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A CRITICAL REVIEW ON MEASURING GENDER AND HUMAN DEVELOPMENT

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I. Introduction

As the first version of the *Human Development Report* (1990) argued,[1] a basic distinction needs to be made between the means and the end of development. Human beings are the real end of all human being's activities, and development must be centered on enhancing their achievements, freedoms, and capabilities. Based on these arguments, the 1995 Human Development Report focused on the women development and gender inequality problems for further socio-economic development. Equality of the opportunity for all people in the society would not only make all human beings participate in -enjoy the benefits from- development processes but also bring sustainable developments for the future generations.

There are no differing opinions as to that human beings are not the means, and the society must be constructed to enhance the individual and social well being. Furthermore, a certain human being is not the means for other human beings, and all human beings, independent from their sex, color, and religion, *etc.*, should have the equal opportunity to improve and enhance their individual and social well-being.

During the past decade, however, there were many debates on

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[1] It starts with a simple but far-reaching statement: "People are the real wealth of a nation. The basic objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives... Human development is a process of enlarging people's choice."

the human development index. Those debates were related, on the one hand, to the concept of human development, and on the other hand, to the measurement problems.

Even if among them, a major debate has been going in the national and the global forum on the concept of the human development, and in its practical policy implication, these debates would mainly focus on the measurement of human development as follows:[2] How can we measure human development?; how can we measure the gender problems?; what is the choice of dimensions and variables?; and how to handle insufficient and low quality of data (*i.e.*, problems about the quality of data for the international comparison) (*e.g.*, Behrman 1990, Dasgupta 1990, Romer 1990, Singer 1994, Anand and Sen 1994, Srinivasan 1994).

To answer these questions some yardsticks of measurement for the human well-being and the gender inequality will be needed because some debates are also related to the concept of the human well-being and the gender inequality. This would bring us concrete concepts and the characteristics of the human being's well-being and the gender problems of which characteristics can better explain the human development measures.

In this paper, the characteristics of human development and its measurement problems will be critically analyzed in the view of measuring human well-being. The primary objective of this paper is to investigate measurement problems of the Human Development Index (HDI), the Gender-Related Development Index (GDI), and the Gender Empowerment Measure (GEM). This paper consists of five sections. After reviewing the concept of human development, a simple social well-being function was introduced for theoretical backgrounds of measuring the human well-being. In the fourth section, the methods of measuring human development (HDI, GDI, and GEM) for the international comparison will be critically analyzed from the viewpoint of a social welfare function. Finally, some concluding remarks will be given.

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[2] For, as Myrdal observed, the fact is that value premises are needed even in the theoretical stage of establishing facts and factual relations. Answers can only be given when questions have been asked. A view is impossible except from a viewpoint (Myrdal 1970). Therefore, we can see that debates about measurements are strongly related to the concepts.

II. A Brief Review of Human Development and Its Concept

Development is a process of the improvements measured with respect to some set of criteria of values, but often, when comparing one country with another, development measures the state of the two countries with respect to a set of values. The values in question are related to the desired conditions in a society. Self-evidently, there is no universal agreement about what these desired conditions should be as individuals certainly have different preferences regarding their life styles and relationships with the rest of the society; furthermore, through their political manifestos and the policies operated by their governments, nations express different collective (majority or minority) views about the desired state of society-views which change through time. Inevitably, therefore, the rate or relative levels of a country's development are normative concepts whose definition and measurement depend upon the value judgements of analysis involved.

The assertion that development is a normative concept, which will be measured differently by different people, constitutes a potentially serious barrier to formal analysis.[3] Not only are value judgements an inevitable part of deciding what concept and relationship should be employed to answer questions such as 'what causes development?' or 'has development occurred in any specific instance?', but they are also necessary when deciding how to represent the concepts empirically.

However, we would have the necessary conditions that the concept of the development must meet, and the desirable goals that the development policy has to pursue. It is the lives that have the intrinsic importance, not the commodities nor the income which are possessed. Income, commodities (basic or otherwise), and wealth do, of course, have the instrumental importance but they do not constitute a direct measure of living standard itself.

A person's income level, for example, does not reveal what expectation of life the person has, whether he or she is presently healthy (or suffering from a disease), disabled or incapable of moving

[3] However, it is one that affects all areas of the social sciences and is not unique to the development studies.

about freely, *etc*. Even for those features of the living standard in which the instrumental significance of private income is likely to be greater, such as an adequate nutrition, there are enormous variations in converting income into the achieved well-being.

Hence the motivation to focus directly on the lives that people lead - what they succeed in being and doing. Do they have the capability to live long? Can they avoid mortality during infant and childhood? Can they escape from the preventable morbidity? Do they avoid illiteracy? Are they free from hunger and undernourishment? Do they enjoy personal liberty and freedom?

Agreement is fairly broad on some aspects of the human development concept as follows (UNDP 1995, p122):

i) Development must put people at the center of its concerns.
ii) The purpose of development is to enlarge all human choice, not just income, so the human development concept focuses on the entire society, not just the economy.
iii) Human development is concerned both with expanding human capabilities (through investment in people) and with ensuring the full use of these capabilities (through an enabling framework).
iv) Human development is erected on four essential pillars-productivity, equity, sustainability, and empowerment. It regards economic growth as essential but emphasizes the need to pay attention to its quality and distribution and analyses at length with its links to human lives. And it addresses sustainable choices from one generation to the next.
v) The human development approach defines the ends of development - and analyzes the options for achieving them.

These are the features of well-being which derive from looking at people as the center of all development activities. Enhancing them in these elementary ways is what lies at the core of human development. That is, the human development approach values capabilities related to, say, health, nutrition, and basic education as the ends in themselves.[4] And policy objectives for achieving these basic goals

[4] The achievements of peoples in terms of long life or the functional literacy are valued as the ends in themselves.

can be summarized as follows (For details, see Colman and Nixson, 1994, p3):

i) The family income should be adequate to provide a subsistence package of food, shelter, clothing and footwear.
ii) Jobs should be available to all family heads, not only because this will ensure that distribution of income will generally attain subsistence consumption levels but also because a job is something without which personality cannot develop.
iii) Access to education should be increased and literacy ratios raised.
iv) The populace should be given an opportunity to participate in the government.
v) National independence should be achieved in the sense that the views of other government do not largely predetermine one's own government's decisions. As progress is made towards the economic goals, that is, as the undernourishment, unemployment and inequality dwindle, the educational and political aims become increasingly important objectives of the development.

III. Social Well-Being Functions

A person's well-being is an aggregate of its constituents: utility and an index of the worth to him (or her) of the freedoms he (or she) enjoys.[5] Its assessment needs to be made over his (her) entire life because the accounting begins from the period when he (she) has the right to be regarded as a person.[6]

In practice, however, this is a difficult task; it is easier to obtain information for a slice of time. And to estimate income than wealth is easier, even though it is wealth that is often of greater interest. Thus, we will focus on the current income and current persons' well-being.[7]

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[5] From now, we will consider 'he' or 'him' as the neutral gender taxonomy.

[6] Contrasting a person's lifetime well-being index poses yet another class of problems. It is simplest to think it as an integral part of the flow of well-being. See Dasgupta and Heal (1979) for details.

[7] These are familiar matters that well-being at a moment of time is merely a constituent of a person's lifetime well-being and that it is the latter that matters.

We can deduce a person's well-being from his actual choices. However, an individual welfare depends not only on his utility but also on the social freedom and the nature that he can enjoy. An individual utility, one component of an individual well-being, depends on the extent of his choice, and not merely on what is chosen. That is, his utility also depends on other's choices that would affect his choice and his status. Therefore, we can conclude that an individual is characterized not only by his genotype, but also by his developmental history. Combination of these would determine an individual utility level.

Other components of the individual welfare, represented by the nature and the social freedom, would be a function of the feasible (or permissible) set that he can enjoy. Furthermore, the social rule, norm, and institution, basic-needs goods, and the other's choice would determine the feasible set.

Among these factors, the institution would be the most influential factor. The institution can be defined as 'rules, norms and customs, and their enforcement characteristics, which define the rights and duties in human exchange' or as 'cluster of behavior rules governing human actions and relationships in recurrent situation'.[8]

One way to identify the role of institutions is to say that they are established because there are transaction costs in the exchange relation (Coase 1988). Transaction costs appear partly as information costs (imperfect or asymmetric information) and partly as cost for carrying out exchanges.[9] High transaction cost means that the level of

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[8] For the detailed definition of 'institution', see North (1990), and McNicoll (1994). Since it is institution, together with technology, that constrains all forms of human exchanges, it is also by a change in institutions that the conditions of exchanges can be altered. Institutional changes are, therefore, related to the instrument of reforms. But institutions can also be instrumental in obstructing reform. This means that while it may be possible to identify key institutions requiring economic and social transition, one will also find that there are institutional reasons why these key institutions are not implemented, or why similar reforms produce different outcomes.

Furthermore, all institutions that influence the economic behavior of individuals or households are not, by definition, economic institutions. Many forms of human intersections take place without any clear purposes. In pre-industrial societies, however, limited division of labor, economic and other institutions are closely interlinked (See Bengtsson and Gunnarsson, 1994).

[9] They include the cost of establishing contract between economic actors (that is, gathering and diffusion of information) as well as cost for establishing contracts and costs for the control of the enforcement of contracts.

insecurity in transactions is high. The more complex the exchange, the greater the transaction costs and the more likely it is for institutional arrangements to be established to reduce these costs, and hence reduce the insecurity.

Therefore, an individual k's well-being can be written as;

$$W_k(\boldsymbol{a} \ ; \ H_k) = W_k(U_k(\boldsymbol{a} \ ; \ H_k), Q_k(A_k(\boldsymbol{a}_{-k}, H_k)) \qquad (3.1)$$

where U_k : k's utility

$\mathbf{a} = (a_1, a_2, ..., a_n)$: a choice vector in a society

$\mathbf{a}_{-k} = (a_1, a_2, ..., a_{k-1}, a_{k+1}, ..., a_n)$: a choice vector excluding the k^{th} person's choice

N : a number of society member

H_k : individual k's state including his history and characteristics, *etc*

A_k : permissible or feasible set of an individual k's strategies (it also depends on the other's choice and his own state)

$Q_k(\cdot)$: numerical index of A_k

$W_k(\cdot)$: k's welfare function

$Q_k(\cdot)$ measures the nature and the social freedom a person can enjoy, which are dependent on the feasible set, A_k, in which he can actually choose his own actions. And the boundedness (or kernel) of set A_k is determined by the other's choice ($\mathbf{a}_{-k}$) and his own economical, political, physical, and social status (H_k)[10] under given social rules, norm and institutions. Given resources and technology in the society, other's choices would affect his position so that these can represent the distribution status of the society.

Individual well-being functions have U_k and Q_k as constituents of his well-being, and each contributes positively. It follows that $W_k(\cdot)$ is an increasing function of each arguments. Ultimately, individual well-being functions depend on the choice vectors in a society (*i.e.* including other's choices) $\mathbf{a}$, and his own state, H_k.

According to the equation (3.1), there are two ways of assessing the social well-being and its changes. One is to measure the constituents of the well-being (utility and freedom as arguments in the

[10] Status includes his own personal history.

equation (3.1)) and the other is to value the commodity determinants of the well-being (goods and services which are inputs in the production of the well-being). The former procedure measures 'output' (*e.g.* indices of the health) and the latter evaluates and aggregates 'input' (*e.g.* real national income).[11]

Among these inputs and outputs measures, there would be at least three broad kinds of indices that one can use in constructing a measure of a person's well-being: (1) his current and prospective real income (inclusive of certain non-marketed goods and services), (2) his current and future state of health, and (3) his educational attainments. Health and education would seem to be an embodiment of freedom, whereas income contributes to the employment of such freedom. However, income affects a person's welfare as well, and it affects his utility in a direct way as explained in the previous section.

The social well-being in N-person society is an aggregate of individuals' well-being.[12] The collective evaluation is based on them. Therefore, we may write an aggregate well-being defined as a social well-being function. $W(\cdot)$, is[13]

$$W(\boldsymbol{a}) = W(W_1(\boldsymbol{a} \quad ; H_1), \ldots\ldots, W_n(\boldsymbol{a} \quad ; H_n)) \tag{3.2}$$

We take $W(\cdot)$ to be an increasing function of each of the components W_ks, which affirms person k's well-being. We, therefore, conclude that the social well-being is in turn an increasing function of each of its 2N ingredients: utility, and the worth of the liberties enjoyed by each of the N persons in the society as measured by the index $Q_k(\cdot)$.

In this paper, we will focus on the measurement of the health, and the education as output of the individual and the social well-being function among the index $Q_k(\cdot)$, and income as the direct input of those. The Human Development Index focuses on (1) the longevity as measured by life expectancy at birth, (2) educational attainment as

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11 In the equation (3.1), input variables are expressed as **a**, H_k, and output variables are expressed as Q_k.

12 We assume that there are no aggregate problems. To handle aggregate problems would exceed the scope of this paper.

13 We may omit the variable H_k in the social well-being function because we assume that there are no aggregate problems.

measured by the combination of adult literacy (two-thirds weight) and combined primary, secondary and tertiary enrolment ratios (one-thirds weight),[14] and (3) standard of living as measured by real GDP per capita in terms of PPP$.

IV. The Construction of Gender and Human Development Index: A Critical Review

Interest in measuring the development lies in intense. However, it is extremely difficult to measure the comparative levels of the development. The statistical methods available may be thought acceptable for obtaining measures of the growth rate of living standards and of ordinal rankings as to whether one country is more developed than the others. However, they exhibit grave deficiencies when used as cardinal measures of 'by how much or how many times' one country is more developed than the others.

The fundamental causes of the measurement difficulty lie in the definition of the development. As identified in the previous section, many of the criteria or objectives by which the development is to be judged or measured are qualitative.

However, extending the basis for estimating the standard of living has been impending for a long time. In addition to the real per capita national income measures, United Nations Expert Groups recommended that quantitative measures in the fields of health, education, employment, and housing for assessing the standard of living should be constructed (see United Nations, 1954).

Standard of living, health levels, the educational level, and the extent of grass roots participation in the government, and, in general, the social institution with which persons can enjoy themselves are all qualitative criteria, which cannot be measured directly. They have to be measured indirectly using indicators that are directly measurable quantities. Thus, many possible indicators of a nation's state of physical health might include the number of people per trained doctor,

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[14] For the educational measures, the combined primary, secondary and tertiary enrolment ratios have been considered as measurement variables since the 1994 Report.

and the rate of child mortality or average life expectancy. For the standard living we might use such indicators as average national income per capita, the proportion of families with piped water to their living quarters, the proportion of household supplied with electricity, and so on.

The idea here was to leave the estimation of the real national income pretty much the way it then was, and to supplement this index by a further set of indices - reflection various constituents and determinants of the aggregate well-being. This tactic of compiling a heterodox collection of measures has come to dominate international comparisons of well-being.[15]

1. HDI

The methods of UNDP's HDI measure also follow this tradition, but they focus on the health status, education, and income measures. The UNDP's HDI is the sum of certain normalized indices of per capita national income, life expectancy at birth, and adult literacy.[16] For the convenience of explanations, we followed the 1990 *Report.*

In the last six *Human Development Reports*, the human development index (HDI) has been formulated in terms of the country's deprivation or shortfall in each of three separate dimensions - life expectancy at birth (X_1)[17], knowledge (X_2)[18], and adjustment income

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[15] However, this multiplicity of possible indicator for any given general dimension of the development simply compounds the problems arising from the existence of several general dimensions. Firstly, no quantitative indicator is capable of exactly measuring a qualitative criterion. Secondly, no one indicator can conceivably approximate the qualitative levels attained with respect to all the major dimensions of development, especially when it is remembered that these are economic, social, political and cultural. Thirdly, there are appreciable difficulties in deriving a method (weighting scheme) whereby various indicators for different qualities can be added together into a single index of a country's level of development. For details, see Colman and Nixon (1994).

[16] From the 1994 *Repot*, combined enrolment ratios have been calculated.

[17] Life expectancy at birth for measuring health status is not always compatible with the anthropometric measure that is one major indicator of health status. For more details, see Dasgupta (1993).

[18] In the first *Report* (1990), knowledge was measured only as adult literacy ratio. However, since in the *Report* 1991, knowledge has been measured as an additive function of adult literacy and schooling years, weighting two-thirds on the former and one-third on the latter. Furthermore, since 1994, the combined primary, secondary, and tertiary enrolment ratio has been used instead of mean years of schooling.

(X_3).[19,20] The *Report* 1990 defined I_{ij} as the deprivation indicator for the country j with respect to the variable X_i as follows;

$$I_{ij} = \frac{\max_k(X_{ik}) - X_{ij}}{\max_k(X_{ik}) - \min_k(X_{ik})} \tag{4.1}$$

By constructing each deprivation indicator for country j, I_{ij} i=1, 2, 3, lies between 0 and 1. An average deprivation index I_j for the country j across the three variables was defined as a simple un-weighted average of I_{ij}:

$$I_j = \frac{1}{3}\sum_{i=1}^{3} I_{ij} \tag{4.2}$$

The shortfall in the human development index for the country j was then defined to be just this average deprivation. Thus if H_j is the human development index for the country j, we have, by definition $1-H_j = I_j$ or $H_j = 1- I_j$.

For convenience, however, it is preferable to express the human development index H_j in terms of the attainments rather than the

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[19] As explained in the previous section, the shortfall perspective has some merits in drawing attention to the distance a country still has to travel in order to achieve what is regarded as a desirable target or goal.

[20] Income is calculated in terms of PPP$, which is called as Kravis Dollar, in order to compare international real purchasing power. It is the choice of an exchange rate that can influence the individual country's income level when we calculate individual countries' incomes in terms of US$. Furthermore, in terms of US$, certain implications for the relative prices of non-traded goods and services would be quite inappropriate and misleading (Kravis, *et al.* 1978).

1) Purchasing power parity can be defined as follows;
The number of unit of that currency required purchasing the same representative basket of goods and services that a US dollar (the reference currency) would buy in the United States (or a similar basket of goods and services). Purchasing power parity could also be expressed in other national currencies or in SDRs.

2) Real GDP per capita (PPP$) is defined as follows;
The GDP per capita of a country converted into US dollars on the basis of the purchasing power parity of the country's currency. The system of purchasing power parities has been developed by the United Nations International Comparison Program (ICP) to derive more accurate international comparison of GDP and its components than those based on official exchange rates, which can be subjected to the considerable fluctuation (UNDP, 1995, p224).

shortfalls of the country j. This formation certainly seems more natural if one wishes to assess changes in HDI over time. The attainment perspective is more relevant an assessing how well a country is doing, whereas the shortfall perspective is more in looking at the difficulty of the task still remaining.[21]

From the above,

$$H_j = 1 - \frac{1}{3}\sum_{i=1}^{3} I_{ij} \tag{4.3}$$

$$= \frac{1}{3}\sum_{i=1}^{3}\left[1 - \frac{\max_k(X_{ik}) - X_{ij}}{\max_k(X_{ik}) - \min_k(X_{ik})}\right]$$

$$= \frac{1}{3}\sum_{i=1}^{3}\frac{X_{ij} - \min_k(X_{ik})}{\max_k(X_{ik}) - \min_k(X_{ik})}$$

$$= \frac{1}{3}\sum_{i=1}^{3} H_{ij}$$

where

$$H_j = \frac{X_{ij} - \max_k(X_{ik})}{\max_k(X_{ik}) - \min_k(X_{ik})} \tag{4.4}$$

is the i^{th} variable's contribution to the human development index for the country j. Therefore, we can express H_j directly in terms of the attainment levels X_{ij};[22]

$$H_j = \frac{1}{3}\sum_{i=1}^{3} H_{ij} \tag{4.5}$$

In general, j country's HDI is a function of her own longevity, knowledge, income, and other countries' attainments in the above three variables, that is,

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[21] Which perspective we adopt depends on the nature of the exercise.

[22] From the 1994 Report, UNDP adopted the attainment perspective. That is, it has followed the equation (4.4) instead of equation (4.1).

$$H_j = W_j(f_j(X_1, X_2, X_3),\ f_{-j}(X_1, X_2, X_3)) \tag{4.6}$$
$$\frac{\partial W_j}{\partial f_j} \geq \frac{\partial f_j}{\partial X_i} 0,\ i = 1, 2, 3,\ \frac{\partial W_j}{\partial f_{-j}} \leq 0$$

So, it does follow an individual well-being functional form as explained in the equation (3.1). f_{-j} which describes the j^{th} country's position in the international society, is corresponding to the $Q_k(\cdot)$

However, apart from some normative critiques,[23] the original HDI index could not escape from the critique that the HDI did not meet one of Arrow's critical conditions, independence of irrelevant alternatives (IIA), which desirable social welfare functions should satisfy.[24] That is, an improvement in the achievement of the lowest-achieving country (or highest-achieving country) in the sample would decrease the HDI for the country j, and this is not the sort of externalities that one wants in an index. This can be shown as follows;[25]

$$\frac{\partial H_{ij}}{\partial \max_k(X_{ik})} = \frac{X_{ij} - \max_k(X_{ik})}{(\max_k(X_{ik}) - \min_k(X_{ik}))^2} \leq 0 \tag{4.7}$$

because of the definition;

$$\max_k(X_{ik}) \geq X_{ij}, \qquad for \quad every \quad j \tag{4.8}$$

It is clear that the j country's attainment, assuming that the j country is not lowest (or highest) achieved, is independent from the lowest (or highest) country's achievement. This means that country's performances depend on the other countries' achievements which are

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[23] There is not much normative significance in this index, nor is any account provided of HDI's normative significance (See Dasgupta, 1993).

[24] Arrow's four conditions that the desirable social welfare functions should meet are (1) transitivity, (2) Pareto efficiency, (3) independence of irrelevant alternatives, and (4) non-dictatorship. For details, see Arrow (1963).

[25] Equality is realized when the j^{th} country becomes either the lowest country or the highest country.

clearly independent from her own achievement so that it absolutely violates the Arrow's independence of irrelevance condition. Therefore, UNDP's HDI does not have necessary conditions that any desirable social welfare function should satisfy.

It can be argued that the HDI was constructed expressly as a measure of relative performances across countries at a point in time. No special significance is attached to the absolute value of the index, the entire analysis being conducted in terms of ranking of countries relative to one another. Therefore, it can be argued that the absolute value of the HDI is not important and it is meaningless to stick on the absolute value of the HDI.

However, if policymakers want to compare their own country's attainment over time, the absolute value has important roles. For example, if one country has invested his own efforts in the social infrastructure (education, health, shelter, *etc.*), and improved the social institutions (negative and positive freedom, reducing gender problem, *etc.*) and the economic growth, she wants to compare these to the previous status. Furthermore, as long as UNDP classify countries as high-, medium- and low human development countries according to the HDI score, absolute values of the HDI have important meaning for domestic policy makers.[26]

To overcome this weakness of the HDI, maximum value and minimum value of X_{ik} has been fixed from the 1992 *Report*. Fixed minimum and maximum values in the 1995 *Report* can be summarized as in (Table 1). Therefore, from the *Report* 1992, it seems that the HDI can be seen as escaping from the critique of independence of irrelevance.

However, IIA problems still remained for the income indicator. In order to reflect diminishing returns to transforming income into the human capability or the individual well-being function, less weight is given to income argument in the equation (3.1) of previous section.[27]

For less weighting on the income, Atkinson transformation

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[26] According to the 1995 *Report*, if one country's HDI score exceeds 0.80, she is classified as the high human development country. And classified as the medium human development countries are those who are in $0.5 < H_j < 0.8$, and the low human development countries are those with over $H_j < 0.5$.

TABLE 1 The Boundary Value of Three Indicators in HDI, 1995

	Longevity	Knowledge		Income
	Life Expectancy at Birth (years)	Adults Literacy (%) (2/3)*	Combined Enrolment Ratio (%) (1/3)*	Real GDP per capita (PPP$)
Minimum Value	25	0	0	100
Maximum Value	85	100	100	40,000 (5,448[1])

[1] PPP$5,448 is an adjusted value of PPP$40,000.
* Weight between the adult literacy index and the combined enrolment ratio.
Source: UNDP, 1995, p134

(1970) has been used in constructing the HDI since the *Report* of 1992.[28] Atkinson transformation can be summarized as follows;

$$W(y) = y^* + 2y^{*\frac{1}{2}} + 3y^{*\frac{1}{3}} + \cdots + n[(y - (n\text{-}1)y^{*\frac{1}{n}}], \; for \quad (n\text{-}1)y^* \leq y \leq ny^* \tag{4.9}$$

where y* is the world average income in 1992, in terms of real purchasing power parity (PPP$). That is, Atkinson transformation gives a linear weight on the country, of which income level is less than the world average income, and less weights on the country, of which income level exceed the world average income level with the power series. This income was called the adjusted real per capita GDP in terms of PPP$

It is, however, a critical problem that the world average income level (in terms of the real PPP$) plays major roles in changing the individual real PPP$ into the adjusted real PPP$ because the world average income can depend on other countries economic growth independent from her own economic performance. Even if one

[27] If less weighting are not given on the income, the HDI will heavily depend on the national income levels. In this case, constructing the HDI becomes meaningless because the concept of the HDI is originated in overcoming the weakness of income in measuring the human well-being as explained in section 3.
[28] In the 1991 *Report*, log transformation was used (UNDP, 1991).

country has a good economic record (measured in terms of the economic growth), her HDI will decrease when the world average income is increasing, which is possible if one of the large economies has well recorded economic growth and her per capita GDP (in term of PPP$) is increasing independently from the j^{th} country. Therefore, we can see that 1995 HDI also cannot escape from the Arrow's critique (IIA).

In order to escape from Arrow's IIA critique, the world average income y* must be augmented as independent figures from other countries' economic performances. One possible way is to fix y* as a constant level independent from the current world economic situations, such as a certain level which can be chosen as the median (middle) value among the possible historical data, or the minimum income level by which human beings can manage to survive the minimum economic life from the viewpoint of physical conditions.

2. GDI

The gender-related development index (GDI) uses the same variables as the HDI. The difference is that the GDI adjusts the average achievement of each country in life expectation, educational attainment and income in accordance with the degree of the disparity in the achievement between women and men. The GDI is calculated as follows; First we calculate the HDI of each sex.

$$H_{ij}^{g} = \frac{X_{ij}^{g} - \max_{k}(X_{ik}^{g})}{\max_{k}(X_{ik}^{g}) - \min_{k}(X_{ik}^{g})} \tag{4.10}$$

where g=f(female), m(male). The boundary value of these variables can be summarized in (Table 2).

Then, for considering the distribution of the i^{th} variable X_i in the j^{th} country between different sexes, the above index (equation (4.10)) would be transformed by 'gender equally distributed equivalent achievement transformation', which then belongs to the interval $[\min(H_{ij}^{f}, H_{ij}^{m}), \max(H_{ij}^{f}, H_{ij}^{m})]$ and is called the gender-equity-sensitive-indicator (GESI). The GESI can be calculated as follows;

TABLE 2 The Boundary Value of Three Indicators in GDI, 1995

	Longevity		Knowledge		Income
	Life Expectancy at Birth (years)		Adults Literacy (%)	Combined Enrolment Ratio (%)	Real GDP per capita (PPP$)
	Female	Male			
Minimum Value	27.5	22.5	0	0	100
Maximum Value	87.5	82.5	100	100	40,000 (5,448[1])

[1] PPP$5,448 is an adjusted values of PPP$40,000.
Source: UNDP, 1995, p132.

$$G_{ij} = [\frac{P_{jf}}{P_j}(H_{ij}^f)^{1-\epsilon} + \frac{P_{jm}}{P_j}(H_{ij}^m)^{1-\epsilon}]^{\frac{1}{1-\epsilon}} \tag{4.11}$$

is the i^{th} variable's contribution to the gender-related development index for the country j (where P_{jf} = number of female in the country j, P_{jm} = number of male in the country j, P_j = total population size of the country j). Therefore, we can express G_j directly in terms of the attainment levels X_{ij} which have considered distribution of the i^{th} variable in the j^{th} country among different sexes;

$$G_j = \frac{1}{3}\sum_{i=1}^{3} G_{ij} \tag{4.12}$$

It is easy to see that the equation (4.12) satisfies the conditions of the social well-being function (condition of the equation (4.6)). It is noted, however, that GDI is invented only for considering the gender gap regardless of the direction of gender discrimination between different sexes. GESI gives more penalties on the skewed distribution of variables between sexes irrespective of the direction of the discrimination. The longevity measures and the enrolment ratios, for example, are favorable to female, and share of the earned income is favorable to male. Therefore, those variables, *ceteris paribus*, have played roles in decreasing GDI.

Among gender-related index variables in the country j, the methods of calculating income distribution between genders are most

disputable. Gender-related income index of UNDP ($G_{income,\,j}$) consists of two parts. One is an income distribution part, and the other is an adjusted income (y_{adj}) part in terms of PPP$ which is calculated as same methods of the HDI.[29]

The income distribution (ID_j) effect part could be expressed as follows;

$$ID_j = [\frac{P_{jf}}{P_j} (\frac{W_{jf}}{W_j} \frac{L_{jf}/L_j}{P_{jf}/P_j})^{1-\epsilon} + \frac{P_{jm}}{P_j} (\frac{W_{jm}}{W_j} \frac{L_{jm}/L_j}{P_{jm}/P_j})^{1-\epsilon}]^{\frac{1}{1-\epsilon}} \quad (4.13)$$

where, W_{jf} = female's average (non-agricultural) income in the country j, W_{jm} = male's average (non-agricultural) income in the country j, L_j = total labor force (economic activity force) in the country j, L_{jf} = female labor force in the country j, L_{mj} = male labor force in the country j. Therefore, the gender-related income index is summarized as follows;

$$G_{income,\,j} = \frac{ID_j \times y_{adi} - 100}{5{,}448 - 100} \quad (4.14)$$

We can see that the direction of increments in ID_j depends on the initial income distribution between female and male as female's w_f increases;

$$\frac{\partial ID_j}{\partial W_f} = (ID_j)^{\epsilon} \frac{W_m}{W^2} \frac{L_f}{L} \frac{L_m}{L} [(F)^{-\epsilon} - (M)^{-\epsilon}] \leq (\geq) 0 \quad (4.15)$$

$$\text{if } F \geq (\leq) M$$

where $F=(W_f/W)(L_f/L)(P_f/P)$, $M=(W_m/W)(L_m/L)(P_m/P)$. That is, when initial distribution is more favorable to female than to male, the increase in female wage will lower the income distribution index, and *vice versa*. Therefore, we can see that GESI is not biased against male's viewpoint but rather neutral to bias of the gender, and in this sense the GESI would be much more developed than the HDI concept.

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[29] For calculating the gender-related income index, the calculation order is slightly changed compared to the other indexes. That is, first of all, the income distribution effect is calculated with the equation (4.11), then indexed with the equation (4.10).

However, gender-related income index cannot meet the Arrow's critical criteria that the social well-being function (or index) should satisfy - IIA (independence of irrelevant alternatives) condition, which was explained in the previous section, because it is basically composed of an adjusted income with yard stick of world average income (y*) in terms of PPP$.[30] Furthermore, IDj has another weak-points which came from the income distribution effect terms between sexes, and are composed of cultural-structural factors and functional factors in calculating discrimination against one side of sexes with handing same dimension.

In the equation (4.13), gender-equity-sensitive transformation basically has the weighted average concepts - proportional income share of female (F) and proportional income share of male (M) is weighted average with the proportion of sex ratios;

$$F = \frac{W_{jf}}{W_j}\frac{L_{jf}/L_j}{P_{jf}/P_j} \tag{4.16}$$

$$M = \frac{W_{jm}}{W_j}\frac{L_{jm}/L_j}{P_{jm}/P_j}$$

where F, M is proportional income shares of female and male, respectively.

For example, the proportional income share of female can be separated as two parts. One is the ratio of women's average wage rate to the overall average wage in j country (W_f/W), the other is the weighed average of ratio of women's labor force to the total labor force in j country $(L_{jf}/L_j)/(P_{jf}/P_j)$. The former is related to the market-wage discrimination between different sex and could be defined as a "functional discrimination", while the latter is related to the labor participation rate between female and male, and sex ratio - could be defined as a "structural discrimination" depending on the j^{th} country's institutional factors (culture and history, *etc.*).[31] These factors, especially (L_{jf}/L_j), are absolutely related to the non-market activities

[30] See equation (4.9).
[31] For the effect of institutional problems on the social well-beings, see section III.

of which value is difficult to be estimated for conserving and keeping the social security and norms; the home-keeping, the home-education for children, and the identification of family and their culture, *etc.*[32,33]

Therefore, when we calculate the gender-related income variable to construct the GDI for the international comparisons of gender problems, only functional discrimination factors operated in the market economy should be used. Uniformly applying UNDP formula including these factors to calculating the gender-related income index regardless of considering the cultural and the historical differences of the different countries' specific conditions, it is very difficult for the GDI method to escape from the criticism that there is the western society's cultural imperialism working even in calculating the GDI for intently increasing their position in international comparisons or the diversification of culture and history was totally ignored. Only western countries' viewpoint based on their own culture would be accepted as the international norms and the yardstick for the international comparison criteria. However, the cultural and the historical factors have their own rationality and specialty in their own society, so it is not possible to compares to other cultures and other countries' specific situations with the western-biased criteria.

Therefore, the gender-related income index should be changed, considering only the functional discrimination factors, which could be expressed as a follows;

$$ID_j^* = [\frac{P_{jf}}{P_j}(\frac{W_{jf}}{W_j})^{1-\epsilon} + \frac{P_{jm}}{P_j}(\frac{W_{jm}}{W_j})^{1-\epsilon}]^{\frac{1}{1-\epsilon}} \qquad (4.17)$$

That is, for calculating gender-related income index, it is more rational and fair to delete the structural factors from the UNDP's original formula (equation (4.13)), and instead of them, to use ID_j^* transformation equation (4.17) for international comparisons of the gender discriminations in the (wage) income sector.

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[32] In the U.S, one-thirds of the couples has a divorce-experience. This might bring invaluable loss and shocks for their children's mentality and value judgement, who would shape the future of her society.

[33] Because of this factor, Confucianism and Muslim traditional society's GDI were ranked as the lower level.

Furthermore, among the functional discrimination factors (wage rate differentials), the educational differentials and the difference of job careers between gender also must be considered because the wage rates depend on the labor productivity, and the job profiles and history.[34] Therefore, instead of the structural factors, differences of the labor productivity factors between genders should be considered. If we assume that education proportionally increase the labor productivity, the enrolment ratio between gender could be used to consider the difference of the labor productivity and the wage gap between female and male. This factor could be expressed as the following equation, ID_j^{**}

$$ID_j^{**} = \left[\frac{P_{jf}}{P_j}\left(\frac{W_{jf}}{W_j}\frac{E_{jf}}{E_j}\right)^{1-\epsilon} + \frac{P_{jm}}{P_j}\left(\frac{W_{jm}}{W_j}\frac{E_{jm}}{E_j}\right)^{1-\epsilon}\right]^{\frac{1}{1-\epsilon}} \tag{4.18}$$

where E_{jf} = female's overall enrolment ratio in the j country, E_{jm} = male's overall enrolment ratio in the j country, E_j = average overall enrolment ratio in the j country.

If data for the wage differential rate between education levels are obtained country by country, we can measure the gender discrimination, more accurately, in the labor wage rate between female and male. Owing to such information, we can also dis-aggregate the enrolment ratios as the primary, secondary, and tertiary levels between female and male.

3. GEM

Gender empowerment measure (GEM) uses variables constructed explicitly to measure the relative empowerment of men and women in the political and economic spheres of the activity. For measuring the political empowerment status of women relative to the men's, the percentage of congress representatives was used. For measuring the

[34] The World Bank (1995, pp.44~45) also argued that education factor, job experience, occupation factor should be taken for calculating the wage rate differentials between different sexes for capturing the meaningful gender gaps. See World Bank (1995) for more details for the possible problems in measuring gender problems according to the wage gap between different genders.

economic empowerment status of women relative to men's, (1) percentage of administrative and managerial positions, (2) percentage of professional and technical positions (with equal weight on (1) and (2)), and (3) proportional income shares between female and male using same formula of GDI was used.

GEM's method to calculate gender gaps of the empowerment is basically equal to the GDI method. Instead of using the ratio figure within same gender used in the GDI, however, the GEM used the relative percentage ratio figures between genders. It used evenly distributed equivalent percentage (EDEP) which is one variant of gender equally distributed equivalent achievement transformations. Therefore, the figures of variables (especially the political empowerment position, the administrative and managerial positions, and the professional and technical occupation positions) used in the GEM belong to interval [0, 50].[35] EDEP formula can be summarized as follows;

$$X_{j,\,edep} = \left[\frac{P_{jf}}{P_j}\left(\frac{X_{jf}}{X_j}\right)^{1-\epsilon} + \frac{P_{jm}}{P_j}\left(\frac{X_{jm}}{X_j}\right)^{1-\epsilon}\right]^{\frac{1}{1-\epsilon}} \qquad (4.19)$$

where X_{jf} = female's X variable in the j country, X_{jm} = male's X variable in the j country, X_j = X variable in the j country.

For calculating a gender-related income index for the GEM, the same formula (equation (4.13)) was used. Instead of using an adjusted income, however, the unadjusted income (in terms of PPP$) was used in calculating the final gender-related income index (different from the GDI), which could make the Arrow's IIA condition because world average income is not considered but only his own real term PPS$ is considered. Boundary values of variables used in the GEM are summarized as in (Table 3).

However, even if GEM managed to escape the critique of IIA criteria, it has more serious problems; the normative aspect of social well-being problems, in addition to the same critique for the GDI (structural factors). According to the GEM's EDEP formula, the maximum value will be attained by assuming that all people,

[35] For details, see UNDP (1995), p 132.

TABLE 3 The Boundary Value of Three Indicators in GEM, 1995

	Percentage Share of Parliamentary Representation		Percentage Share of Administrative and Managerial Positions (1/2)*		Percentage Share of Professional and Technical Positions (1/2)*		Income Real GDP per capita (PPP$)
	Female	Male	Female	Male	Female	Male	
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	100
Minimum	50.0	50.0	50.0	50.0	50.0	50.0	40,000

* Weight between (1) percentage share of administrative and managerial positions, and (2) percentage share of professional and technical positions.
Source: UNDP, 1995

belonging to the same group whose size is evenly distributed, must have same idea and same attitude irrespective of their own personality. That is, all people belonging to the same gender group should have arithmetical equal division and position about their political opinions, the job selection, and the professionalism. This would be an extreme equalitarian viewpoint and sometimes it could be understood as a totalitarian viewpoint.

Therefore, it is difficult to derive how empowerment is distributed between genders from GEM; at best it would mislead human beings to understand the situation of the empowerment distributions between different genders when countries are ranked and compared according to the GEM scores.[36]

V. In Lieu of Conclusions

Despite the growing number of studies in measuring human well-being

[36] Before measuring the ratio of the female congress representatives and the administrative, the political freedom and the social system should be considered. Some countries, which have experiences of being under the communist or the socialist government, get absolutely high scores of the GEM, irrespective of the individual political and economic freedom.

status in developing countries, the lacunae in our knowledge remain substantial. Many of the questions raised in our introduction about measuring gender and human development remain unanswered.

Our questions pertain to the measurement of the human development thus the extent, incidence and determinants of human development inadequacies. In the well-being function (equation (3.1), (3.2)), we can find variables which affect the individual and social welfare levels. There are, however, difficult questions about how can policy-markers or other analysts can identify at a reasonable cost who is undeveloped in a population in the individual country level. The failure to find much in the way of positive results regarding the determinants of human development, for another example, may be due to substantial measurement errors in representing human development. Frequently, respondent-reported disease data are used as basic indicators of health or longevity, though such reports are likely to be determined endogenously by characteristics like wealth. Also, environmental variables must be considered to measure human development.

It is a difficult and tremendous job to invent the gender-related index considering the difference in the cultural and socioeconomic norms among different countries because many statistics have been defined in terms that portray men's condition and contributions rather than women's, or that simply ignore gender. However, for gender-related development issues, instead of the UNDP's GDI method, the functional discrimination factors adjusted by educational enrolment ratio should be used for international comparisons. If we get countries' dis-aggregate data for the wage and the education level between gender, we can get more refined indicators to capture the functional discrimination between genders. This can also improve the quality of the gender empowerment distribution. However, it is difficult to find the meaning of the UNDP's GEM that can take into consideration the political and the socioeconomic senses. It is apprehensive that GEM of the UNDP could bring misconception of gender problems and the disincentive in handling gender issues.

In the meantime, conclusions are based to be qualified because of their conditionality on the quite imperfect gender and human development indicators. More studies might explore fruitfully how robust their results are to alternatives such as latent variable

specifications of the gender and human development as have been undertaken in several recent studies.

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