Normative and Positive Approaches to Ranking Human Development

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一橋大学大学院経済学研究科 比較経済・地域開発専攻

道中 真紀

This dissertation investigates how to rank the levels of human development for given observations such as individuals, villages, or countries. In order to set the targets for antipoverty policies, it is important to rank levels of human development in an appropriate manner.

Specifically, I focus on the following three questions:

(I) What kind of rules are DESIRABLE to rank the levels of human development? (II) What kind of rules are USEFUL for practical usage? (III) How do we EXTEND these rules to overcome limitations in the accuracy of data?

Chapter 1 introduces this dissertation. I begin by reviewing previous research on human development and multidimensional poverty measurement and then describe the motivations of the dissertation, which involve the importance of choosing rules for ranking human development.

Human development is a concept of human well-being based on the capability approach proposed by Amartya Sen. The essence of the capability approach is that the well-being of a person should be evaluated based on what the person does rather than what the person has. The capability approach also includes the idea that both poverty and well-being are not only unidimensional monetary problems but multidimensional issues, encompassing various aspects of life that are essential to human beings, such as health, education, and social inclusion. Based on this concept, the United Nations Development Programme (UNDP) has defined human development as the process of enlarging people's choice of life.

The Human Development Index (HDI) proposed by the UNDP is one of the most prevalent human development measurement tools. It is a composite index of four kinds of development indicators, that is, life expectancy at birth; adult literacy rate; combined gross enrollment ratio for primary, secondary and tertiary; and gross domestic product (GDP) per capita.[1]

[1] These indicators were adopted from 1995 to 2009. In 2010, these indicators were replaced by the following four: life expectancy at birth, mean years of schooling, expected years of schooling, and gross national income (GNI) per capita. The indicators and aggregation methodology of the HDI have also been modified in other

The indexation of levels of human development such as the HDI enables us to capture these levels intuitively and easily compare those of different countries. At the same time, however, any indexation method can be criticized from two different perspectives for its inherent arbitrariness. One concerns the arbitrariness of the selection of indicators that measure the levels of human development. The other is the arbitrariness of the calculation process that aggregates four indicator values of abovementioned development indicators into one index value. This dissertation focuses on the latter issue.

Even if the dataset and individual preferences are constant, we can obtain different index values and ranking results by simply changing an aggregation rule. This could make it possible to manipulate index values or rank results in an arbitrary manner. However, it is difficult to entirely eliminate this kind of arbitrariness, because every ranking rule always involves a certain implicit arbitrariness, in the sense that any criteria or philosophy for the selection of particular formulas or weights can be used. One of the possible solutions to this problem is to choose rules based on the most acceptable criteria. If a rule is characterized based only on reasonable assumptions that appropriately represent unanimously acceptable criteria, then, consequently, the index values and ranking results based on the rule would be unanimously accepted.

With this goal in mind, this dissertation investigates ranking rules to rank the levels of human development of any observations when indicators composing various human development dimensions are given. I provide two types of ranking rules, the maximal order ranking (MAXOR) and the minimal order ranking (MINOR), and then examine the practical usefulness of these rules, extending them to fit the limitations of the accuracy of existing data.

Chapter 2 focuses on Question (I). I suggest two types of human development ranking

ways over the past twenty years.

rules, the MAXOR and MINOR, and examine their characteristics. For the purpose of eliminating the inherent arbitrariness that exists in typical ranking rules, I propose ranking rules that do not require any aggregation or indexation. Instead, I adopt specific axioms and ranking processes.

The axioms are: *ordinalism:* **(O)**, *dominance principle:* **(DP)**, *superiority of non-dominated observations:* **(SNO)**, *inferiority of non-dominating observations:* **(INO)**, *non-existence of dominance relation in a same rank order:* **(NDR)** and *monotonicity* **(M)**. **(O)** requires that not using cardinal but ordinal information in generating a ranking. **(DP)** requires that if an observation achieves greater attainments in all human development dimensions to another observation, then the observation is ranked higher to another one. **(SNO)** requires that if an observation is not dominated by any other observations, then the observation is ranked the first rank order, while **(INO)** requires that if an observation does not dominate any other observations, then the observation is ranked to the bottom rank order. **(NDR)** requires that the binary relations for any pair of observations ranked in the same order always correspond to indifference or incomparablity. **(M)** requires that if an indicator value of an observation is improved while the observation is originally ranked higher than another observation, then the improvement does not reverse the hierarchy of these two observations.

The MAXOR and MINOR are generated as follows.

As a preliminary step to generate the MAXOR, I define a maximal set, X, as follows:

$$\overline{M}(X, \succ) = \{x \mid x \in X \;\&\; \nexists y \in X \text{ such that } y \succ x\}$$

The maximal order ranking (MAXOR) over X is generated according to the following recursive steps:

1. Make the maximal set on X, and call it $\overline{M}_1$
2. Define $X \backslash \overline{M}_1 = X_1$

3. Again, make the maximal set $\overline{M}_2$ on X_1, namely,

$$\overline{M}_2(X_1, \succ) = \{x \mid x \in X_1 \;\&\; \nexists y \in X_1 \text{ such that } y \succ x\}$$

4. In like manner, consecutively make maximal sets $\overline{M}_i$ on X_{i-1} until $X_{i-1} \backslash \overline{M}_i = \emptyset$

5. These procedures make a sequence of maximal sets, that is, $\overline{M}_1$, $\overline{M}_2$, $\ldots$, $\overline{M}_i$, $\ldots$, $\overline{M}_m$. We regard $x \in \overline{M}_1$ as the observations ranked to the first rank order, $x \in \overline{M}_2$ as the observations ranked to the second rank order, $\ldots \overline{M}_m$ as the observations ranked to the bottom rank order.

The minimal order ranking (MINOR) over X is defined in a way reverse to that of the MAXOR. I firstly define a minimal set of a set X as follows:

$$\underline{M}(X, \succ) = \{x \mid x \in X \;\&\; \nexists y \in X \text{ such that } x \succ y\}$$

The MINOR over X is then generated according to the similar recursive way to MAXOR.

In other words, each of MAXOR and MINOR is a partition of a set of observations. The ranking result of MAXOR is generated by recursive steps of making maximal sets in a set while that of MINOR is generated by recursive steps of making minimal sets in a set. The MAXOR satisfies **(O)**, **(DP)**, **(SNO)**, **(NDR)** and **(M)**, while the MINOR satisfies **(O)**, **(DP)**, **(INO)**, **(NDR)** and **(M)**. On the other hand, the MAXOR and MINOR do not satisfy **(IIA)** unlike the HDI.

Chapter 3 addresses Question (II). In it, I examine the practical utility of the ranking rules proposed in Chapter 2 by using the ranking results derived from the balanced and unbalanced cross-country panel datasets for the period from 1980 to 2007. I adopt four human development indicators identical to those used when calculating the HDI, that is, life expectancy at birth, adult literacy rate, combined gross enrolment ratio, and GDP per capita. As a means of illustration, I compare these ranking results with the ranking of the HDI. For example, 182 countries are ordered in eighteen groups, both based on the MAXOR and MINOR in 2007 using the unbalanced panel dataset.

The HDI panel dataset used to generate the rankings have three notable features: (1) the levels of all indicator values among all observations (namely, the average for each indicator value) have been increasing year by year, (2) the total number of observations have increased year by year, and (3) the levels of all indicator values are relatively close for the most of countries (namely, the normalized indicator values for all indicators are close). In the case of two dimensions, the most of countries are located around a 45-degree line. In this section, I examine several characteristics of the MAXOR and MINOR derived from data including these features.

At first, the MAXOR can be regarded as a "specialist" ranking, while the MINOR can be regarded as an "all-round" ranking. This is because a country can be ranked high in the MAXOR if it has at least one high indicator value, but an observation can never be ranked high in the MINOR if there exists just one low indicator value. In this sense, it is tougher to be ranked higher in the MINOR than in the MAXOR. In other words, the MAXOR and MINOR highlight the "development" and "non-deprivation" aspects of each country respectively.

The MAXOR and MINOR do not need any indexation or aggregation process to generate the ranking results. Instead, they use three kinds of binary relations and certain particular recursive steps to generate these results. Reducing multiple indicators' attainments to a single index value weakens an index's ability to capture the diverse nature of human development, while a combined index does not give information about the attainment level of each indicator that corresponds to each dimension of human development. A lack of consideration of diversity somewhat contradicts the multidimensional concept of human development. Hence, the ranking rules that I propose generate no scalar index of the human development level for each observation, but do generate a ranking of the human development level for all observations. As such, the proposed rules are not meant to derive a scalar index of the level of a specific observation. Instead, they are rules for ranking all observations in order of the levels of human development.

Another feature of these ranking results can be found in the binary relations used in the process of generating the ranking results. I allow incomparability to the binary relation of two observations. As a result, the ranking results derived from the rules are not complete top-to-bottom rankings like as the HDI, because several incomparable observations are placed at the same rank order. Although this feature seems like a practical disutility, it can also be regarded as an appreciation of the diversity of human development among different observations, in the sense that we never impose assigning different rank orders to incomparable observations.

This chapter concludes that the MAXOR and MINOR have the relatively stable number of ranks and distributions of the observations during this period. This fact means that a rank order in the MAXOR or MINOR for a specific observation shows its relative position to all other observations in a stable way, regardless of the year or total number of observations.

Chapter 4 focuses on Question (III). I extend the MAXOR and MINOR based on two purposes. The first is to fit the MAXOR and MINOR to the limitations of the existing dataset. The second is to overcome the disadvantages resulting from the fact that a non-negligible number of observations are ranked in the same position.

It seems reasonable to assume that all available datasets possibly include some measurement errors. In order to reduce the disadvantages of the MAXOR and MINOR, and to fit the ranking rules to the accuracy limitations of the existing dataset, I propose extended ranking rules that allow the data to involve a certain range of measurement errors. By regarding indicator values included in a certain range as indifferent, we can reduce the number of observations with the same ranking. For the dataset of HDI 2006, when we allow data variation of approximately 5.37%, the practical utility is maximized and the number of observations that have the same rank is minimized. As a secondary effect of this extension, the robustness of the ranking with regard to measurement error is also enhanced, which is shown in a simulation exercise.

Chapter 5 concludes the dissertation. It summarizes the findings of the analysis and provides directions for future research. I took a normative approach in building the ranking rules in this paper, in order to eliminate the possibility of manipulation of ranking results. I also took a positive approach in examining and extending the MAXOR and MINOR. Not only for ranking human development but also other alternatives, the MAXOR and MINOR have versatility. For example, the ranking of comfortable cities may be achieved by taking account of various factors such as traffic convenience, security, infrastructure, and health services. By the same token, the Olympic host city is selected by considering of various factors such as public support, public security, accommodation facilities, and climate. MAXOR and MINOR can thus also be applied to other cases. In cases of ranking certain alternatives by taking account of multiple factors, MAXOR and MINOR have broad applicability. This dissertation thus demonstrates the advantage of combining normative and positive approaches to rank human development. Through a normative approach, the acceptability of the ranking rules is enhanced, while positive approaches allow the practical utility of the ranking rules to be empirically demonstrated. The MAXOR and MINOR can be used in the future to enhance our further understanding of multidimensional human development.