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"MEASURING INEQUALITY"

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1. SOME THEORETICAL ISSUES ABOUT INEQUALITY

1.1. The effects of inequality on economic growth

During the 1970s, economic development came to be redefined in terms of the reduction or elimination of poverty, inequality, and unemployment within the context of a growing economy. The basic issue, at that time, was not only how to make GNP growth but also who would make it grow. Many developing countries had experienced relatively high rates of economic growth by historical standards. Such growth had brought little support to their poor. The distribution of incomes seemed to have become less equitable during the past years.

"Redistribution from growth" became a common slogan. Professor Dudley Seers posed the basic question about the meaning of economic development. The questions to ask about a country's development are: "What has been happening to poverty? What has been happening to unemployment? What has been happening to inequality? If all three of these have declined from high levels then without any doubt this has been of development for the country concerned. If one or two of these central problems have been growing worse, especially if all three have, it would be strange to call the result "development" even if per capita income doubled" (Seers, 1969, p.3).

Inequality is in itself an awkward word, as well as one used in connection with a number of awkward social and economic problems. It obviously suggests a departure from some idea of equality.

At the current time, among the economists there have been controversial approaches to economic inequality.

On the one side, much of economic theory in essence asserts that highly unequal distributions are necessary conditions for generating rapid economic growth. There are some discussions to the effect that wide inequalities are a necessary condition of maximum growth and that in the long run, maximum growth is a necessary condition of rising standards of living. It follows that direct concern with the alleviation of income inequality would be self-defeating. The main economic argument to justify large income inequalities was that high personal income was a necessary condition for saving, which made possible investment, and economic growth. The mechanism was that rich people save and invest significant proportions of their incomes while the poor people spend all their income

on consumption goods. From this it is argued that GNP growth rates are directly related to the proportion of national income saved so that an economy characterised by highly unequal distributions of income would save more and grow faster than one with a more equitable distribution of income. Until such a time reached, any attempt to redistribute incomes significantly would serve only to lower growth rates.

On the other side, many development economists argue that rich people's savings and investments do not necessarily add to the nation's productive resources, as much of their incomes is on imported luxury goods, expensive houses and foreign travel. I think, it is an extremely true in the case of less developed world. Because, the lower level of income and living for a poor, which are manifested in poor health, and poor education. But raising demand for local goods provides a greater stimulus to local production, employment, and investment. By contrast, a more equitable distribution of income achieved through the reduction of mass poverty can stimulate healthy economic expansion. That is, an equitable income creates the conditions for rapid economic growth and a broader participation in economic growth.

1.2. Welfare economics and Pareto optimality

Inequality is a historical problem, it was being considered by Athenian intellectuals. However, the concepts of equity and justice have changed over time. In the current period, the stratification and differentiation has grown, and the concept of inequality has gone through a radical transformation. The concept of inequality is extremely broad. In my dissertation I'm concerned only with economic inequality. In order to discuss economic inequality, I shall argue that the historical nature of the notion of inequality, as viewed by economists today. We begin with some methodological points concerning the measurement of inequality.

Firstly, from the methodological point, measures of inequality are divided broadly into 2 features; *objective* and *normative*, in the economic literature. The objective sense is to employ some statistical measure of the relative variation of income, expressed by indices. The normative notion of social welfare tries to measure whether a higher degree of inequality corresponds to a lower level of social welfare for a given total of income. Both these approaches can be distinguished between seeing more or less inequality and valuing it more or less in ethical terms. Even though these two approaches are closely related to each other.

The second methodological issue concerns the type of measurement of inequality. Is inequality a *ratio-scale* like, weight or height that makes one weight twice as much as another. For example, the gap between 165 kg and 175 kg is recorded as twice that between 150 kg and 155 kg. Or is inequality to be measured on an interval-scale, referred to in utility theory as *cardinal* and *ordinal* (looser measure). The cardinal scale involves a set of numbers for different objects, or a positive linear transformation of these numbers. The ordinal scale does not involve any 'numerical representation, (a set of alternatives a_1, a_2 and a_3 may be ranked as, a_2 highest, a_3 next and a_1 last). This kind of ordering involves a ranking such as completeness (it requires that if we take any pair of alternatives then in terms of the ranking relation, either $x > y$ hold or $y > x$ holds, or both) and transitivity (it demands that any three alternatives x, y, z and $x > y$ and $y > z$ both hold, then so does $x > z$).

If a relation is a transitive but not necessarily complete, it is called a *quasi-ordering*. Even though, there is still some problems, when it happens where the ranking relation is complete but not necessarily transitive.

In most cases in the real life, a statistical measure of the economic inequality level assumes a high degree of measurement, a ratio-scale or at least an interval-scale. So, we may not be able to decide whether one distribution is more or less unequal than another, but we may be able to compare some other pairs perfectly well.

One way of introducing social values concerning inequality is to use a social welfare function (SWF) which simply ranks all the possible states of society in the order of preference. Now let me introduce the social welfare function as shown Cowell (1995, p. 35-36). As discussed above the following assumptions are used commonly to measure economic inequality.

1. The SWF is *individualistic* and *non-decreasing*, if the welfare level in any state A , denoted by a number W_A can be written

$$W_A = W(y_{1A}, y_{2A}, \dots, y_{nA})$$

and if $y_{iB} \geq y_{iA}$ implies, *ceteris paribus*, that $W_B \geq W_A$, which in turn implies that state B is at least as good as state A

2. The SWF is *symmetric* if it is true that, for any state,

$$W(y_1, y_2, \dots, y_n) = W(y_2, y_1, \dots, y_n) = \dots = W(y_n, \dots, y_2, y_1)$$

that is, the value of W does not depend on the particular assignment of labels to members of the population.

3. The SWF is *additive* if it can be written

$$W(y_1, y_2, \dots, y_n) = \sum_{i=1}^n U_i(y_i) = U_1(y_1) + U_2(y_2) + \dots + U_n(y_n)$$

where U_i is a function of y_i alone, and so on. If these three properties are all satisfied then we can write the SWF like this

$$W = U(y_1) + U(y_2) + \dots + U(y_n)$$

where U is the same function for each person and where $U(y_i)$ increases with y_i ($U(y_i)$ is the social utility of, or the welfare index for, person 1). The rate at which this index increases is $U'(y_i) = dU(y_i)/dy_i$ is known as the *social marginal utility* of, or the *welfare weight* for person 1.

4. The SWF is *strictly concave* if the welfare weight always decreases as y_i increases.

5. The SWF has *constant elasticity*, or *constant relative inequality aversion* if $U(y_i)$ can be written:

$$U(y_i) = (y_i^{1-\varepsilon} - 1)/(1-\varepsilon)$$

where ε is the *inequality aversion parameter*, which is non-negative.

These results don't make use of either the concavity or the constant – elasticity properties. But these theorems provide us with some fundamental insights on the welfare and inequality rankings.

Even though these results may be inferred from income distributions, they are limited in two ways. *First*, the results are cast exclusively within the context of social welfare analysis. *Second*, in some way, these three theorems are not sufficient for the practical business of inequality measurement. We often desire a unique numerical value for inequality in order to make comparisons of different changes in inequality. In most cases, we use the social welfare function to find measures of inequality.

Pareto optimality

The discussion of distributional judgements, in recent years, has gone beyond Pareto optimality. As discussed above, welfare increases with any U given the set of utilities of all other individuals and Pareto optimality can be built into the exercise of maximising welfare. But the main issue for maximising SWF is to go beyond this limited concept by ranking all the Pareto optimal states *vis-a-vis* each other.

The analysis of inequality has little contact with modern welfare economics. Much of modern welfare economics is based on avoiding judgements of income distribution. The concentration seems to be on issues that involve no conflict between different individuals. The basic theorem of welfare economics is concerned with the relation between competitive equilibria and Pareto optimality. The concept of Pareto optimality was evolved precisely to cut out the need for distributional judgements. But a change implies a Pareto – improvement if it makes no one *worse off* and someone *better off*. For example, the case of the division of a cake, each person prefers to have more of the cake rather than less of it. Every possible distribution will be Pareto optimal, but *any* change will be Pareto suboptimal, because any change that makes someone better off makes someone else worse off.

Arrow (1951) has shown that a set of extremely mild-looking restrictions eliminate the possibility of having any such functional relation F whatsoever. Given Arrow's "impossibility" result, the system needs some give; transitive (it requires that $x > y$, and $y > z$ should imply $x > z$), complete (either x is regarded as at least as good as y , or y regarded as at least as good as x), reflexive (it is that x be regarded as at least as good as itself). Relating to this, there are 5 conditions on the relation between individual preference orderings and social preference relation.

The first condition permits systematic social choice. *The second* shows individuals to have any preference pattern. *The third* establishes a relation between individual and social preferences. *The fourth* is simply the familiar Pareto rule. *The fifth*, a permutation of individual ordering over the individuals keep the social preference unchanged. Pareto optimal is either *Pareto indifferent* or *Pareto – uncomparable* and Pareto optimality is both necessary and sufficient for overall social optimality, but judgements on inequality are not permitted.

Theorem 1.1, the only functional relation F satisfying conditions 1-5 must make all *Pareto-uncomparable* states socially indifferent (Sen, 1973, p.10). It makes Pareto comparisons the basis of social choice. Given the axioms of Theorem 1.1, even if one person prefers one state to another, and all others have the opposite preference, then two states must be declared to be equally good from the social point of view.

What is generating these difficulties? The answer is, the trouble lies in the conception of a social welfare function which makes social preference dependent on individual orderings. Individual's social choice is made without using interpersonal comparability or cardinality.

1b. Utilitarianism

Utilitarianism is one of the widely used approaches of consuming a measure of social welfare. It discussed by Bentham (1789), Marshall (1890), Pigou (1920), Robertson (1952), and Sen (1973).

Utilitarianism takes the sum of the individual utilities as the measure of social welfare, and alternative social states are ordered as value of the sum of individual utilities. Marshall (1890) and Pigou (1920) were attacked by Robbins (1938) and others for their supposedly egalitarian use of the utilitarian framework. This gave utilitarianism an undeserved reputation for being equality-conscious.

Utilitarian equality

Equality can be derived from the utilitarian concept of goodness applied to problems of distribution. It is called *utilitarian equality*. The utilitarian objective is to maximise the sum-total of utility irrespective of distribution. It requires the equality of the marginal utility of everyone. *Marginal utility* is defined as the incremental utility each person would get from an additional unit of something.

Notably, the case which everyone has the same utility function. In the pure distribution, it requires absolute equality of everyone's total utilities. In case, everyone has the same utility function, the marginal utilities are equated. If human beings are identical, it will be equal marginal utilities of all equal treatment of needs, equal total utilities and their overall interests equally. However, human beings are not identical.

Hence, utilitarian conception of equality is limited assumption. It is accepted as the only basis of moral importance and captures the requirements of equality.

Total utility equality

In this sense, utilitarianism is a special case of welfarism. What is the welfarism? Welfarism is the view that the goodness of a state of affairs can be judged by the goodness of the utilities. It is an extremist position and its denial can take many different forms pure and mixed. But utilitarian equality is one type of welfarist equality. Equality of total utility shifts the focus from marginal utility to total utility. There is an important difference between them.

As noted by Sen (1973, p.147), firstly, marginal is an essentially *counter-factual* notion: "marginal utility is the additional utility that would be generated if the person had one more unit of income". Total utility is not an inherently counter-factual concept. It is an important argument to equality. Secondly, "utilitarianism provides a complete ordering utility distributions, the ranking reflecting the order of the sums of individual utilities". But ranking would be completed in way different ways.

In the framework of interpersonal comparisons, one person *A* derives exactly twice as much utility as person *B* (*B* has being a cripple) from any given level of income. In this case, made *A* would have received more utility than *B* and instead of reducing this inequality.

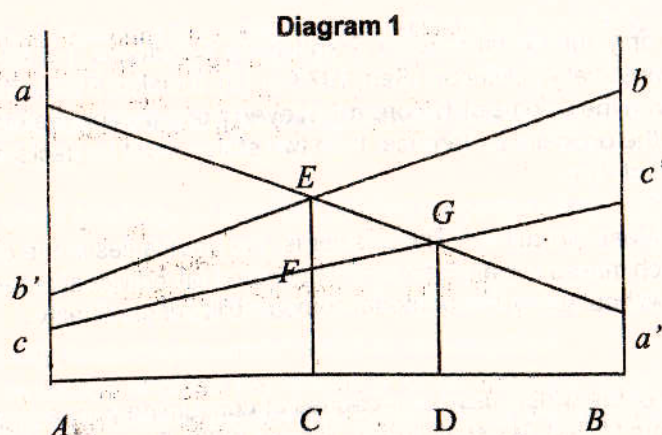


Diagram 1 illustrates (A. Sen, 1973, p.17) that the total amount of income to be divided into *A* and *B*. The share of *A* is measured in the direction *AB* and that of *B* in the direction *BA*. But *C* or *D* reflects a particular division of total income. The marginal utility of *A* is measured by *aa'* and *B* is measured by *bb'*. They are exact mirror images of each other. The maximum total of utility is secured by dividing income equally as given point *C* with *AC=BC*. *B*'s marginal utility schedule is exactly half that of *A*, so that his marginal utility is no longer given by *bb'* but by *cc'*. If the income distribution is left unchanged, *A*'s total utility will be *AaEC* and *B*'s will be *Bc'CF*. So, *B* will be much worse off. To compensate this, income will be shift from *A* to *B* which a transfer income from poor *B* to rich *A*. The new optimal point will be *D* with *A* enjoying a total utility of *AaGD* and *B* merely *Bc'GD*. It seems that utilitarianism is very far from an egalitarian approach. But most attempts at measuring inequality have concentrated on the utilitarian approach.

The evaluation of inequality will obviously depend on whether we are concerned only with the loss of the sum of individual utilities through a bad distribution of income, or also with the inequality of welfare levels of different individuals. It is the failure of utilitarianism to be concerned with the inequality of different individuals.

2. PRACTICAL MEASURES OF INEQUALITY

2a. The Atkinson welfare measure

The inequality is a historical issue, however "measuring the inequality" was emerged recently. As noted earlier, inequality is one of the major issues in economic development. Since the 1970s, remarkable changes in public and private perceptions about the ultimate nature of economic activity in the developing countries such as Mongolia have been witnessed, with the main concern being focused on the questions of economic growth and income inequality.

As we noted earlier, the income was distributed deliberately in Mongolia before 1990, so everybody had a much equal income. Since 1990 Mongolia has been undergoing the transition from a planned economy to a market economy. During the last 10 years, Mongolia has experienced growing social and economical differentiation among the population. A negative result of social and economical transition had been the deterioration in the educational and health status of the population, which constitutes a wasting away of the country's human capital.

Income inequality is a quite new phenomenon in Mongolian economic and social life. Income inequality is getting worse, it underlines for reform process as a whole and risks discredited efforts to construct a market economy. We have a requirement to study income inequality in Mongolia. Very few studies have been done on Mongolian data, so we have focus on attempting to upgrade income inequality research work. This chapter attempts to measure income inequality in Mongolia, by using the Atkinson welfare measure and statistical indices such as the range, the relative mean deviation, variance, and the Gini coefficient.

Firstly, we attempt to measure the Atkinson welfare measure in the case of Mongolia. Before calculating this measure, we need to analyse the data. We use the household income and expenditure data of Mongolia in 1997.

I'm going to calculate the Atkinson welfare measure using the data of 1997 in Mongolia, in the both rural and urban regions. As noted earlier, Atkinson measure reflects relative sensitivity to redistribution from the rich to the not-too rich vis-a-vis redistribution from the not-too-poor to the poor. The sensitivity of Atkinson measure depends on the inequality aversion parameter ϵ .

Atkinson measure can be written as:

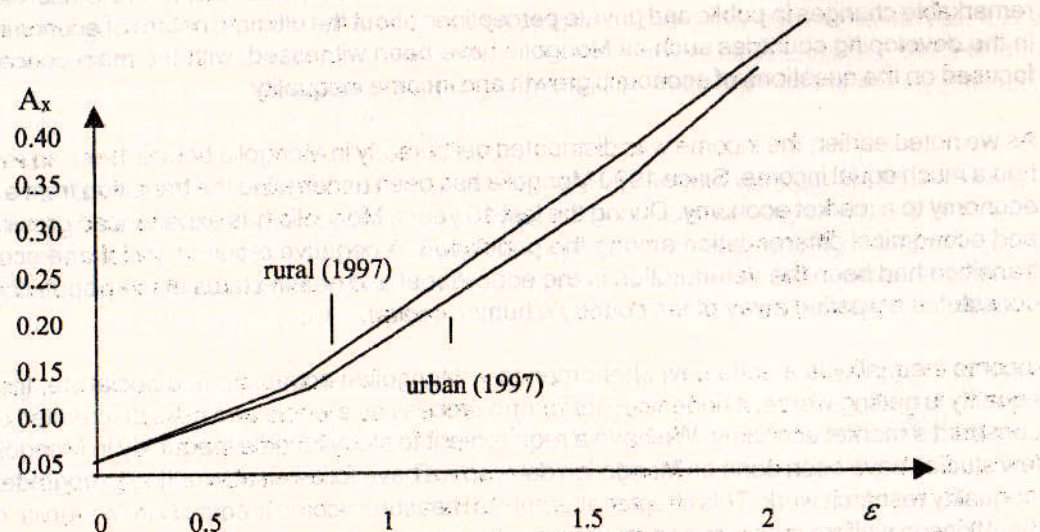
$$A_e = 1 - 1/\gamma \left[U^{-1} \left(1/n \sum_{i=1}^n U(y_i) \right) \right] = 1 - \left[1/n \sum_{i=1}^n (y_i / \bar{y}) \right]^{1/(1-\gamma)}$$

We have calculated the Atkinson measure and the results are shown below:

	Urban	Rural
\bar{Y}	824645.6	850572.4
A_0	0.0078	0.0111
$A_{0.5}$	0.0805	0.0807
$A_{1.5}$	0.2278	0.2568
A_2	0.3007	0.3464

According to the Atkinson measure income inequality is higher in the rural than in the urban.

Figure1. INEQUALITY AVERSION AND INEQUALITY RANKINGS, rural and urban regions of Mongolia, 1997



The figure 1 shows that the SWF-based index A_e will rank the rural as more unequal than the urban for all values of inequality aversion ε . The main point of this parameter is that if a quite high inequality aversion is specified, nearly all income distributions that are encountered will register high measured inequality.

The Atkinson measure has a weak principle of transfers and we must not forget that it shows the difference in marginal utilities. However, it is a relative measure.

2b. Comparing the inequality indices

A particularly convenient method of constructing such indices is to measure the extent to which an

actual distribution of income deviates from the case in which all income are equal, the egalitarian distribution of income.

The measures of inequality, most often used in practice are derived directly from the data. We note that the data can be presented in a number of alternative ways. Therefore, various measures of inequality can be derived by comparing each of these representations of the data with what they would be in the case, where all incomes were equally distributed.

If one distribution is more unequal than another, it is further removed from an equal distribution. For this purpose, one convenient approach is to use the various measures of dispersion commonly used in the statistical methods of summarising data.

As noted before, the statistical measures such as the range, the relative mean deviation, the variance and the Gini coefficient, mostly used for measuring income inequality. Now I'm going to calculate the Gini coefficient by using the data in the table 4 and 5. The Gini coefficient is the most appropriate index to show income inequality. As shown in figure 3, we can calculate this coefficient as follows:

Figure 2 . THE URBAN REGION, 1997

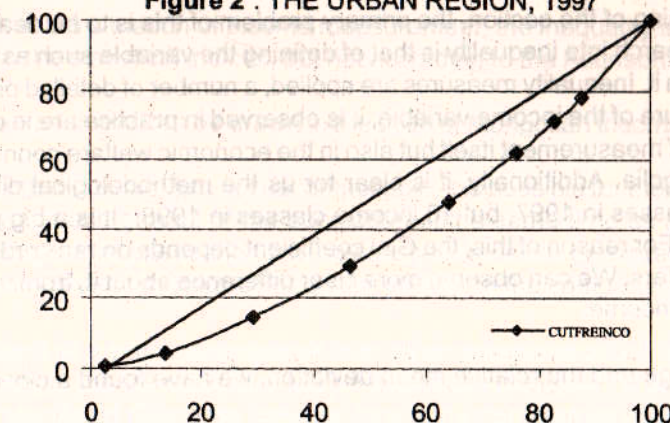
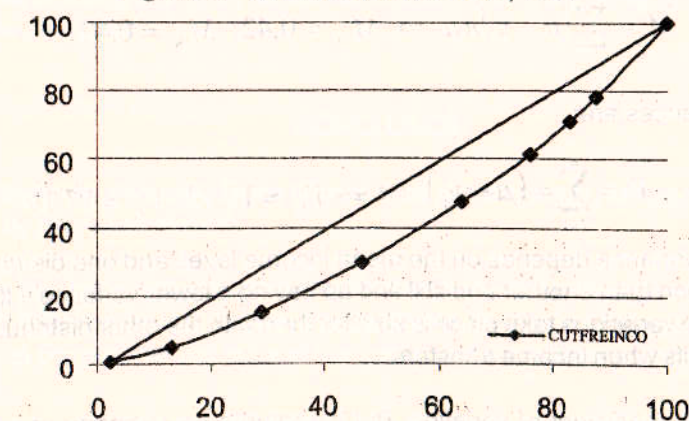


Figure 3. THE RURAL REGION, 1997



Gini coefficient = Shaded area A/ total area of BCD

It shows, income is distributed a relative equal in Mongolia. But there is a significant difference between rural and urban regions. The Gini coefficient shows, the rural region's income inequality

$$G_R = 0.24376$$

$$G_U = 0.2551$$

is by 0.02 lower than the urban region's, in 1997. As I calculated the Gini coefficient using the statistical data of 1998, it's shown the following results.

The G coefficient of the urban region is by 0.05 higher than the rural region in 1998. From this, I shall say, this big difference may be related to research work methodology such as income

$$G_R = 0.3114$$

$$G_U = 0.3595$$

classes, sample size etc.

As I mentioned beginning of the section, the primary problem of this is to be dealt with by anyone doing quantitative research into inequality is that of defining the variable such as income and then getting observations on it. Inequality measures are applied, a number of detailed preliminary considerations about the nature of the income variable, it is observed in practice are in order. So, it is not only in the technique of measurement itself but also in the economic welfare connotations attached to the income of Mongolia. Additionally, it is clear for us the methodological difference such as classified 9 income classes in 1997, but 10 income classes in 1998. It is a big point to compare above two years data. For reason of this, the Gini coefficient depends on rank ordering and it has a weak principle of transfers. We can observe more clear difference about it, from the histogram and the pie of household's income.

As I calculated the range and the relative mean deviation, we have found a closer result in these both regions in 1997.

$$E = [\max y_i - \min y_i] / \mu \Rightarrow E_U = [1683151 - 208262.6] / 824645.6 = 1.79$$

$$E_R = [1517690 - 186372.9] / 850572.4 = 1.57$$

$$M = \sum |\mu - y_i| / n\mu \Rightarrow M_U = 0.42; M_R = 0.42;$$

In our cases, the variances are:

$$V = \sum_{i=1}^n (\mu - y_i)^2 / n \Rightarrow V_U = 17.73; V_R = 17.19$$

As noted before, the variance depends on the mean income level, and one distribution may show greater relative variation than another and still end up having a lower variance if the mean income level around which the variations take place is smaller than with the other distribution. The relative mean deviation just fails when income transfers.

We know that c is the coefficient of variation. But it captures the property of being sensitive to income transfers for all income levels. So, the property of being sensitive to income transfers are the lower under rural than under urban, for all income levels. The coefficient of variation has a weak

transfer as like Gini coefficient.

$$c = \sqrt{V} / \mu \Rightarrow c_U = \sqrt{17.73} / 8.25 = 0.51; c_R = \sqrt{17.19} / 8.5 = 0.49$$

Table 1. The household's annual average income, 1997

	Urban	Rural
\bar{Y}	824645.6	850572.4
G	0.2551	0.2376
$A_{1.5}$	0.2278	0.2568
A_2	0.3007	0.3464
E	1.79	1.49
M	0.42	0.42
V	17.43	17.19
c	0.51	0.49

Now, let me look at the situation of income measurement, the inequality is higher in urban than in rural according to the statistical indices, but not according to the Atkinson measures in 1997.

From this a little experiment can be drawn in the case of Mongolian income distribution.

Some inequality measures are just not decomposable, it is possible for them to register an increase in inequality in some sub groups of the population at the same time as a decrease in inequality overall. Even though, it happens then it is obviously impossible to express the overall inequality change as some consistent function of inequality change in the component subgroups.

The Gini coefficient is a prime example of this, other measures which behave in this perverse fashion are the range, the variance, and the relative mean deviation. Though, calculation of the G coefficient has a significant difference between rural and urban regions during the 1997 and 1998, in the case of Mongolia.

The powerful result of my dissertation clarifies that the inequality measures will satisfy decomposability in the case of Mongolia. And, as we have seen, there are close connections between all indices of income inequality.

CONCLUSION

Inequality is in itself very awkward issue of economic development. I suggest the following points about inequality by my researchwork.

1. The inequality has two main opposite approaches such as justifying inequality and supporting equality. Until this time period, income inequality has been dominating in all developing economies, it still has proved that not income inequality, but equality supports economic growth and development.
2. The inequality is socio-economic phenomena, it involves quantitative and qualitative social values such as income, preference (SWF), and utilities (total and individual). The measure of in-

equality has both of objective and normative features. A serious difficulty of measuring inequality is existed here, because of both above approaches can be distinguished between seeing more or less inequality and valuing it more or less in ethical terms.

3. The welfare and statistical measures of inequality is most common to reveal income inequality. For instance, if we are interested in dealing with any and every possible income distribution, it may be reasonable to use one measure. We must try to use as much as possible measures in our study. But, in choosing a measure that conforms to this principle it is useful to have one that may either be related to the purpose or the data characteristics.
4. I have analysed the income distribution of Mongolia, using statistical data in 1997. As I calculated the Atkinson welfare measure and Gini coefficient, I have found a useful result from above two measures, in urban and rural regions of Mongolia in 1997. It is a decomposability of inequality measures.
5. As a result of calculation of Gini coefficient, income inequality in 1998 was a higher than in 1997, in Mongolia. But the income inequality in urban region always a higher than in rural region, in both above years.
6. I would conclude that income inequality measures are more sensitive and decomposable.

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