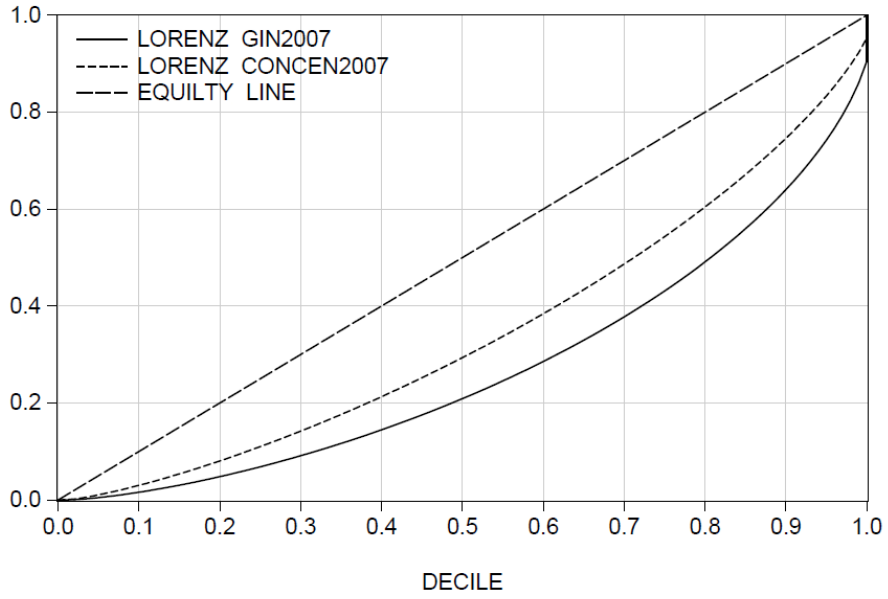

Figure 5: Lorenz curves for income and health expenditure 2007 [Rural]

compared Health inequality using Bootstrap technique. The following graphs for each of urban and rural areas indicated that sample size for each sub-period increases to 10000 observations. for urban and rural areas, in graphs 6 and 7, we obtained Mean's Kakwani indices for two sub-samples above, respectively. For calculating Bootstrap simulation, we have used MATLAB programming

facilities, it is worth noting that we have been using version (7.8).

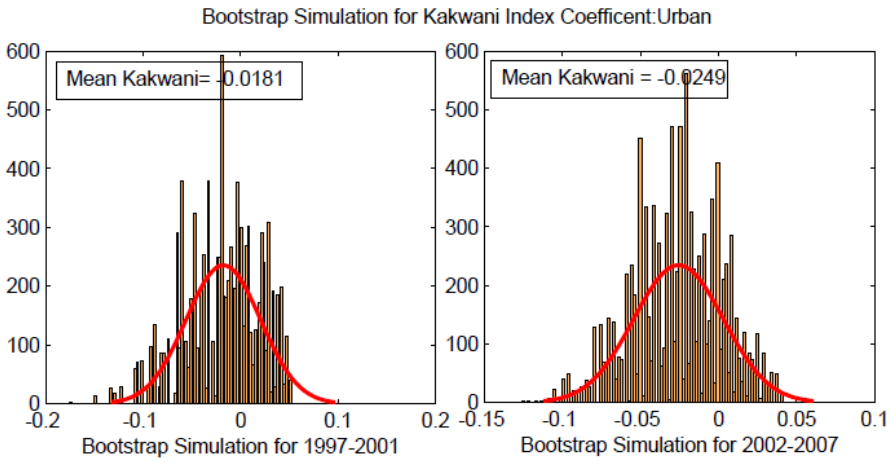

Figure 6: Distribution of kakwani's index for progressivity health care financing system in urban areas, (Bootstrap simulation with 10000 iterations)

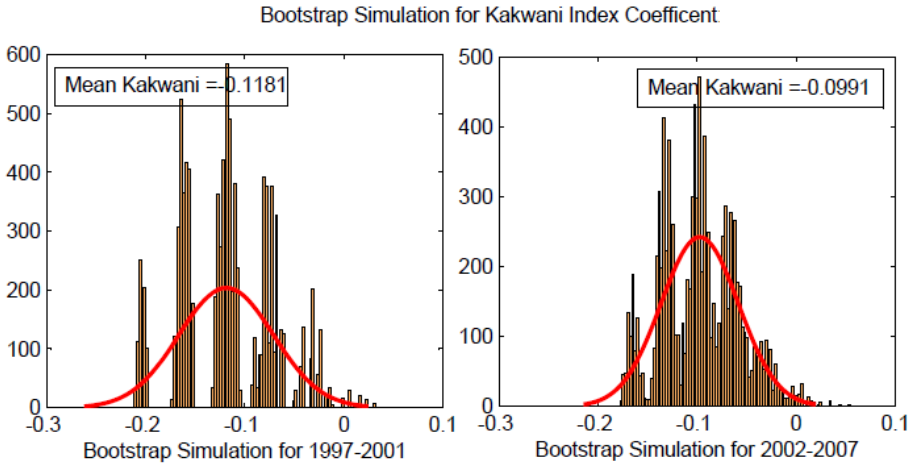

Figure 7: Distribution of kakwani's index for progressivity health care financing system in rural area, (Bootstrap simulation with 10000 iterations)

The results in Table 3 show in both rural and urban areas because of negativity of Kakwani's index of the household expenditures which are financed by themselves are not progressive at all. But changes in Kakwani's indices show that in urban areas degrees of progressivity is more negative, while in rural areas the situation has improved.

Table 3: bootstrap simulation for Kakwani progressivity Index (KI).

Sub-Sample	Regions	
	Urban	Rural
(1997-2001)	-0.0181	-0.1180
(2002-2007)	-0.0249	-0.0991
Change in Kakwani Index ($\Delta\Pi_k$)	-0.0068	0.0189

5 Results

Kakwani's index which is based on the un-proportionality of financing approach (for health expenditures) shows a degree of descending progressivity in urban areas while in rural areas it has witnessed a slight improvement. However as the results show in both rural and urban area because of negativity of Kakwani's index of the household expenditures which are financed by themselves is not progressive at all. Also the ratio of share richest quintile to poorest quintile for health care in urban and rural areas are 8.79 and 8.01 respectively (see tables 1 and 2).

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