

Ranking Countries and Other Essays

Tanweer Akram

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ABSTRACT

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This dissertation is composed of three parts. Part A, which consists of one essay, is an inquiry into the ranking and the grouping of countries. Part B, which consists of two essays, looks at certain aspects of Bangladesh's privatization and private sector development. Part C, which consists of one essay, examines the international foreign aid regime.

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Dedication

To my parents, Mr. S.M. Akram and Dr. Fateha Akram

Preface and Acknowledgements

This collection of essays is a result of my graduate studies in the Department of Economics at Columbia University. At Columbia, I had the pleasure of being exposed to some of the leading figures of economics in seminars and in graduate classes. Besides the formal lectures, the University often holds public lectures by some of the foremost academic thinkers from a wide range of disciplines. Over the years I have profited much from this exposure to a number of distinguished resident and visiting scholars. The Department of Economics at Columbia University provides a convivial atmosphere for the pursuit of intellectual interests. The university's resources, particularly its library facilities, are truly outstanding. I am grateful to the Department of Economics, its faculty and administrative staff, and Columbia University for the opportunity to study at this remarkable institution. I am deeply indebted to many of my teachers. Professor Dan O'Flaherty has kindly agreed to be my advisor and sponsor. I very much appreciate his thoughtful comments, insightful criticisms, and his generous support for graduate students, such as myself, who seek a professional career outside of academia. I am grateful to Professor Sanjay Reddy for helping me to initiate the research on ranking countries and for his invaluable suggestions. His research (with Professor Thomas Pooge) on global poverty, questioning current practices of a leading international development agency, shows the need for paying meticulous attention to questions of fact and for retaining a healthy skepticism of official pronouncements. I have learnt

from Professor Shubham Chaudhuri the value of developing a rigorous research agenda and carefully implementing it. I hope that I will be able to follow his footsteps. His candid assessments of my earlier efforts shall always inspire me to try to improve my future work and set higher standards for myself. I also appreciate the detailed comments and many insightful suggestions the Professor André Burgstaller. I had earlier benefited from his lectures on the history of political economy.

Throughout my years at Columbia, I have intellectually benefited either directly from the lectures or indirectly from the publications of Professors Jagdish Bhagwati, Akeel Bilgrami, Ronald Findlay, Duncan Foley, Fumio Hayashi, Sharon Harrison, John McLaren, Edward Said,¹ and David Weinstein. As a graduate student, I feel deeply privileged to have been a student of a university with such a diverse range of top-notch economists and other distinguished scholars. Acknowledgments are also due to the support from the Centre for Policy Dialogue, especially to Professor Rehman Sobhan, and from North South University for giving me research facilities when I visited Bangladesh.

I express my gratitude to Boram Lee who has always given detailed comments on earlier drafts of these essays. I have relied on Sangeeta Goyal for her wise counsel. I have been able to count on Mohammed Amin, Tavis Barr, Xu Cheng, Nandita Ghosh, Jayanth Nazareth, and Jayant Ray for their friendship throughout my studies at

¹ Professor Edward Said passed away in September 2003. My tribute to Professor Said appears in: <http://www.pressaction.com/pablog/archives/001037.html#001037>

Columbia and beyond. In Washington DC, I enjoyed many engaging conversations with Professor Thomas Nagy on peace and justice and other contemporary issues.

I am deeply indebted to my family. My loving wife, Sharifa Nazneen, has always been there for me. Her good cheer and confidence in me strengthened my resolve to finish up this dissertation. My dear parents, Mr. S. M. Akram and Dr. Fateha Akram, and my beloved brother, Mr. Tehsin Akram, have been consistently supportive of my intellectual pursuits at every stage of my life. Nothing would have been possible without the assistance and the encouragement of my family.

The contributions of my teachers, colleagues, friends, and family have influenced my thinking. However, I am alone responsible for the views expressed in the essays collected here and for any remaining errors.

Washington DC
January 2004

INTRODUCTION

This dissertation analyzes three different and disparate issues. Part A is an inquiry into the ranking and the grouping of countries. Part B looks at certain aspects of Bangladesh's privatization and private sector development. Part C examines the international foreign aid regime.

Part A: Ranking Countries

Part A consists of Essay 1 which applies a partial ordering approach to ranking countries. There is a distinguished pedigree in economics and social analysis in applying partial order approaches to the comparison of the elements of various sets and the identification of superior elements within various sets. For example, Sen (1976) applies partial ordering in comparing real national income; Suppes (1975), Suppes, Flechter and Zanotti (1976), Suppes and Zanotti (1996), and Tock and Suppes (2002) employ partial ordering approaches to interpret students' individual educational performance.

Essay 1, "Ranking and Grouping Countries," is meant to be the main contribution in this collection of essays. This essay attempts to rank and group countries' social and economic achievements. The ranking and grouping of countries of the world, based on different economic and social data, is often a

necessary and useful task not only for policy and planning purposes but also for gaining a more profound understanding of the state of the world and for offering explanations of the variations in economic and social performance of countries. However, the ranking of countries and the grouping of countries often pose numerous practical and theoretical problems. In particular the ranking and the grouping of countries may depend on how indicators are weighted. Are there alternative ways of arriving at more robust rankings and groupings of countries that are independent of the evaluator's assignments of weights to certain welfare indicators? Essay 1 attempts to devise a method that yields an unambiguous rankings and groupings of countries that is independent of welfare weights. It shows that it is possible to arrive at an unambiguous ranking and grouping of countries based on a partial ordering approach. An intersection partial ordering methodology to classify countries of the world is developed here for choosing among alternative partial orderings based on information statistics. This methodology is implemented to rank and group countries into different sets of countries.

Essay 1 has not yet been submitted for publication. It is hoped that a thoroughly revised version of this essay will be submitted to a peer-reviewed economics journal. Therefore, comments and suggestions for improving this essay would be truly appreciated.

Part B: Essays on Bangladesh

Part B consists of two essays on certain aspects of Bangladesh's economy. These essays were written in the context of economic reforms of privatization and liberalization that the authorities have carried out in Bangladesh. While privatization can bring about benefits under certain conditions, transfer of ownership is by no means a sufficient condition for improved performance of firms and setting-off economic growth. Joseph Stiglitz (1999 and 2001) has argued that perverse outcomes of privatization leading to the perpetuation of soft-budget constraints and to nefarious asset stripping might occur in the absence of robust market institutions, contract enforcement, and prudential regulations. The experience of many developing countries and transitional countries lend credence to the view that such outcomes cannot be ruled out. Essay 2 substantiates this point of view. Essay 3 shows that in Bangladesh there have been major changes in the composition of manufacturing establishments by different types of ownership and by three-digit industry code.

Essay 2, "Publicly Subsidized Privatization: A Simple Model of Dysfunctional Privatization," points out the limitations of the privatization program in Bangladesh, with particular reference to the debt-default status of privatized firms. Firstly, a detailed analysis of the debt-default status of privatized firms is presented using data obtained from the central bank.

Secondly, a simple model of dysfunctional privatization is constructed to show that perverse outcomes of privatization are possible. In contrast to Boycko, Shleifer and Vishny (1996), here it is argued that perverse post-privatization outcomes are possible because the firm retains a soft-budget constraint even after privatization. The experience of developing economies, such as Bangladesh, lends credence to such a perspective. Finally, various types of privatization are classified following Professor Bhagwati's (1982) typology of directly unproductive profit-seeking activities.

Essay 2 appeared in *Applied Economics* (2000), 32(13): 1689-1699, and a related version of this essay has appeared in *Journal of Financial Management and Analysis* (2003), 16(1): 27-35.

Essay 3, "Net Entry and Exit patterns of Bangladesh's Manufacturing Industries," provides an empirical analysis of net entry and net exit patterns of manufacturing industries in Bangladesh. The analysis is based on a panel data set consisting of five census years' three-digit level data from Bangladesh's Census of Manufacturing Industries (CMI). The data show that over the years the number of manufacturing establishments in the private sector and its share among all establishment have increased, while the number of public sector manufacturing establishments and its share among all establishments have decreased because of shutdowns, closures, and the privatization of some entities.

There has also been an increase in the number of joint ventures with foreign owners. Essay 3 appeared in *Applied Economics Letters* (2002), 9(1): 25-31.

Part C: Foreign Aid Regime

Part C consists of an essay on the international foreign aid regime. Boone's (1994 and 1996) findings have led to a revival of interest in issues related to foreign aid in the economics literature. He demonstrated that aid neither significantly increases investment and growth, nor benefits the poor, as measured by improvements in human development indicators, but it does increase the size of government. These results would seem to confirm Friedman's (1958) skeptical political economy views on the limited positive impact of foreign aid on economic growth and development. Not surprisingly the World Bank (1998), the leading multilateral development agencies, has responded to this work. It has held that foreign aid has a big positive impact on economic growth and development if and only if countries have appropriate economic institutions and follow what the World Bank deems to be correct policies. The subsequent research has gone in many different directions. Alesina and Dollar (2000) examine who gives aid to whom and why. Recently Alesina and Weder (2002) have argued that corrupt regimes receive more foreign aid than less corrupt ones. The continuing research on the foreign aid remains one of topical interest and controversy.

Essay 4, "The International Foreign Aid Regime: Who Get Foreign Aid and How Much?" analyzes the data on international foreign aid. Whereas Alesina and Dollar (2000) identify the determinants of foreign aid disbursement, the objective of this essay is to assess whether aid disbursement is allocated to those countries that need it the most. It examines the basic data on who gets foreign aid and how much, how aid dependent are the recipient countries, and how the international foreign aid regime has evolved. It is argued that the pattern of foreign aid flows suggests that aid provided has had little relevance to human needs in developing and transitional countries. Essay 4 is forthcoming in *Applied Economics* (2003), 35(11): 1351-1356)

The Aim of this Collection of Essays

It is hoped that the essays collected in this dissertation will make a contribution, even if merely incremental, to the extension of knowledge. It is also hoped that these essays will be of interest not just to scholars but also to those who seek answers to the practical problems of economic policy-making related to a variety of questions, such as how to rank and group countries of the world, what are some of the impediments to successful privatization and private sector development in least developed countries, such as Bangladesh, and what can be done to improve the efficiency of the international foreign aid regime and align

the disbursement of global inter-country transfers to authentically address human needs.

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PART A: RANKING COUNTRIES

RANKING AND GROUPING COUNTRIES

A PARTIAL ORDERING APPROACH

TANWEER AKRAM*

DRAFT 10.0

Dated: December 15, 2003

Washington, DC

* *Academic Affiliation:* Department of Economics, Columbia University, New York, NY 10027, USA.

Correspondence Address: 5550 Columbia Pike, Apt 803, Arlington, VA 22204, USA. *Email:*
ta63@columbia.edu

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RANKING AND GROUPING COUNTRIES

A Partial Ordering Approach

ABSTRACT

This essay attempts to rank and group countries according to their social and economic achievements. It shows that it is possible to arrive at an unambiguous ranking and grouping of countries based on intersection partial orderings. A partial ordering methodology to classify countries of the world is developed. This methodology enables the evaluator to choose among alternative partial orderings. The criteria for choosing alternative partial orderings are rigorously developed and refined. This methodology is implemented to rank and group countries into different sets of dominating countries and dominated countries. (*JEL O10, D60, D63*)

Keywords: vector dominance, partial ordering, partially ordered set, ranking of countries, Hasse diagrams

RANKING AND GROUPING COUNTRIES

A Partial Ordering Approach

INTRODUCTION

Economists want to know whether some economic objects (individuals, organizations, and countries) are similar to or different from one another.

Quantitative and qualitative comparisons of objects are important tasks for arriving at sound descriptions, explanations, and predictions in economics and other social sciences.

Comparison of countries of the world, based on data on different economic and social achievements, is often a necessary and useful task not only for policy-making and planning purposes but also for gaining a deeper understanding of the state of the world and for offering explanations of the variations in economic and social performance of countries. Ranking and grouping of countries is sometimes critical to obtain comparisons of well-being. However, the ranking of countries and the grouping of countries often pose numerous practical and theoretical problems. In particular the ranking and the grouping of countries may depend on how indicators are weighted in

constructing an index. Are there alternative ways of arriving at more robust rankings and groupings of countries that are independent of the evaluator's assignment of weights to certain welfare indicators? This essay attempts to devise a method that yields rankings and groupings of countries which are independent of the evaluator's assignment of weights to certain welfare indicators. The method proposed in this essay is based on a partial ordering approach. Application of this method can result in an unambiguous ranking and grouping of countries.

The partial ordering approach offers a sound and superior method for unambiguously ranking and grouping countries in terms of social and economic achievements. While certain issues of judgment and selectivity are unavoidable under this method, these issues are resolved at a higher level and are transparent. Unlike index construction or cluster analysis, which are the common methods often used for ranking and grouping countries, the partial ordering approach is independent of the weights assigned to welfare indicators. A partial ordering approach is based on the ordinal relationships of the countries' welfare indicators. It is easily implemented. The results obtained under a partial ordering approach are percipient and intuitive. It can also be useful to policy-makers. This essay develops a partial ordering approach to ranking and grouping countries, and derives insights from this approach. The

key motivation of this exercise is to characterize the multi-dimensional nature of inequality in social and economic achievements among countries in the world. It is hoped that this will result in revealing characteristics of the world that is compatible with the data and reveal the differences among countries. It can also show which sets of countries are privileged and which sets of countries are underprivileged.

The UNDP's (various years) Human Development Index, which provides a well-known ranking of countries, has been criticized by Srinivasan (1994), who argues that these results acutely depend on the weights assigned and therefore should not be regarded as robust. One of the findings of this essay is that given a set of reasonable and parsimonious assumptions it is possible to arrive at an unambiguous ranking of countries.

Key Questions

The questions asked here are: Can countries be ranked? If so, how? Do some countries unambiguously dominate other countries? If so, what are the hierarchical structures? Do countries fall into some patterns? How robust are these patterns? Can countries be clustered into sets? What are the main sets of countries? Do some countries have ambiguous status? How important is assigning weights to key welfare indicators in ranking countries? Does the methodology for ranking countries offer any useful insights about the hierarchy

of countries? Are there any valuable policy perspectives that can be drawn from this method of ranking and grouping countries? This essay raises these questions and attempts to address them.

Outline of this Essay

The essay is organized as follows. Section I presents the economic and social data that are used here for ranking and grouping countries. Section II gives the basic concepts applied in the essay and the diagrammatic representations of partial orderings of the countries of the world. It also compares one of the Hasse diagrams with a listing of countries by real income per capita. Section III lays down a methodology and conceptual framework for ranking and grouping countries; it motivates and explains the method used to classify countries of the world. Section IV provides (a) the information statistics that can be used to classify the nations of the world into different groups, and (b) the list of the parameters used in constructing the information statistics and explain their relationship to the information statistics. Section V identifies some areas of research and in particular suggests economic topics in which a partial ordering approach to ranking and grouping countries may be applied. Section VI concludes by summarizing the findings, reflecting on their implications, and reiterating the main arguments of the essay. Appendix 1 reviews the underlying foundational concepts applied here. Appendix 2 gives the code developed to

generate the diagrammatic representations of partial orderings displayed in this essay. Appendix 3 provides several tables, additional diagrammatic representations of partial orderings of countries, and various information statistics. Appendix 4 addresses concerns regarding the dispersion and volatility of the data.

SECTION I: DATA FOR RANKING COUNTRIES

Data

This essay covers all countries with a population of more than 1 million people for which data is available. Table [1A] and Table [1B] (in Appendix 3) list these 173 countries, which are abbreviated by two-lettered International Organization for Standardization (known as ISO, the abbreviation of its name in French) country codes. In order to examine the questions raised in this essay, national data on key indicators are obtained from the United Nations Development Program's *Human Development Report* (2002) and the World Bank's *World Development Indicators* (2002). When some statistics are unavailable from the above sources, they are collated from either the Central Intelligence Agency's *World Fact Book* (2002) or the Economist Intelligence Unit's "Country Data" (2003). Data on indicators of interest are collected for all the 173 countries.

Key Indicators of Interest

The investigation of the ranking of countries will be focused mainly on three important indicators: namely, per capita real income (PPP-adjusted), average life expectancy, and adult literacy. Attention will be given to the rankings and the groupings of countries that emerge from the examination of all possible (non-trivial) subsets of the above set of indicators, namely: (i) per capita real income, life expectancy, and adult literacy; (ii) per capita real income and life expectancy; (iii) per capita real income and adult literacy; (iv) life expectancy and adult literacy; (v) per capita real income; (vi) life expectancy; and (vii) adult literacy.

There are good reasons to focus on the above set of indicators and their various (non-trivial) subsets. Per capita real income, adult literacy, and life expectancy are useful indicators that reveal valuable information about the elementary capabilities of people in a given country and whether they can effectively function and participate in the economic and social life of their society (Haq (1995) and UNDP (various years)). The magnitudes of these indicators tell much about the opportunities available to the people of a country. In a capability-based approach, as discussed by Sen (1985, 1995, and 1999), it is sensible to begin with a focus on human capabilities that are deemed important. Since per capita real income, the ability to read and write, and the longevity of human life are indicators that help to capture fundamental aspects of a people's

ability and expectation to live a full life in their society, the main focus of ranking and grouping countries will be based on these key indicators.

Besides the above mentioned indicators, the essay will make perfunctory use (in Appendix 3) of a few other indicators of human development: (a) life expectancy at birth (in years, male), 2000; (b) life expectancy at birth (in years, female), 2000; (c) combined primary, secondary, and tertiary gross enrollment ratio (percent), 1999; (d) infant with low birth weight (percent), 1995-2000; (e) infant mortality rate (per 1,000 live births), 2000; and (f) probability at birth of surviving to age 65, female (percent of cohort), 1995-2000. Table [2] (in Appendix 3) gives the summary statistics of the key indicators as well as the above listed indicators.

Table [3] (in Appendix 3) provides the matrix of rank correlations of each pair of indicators for the 173 countries. Table [4] (in Appendix 3) provides the matrix of simple correlations of each pair of the indicators for these countries. These tables show that the selected development indicators vary in their rank correlations and cardinal correlations with one another for these countries. These tables demonstrate that these indicators are by no means neither totally correlated nor totally uncorrelated. This suggests that a partial ordering approach to ranking and grouping countries in these domains will be useful, whereas if these indicators were totally correlated or totally uncorrelated with

one another there would not be any need to examine the rankings of countries in such a way.

Ranking Countries by Key Indicators

As a preliminary inquiry, it is quite informative to see how countries rank when one considers each of the key indicators by itself. Table [5] (in Appendix 3) ranks countries in descending order on the basis of their per capita real income. Table [6] (in Appendix 3) ranks countries in descending order on the basis of their average life expectancy. Table [7] (in Appendix 3) ranks countries in descending order on the basis of their adult literacy rate.

While these rankings based on a single indicator are a valuable start, it is much more useful to consider rankings of countries based on multiple indicators because in order to understand, compare, rank and group the standard of living of different countries around the world, one ought to examine various aspects of essential capabilities of the peoples of these countries. The varied and the complex nature of peoples' well-being require one to undertake multi-dimensional comparisons since countries' achievements in different social and economic domains are neither completely congruous nor completely incongruous with one another.

SECTION II: CONCEPTS AND DIAGRAMATIC REPRESENTATIONS OF PARTIAL ORDERINGS

This section explains the concepts that are used in this essay. It also provides diagrammatic representations of partial orderings for ranking and grouping countries. These diagrammatic representations enable one to rank countries for multi-dimensional data.

Intersection Partial Orderings and Vector Dominance

An ordering (or order) is a method for choosing the order in which objects are placed. In other words, ordering is a sorting function. For some economic topics one can often assign a natural ordering to a group of objects. However, one may not be always able to compare between the elements or the subsets of some sets.¹

A relation R is a *partial order* if R is *reflexive*, *transitive*, and *anti-symmetric* (the definitions of these concepts are provided in Appendix 1). If R is a *partial order* on set S , then $\langle S, R \rangle$ is said to be a *partially ordered set* or a *poset*. The

elements a and b of a partially ordered set $\langle S, R \rangle$ are *comparable* if either aRb or bRa . The elements a and b of a partially order set $\langle S, R \rangle$ are *incomparable* if neither aRb nor bRa . If every two elements of a partially ordered set $\langle S, R \rangle$ are *comparable*, then S is called a *completely ordered set* and R is called a *complete order* or *complete ordering*. An *intersection partial ordering* is the intersection of a collection of complete orderings. It is induced by the partial orderings for the measures on the set S . Since multidimensional data on countries' social and economic achievements may not necessarily result in a completely ordered set and complete orderings, intersection partial orderings may be used to rank and group countries.²

Weak vector dominance (\geq) is defined by $x \geq y \Leftrightarrow x_i \geq y_i \forall i = 1, \dots, n$. *Strong vector dominance* ($>$) is defined by $x > y \Leftrightarrow x_i > y_i \forall i = 1, \dots, n$. The components of

¹ Consider the case when data are a set of discrete elements. Some elements of a set may be larger in value than others, or they may show some other relationship that may enable one to rank them or put them in some order. For example, consider the set of all flowers, V . Let T be the set of all roses, and F be the set of all magnolias. Consider P , the set of all red roses. It is a subset of the set of all roses, that is, $P \subset T$. Likewise Q , the set of all white magnolias, is a subset of all magnolias, that is $Q \subset F$. In the set of flowers V there are some subsets that one can compare with other sets but there are some that cannot be compared with other sets. The set V is said to be partially ordered. Formal definitions of partial orders and partially ordered sets are given in the main text.

² Suppose there are three countries: A , B , and C and data on two types of economic and social achievements. The data with respect to one type of social and economic achievement gives the following ordering $A \succ B \succ C$ and the data with the other type of achievement gives the following ordering $C \succ A \succ B$. While a complete ordering cannot be obtained for the set, the intersection partial ordering obtains the following: $A \succ B$.

vectors are data that measure various social and economic achievements of countries.

Intersection Partial Orderings in Economics and Social Analysis

Partial ordering and vector dominance can be used in comparing performance and achievements when the evaluator needs to rank alternatives and identify the superior elements of various sets of economic and social data.

Sen (1976) applies partial ordering in comparing real national income. He develops an approach to real national income comparison that generates a partial ordering of complete welfare indicator based on making judgments. He applies this method for real income comparison to study regional differences in the standard of living in different states in India.

Suppes (1975), Suppes, Flechter and Zanotti (1976), Suppes and Zanotti (1996), and Tock and Suppes (2002) employ partial ordering approaches to interpret students' individual educational performance. Tock and Suppes (2002) use intersection partial orderings to show that recognizing multiple dimensions of learning abilities causes the number of possible ranks of students to fall dramatically. Based on their analysis of the data, they conclude that allowing students to learn at their own pace can enable them to advance much more than otherwise. Charron's (2002) investigation of the conception of mathematical problems among adolescents shows that the different types of mathematical

problems are mastered in a partially ordered hierarchy with multiple developmental paths. Porter and Alison (2001) find a partially ordered scale of influence in violent group behavior in a study of 120 offenders in 39 cases of violent gang activities. Taylor (2002) used partial orderings to graphically represent similarities and differences among episodes of crisis negotiations. Schweickert *et al* (2000) analyze various mental processes under the assumption that the processes are partially ordered. Kainz *et al* (1993) represent subdivisions of land as partially ordered sets to address spatial issues about inclusion and containment of spatial areas.

Antoch and Hanousek (2000) define a partial ordering over the space of considered economic models. They also propose an algorithm for determining the best model for a chosen criteria. Krishna and Thursdby (1994) provide a partial ordering for certain types of economies in terms of the flexibility to adjust to exogenous macroeconomic shocks. Kanbur and Stiglitz (1986) develop concepts for the comparison of social mobility. After deriving necessary and sufficient conditions for social welfare dominance they relate the implied partial orderings to intuitive views on social mobility. Dardanoni (1993) derives partial orderings for social mobility motivated by welfare considerations. He shows that these correspond to certain intuitive concepts and are valuable for measuring social mobility. Mitra and Ok (1998) also apply a partial ordering

approach to the measurement of income mobility. Zheng (2000) reviews the literature of partial poverty orderings, which are based on unanimous poverty ranking for a set of poverty measures. He shows that that poverty partial orderings have a close link with the stochastic dominance relations which are based on comparing cumulative distribution functions. Bishop, Chakraborti, and Thistel (1994) show that union-intersection tests should be applied to test for partial orders on income distribution (such as relative inequality, absolute inequality, and welfare).

Diagrammatic Representations of Partial Orderings

Finite partially ordered sets can be diagrammatically represented as Hasse diagrams, that is, graphs where the vertices are the elements of the partially ordered set and the ordering relation is indicated by the edges and the relative positions of the vertices.

A Hasse diagram, which is formally defined below, provides a useful way of depicting which countries vector dominate other countries, which countries are vector dominated by other countries, and which countries neither vector dominate nor are vector dominated by other countries in a context of multi-dimensional data. In this section, numerous Hasse diagrams are presented to show relationships of dominance among countries for various classes of indicators.

*Hasse Diagrams*³

A Hasse diagram is a simplified graphic drawing representing a partial order (or a quasi-order) on a finite set. Let \prec be a partial order (or a quasi-order) on a finite set S . A *Hasse diagram* representing the partially ordered set $\langle S, \prec \rangle$ is a graphical drawing defined as follows: (a) each element of the set S is represented by a vertex; and (b) if $x \prec y$ for distinct elements x and y then the vertex for y is positioned higher than the vertex for x ; and if there is no w different from both x and y such that $x \prec w$ and $w \prec y$ then an edge is drawn from vertex x upward to vertex y .

A *minimal element* of the partially ordered set $\langle S, \prec \rangle$ is an element $\underline{m} \in S$ such that $\forall x \in S, x \not\prec \underline{m}$. The *minimal set* is the set of the minimal elements. A *maximal element* of the partially ordered set $\langle S, \prec \rangle$ is an element $\overline{m} \in S$ such that $\forall x \in S, x \prec \overline{m}$. The *maximal set* is the set of maximal elements. The *greatest element* of the partially ordered set $\langle S, \prec \rangle$ is a if $b \prec a \forall b \in S$ and the *least element* of the partially order set $\langle S, \prec \rangle$ is a if $a \prec b \forall b \in S$. Let $A \subset S$. If $u \in S$ such that $a \prec u \forall a \in A$ then u is an *upper bound* of A . If $l \in S$ such that $l \prec a \forall a \in A$ then l is a *lower bound* of A . If x is an upper bound of A and $x \prec z$ whenever z is an upper bound of A , then x is called the *least upper bound* of A . If y is a lower

³ Hasse diagrams are named after the German mathematician Helmut Hasse (1898-1979) who first

bound of A and $z \prec y$ whenever z is a lower bound of A , then y is called the *greatest lower bound* of A .

The following concepts are given for the Hasse diagram. The *ordinal distance* between two vertices, v_s and v_t , is a count of the number of edges when vertex v_s is located above vertex v_t in a Hasse diagram. The *tiers* are the horizontal rows of vertices in a Hasse diagram. Thus, the number of tiers expresses the total number of horizontal rows of vertices in a Hasse diagram.

Hasse Diagrams in the Sciences

Hasse diagrams have been used in the social sciences and the physical sciences as a tool for analysis of intersection partial orderings and rankings. Lohr (1995) gives an overview of its uses in applied statistics. Sen's (1976) paper uses data on the value of distribution-adjusted per capita real income of each state at prices of every state to construct a Hasse diagram of summarized rankings of the standard of living in the rural communities of the states of India. Lerche *et al* (2003) apply Hasse diagrams technique in understanding environmental issues. Jensen *et al* (2003) apply the method of partial ordering to rank 74 contaminated sites located in Denmark and display these rankings by Hasse diagrams. Lerche *et al* (2002) use Hasse diagrams to give simple scores of risk assessments of chemical substances. Sehgal *et al* (2001) use Hasse diagrams to graphically

introduced it in the theory of lattices and ordered sets.

compare “tribomaterials,” based on a large number of wear parameters.

Bruggemann *et al* (2001) find a qualitative basis for the relationship of ecotoxicological properties using a Hasse diagram. The papers cited above are a selection of numerous applications of the Hasse diagram in various sciences.

Even though the use of Hasse diagrams in the sciences is widespread, analysis based on Hasse diagrams have not yet been applied for ranking and grouping countries’ economic and social achievements.

Hasse Diagrams for Ranking Countries

Figures below provide Hasse diagrams based on countries’ data for a given set of indicators. Each country is associated with a vector. In the diagrams each vertex represents a country. The names of the countries are given by two-lettered abbreviations as shown in Table [1] and Table [2] (in Appendix 3).

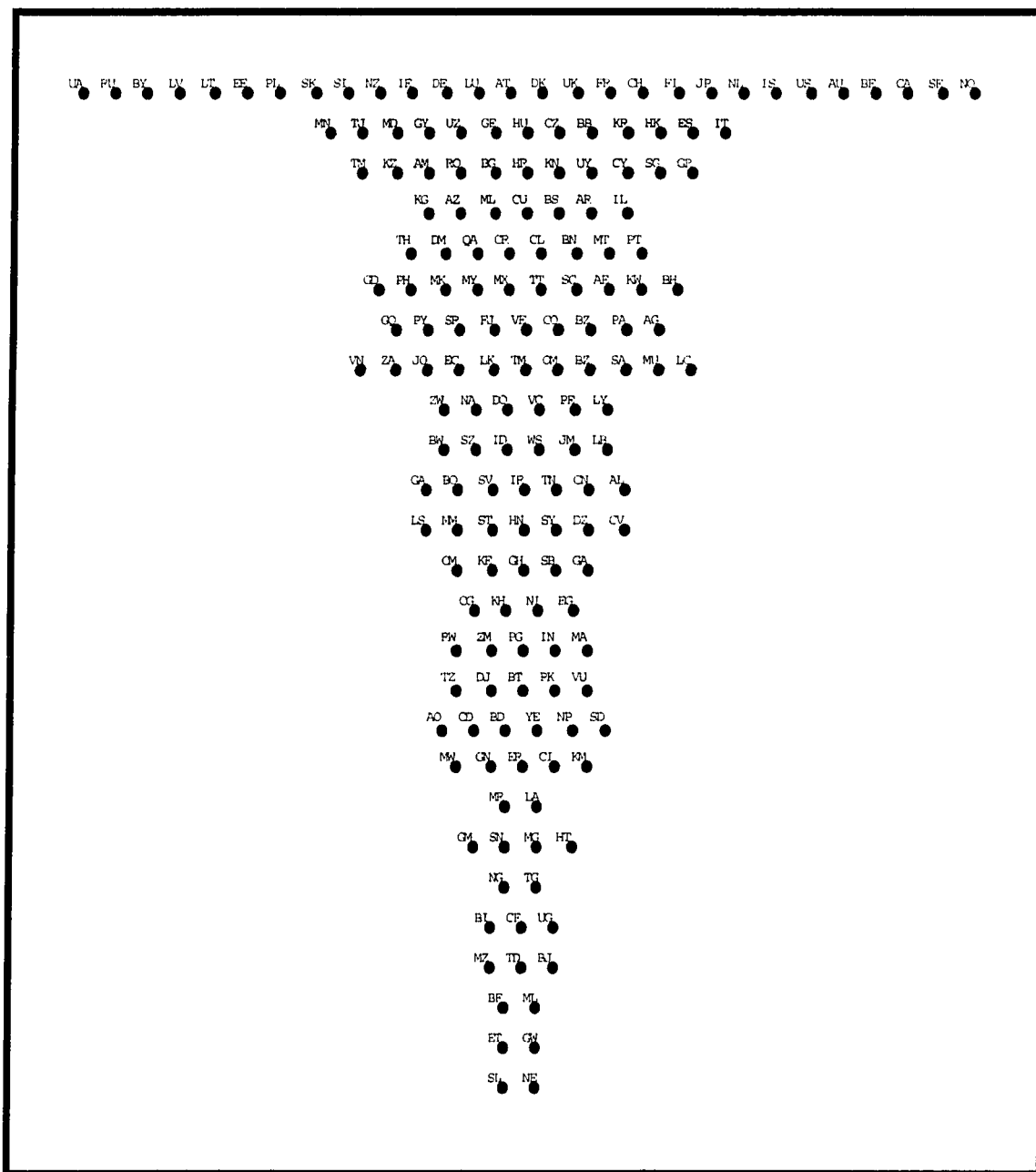


Figure [2.2]: Hasse diagram with $>$ and the following *two* dimensions: per capita real income and adult literacy. Countries fall into 26 tiers. The *maximal elements* are: AT, AU, BE, BY, CA, CH, DE, DK, EE, FI, FR, IE, IS, JP, LT, LU, LV, NO, NL, NZ, PL, RU, SE, SI, SK, UA, UK, and US; and the *minimal elements* are: NE and SL.

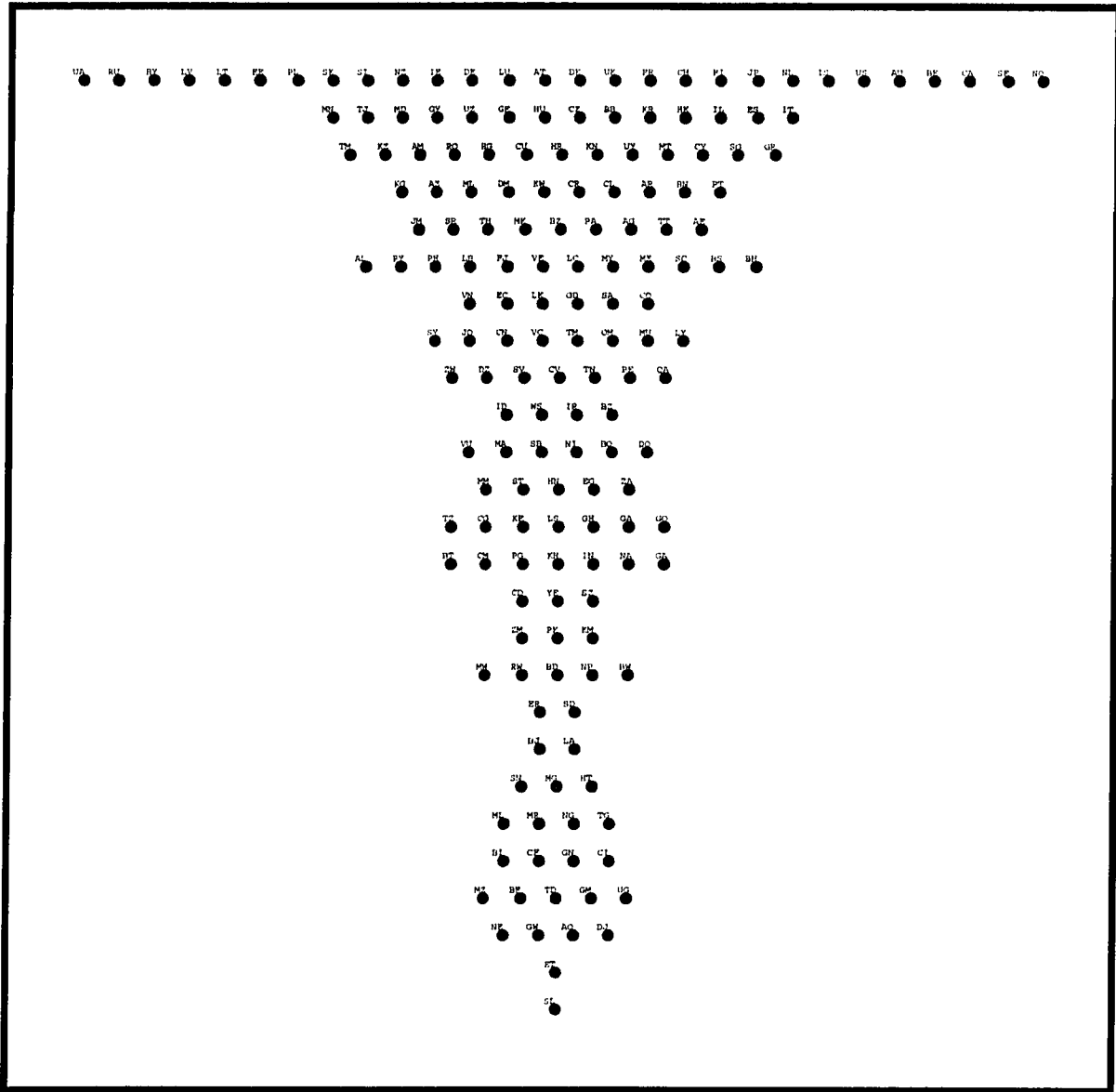


Figure [2.3]: Hasse diagram with $>$ and the following *two* dimensions: average life expectancy and adult literacy. Countries fall into 26 tiers. The *maximal elements* are: AT, AU, BE, BY, CA, CH, DE, DK, EE, FI, FR, IE, IS, JP, LT, LU, LV, NL, NO, NZ, PL, RU, SE, SK, SI, UA, UK, and US; and the *minimal elements* are: MZ, NE, and SL.

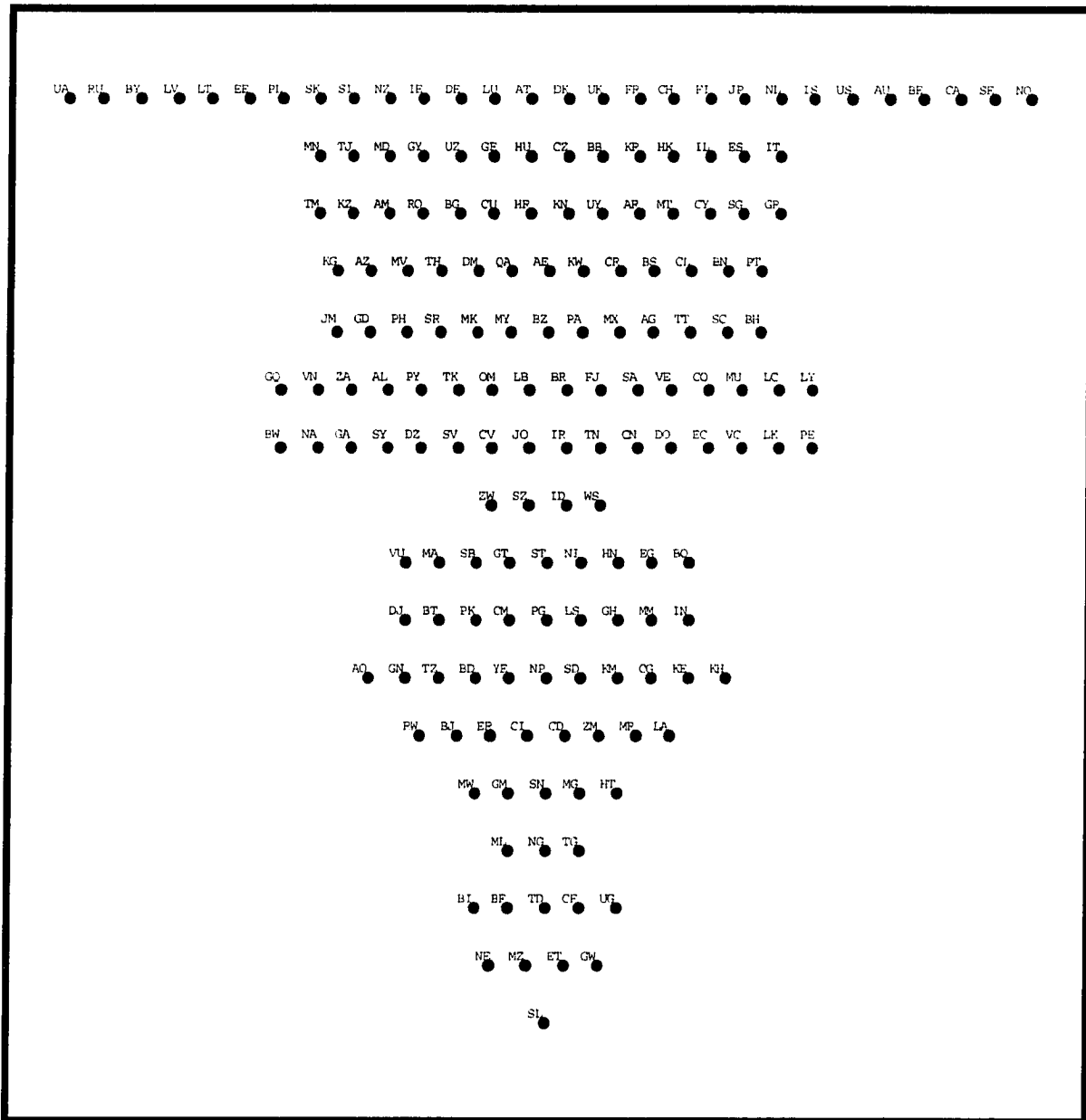
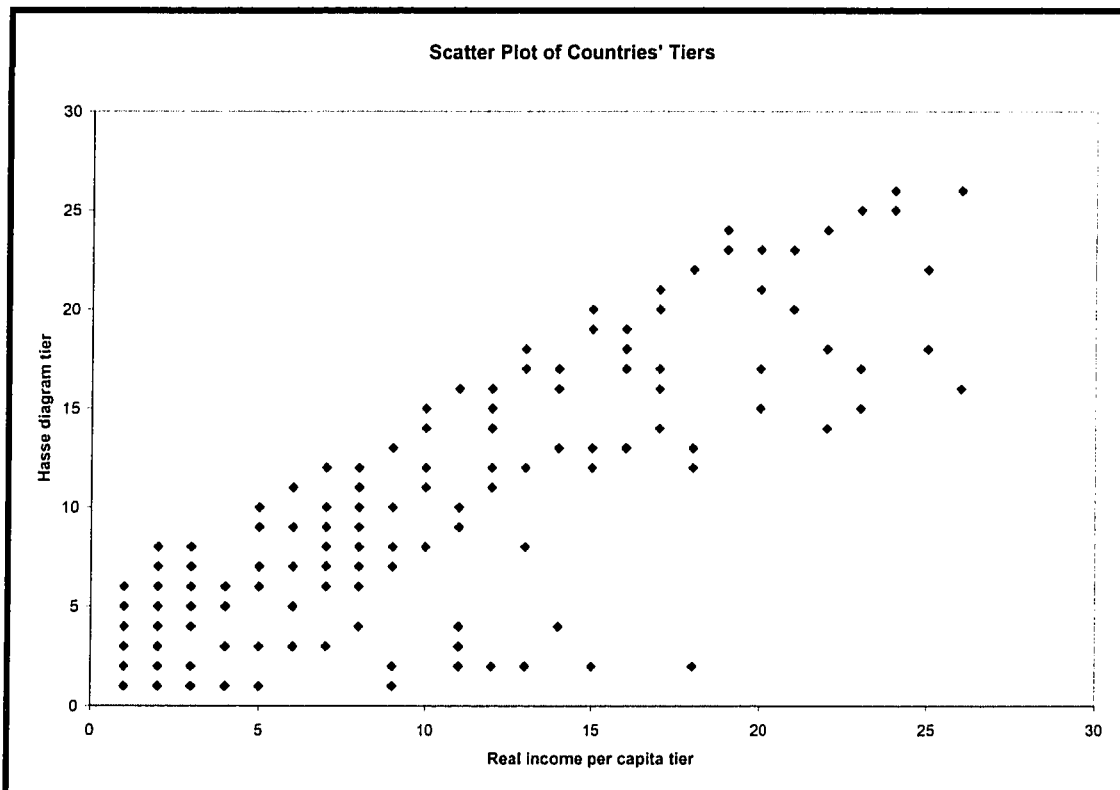


Figure [2.4]: Hasse diagram with $>$ and the following *three* dimensions: per capita real income; life expectancy (average); and adult literacy. Countries fall into 17 tiers. The *maximal elements* are: AT, AU, BE, BY, CA, CH, DE, DK, EE, FI, FR, IE, IS, JP, LT, LU, LV, NL, NO, NZ, PL, RU, SE, SI, SK, UA, UK, and US; and the *minimal elements* are: NE and SL.

Comparison of Hasse Diagram Tiers and Per Capita Real Income Tiers

The following scatter plot compares the tiers from a list of countries by per



capita real income and the tiers of Hasse Diagram in Figure [2.2].

Figure: Scatter Plot of Countries' tiers

The table below gives the results of regressing the Hasse diagram tiers on per capita real income tiers. It shows that the coefficient on the per capita real income tiers is positive and statistically significant at 1 percent. This implies that the Hasse diagram tiers is sensitive to per capita real income tiers. It shows as

expected that per capita real income has an effect on countries' socio-economic achievements and relative ranks with respect to other countries of the world.

Hasse diagram tiers and per capita real income tiers (Dependent variable: Hasse diagram tier)			
<i>Independent variable</i>	<i>Coefficients</i>	<i>Standard error</i>	<i>t Statistic</i>
Intercept	1.43	0.47	3.05
Per capita real income tiers	0.84	0.04	20.27
Regression statistics			
R ²	0.71		
Adjusted R ²	0.70		
SE of regression	3.79		
F-statistics	411		
Observations	173		

Source: Author's calculations

The Value of Hasse Diagrams

The Hasse diagrams provide worthwhile information about the ranking hierarchy of countries for some given dimensions of social and economic achievements. The value of a Hasse diagram is that it gives a visual representation to the hierarchies that occur among countries in social and economic achievements.

It shows the *maximal elements*, the *minimal elements*, which countries dominate others, which countries are dominated by others, which countries neither dominate others nor are dominated by others, and so on. It also shows the *ordinal distance* between the dominating countries and the dominated

countries as expressed by the number of edges between vertex v_s and vertex v_t , where vertex v_s is above vertex v_t . It also shows the *tiers* of vertices as given by the numbers of horizontal rows of vertices in the diagrams. Knowledge of maximal elements, minimal elements, dominance relationships, ordinal distances among vertices, and the number of tiers in a Hasse diagram are germane to understanding respectively which countries have the highest achievements, which countries have the lowest achievements, what are the comparative levels of achievements of countries, what are the differences in the rankings of achievements among certain countries, and how many levels of tiers of achievements that one can find among the countries of the world.

These Hasse diagrams show the hierarchies that emerge amongst the countries of the world when some countries and groups of countries vector dominate other countries and groups of countries. It is interesting to observe the changes in the hierarchies as more indicators are progressively added to the vectors, or different sets of indicators are chosen. There are clear patterns of vector dominance of one set of countries over some other sets of countries, but the remaining countries' positions are often ambiguous in terms of their achievements in human development. As more dimensions are progressively added to the vectors, the number of tiers decreases (see Appendix 3). The Hasse diagrams may appear to confirm one's prior beliefs that there are three major

“clusters” of countries. However, one needs to be quite cautious in interpreting Hasse diagrams and refrain from drawing unwarranted conclusions.

The Limits of Hasse Diagrams

The Hasse diagram is limited to only using ordinal information from the data. However, cardinal information about the countries may be quite important. As a result, glancing only at the absolute and relative positions of countries in a Hasse diagram without knowledge of the underlying data may often mislead the evaluator. Firstly, though a country can be placed high up in the tiers of the diagram, this does not preclude the possibility that it can be disadvantaged in many dimensions as compared to other countries. Secondly, though a country can have high levels of achievements in several dimensions, it can be placed in the lower tiers of the diagram if there are some other countries that are only a bit higher in each of the dimensions. Therefore, one needs to be very careful about interpreting a country’s status based on its position within the tiers of a Hasse diagram.

The Hasse diagram provides a very detailed and complex view of dominance relations among the countries of the world. It does not, however, provide a parsimonious representation of the world. A very detailed and complex view may not be the most informative picture of the world. Hasse diagrams do not afford clear and distinct categories of countries. While it is

possible to examine how many countries fare above or below a particular set of countries by counting the number of vertices connected to the tiers above and to the tiers below, it is tedious and time-consuming to do so. Moreover the number of tiers and the ordinal distance as indicated by the number of edges between vertices in the diagram are subject to major changes even with minor perturbations of the data. These are some of the limitations inherent in Hasse diagrams. The information that can be obtained from the Hasse diagrams do not establish a clear and distinct classification of countries into L sets of countries.

Parsimonious Representations of the World

These diagrams do not reveal which sets of countries are suitable candidates for acting as benchmarks to unambiguously classifying countries into different sets of countries. It is more useful to obtain simplified and parsimonious views of the world.⁴ One of the tasks of the sciences is to achieve parsimonious representations of the world amidst complex and even conflicting data.⁵ Moreover the evaluator is more likely to use simple information than she would complex information. The next section develops a methodology and

⁴ Karl Popper once remarked, "Science may be described as the art of systematic over-simplification" [*Observer* (London, August 1, 1982)].

⁵ The works of Ronald Coase (1937), Oliver Williamson (1975 and 1985), Sanford Grossman and Oliver Hart (1986), Hart and John Moore (1990) and numerous new economists working in the tradition of new institutional economics support view that economic contracts and organizations are institutions that arise from an attempt to simplify dealings and relations in a complex and multifaceted world.

conceptual framework to obtain parsimonious views of the world that result in a clear and distinct categories of countries.

SECTION III: A METHODOLOGY AND CONCEPTUAL FRAMEWORK FOR RANKING AND GROUPING COUNTRIES

This section develops a methodology and conceptual framework to select among alternative partial orderings for unambiguous ranking and grouping the countries of the world. It provides for an intersection partial ordering approach to arrive at an internally unambiguous and parsimonious description of the hierarchies among the countries in the world. It enables one to traverse from Hasse diagrams, which render a high dimensional and complex characterization of dominance relations, to more straightforward, intelligible, and simple yet accurate rankings and groupings of countries.

Information Statistics and Methodology

In order to analyze whether different countries can be ranked and grouped, a simple method of unambiguously classifying countries is proposed in this section of the essay. The method is based on developing a notion of a “pivot” set of countries that divide the world into sets of dominating countries and dominated countries. The notion of a “pivot” set of countries is explained here, and followed by definitions of a few information statistics to capture some characteristics of the division of the world created by the choice of “pivot” set.

The conceptual framework presented here enables the evaluator to obtain L sets of countries, organized as required into two-tiered or multi-tiered divisions of the world. This is a refinement of the procedure of ranking and grouping countries based on using Hasse diagrams. It gives hierarchical rankings and classifications that identify which sets of countries are strictly (or weakly) better off than some other sets of countries. The chief merit of this approach is that it leads to unambiguous rankings and groupings of countries.

General Problem

The general problem that will be addressed here is to rank and group the countries of the world into L sets of countries. Special cases of this problem are to divide the world into two-tiered or three-tiered or M tiered classifications of the world. The concepts developed here enable the evaluator to arrive at M tiered classifications of the world. Notice that $M = L - 1$.

Two-tiered Classification and Multi-tiered Classification

Firstly concepts to implement two-tiered divisions of the world are developed. Secondly concepts to implement multi-tiered classifications of the world are developed.

Motivation of Pivot Sets

The pivot country is used to separate out the set of countries into distinct groups of countries: namely, dominating countries and dominated countries.

The use of a set of pivot countries helps to differentiate between the set of countries that are privileged and the set of countries that are underprivileged in social and economic achievements. Pivot country serves as a benchmark for separating out two sets of countries. All the dominating countries are better off in the dimensions of the welfare indicators than the set of pivot countries whereas all the dominated countries are worse off in the dimensions of the welfare indicator than the set of pivot countries.

The evaluator may select a set of countries as a pivot set in order to find out many countries are better off and how many countries are worse off than the given set of countries.

This section will first present the notion of a single pivot and then develop notion of a pivot set.

Single Pivot

Let W be the set of all countries under consideration. Each country w_i is associated with a vector of κ indicators: $w_i = (v_1, v_2, v_3, \dots, v_\kappa)$. A "pivot" is a country, w_i , for which there are (a) a set of countries, U_i , that dominate it; (b) a set of countries, D_i , that are dominated by it; and there may also be (c) a set of countries, G_i , that neither dominate w_i nor are dominated by it. If country w_i ,

vector dominates w_i , it belongs to the dominating set of countries, that is, $w_U \in U_i$. If country w_D is vector dominated by w_i , it belongs to the dominated set of countries, that is, $w_D \in D_i$. If country w_G neither vector dominates w_i nor is vector dominated by w_i , it belongs to the set of countries that neither vector dominates nor are vector dominated, that is, $w_G \in G_i$.

$$W = U_i \cup D_i \cup G_i \forall i.$$

The number of countries under consideration, $N = n[W]$ where $n[\cdot]$ is the number of elements in the given set. When the pivot is country w_i , the number of dominating countries, $N_1 = n[U_i]$; the number of dominated countries $N_2 = n[D_i]$; and the number of countries that are neither dominating nor dominated, $N_3 = n[G_i]$.

$$N = N_1 + N_2 + N_3.$$

Figure [3.1] and Figure [3.2] show how the choice of pivot country (under pivot country A and pivot country B) determines the corresponding D_i, U_i, G_i .

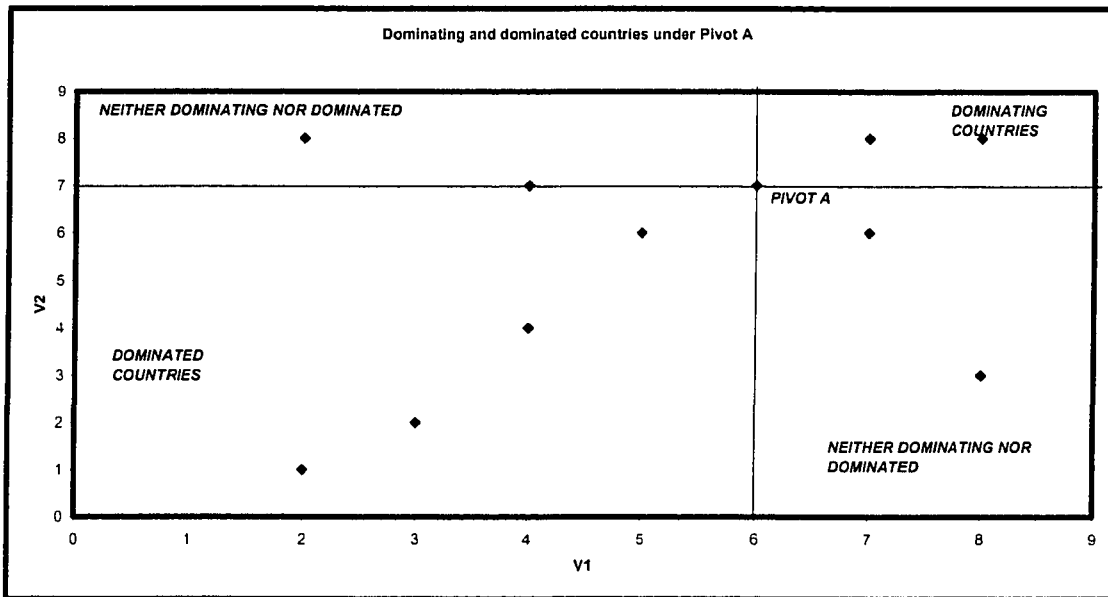


Figure [3.1]: Dominating countries and dominated countries under pivot A

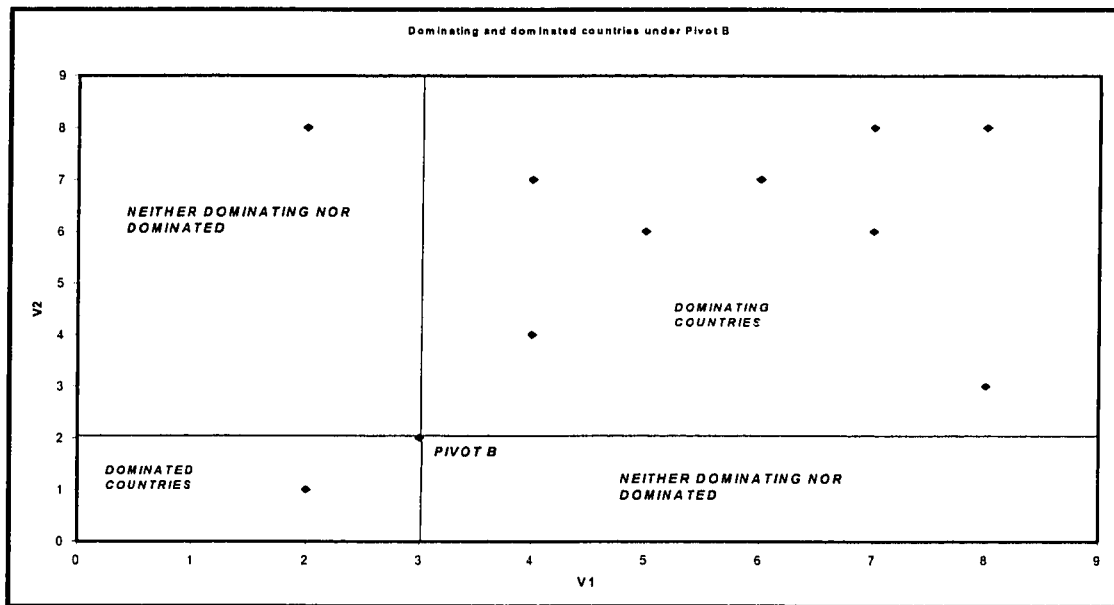


Figure [3.2]: Dominating countries and dominated countries under pivot B

$I_1(\kappa)$ information statistics

Each country is associated with a vector of κ dimensions where each dimension represents some indicator. From the list of N countries, every country ($w_i, \forall i$) is taken as a candidate “pivot” to determine: (a) the number of countries, N_1 , that strongly vector dominate the given country; (b) the number of countries, N_2 , that are strongly vector dominated by the given country; and (c) the number of countries, N_3 , that are neither dominating nor dominated by this country.

Define *coverage ratio* as $I_1(\kappa) = \frac{N_1 + N_2}{N}$ for all countries. This is a ratio of the number of countries that are dominating or dominated to the total number of countries under consideration. $I_1(\kappa)$ can be calculated and obtained for all countries when each country is selected as the “pivot” country ω_i . $I_1(\kappa)$ is an information summary statistic. This statistic can be calculated for vectors of different dimensions; κ represents the number of dimensions of the vectors.

One can obtain the following population-weighted coverage ratio,

$$I_1(\kappa)_p = \frac{P_1 + P_2}{P} \text{ where } P \text{ is the world population, } P_1 \text{ is the total population of}$$

the dominating countries, and P_2 is the total population of the dominated countries.

It may be useful to decompose coverage ratio into dominating ratio and dominated ratio as follows: $I_1(\kappa) = u(\kappa) + d(\kappa)$ where the *dominating ratio*,

$$u(\kappa) = \frac{N_1}{N}, \text{ and the } \textit{dominated ratio}, d(\kappa) = \frac{N_2}{N}. \text{ The population weighted versions}$$

of these ratios are as follows: dominating ratio, $u(\kappa)_p = \frac{P_1}{P} = \theta_1$, where θ_1 is the

dominating countries' share of the global population; and dominated ratio,

$$d(\kappa)_p = \frac{P_2}{P} = \theta_2 \text{ where } \theta_2 \text{ is the dominated countries' share of the global}$$

population.

$I_1(\kappa)$ and $I_1(\kappa)_p$ summary statistics provide measures of coverage but do not indicate how far the dominating countries are from the dominated countries.

The value of $I_1(\kappa)$

The value of this information statistic lies in showing how many countries fall within the set of dominating countries and the set of dominated countries for a given pivot.

$I_2(\kappa)$ information statistics

In order to calibrate how far the dominating countries are from the dominated countries, consider some $k = (k_1, k_2, \dots, k_\kappa)$ that measures the ratio between the components of the vectors when vector $a = (a_1, a_2, \dots, a_\kappa)$ dominates vector $b = (b_1, b_2, \dots, b_\kappa)$. Each component of the vector k is the ratio of a dimension between a dominating country and a dominated country. It is a measure of the differences in social and economic achievements between a dominating country and a dominated country in the chosen set of indicators.

If $(a_1, a_2, \dots, a_\kappa) = (\tilde{k}, \tilde{k}, \dots, \tilde{k})(b_1, b_2, \dots, b_\kappa) = (\tilde{k}b_1, \tilde{k}b_2, \dots, \tilde{k}b_\kappa)$ then the vector a is said to \tilde{k} dominate the vector b .

For the T th dimension, the following statistic can be defined:

$$I_2^T = \frac{\left[\sum_{i=1}^n \sum_{j=1}^m (k_{ij})^z \right]^{\frac{1}{z}}}{nm} \text{ where } i = 1, 2, \dots, n \text{ is the number of dominating countries,}$$

and $j = 1, 2, \dots, m$ is the number of dominated countries; and $z > 0$ (the role of z will be explained later).

I_2^T can be calculated for a given country, ω_i , taken as a candidate pivot. Note that there could also be a population-weighted version of this statistic given as follows:

$$I_{2p}^T = \frac{\left[\sum_{i=1}^n \sum_{j=1}^m (k_{ij} P_i P_j)^z \right]^{\frac{1}{z}}}{nmP_T} \text{ where } P_i \text{ is the population of the } i \text{ th dominating}$$

country; P_j is the population in the j th dominated country; and P_T is the total population of all the dominating countries and the dominated countries.

Interpretation of z

z transforms the ratio of a given dimension between a dominating country and a dominated country. If the evaluator believes that the differences in achievements in the given socioeconomic indicator among countries with larger differences matter more than additional differences among countries with smaller differences then she sets $z > 1$. If the evaluator believes that additional gaps among countries with larger differences matter less than additional gaps among countries with smaller differences then she sets $0 < z < 1$. If the evaluator believes that additional gaps among countries with larger differences matter as much as additional gaps among countries with smaller differences then she sets $z = 1$.

Aggregating I_2^T

I_2^T information statistics are calculated for each component of the vector.

These information statistics are then defined for the vector. For the two-components (dimensions) case, $I_2(2) = (I_2^1, I_2^2)$ and for the κ components (dimensions) case, $I_2(\kappa) = (I_2^1, I_2^2, I_2^3, \dots, I_2^\kappa)$. The aggregated scalar version of $I_2(\kappa)$ is defined below.

Consider the following formulation in which some weighted average of the components is used for constructing $I_2(\kappa)$ by some function ϕ defined below, where the components are: I_2^Y (component for per capita real income), I_2^{LE} (component for average life expectancy), and I_2^{LIT} (component for adult literacy).

A weighted average formulation of $I_2(2)$ based on I_2^Y and I_2^{LE} would be as follows:

$$I_2(2) = \phi(I_2^Y, I_2^{LE}) = g(\theta_Y I_2^Y, \theta_{LE} I_2^{LE}) = \frac{1}{\theta_Y + \theta_{LE}} (\theta_Y I_2^Y + \theta_{LE} I_2^{LE}) \text{ where } \theta_Y + \theta_{LE} = 1.$$

A "Cobb-Douglas" formulation of $I_2(2)$ based on I_2^Y and I_2^{LE} would be as follows:

$$I_2(2) = \phi(I_2^Y, I_2^{LE}) = A(I_2^Y)^{\alpha\beta} B(I_2^{LE})^{(1-\alpha\beta)} \text{ where } 0 < \alpha\beta < 1, \alpha > 0, \beta > 0, A > 0, B > 0.$$

A "Cobb-Douglas" formulation of $I_2(3)$ based on I_2^Y, I_2^{LE} , and I_2^{LIT} would be as follows:

$$I_2(3) = \phi(I_2^Y, I_2^{LE}, I_2^{LIT}) = a(I_2^Y)^{\alpha_1\beta_1} b(I_2^{LE})^{\alpha_2\beta_2} c(I_2^{LIT})^{\alpha_3\beta_3} \text{ where}$$

$$\alpha_1\beta_1 + \alpha_2\beta_2 + \alpha_3\beta_3 = 1, \alpha_i > 0, \beta_i > 0, 0 < \alpha_i\beta_i < 1, a > 0, b > 0, c > 0.$$

Interpretation of α and β

Here α and β are distinct parameters that can be used to represent respectively (a) the relative importance given to the *seriousness* of the trade-off of one type of deprivation over another type of deprivation, and (b) the relative importance given to the *description* of one type of deprivation over another type of deprivation. These distinctions represent two different types of trade-offs between the two indicators. The evaluator may believe that one type of deprivation is more important than another. In this case her choice of α parameters will vary. The α parameters will convey what the evaluator believes to be the welfare trade-off among the indicators. The evaluator may also believe that it is more important to describe one indicator than other indicators. The β parameters will convey what importance she gives to the description of different indicators. The values given to β parameters may depend on data limitations and errors. Even if two evaluators agree on how to evaluate certain types of deprivations, they may disagree on which one is relatively more important to describe. Even if two evaluators agree on the descriptive importance of the indicators, they may diverge on the effect of these indicators on people's welfare.

Two different types of parameters are required to address these distinct concerns.

The value of $I_2(\kappa)$

The value of $I_2(\kappa)$ statistic lies in showing how far apart the set of dominating countries are from the set of dominated countries for a given choice of a pivot.

I_3^T information statistics and Γ_1^T, Γ_2^T statistics

For any given dimension, one may also construct another information statistic, I_3^T , which may be defined as follows:

$I_3^T = \sum_{i=1}^n \sum_{j=1}^m \|y_i - y_j\|$ where n is the number of dominating countries and m is the

number of dominated countries, and y is the variable for the dimension of interest.

The population-weighted version of this statistic is as follows:

$I_{3\ p}^T = \frac{\sum_{i=1}^n \sum_{j=1}^m \theta_i \theta_j \|y_i - y_j\|}{\sum_{i=1}^{n+m} \theta_i y_i}$ where θ_i is the country's population share in the total

world population.

Γ_1^T -statistics

In order to examine for some given dimension T how much of the share of the overall world inequality is explained by the inequality between and among the dominating countries and the dominated countries when a pivot is chosen, one may consider the following ratio:

$$\Gamma_1^T = \frac{\sum_{i=1}^{n+m} \sum_{j=1}^{n+m} \|y_i - y_j\|}{\sum_{i=1}^N \sum_{j=1}^N \|y_i - y_j\|}$$

Here $\Gamma^T \in [0,1]$. For any given dimension, $\Gamma^T = 1$ when the set of dominating countries and the set of dominated countries account completely for the inequality among the countries in the world, whereas $\Gamma^T = 0$ when they account for none of the inequality across countries.

Actually it may be more useful to consider the population-weighted versions of this statistic as defined below:

$$\Gamma_p^T = \frac{\sum_{i=1}^{n+m} \sum_{j=1}^{n+m} \theta_i \theta_j \|y_i - y_j\| / \sum_{i=1}^{n+m} \theta_i y_i}{\sum_{i=1}^N \sum_{j=1}^N \theta_i \theta_j \|y_i - y_j\| / \sum_{i=1}^N \theta_i y_i}$$

Here $\Gamma_p^T \in [0,1]$. For any given dimension, $\Gamma_p^T = 1$ when the inequality among and between the set of dominating countries and the set of dominated countries completely account for the inequality among the countries in the world, whereas $\Gamma_p^T = 0$ when they account for none of the inequality among the countries of the world.

Γ_2^T -statistics

In order to examine for some given dimension T how much of the share of overall world inequality is explained by the inequality between the dominating countries and the dominated countries when a pivot is chosen, one may consider the following ratio:

$$\Gamma_2^T = \frac{\sum_{i=1}^n \sum_{j=1}^m \|y_i - y_j\|}{\sum_{i=1}^N \sum_{j=1}^N \|y_i - y_j\|}$$

Here $\Gamma_2^T \in [0,1]$. For any given dimension, $\Gamma_2^T = 1$ when the inequality between the set of dominating countries and the set of dominated countries completely account for the inequality among the countries in the world, whereas $\Gamma_2^T = 0$ when they account for none of the inequality among the countries of the world.

It may be useful to consider the population-weighted version of this statistics as defined below:

$$\Gamma_p^T = \frac{\sum_{i=1}^n \sum_{j=1}^m \theta_i \theta_j \|y_i - y_j\| / \sum_{i=1}^{n+m} \theta_i y_i}{\sum_{i=1}^N \sum_{j=1}^N \theta_i \theta_j \|y_i - y_j\| / \sum_{i=1}^N \theta_i y_i}$$

The value of I_3^T and Γ_1^T, Γ_2^T statistics

The value of I_3^T lies in showing what the aggregated distance of the set of dominating countries is from the set of dominated countries in the T th dimension for a given pivot. The value of Γ_1^T, Γ_2^T statistics lies in showing how much of the world inequality in the T th dimensions is due to the inequality among the dominating countries and the dominated countries for a given pivot.

Between and Within Group Variance: Dominating Countries and Dominated Countries

For each indicators the following statistics may be constructed. Let the total variance of the indicator be, V_T^2 . Let the variation of that indicator among the set of dominating countries be V_U^2 . Let the variation of that indicator among the set of dominated countries, V_D^2 . Let the variation of that indicator among the set of countries that are neither dominating nor dominated be V_G^2 . Let V_B^2 be the between group variance; it estimates the variation between each set of countries. Let V_W^2 be the within group variance; it estimates the variation within each set of countries and is based on the weighted average of the variances of those the set of countries. It may be useful to test whether the between group variance equals the within group variance, using the F -statistic, defined as follows: $F = V_B^2 / V_W^2$.

Multi-layered Analysis

The methodology developed here could be generalized and utilized for creating a set of pivots in order to get multi-layered divisions of the world into L sets of countries. Consider the following pivots set $\Psi = \{\rho_1, \rho_2, \dots, \rho_L\}$ where (i) $\rho_1 \succ \rho_2 \succ \dots \succ \rho_L$ (that is, pivot ρ_1 dominates pivot ρ_2 , pivot ρ_2 dominates pivot ρ_3 , and so forth) and (ii) if country ω_i is dominated by pivot ρ_j , then it is also dominated by all pivots ρ_i when ρ_i dominates ρ_j , that is, $\rho_i \succ \rho_j$. Here the set of pivots $\Psi = \{\rho_1, \rho_2, \rho_3, \dots, \rho_L\}$. With each pivot $\rho_1, \rho_2, \dots, \rho_L$ there is respectively an associated set of dominating countries: U_1, U_2, \dots, U_n and an associated set of dominated countries: D_1, D_2, \dots, D_L . Since $\rho_1 \succ \rho_2 \succ \dots \succ \rho_L$, it follows that $U_1 \subseteq U_2 \subseteq \dots \subseteq U_L$ and $D_1 \supseteq D_2 \supseteq \dots \supseteq D_L$.

It may be useful to look at the following Figure [3.3] where there are two pivots P and Q .

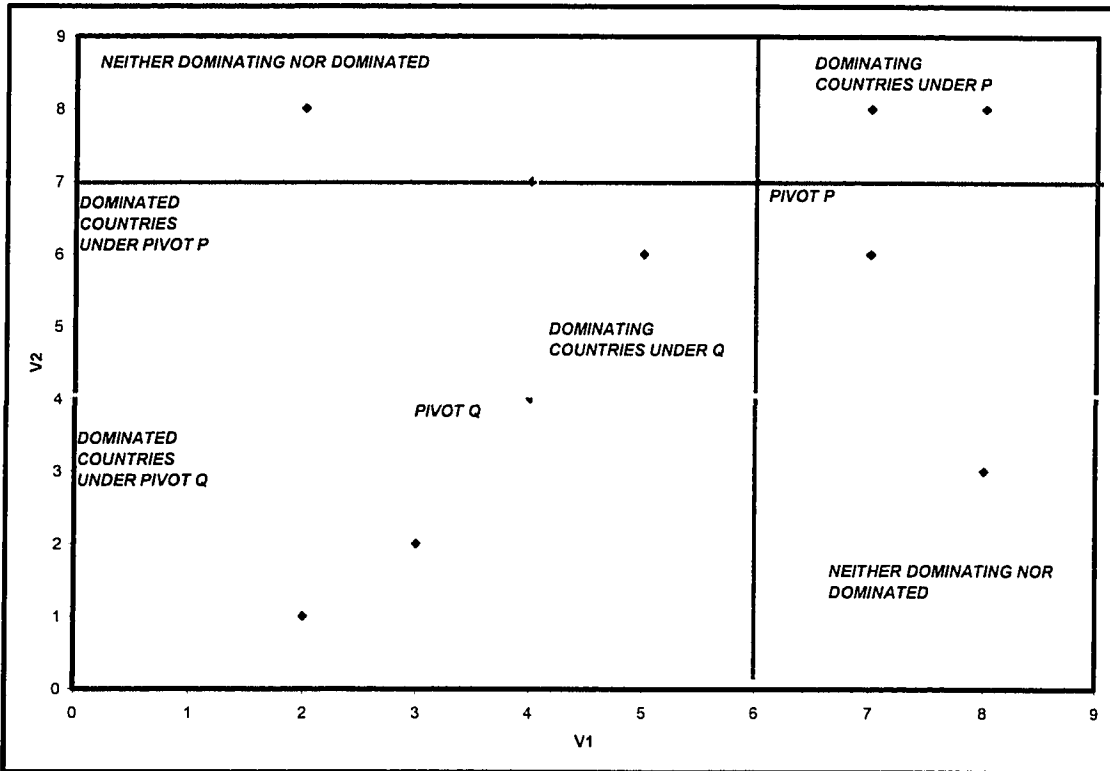


Figure [3.3]: Pivot *P* and Pivot *Q*

The information statistics for the multi-layered case can be defined as follows:

Multi-layered $I_1(\kappa; \Psi)$

For $I_1(\kappa; \Psi)$ there are two versions: (a) union-concept and (b) intersection- concept.

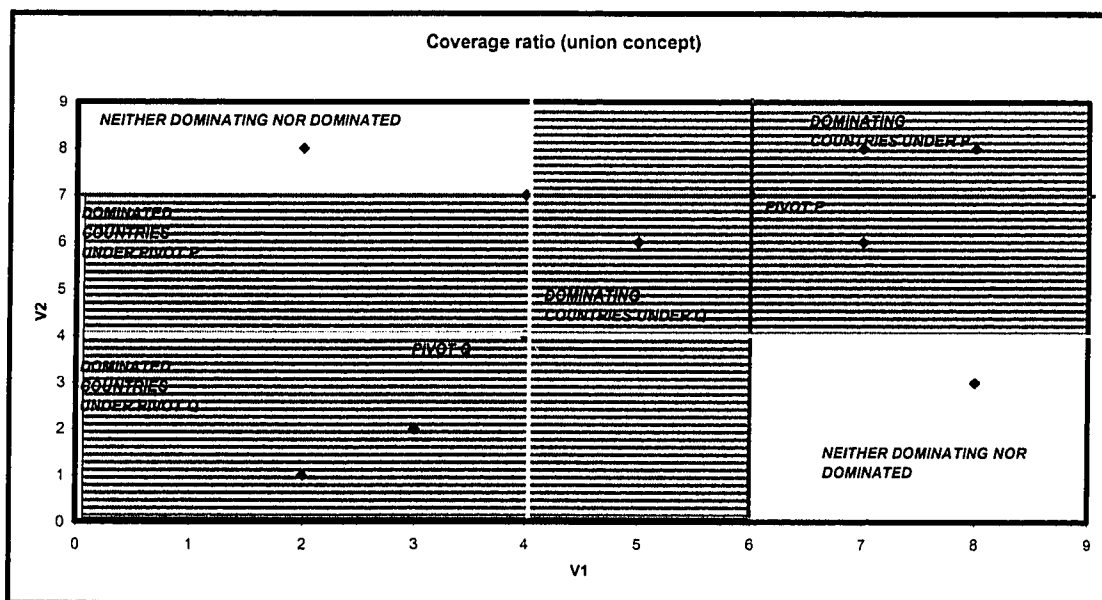
Union concept $I_1(\kappa; \Psi, \cup)$

The information statistics may defined as the ratio of the total number of countries covered under a set of pivots by any *one* of the pivots and the total number of countries:

$$I_1(\kappa; \Psi, \cup) = \frac{n[(U_1 \cup U_2 \cup \dots \cup U_L) \cup (D_1 \cup D_2 \cup \dots \cup D_L)]}{N} = \frac{n[U_L \cup D_1]}{N} \text{ where } n[\cdot] \text{ is}$$

the number of countries in the respective sets of countries.

This version of the information statistic enumerates every country that either dominates or is dominated by at least one of the elements of the pivot set Ψ . This means that the countries in the set of countries covered by $I_1(\kappa; \Psi, \cup)$ either dominates or is dominated by *some* pivot(s) (one pivot or more) in the pivot set. This



is shown in the following Figure [3.4]:

Figure [3.4]: Coverage ratio (union concept)

Intersection concept $I_1(\kappa; \Psi, \cap)$

The information statistic may also be defined as the ratio of the total number of countries covered under a set of pivots by *each and every* pivot and the total number of countries:

$$I_1(\kappa; \Psi, \cap) = \frac{n[U_1] + n[D_1 \cap U_2] + n[D_2 \cap U_3] + \dots + n[D_{L-1} \cap U_L] + n[D_L]}{N} \text{ where } n[\cdot] \text{ is}$$

the number of countries in the respective sets of countries.

This version of the information statistic enumerates every country that either dominates or is dominated by all of the elements of the pivot set Ψ . This means that any country in the set of countries covered by $I_1(\kappa; \Psi, \cap)$ either dominates or is dominated by *all* of the pivots in the pivot set.

This is shown in the following Figure [3.5]:

The intersection concept of this information statistics has a more meaningful interpretation. Consider the pivot set $\Psi = \{\rho_1, \rho_2, \dots, \rho_L\}$, where $\rho_1 \succ \rho_2 \succ \dots \succ \rho_L$; and define the following sets:

$$S_1 \equiv \{\omega_i | \omega_i \succ \rho_1\} = U_1;$$

$$S_2 \equiv \{\omega_i | \rho_1 \succ \omega_i \succ \rho_2\} = D_1 \cap U_2;$$

$$S_3 \equiv \{\omega_i | \rho_2 \succ \omega_i \succ \rho_3\} = D_2 \cap U_3;$$

....

$$S_{L-1} \equiv \{\omega_i | \rho_{L-1} \succ \omega_i \succ \rho_L\} = D_{L-1} \cap U_L; \text{ and}$$

$$S_L \equiv \{\omega_i | \rho_L \succ \omega_i\} = D_L.$$

On the basis of the above definitions, $I_1(\kappa; \Psi, \cap)$ can be re-written as follows:

$$I_1(\kappa; \Psi, \cap) = \frac{n[S_1] + n[S_2] + n[S_3] + \dots + n[S_L]}{N} \text{ where } n[.] \text{ is the number of countries}$$

in the respective sets of countries.

With the intersection concept of coverage, the above defined sets S_1, S_2, \dots, S_L , provide some relevant information about the world. All members of S_1 dominate pivot ρ_1 ; all members of S_2 dominate pivot ρ_2 and are dominated by pivot ρ_1 ; all members of S_3 dominate pivot ρ_3 and are dominated by pivot ρ_3 ; and so forth.

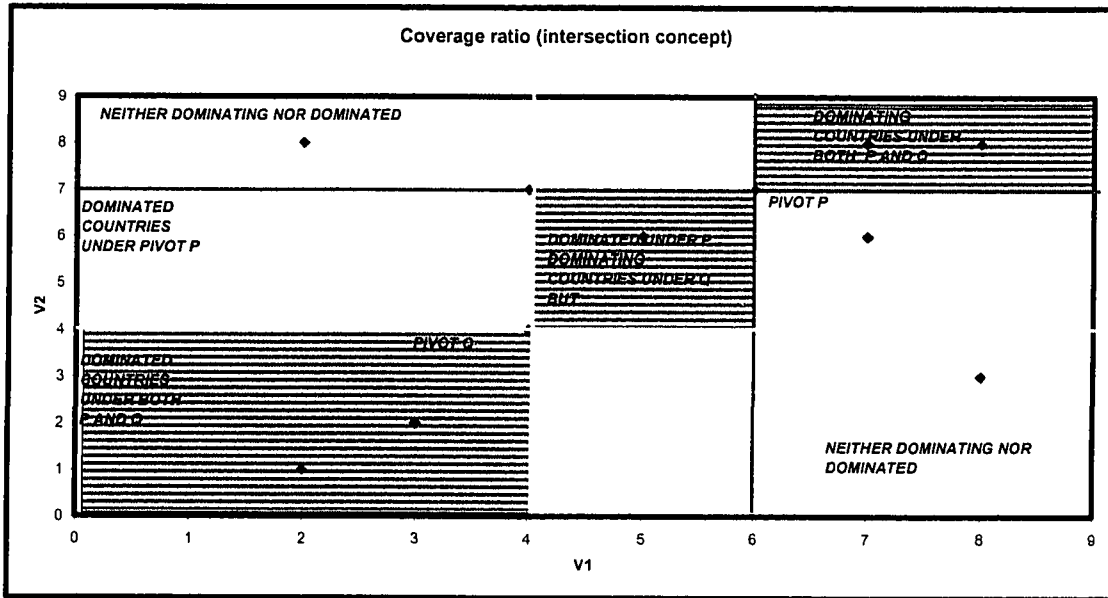


Figure [3.5]: Coverage ratio (intersection concept)

Multi-layered $I_2(\kappa; \Psi)$

The multi-layered version of $I_2(\kappa; \Psi)$ can be defined using the concepts introduced above.

The $I_2(\kappa)$ generated for each pivot in the pivot set are as follows:

$$\hat{I}_2^1(S_1, S_2), \hat{I}_2^2(S_2, S_3), \dots, \hat{I}_2^{L-1}(S_{L-1}, S_L)$$

The multi-layered equivalent of $I_2(\kappa)$ is now defined as follows:

$$I_2(\kappa; \Psi) = \varpi \left[\varsigma_1 (\hat{I}_2^1)^\eta + \varsigma_2 (\hat{I}_2^2)^\eta + \dots + \varsigma_{L-1} (\hat{I}_2^{L-1})^\eta \right]^{\frac{1}{\eta}} \text{ where } \eta \in (-\infty, 1],$$

$\varpi > 0; \varsigma_1 > 0, \varsigma_2 > 0, \dots, \varsigma_{L-1} > 0; \varsigma_1 + \varsigma_2 + \dots + \varsigma_{L-1} = 1$. Here $\varpi > 0$ is the efficiency parameter; and the ς s are the distribution parameters.

When $\eta \rightarrow 0$, I_2 has the form of a Cobb-Douglas function. When

$\eta \rightarrow -\infty$, I_2 has the form of a Leontieff function. When $\eta = 1$, I_2 has the form of a linear function.

This definition of multi-layered $I_2(\kappa)$ ensures that each pivot in the pivot set is selected such that each pivot set obtains a set of dominating countries and a set of dominated countries such that the difference in achievements between them are high. Moreover the difference in the achievements between the set of dominating countries and the set of dominated countries given by one pivot do not substitute for the gaps generated by other pivots. The constant elasticity of substitution among the information statistics, \hat{I}_2^j , generated by the pivot set, is parameterized by η . $I_2(\kappa; \Psi)$ is defined in a constant elasticity of substitution form because it is quite flexible and amenable to different specific forms with an appropriate choice of parameters.

$I(\kappa)$ Information Statistics

Consider the following information statistic $I(\kappa) = F[I_1(\kappa), I_2(\kappa)]$. Note that $I_1(\kappa)$ and $I_2(\kappa)$ are alternative information statistics that cast light upon different aspects of vector dominance in the world. How the functions F are defined will depend on the problem that is being addressed. One may obtain $I(\kappa)$ for each country and select a set of pivot countries $\Psi(\kappa) = \{\dots, \rho_s, \rho_l, \dots\}$. The set of pivots, $\Psi(\kappa)$, obtained will depend on both $I_1(\kappa)$ and $I_2(\kappa)$.

$$F_A[I_1(\kappa), I_2(\kappa)] \rightarrow \Psi_A(\kappa)$$

$$F_B[I_1(\kappa), I_2(\kappa)] \rightarrow \Psi_B(\kappa)$$

$$F_C[I_1(\kappa), I_2(\kappa)] \rightarrow \Psi_C(\kappa)$$

Let $\partial F/\partial I_1 > 0$; and $\partial F/\partial I_2 > 0$. The information statistics maps into a pivot set. This mapping need not be one-to-one. For a given information set there may well be several pivots sets. The evaluator may pick multiple pivot sets or select one of the pivot set from the numerous pivot sets.

The choice of the pivot set may well be based on one's prior beliefs about which set of countries constitutes suitable divider(s) between the "North" and the "South," or the "First World," the "Second World," and the "Third World," or whichever set of countries are chosen to divide the world into L sets of countries.

It should be stated that $I_1(\kappa), I_2(\kappa)$ are different types of measures; the first information statistic gives a measure of how many countries are dominating and dominated, and the second information statistic gives an aggregated measure of comparison in achievements between the set of dominated countries and the set of dominating countries. Hence, whether emphasis is given to one information statistic rather than the other will depend on the objective of the inquiry. Which pivot set, $\Psi(\kappa)$, to choose will depend on what descriptions of the world are regarded as important and satisfactory. Prior judgments and values will enable one to regard some features of the world to be more salient than others. It is also the case that the choice of pivot depends on which aspects (dimensions) of the world are considered to be important. The choice of pivots may depend on the dimensions of the world that are considered relevant for ranking the countries of the world.

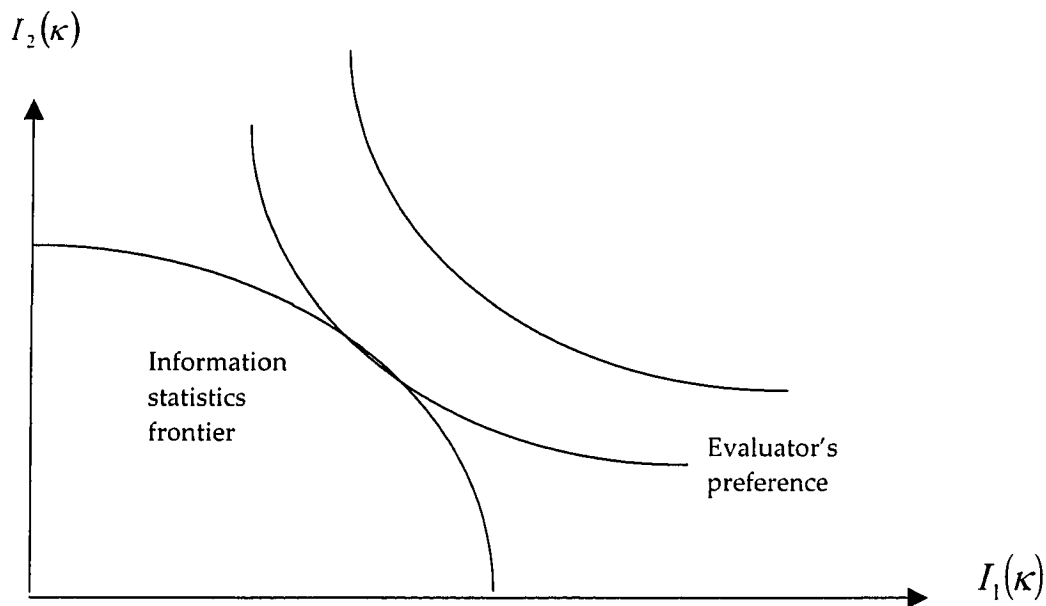


Figure [3.6]: Information statistics frontier and the evaluator's preference

It might be argued that one should select the "pivot" country with the maximum amount of coverage of countries into the categories of either dominating or dominated countries. If the objective of the exercise is to determine the extent to which the world can be dichotomized into a world of "haves" and "have-nots" it may be sensible to proceed in this manner. This would lead to as much coverage as possible. This would obtain the comparator set that provides the maximum coverage under the rubrics of the set of the dominating countries and the set of dominated countries. However, it could also be plausibly argued that one should choose the set of pivots that provides a high amount of aggregated gaps between the set of dominating countries and the set

of dominated countries. If the objective of the exercise is to show the stark differences between the “haves” and the “have-nots” of the world, it may be sensible to proceed in this manner. This would lead to as much contrast as possible between the set of dominating countries and the set of dominated countries. Clearly $I_1(\kappa)$ and $I_2(\kappa)$ illuminate two different aspects in the problem of ranking countries. There may sometimes be a trade-off between these two information statistics. This is represented by the information statistics frontier, $F[I_1(\kappa), I_2(\kappa)]$, as shown in Figure [3.6] above.

It may be useful to posit the evaluator’s preference as follows:

$V = v(I_1(\kappa), I_2(\kappa), \xi)$ where the first two arguments are the information statistics and the third argument, ξ , is some additional restrictions that the evaluator may impose, such as the minimum number of countries that belong to the set of dominating countries and the set of dominated countries. Figure [3.6] above places the information statistics frontier, F , and the evaluator’s indifference curve, V , in the $I_1(\kappa), I_2(\kappa)$ space. The “optimal” set of pivots would be selected where the evaluator’s preference is tangent to the information statistics frontier.

The methodology developed here can be useful in narrowing down the choice of the pivot set and in establishing the robustness of the pivot sets for a range of indicators. There are certain ambiguities in the type of unambiguous

rankings and groupings of countries derived based on intersection partial orderings.

Complications with the Use of Information Statistics: "The Sierra Leone Problem" and Other Issues

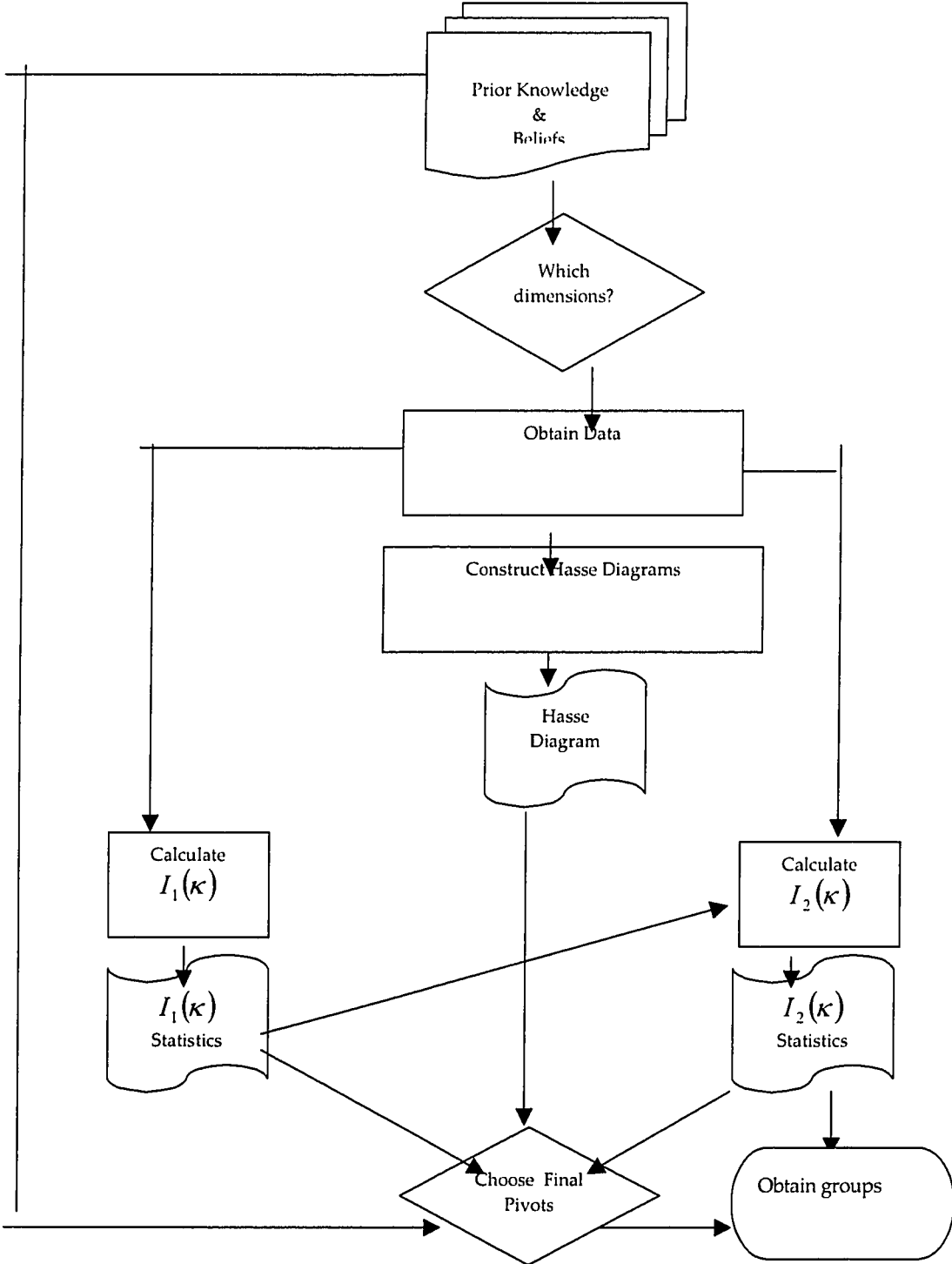
Certain problems may arise if the pivot set is selected only on the basis of information statistics without carefully examining the data or the implications in terms of the proposed categorization of the world. For example, suppose country A happens to be the worst-off country in terms of all indicators and there is another country B which is slightly better than country A in all the indicators, but below is below all other countries of the world except country A . If country B is chosen as a pivot, the I_1, I_2 information statistics generated by the set of dominating counties and the set of dominated countries could be higher than for any other choice of pivot. This does not necessarily mean that country B constitutes a suitable choice of pivot for the purposes of essay. This problem suggests that besides looking at the information statistics the evaluator should use her prior beliefs and knowledge about the countries of the world and the indicators, Γ_1 and Γ_2 statistics, between group and within group variances of key indicators among various sets of countries, and other prudential criteria to select appropriate pivot sets.

Selecting Pivot(s) and Ranking and Grouping Countries of the World

The methodology outlined in this essay provides the evaluator with additional tools besides prior knowledge about the world in order to group countries into L sets of countries. The evaluator can use Hasse diagrams of various combinations of indicators to check how robust are her choices of pivot set(s) of countries. Information statistics, $I_1(\kappa)$ and $I_2(\kappa)$, as developed here, provide additional quantitative information about the coverage, the extent of dominance, and the share of world inequality due to the inequality between the set of dominating countries and the set of dominated countries for the chosen pivot set.

Starting with the evaluator's previous knowledge and beliefs about the world, the generation of Hasse diagrams and information statistics can assist the evaluator in reducing the potential candidates for the pivot set and the number of elements in the pivot set. The flow chart below, as shown in Figure [3.7], provides an overview of how the evaluator may narrow down her choice of the set of pivots, and finally select the pivot(s).

FLOWCHART



SECTION IV: ESTIMATED INFORMATION STATISTICS AND FINDING A SET OF PIVOT COUNTRIES

This section implements the grouping of countries. Firstly, countries are divided into “the North” and “the South” with a single country as a pivot. Secondly, countries are divided into Class I, Class II, and Class III countries using multi-pivots. Thirdly, issues that arise in the implementation of the methodology of grouping countries are discussed.

The North and the South: A Two-Tiered Classifications of the World

$I_1(\kappa)$ estimates

$I_1(\kappa)$ are estimated for the following dimensions: $\kappa = 2$ where the dimensions are (a) per capita real income and average life expectancy [Case 2A], (b) per capita real income and literacy [Case 2B], and (c) average life expectancy and literacy [Case 2C]; and $\kappa = 3$ where the dimensions are per capita real income, life expectancy, and literacy [Case 3].

$I_2(\kappa)$ estimates

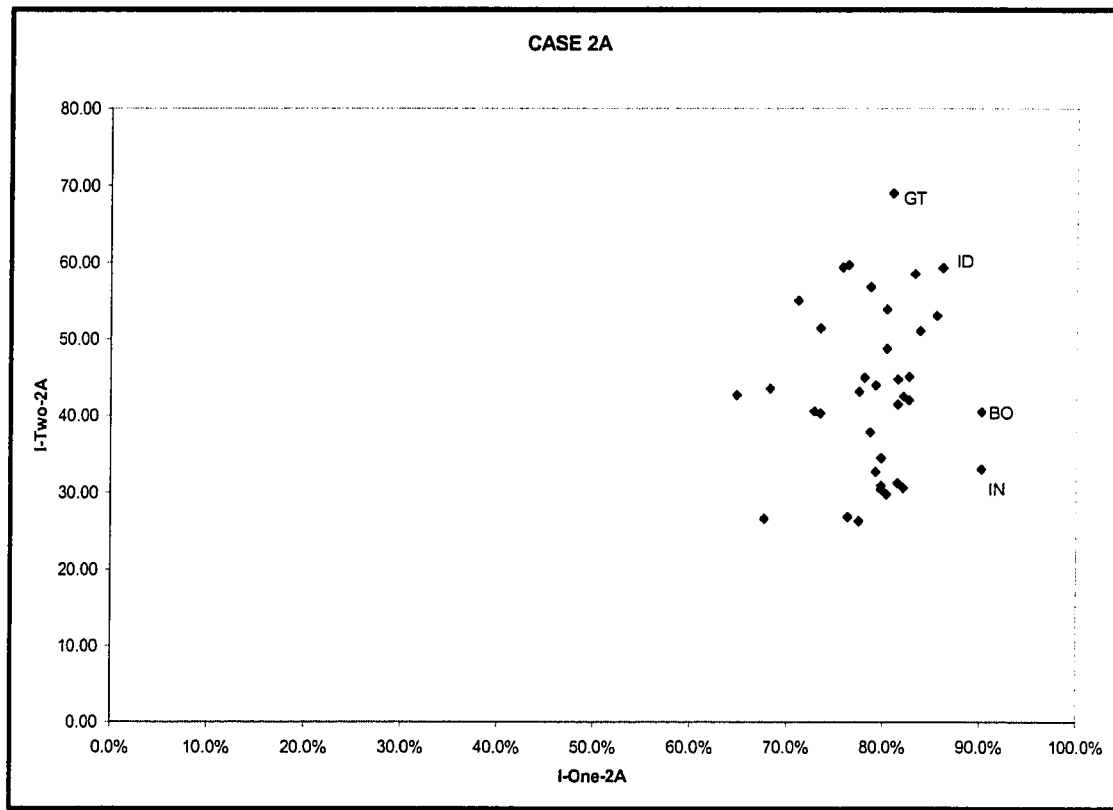
For the purposes of calculating $I_2(\kappa)$ statistics, the number of dimensions are restricted. Restricting the calculations of $I_2(\kappa)$ to Case 2A, Case 2B, Case 2C, and Case 3 makes the empirical implementation more manageable.

From Information Statistics to Singular Pivots

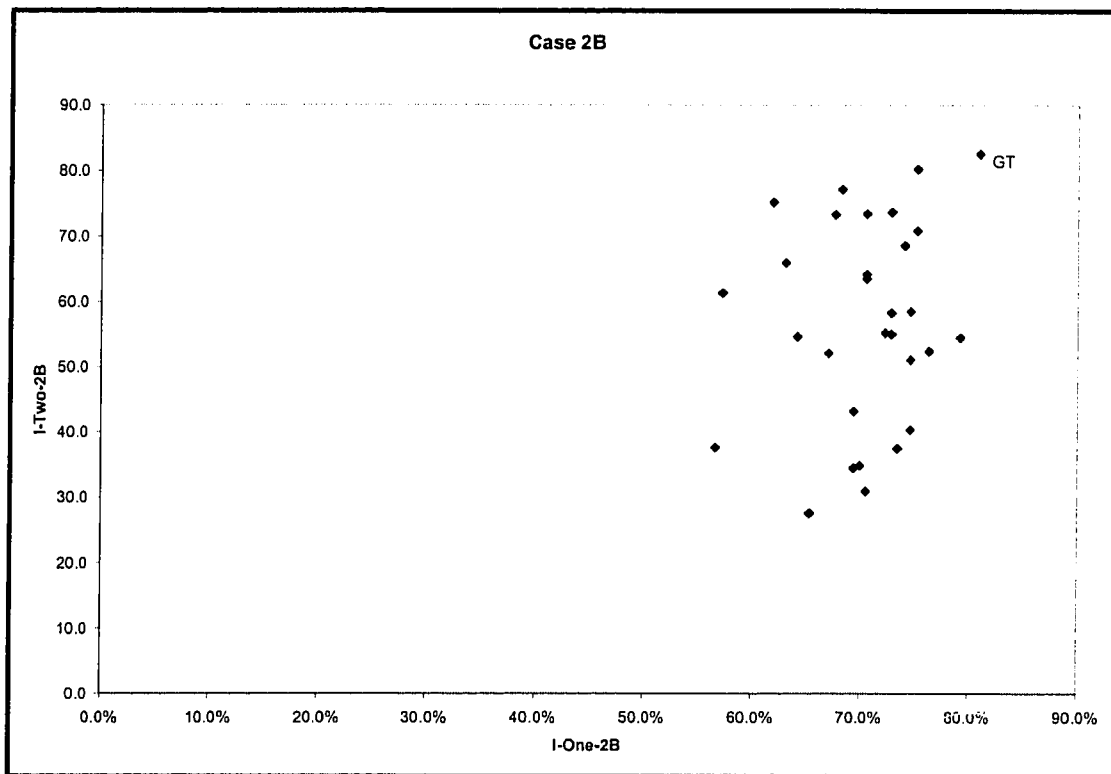
In these calculations, it is assumed that $z = 1$. The figures below plot $I_1(\kappa)$ and $I_2(\kappa)$ with additional restrictions as specified below.

In Figure [4.1] for case 2A, with additional restrictions: $n[U_i] > 40; n[D_i] > 40$, the candidates for the singular pivot are: BO, ID, IN, and GT. The additional restrictions imply that the pivot countries must be dominated by at least 40 countries and they must also dominate more than 40 countries.

Figure [4.1]: Case 2A

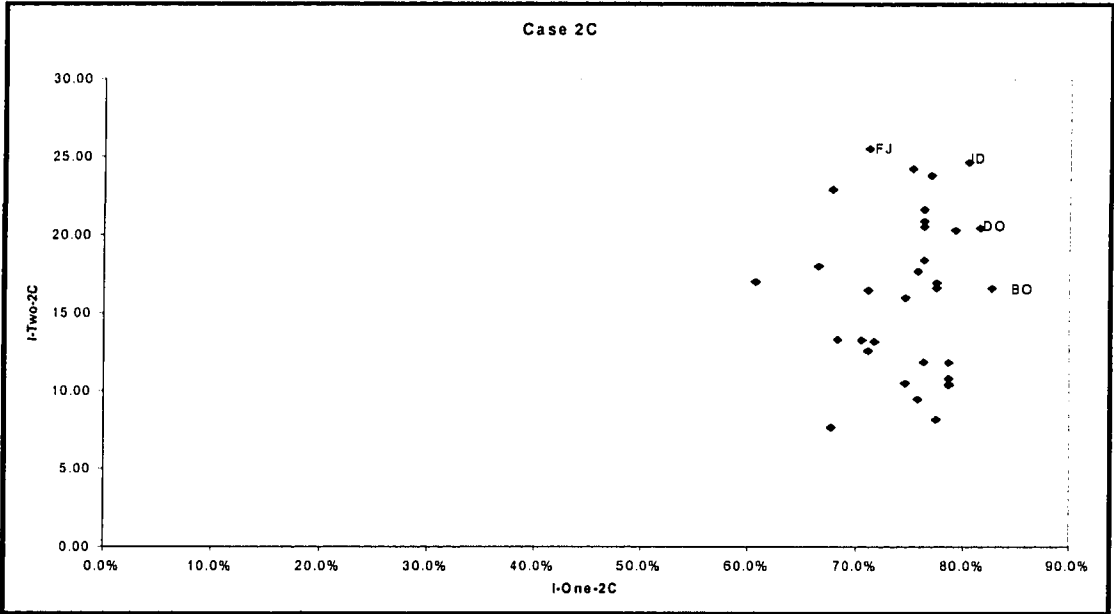


In Figure [4.2] for case 2B, with additional restrictions: $n[U_i] > 40$; $n[D_i] > 40$, there is only one candidate for the singular pivot: GT. The additional restrictions imply that the pivot countries must be dominated by at least 40 countries and they must also dominate more than 40 countries.



Figure[4.2]: Case 2B

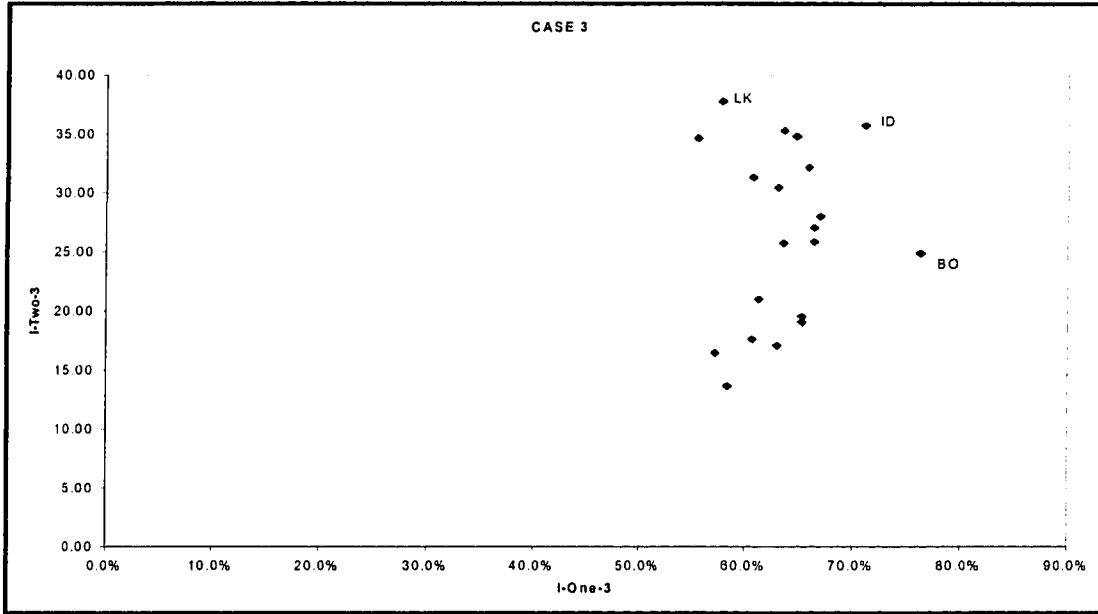
In Figure [4.3] for Case 2C, with additional restrictions: $n[U_i] > 40$; $n[D_i] > 40$, the candidates for the singular pivot are: BO, DO, FJ, and ID. The additional restrictions



imply that the pivot countries must be dominated by at least 40 countries and they must also dominate more than 40 countries.

Figure [4.3]: Case 2C

In Figure [4.4] for Case 3, with additional restrictions: $n[U_i] > 40$; $n[D_i] > 40$, the candidates for the singular pivot are: BO, ID, and LK. The additional restrictions



imply that the pivot countries must be dominated by at least 40 countries and they must also dominate more than 40 countries.

Figure [4.4]: Case 3

As shown in Section III, each pivot maps to: a set of dominating countries, a set of dominated countries, and a set of countries that are neither dominating nor dominated. Table [8] (in Appendix 3) provides the list of these sets of countries for the candidate pivots in each of above cases. Table [9] (in Appendix 3) gives the Γ_1^T, Γ_2^T statistics associated with various dimensions for each of the chosen pivots.

$I_1(\kappa)$ statistics for $\kappa > 3$ are also provided in Appendix 3.

Class I, Class II, and Class III: A Multi-layered Classification of the World

Using a pivot set consisting of multiple pivots (two pivots) one can obtain multi-layered (three-layered) divisions of the world. Here $I_1(\kappa; \Psi)$ and $I_2(\kappa; \Psi)$ for three-layered divisions of the world based on a pivot set consisting of two pivots are obtained as follows:

$$I_1(\kappa; \Psi) = \frac{n[U_1] + n[D_1 \cap U_2] + n[D_2]}{N}; \text{ and } I_2(\kappa; \Psi) = \left[\frac{1}{2}(I_2^1)^\eta + \frac{1}{2}(I_2^2)^\eta \right]^{\frac{1}{\eta}}.$$

In calculations undertaken here let the constant elasticity of substitution $\eta = 0.7$.

This means that elasticity of substitution among I_2 is held constant at 70 percent.

The pivot sets for the cases considered are provided below. The pivot sets are selected on the basis of their information statistics. In the pivot set, the first pivot dominates the second pivot. The first pivot is dominated by Class I countries and it dominates Class II countries. The second pivot is dominated by Class I and Class II countries, and it dominates Class III countries.

For Case 2A, the candidates for the pivot set which are as follows: (CR, KH), and (AR, SD).

For Case 2B, there is only one candidate for the pivot set, which is as follows: (MX, SD).

For Case 2C, there is only one candidate for the pivot set, which is as follows:

(LC, ZA)

For Case 3, the candidates for the pivot set are as follows: (KR, JO), and (CY, AL).

Here each pivot set maps into: a set of Class I countries, a set of Class II countries, a set of Class III, and a set of countries that belongs to none of the above classes of countries. Table [10] (in Appendix 3) provides the list of these sets of countries for the candidate pivot sets in each of the above cases.

Issues in Implementation

The ranking and the grouping of countries will depend on the application of the choice of the functional form used in constituting $I_2(\kappa; \Psi)$, the quality and the availability of data, and the choice of indicators. The choice of the function form used may depend on both the evaluator's values and perceptions, and the scope and limits of the data available. However, once these are decided upon, the results obtained will be quite unambiguous. The results obtained through the implementation of the methodology developed in the essay may often be at variance with one's prior knowledge and beliefs about the world. In case the results are counter-intuitive and particularly if they seem to lack any economic foundation, the

evaluator may have to re-examine her choice of functional forms, data, indicators, and parameters.⁶ Following Rawls' (1971) use of "reflective equilibrium," which he deploys in ethics and political philosophy, an iterative process may be necessary in order to obtain satisfactory and tenable results in ranking and grouping countries. In this aspect the present methodology is not altogether different from other empirical exercises in economics and social analysis that often require iterations and feedbacks to secure reliable and credible results.

A List of Parameters

The parameters used in the construction of information statistics are as follows:

$\alpha_i > 0$ represents the value that the evaluator assigns to the welfare trade-off among indicators.

$\beta_i > 0$ represents the value that the evaluator assigns to the description of different indicators.

Note that $\sum_i \alpha_i \beta_i = 1$.

⁶ Noam Chomsky (1975, p.7) observes:

"Our systems of belief are those that the mind, as a biological structure, is designed to construct. We interpret experience as we do because of special mental design. We attain knowledge when the 'inward ideas of the mind itself' and the structures it creates conform to the nature of things."

$a > 0, b > 0, c > 0, \dots$ are parameters.

$z > 0$ is a parameter that transforms the ratio of a given dimension between a dominating country and a dominated country.

$\varpi > 0$ is the efficiency parameter in the multi-layered I_2 .

$\varsigma_1 > 0, \varsigma_2 > 0, \dots, \varsigma_{L-1} > 0$ which are distribution parameters in the multi-layered I_2 .

Note that $\varsigma_1 + \varsigma_2 + \dots + \varsigma_{L-1} = 1$.

$\eta \in (-\infty, 1]$ is constant elasticity of substitution in the multi-layered I_2 .

Note that the parameters are *not* related to one another in any way unless noted above. The specific values chosen for the parameters in the exercise carried out depends on the evaluator's prior beliefs and knowledge, the quality of available data, and the task at hand.

SECTION V: APPLICATIONS

The methodology developed here to rank and group countries may be applied to address economic policy questions.

Ranking Countries without Per Capita Real Income Data

The international PPP-adjusted estimates of each country's per capita real income are subject to a variety of problems and errors. Ravallion (2003) acknowledges that dramatically differing positions taken in globalization and poverty debates often stem from the differences in the concepts and the definitions used and from the differences in the data sources and the measurement assumptions. There are clear problems and difficulties with the current measures and methodologies of PPP-adjusted estimates of per capita real income.

Per capita real income is widely used for comparing countries. The data on PPP-adjusted per capita real income are used to classify countries and to determine whether a country is eligible for World Bank's International Development Association "soft" loans and/or HIPC debt forgiveness. Given the controversies and problems with per capita real income data, it may be useful to try to rank countries on the basis of other indicators provided these are more reliable and less contested. Examining intersection partial orderings and vector dominance among countries would be a step in the direction of making the

capability approach operational in ranking countries. This is particularly useful when the data on per capita real income is questionable and effectively fails to be an operational metric for weighting commodities (cf. Sugden 1993 and Srinivasan 1994). The need for using information on functionings and other features of human life and individual advantage becomes more pressing when data on comparative per capita real income are inadequate.

In this section, Hasse diagrams of countries are provided to show dominance relationships among countries without relying on per capita real income.

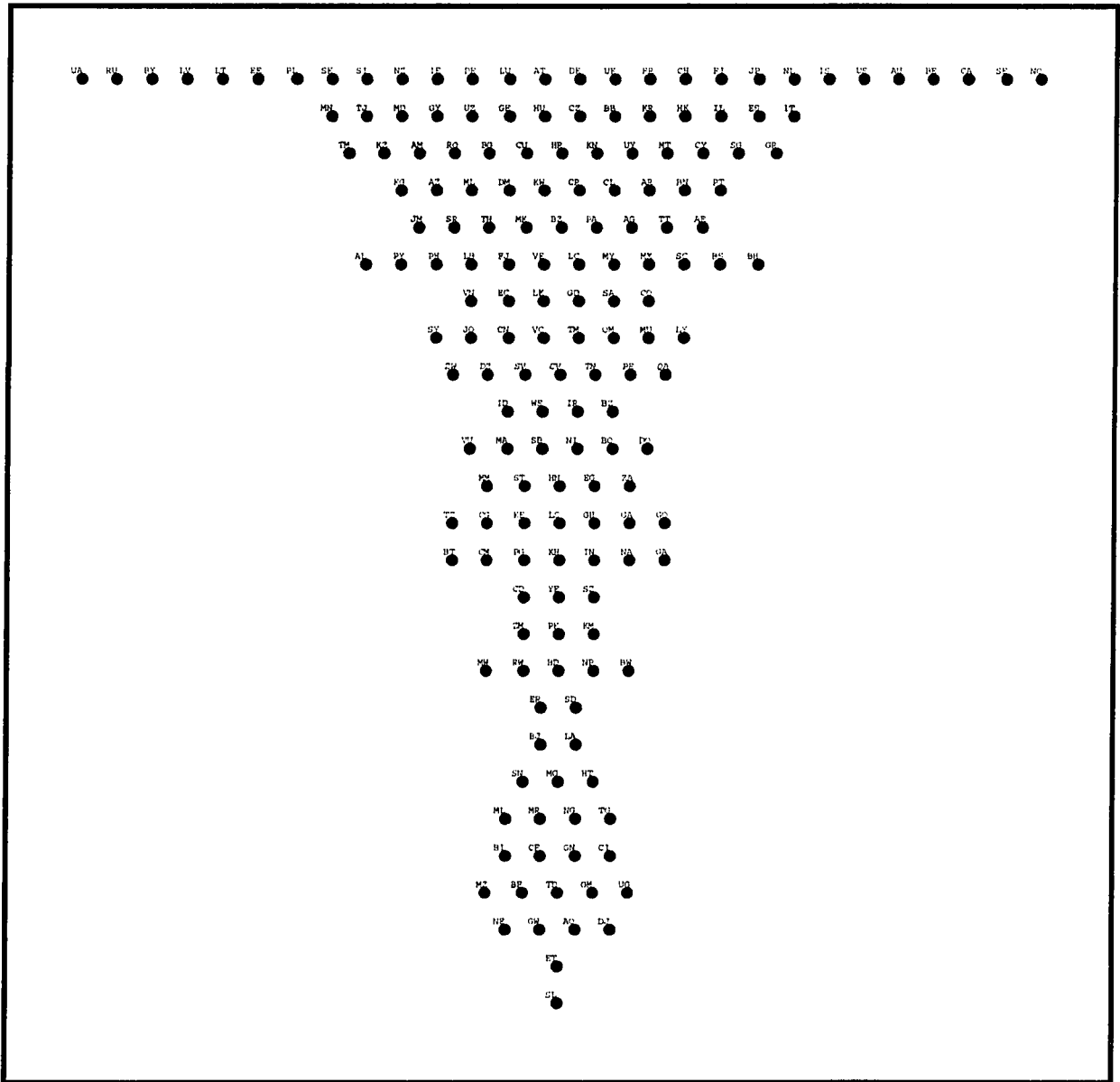


Figure [5.1]: Hasse diagram with $>$ and the following *two* dimensions: life expectancy and adult literacy. Countries fall into 26 tiers. The *maximal elements* are: AU, AT, BE, BY, CA, CH, DE, DK, EE, FI, FR, IE, IS, JP, LT, LU, LV, NL, NO, NZ, PL, RU, SE, SI, SK, UA, UK, and US; and the *minimal elements* are: MZ, NE, and SL.

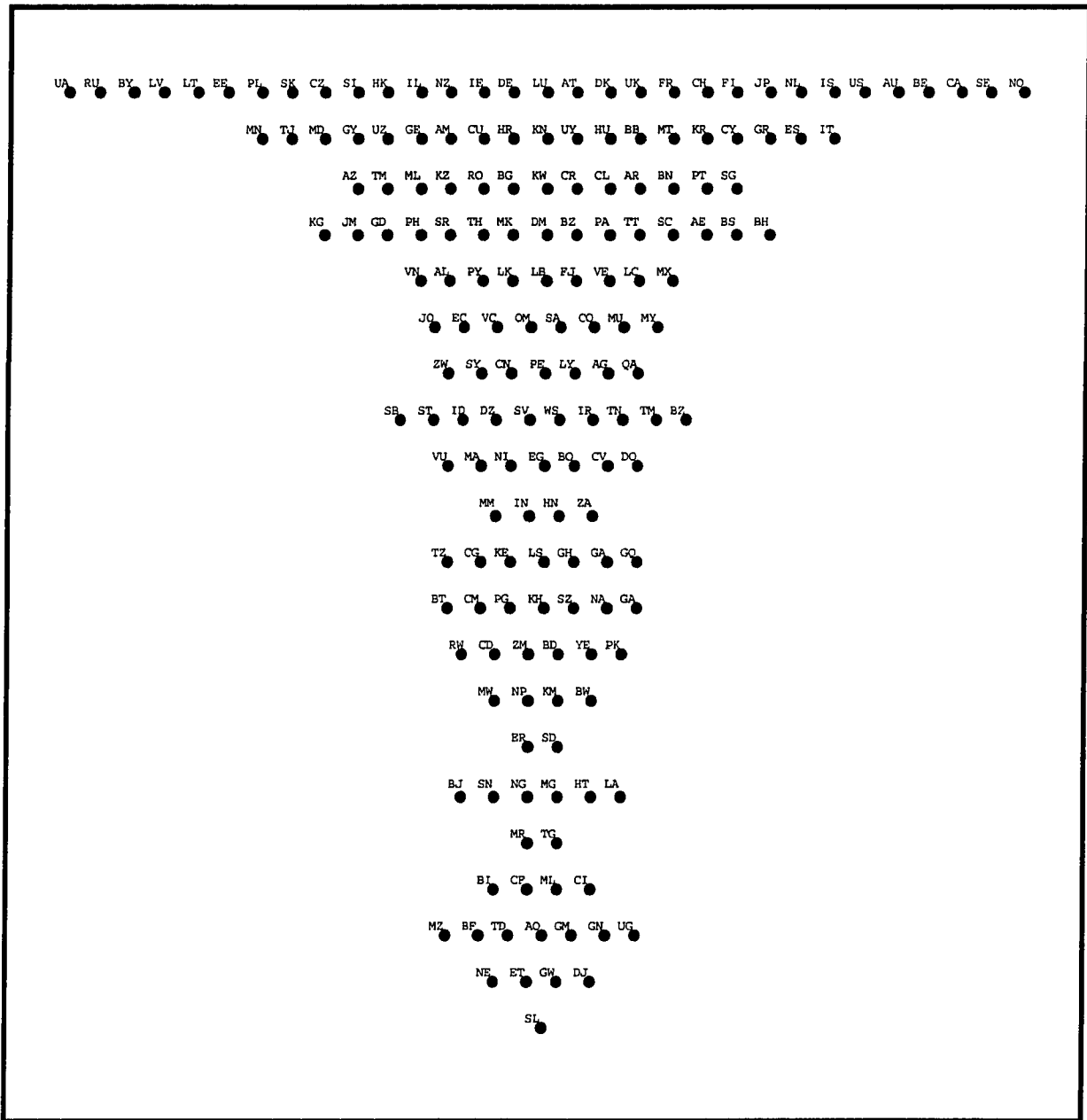


Figure [5.2]: Hasse diagram with $>$ and the following *three* dimensions: life expectancy (male); life expectancy (female); and adult literacy. Countries fall into 21 tiers. The *maximal elements* are: AT, AU, BE, BY, CA, CH, CZ, DE, DK, EE, FI, FR, HK, IE, IL, IS, JP, LT, LU, LV, NL, NO, NZ, PL, RU, SE, SI, SK, UA, UK, and US; and the *minimal elements* are: MZ, NE, and SL.

Additional Hasse diagrams without per capita real income data are given in Appendix 3.

SECTION VI: FURTHER RESEARCH

This section identifies several areas of research for the future.

Cluster Analysis

It may be useful to apply the techniques of cluster analysis (Everitt 2001; Gordon 1980; Pillar 1999; and Stuetzle 1995) to organize information about various dimensions of countries so that relatively homogenous groups, or “clusters,” can be formed. The clusters formed with this family of methods would be highly *homogenous internally* (members are similar to one another) and highly *heterogeneous externally* (members are not like members of other clusters). Visualizing clusters, measurements of proximity, and hierarchical clustering using the techniques developed in cluster analysis may prove helpful. It may be useful to examine whether the classification produced under the methodology developed here conforms to the clusters that result from the application of the techniques of cluster analysis.

Globalization and Openness

The method developed here could be extended to analyze globalization and openness of countries by looking at vector dominance and intersection partial orderings among the following dimensions: (i) trade as share of GDP, (ii)

foreign direct investment as a share of GDP, (iii) portfolio investment as a share of GDP, (iv) income payments and receipts as a share of GDP, (v) cross-border transfer payments as a share of GDP; and so forth. Other dimensions, such as the share of foreign capital in a nation's capital stock, foreign-born workers as a share of total labor force, the number of immigrants in the population, and so on, may also be considered.

Inequality Measures

One may use intersection partial ordering analysis with inequality measures, such as: (i) share of income of the richest 10 percent to the poorest 10 percent, (ii) share of income of the richest 20 percent to the poorest 20 percent, and (iii) Gini index. This would complement the recent literature on inequality, such as Fields (2001).

Additional Dimensions

This research could be extended to examine intersection partial orderings and vector dominance among countries by incorporating more development indicators as shown in Table [11] (in Appendix 3).

SECTION VII: SUMMARY AND CONCLUSION

This essay has used intersection partial orderings to investigate the ranking and the grouping of countries based on social and economic indicators. It presented Hasse diagrams of countries. It outlined a methodology and

conceptual framework for ranking and grouping countries. It provided information statistics about the set of dominating countries and the set of dominated countries of the world. Some applications of the methodology presented here are provided. The essay has shown that some countries vector dominate others over a range of dimensions. A set of “pivot” countries that divide the world into sets of dominating countries, dominated countries, and neither dominating nor dominated countries are identified on the basis of the estimated information statistics. The hierarchical structure among countries without the use of per capita real income data is also displayed. The essay also identified areas of research and inquiry, and thereby suggested further possible applications of the partial ordering approach to ranking and grouping countries.

This essay has examined the dominance relationship among countries for various key indicators related to social and economic achievements and human development. The extension of analysis beyond single indicators, such as per capita real income, provides a far more encompassing and comprehensive perspective on the rankings and the grouping of countries in selected dimensions. Considering the ranking and the grouping of countries as a partial ordering exercise has certain merits from both descriptive and policy perspectives. Empirical investigations, such as the one undertaken here, provide some useful insights on where countries stand in relationship to other countries

vis-à-vis social and economic achievements, what are the broad “clusters” of countries, and how far one set of countries is from another set of countries. For policy issues, analysis of partial orderings and vector dominance may induce one to investigate not only what the overall global, regional and group trends are but also which specific history and policy interventions may cause a set of countries to substantially deviate from the norm in certain aspects of their achievements as well as their failures. This can also be a topic for future research.

Appendix 1: Foundational Concepts

This Appendix provides a brief overview of some concepts used in this essay. It can be skipped by a reader already familiar with these elementary concepts, which can be found in any introductory textbook on discrete mathematics.

For two sets X and Y , the Cartesian product $X \times Y$ is the set of all ordered pairs formed by an element of X and an element of Y . Hence,

$$X \times Y = \{(x, y) : x \in X, y \in Y\}$$

Sets whose elements can be ranked are known as *ordered sets*. Various kinds of ordered set are used for understanding aspects of economy and society.

A *relationship* $R : X \rightarrow Y$ is subset R of $X \times Y$, that is, $R \subseteq X \times Y$. Given two relations P and Q defined on the product set $X \times Y$, P is a *sub-relation* of Q if $P \subseteq Q$ or equivalently if $xPy \Rightarrow xQy$. Let $R : X \rightarrow Y$ and $V : Y \rightarrow Z$. Their composite $R \circ V : X \rightarrow Z$ is as follows: $R \circ V = \{(x, z) : \exists y \in Y : (x, y) \in R, (y, z) \in V\}$.

Let S be any set and let R be a *binary relation* on S . If $\forall s \in S, sRs$ then R is *reflexive*. If sRt implies that tRs , then R is *symmetric*. If sRt and tRs implies $s = t$, then R is *anti-symmetric*. If sRt implies $\neg(tRs)$ then R is *asymmetric*. If sRt, tRs , or both then R is *complete*. If sRt and tRu implies sRu , then R is *transitive*.

Note that $R \subset S$. Hence, the previous properties can be expressed in terms of ordered pairs. *Reflexive* means that $\forall s \in S, (s, s) \in R$. *Symmetric* means that $(s, t) \in R$ implies that $(t, s) \in R$. *Anti-symmetric* means that $(s, t) \in R$ and $(t, s) \in R$ implies that $(s, s) \in R$. *Asymmetric* means that $(s, t) \in R$ implies that $(t, s) \notin R$. *Complete* means that either $(s, t) \in R$, $(t, s) \in R$, or both. *Transitive* means that $(s, t) \in R$ and $(t, u) \in R$ implies that $(s, u) \in R$.

Let S be any set. An *equivalence relation* on S means a relation that is *reflexive, symmetric, and transitive*. If two elements, s and t , of S are related by an equivalence relation, then s and t are *equivalent* and this is expressed by $s \equiv t$.

Let R be an *equivalence relation* on a set S . Let s be an element of S . By the *equivalence class* of s , denoted $[s]$, it is meant that $\{x \in S | x \equiv s\}$. Let T be any set. *Partition* of T means that it is a collection, Γ , of non-empty sets $\{T_i\}$ such that $\bigcup T_i = T$ and $T_i \cap T_j = \emptyset$.

A set S can be partitioned into classes by using an equivalence relation R as a criterion for assigning two elements into the same class. Conversely every partition of a set defines an equivalence relation on it.

A binary relation R is a *partial pre-order* defined on a set S if it is *reflexive* and *transitive*, that is, if $\forall s, t, u \in S, sRt$ and $[(sRt, tRu) \Rightarrow sRu]$.

R is a *partial order* if R is *reflexive*, *transitive*, and *anti-symmetric*. If R is a *partial order* on S , then $\langle S, R \rangle$ is said to be a *partially ordered set* or a *poset*.

A relation that is *partially ordered* is denoted by \prec . Thus, the notation $\langle S, \prec \rangle$ is used to denote a *partially ordered set* where S is the set and \prec is a *partial order* on S .

If S is a *partially ordered set* and for two elements s and t of S , either $s \prec t$ or $t \prec s$, then s and t are *comparable*. A relationship R is a *complete order* if it satisfies the above three properties of *partial order* and in addition is *comparable*.

A *lattice* $L(\wedge, \vee)$ is a *partially ordered set* in which every pair of elements have a *least upper bound* and a *greatest lower bound*. If x and y are any two elements in a *lattice*, their *least upper bound*, denoted $x \wedge y$, is an element of the *lattice* which is called the *joint* of x and y . Their *greatest lower bound*, denoted $x \vee y$, is called their *meet*.

A *Hasse diagram* is a graphical rendition of a *partially ordered set*. A vertex is drawn for each element of the *partially ordered set* and line segments (called *edges*) are drawn between these vertices according to the following two rules: (i) if $a < b$ in the *partially ordered set* then the vertex corresponding to a appears lower in the drawing than the vertex corresponding to b ; and (ii) the edge

between the vertices corresponding to any two elements a and b of the *partially ordered set* is included in the figure if and only if a covers b or b covers a .

Appendix 2: Code to generate Hasse Diagrams in *Mathematica* with *Combinatorica*

The *Mathematica* code provided below was developed with substantial assistance of Levon Lloyd of Combinatorica.com for this essay. The code can be used to create a wide range of Hasse Diagrams for many different purposes.

Preparing the Data

- 1) The data in Microsoft Excel should be formatted as numbers so that (a) these numbers do not appear with commas and (b) negative numbers are shown as $-X$ instead of (X) .
- 2) The Excel file should be saved as a Comma Separated Values (CSV) file.

Code for Creating Hasse Diagrams in Mathematica with Combinatorica

The following code should be applied within *Mathematica*. Comments and explanation are provided in italics.

- 1) `<< DiscreteMath`Combinatorica`` *See Skiena and Pemmaraju (2003).*
- 2) `data=Drop[Import["a:\file.csv"], 1]` *This imports the data and gets rid of the header row.*
- 3) `g = MakeGraph[data, (#1!= #2 && Apply[And, Table[#1[[x]] >= #2[[x]], {x, 2, Length[#1]}]]) &]` *This builds the graph based on the partial order.*
- 4) `h = HasseDiagram[g]` *This builds the Hasse Diagram. This step may take a long time even in the most powerful machine.*

- 5) `h = SetGraphOptions[h, VertexStyle -> Disk[Small]]`
- 6) `h = SetGraphOptions[h, EdgeColor -> Gray]`
- 7) `h = RotateVertices[h, Pi]`
- 8) `h = SetVertexLabels[h, Table[data[[x,1]], {x, 1, Length[data]}]]` *This adds the labels to the nodes.*
- 9) `ShowGraph[h, TextStyle -> {FontSize -> 4}, VertexLabelPosition -> {0.01, 0.01}, EdgeStyle -> Thin, EdgeColor -> Gray]` *This displays the new graph.*

Additional codes to export the graph in Microsoft Office:

- 10) `Export["a:\file.wmf", ShowGraph[h], "WMF"]`

This saves the graph to a file that one can import into Microsoft Office programs.

`Export["a:\filename.wmf", ShowGraph[g, TextStyle -> {FontSize -> 4}, VertexLabelPosition -> {0.01, 0.01}, EdgeStyle -> Thin], "WMF"]` *This saves the graph to a file that one can import into Microsoft Office programs.*

Appendix 3: Tables, Additional Hasse Diagrams and Further Analysis of Information Statistics

Tables

The first section of this appendix gives tables providing data related to the essay, the second section provides additional Hasse Diagrams, and the third section provides information statistics, $I_1(\kappa) \forall \kappa > 3$.

Table 1A							
List of Countries and their Abbreviations							
Albania	AL	Ethiopia	ET	Morocco	MA	Turkmenistan	TM
Algeria	DZ	Fiji	FJ	Mozambique	MZ	Uganda	UG
Angola	AO	Finland	FI	Myanmar	MM	Ukraine	UA
Antigua & Barbuda	AG	France	FR	Namibia	NA	United Arab Emirates	AE
Argentina	AR	Gabon	GA	Nepal	NP	United Kingdom	UK
Armenia	AM	Gambia	GM	Netherlands	NL	United States	US
Australia	AU	Georgia	GE	New Zealand	NZ	Uruguay	UY
Austria	AT	Germany	DE	Nicaragua	NI	Uzbekistan	UZ
Azerbaijan	AZ	Ghana	GH	Niger	NE	Vanuatu	VU
Bahamas	BS	Greece	GR	Nigeria	NG	Venezuela	VE
Bahrain	BH	Grenada	GD	Norway	NO	Viet Nam	VN
Bangladesh	BD	Guatemala	GT	Oman	OM	Yemen	YE
Barbados	BB	Guinea	GN	Pakistan	PK	Zambia	ZM
Belarus	BY	Guinea-Bissau	GW	Panama	PA	Zimbabwe	ZW
Belgium	BE	Guyana	GY	Papua New Guinea	PG		
Belize	BZ	Haiti	HT	Paraguay	PY		
Benin	BJ	Honduras	HN	Peru	PE		
Bhutan	BT	Hong Kong, China (SAR)	HK	Philippines	PH		
Bolivia	BO	Hungary	HU	Poland	PL		
Botswana	BW	Iceland	IS	Portugal	PT		
Brazil	BR	India	IN	Qatar	QA		
Brunei Darussalam	BN	Indonesia	ID	Romania	RO		
Bulgaria	BG	Iran, Islamic Rep.	IR	Russian Federation	RU		
Burkina Faso	BF	Ireland	IE	Rwanda	RW		
Burundi	BI	Israel	IL	Saint Kitts & Nevis	KN		
Cambodia	KH	Italy	IT	Saint Lucia	LC		
Cameroon	CM	Jamaica	JM	Samoa (Western)	WS		
Canada	CA	Japan	JP	Sao Tome & Principe	ST		
Cape Verde	CV	Jordan	JO	Saudi Arabia	SA		
Central African Republic	CF	Kazakhstan	KZ	Senegal	SN		
Chad	TD	Kenya	KE	Seychelles	SC		
Chile	CL	Korea, Rep.	KR	Sierra Leone	SL		
China	CN	Krygzstan	KG	Singapore	SG		
Colombia	CO	Kuwait	KW	Slovakia	SK		
Comoros	KM	Lao PDR	LA	Slovenia	SI		
Congo	CG	Lativia	LV	Solomon Islands	SB		
Congo, Dem. Rep.	CD	Lebanon	LB	South Africa	ZA		
Costa Rica	CR	Lesotho	LS	Spain	ES		
Cote d'Ivoire	CI	Libyan Arab Jamahiriya	LY	Sri Lanka	LK		
Croatia	HR	Lithuania	LT	St. Vincent & the Grenadines	VC		
Cuba	CU	Luxembourg	LU	Sudan	SD		
Cyprus	CY	Macedonia, TFYR	MK	Suriname	SR		
Czech Republic	CZ	Madagascar	MG	Swaziland	SZ		
Denmark	DK	Malawi	MW	Sweden	SE		
Djibouti	DJ	Malaysia	MY	Switzerland	CH		
Dominican Republic	DO	Maldives	MV	Syrian Arab Republic	SY		
Dominica	DM	Mali	ML	Tajikistan	TJ		
Ecuador	EC	Malta	MT	Tanzania, U. Rep.	TZ		
Egypt	EG	Mauritania	MR	Thailand	TH		
El Salvador	SV	Mauritius	MU	Togo	TG		
Equatorial Guinea	GQ	Mexico	MX	Trinidad & Tobago	TT		
Eritrea	ER	Moldova, Rep.	MD	Tunisia	TN		
Estonia	EE	Mongolia	MN	Turkey	TK		

Source: International Organization for Standardization

Table 1B

List of Country Abbreviations and Countries

AE	United Arab Emirates	ES	Spain	MG	Madagascar	TG	Togo
AG	Antigua & Barbuda	ET	Ethiopia	MK	Macedonia, TFYR	TH	Thailand
AL	Albania	FI	Finland	ML	Mali	TJ	Tajikistan
AM	Armenia	FJ	Fiji	MM	Myanmar	TK	Turkey
AO	Angola	FR	France	MN	Mongolia	TM	Turkmenistan
AR	Argentina	GA	Gabon	MR	Mauritania	TN	Tunisia
AT	Austria	GD	Grenada	MT	Malta	TT	Trinidad & Tobago
AU	Australia	GE	Georgia	MU	Mauritius	TZ	Tanzania, U. Rep.
AZ	Azerbaijan	GH	Ghana	MV	Maldives	UA	Ukraine
BB	Barbados	GM	Gambia	MW	Malawi	UG	Uganda
BD	Bangladesh	GN	Guinea	MX	Mexico	UK	United Kingdom
BE	Belgium	GQ	Equatorial Guinea	MY	Malaysia	US	United States
BF	Burkina Faso	GR	Greece	MZ	Mozambique	UY	Uruguay
BG	Bulgaria	GT	Guatemala	NA	Namibia	UZ	Uzbekistan
BH	Bahrain	GW	Guinea-Bissau	NE	Niger	VC	St. Vincent & the Grenadines
BI	Burundi	GY	Guyana	NG	Nigeria	VE	Venezuela
BJ	Benin	HK	Hong Kong, China (SAR)	NI	Nicaragua	VN	Viet Nam
BN	Brunei Darussalam	HN	Honduras	NL	Netherlands	VU	Vanuatu
BO	Bolivia	HR	Croatia	NO	Norway	WS	Samoa (Western)
BR	Brazil	HT	Haiti	NP	Nepal	YE	Yemen
BS	Bahamas	HU	Hungary	NZ	New Zealand	ZA	South Africa
BT	Bhutan	ID	Indonesia	OM	Oman	ZM	Zambia
BW	Botswana	IE	Ireland	PA	Panama	ZW	Zimbabwe
BY	Belarus	IL	Israel	PE	Peru		
BZ	Belize	IN	India	PG	Papua New Guinea		
CA	Canada	IR	Iran, Islamic Rep.	PH	Philippines		
CD	Congo, Dem. Rep.	IS	Iceland	PK	Pakistan		
CF	Central African Republic	IT	Italy	PL	Poland		
CG	Congo	JM	Jamaica	PT	Portugal		
CH	Switzerland	JO	Jordan	PY	Paraguay		
CI	Cote d'Ivoire	JP	Japan	QA	Qatar		
CL	Chile	KE	Kenya	RO	Romania		
CM	Cameroon	KG	Kyrgyzstan	RU	Russian Federation		
CN	China	KH	Cambodia	RW	Rwanda		
CO	Colombia	KM	Comoros	SA	Saudi Arabia		
CR	Costa Rica	KN	Saint Kitts & Nevis	SB	Solomon Islands		
CU	Cuba	KR	Korea, Rep.	SC	Seychelles		
CV	Cape Verde	KW	Kuwait	SD	Sudan		
CY	Cyprus	KZ	Kazakhstan	SE	Sweden		
CZ	Czech Republic	LA	Lao PDR	SG	Singapore		
DE	Germany	LB	Lebanon	SI	Slovenia		
DJ	Djibouti	LC	Saint Lucia	SK	Slovakia		
DK	Denmark	LK	Sri Lanka	SL	Sierra Leone		
DM	Dominica	LS	Lesotho	SN	Senegal		
DO	Dominican Republic	LT	Lithuania	SR	Suriname		
DZ	Algeria	LU	Luxembourg	ST	Sao Tome & Principe		
EC	Ecuador	LV	Latvia	SV	El Salvador		
EE	Estonia	LY	Libyan Arab Jamahiriya	SY	Syrian Arab Republic		
EG	Egypt	MA	Morocco	SZ	Swaziland		
ER	Eritrea	MD	Moldova, Rep.	TD	Chad		

Source: International Organization for Standardization

Table 2								
Summary Statistics								
Statistic	GDP per capita PPP-adjusted	Life Expectancy (male)	Life expectancy (female)	Adult Literacy	Combined Primary Secondary & Tertiary Gross Enrollment Ratio	Infant with Low Birth weight	Infant Mortality Rate	Probability at Birth of Surviving to Age 65, female
Abbreviation	GDP PC	LE(M)	LE (F)	LIT	ENROLL	BIRTH WT	MORT	SURV (F)
Units	PPP US\$ 2000	years 2000	(years) 2000	(% age > or =15)	(%) 1999	(%) 1995-2000	(per 1000 birth) 2000	(% cohort) 1995- 2000
Mean	8,506	63	68	81	66	12	44	70
Median	4,952	67	72	88	70	8	27	76
Std. Dev.	8,969	11	12	20	20	9	40	19
Maximum	50,061	77	84	100	116	57	180	92
Minimum	490	38	40	16	16	3	3	23

Source: UNDP, Human Development Report, various years; Author's calculations

Table 3								
Matrix of Rank Correlations								
	INC	LE (F)	LE (M)	LIT	MORT	B WT	SURV (F)	ENROLL
INC	1.00	0.83	0.81	0.69	-0.84	-0.53	0.84	0.77
LE (F)	0.83	1.00	0.95	0.78	-0.90	-0.58	0.98	0.74
LE (M)	0.81	0.95	1.00	0.66	-0.87	-0.53	0.95	0.67
LIT	0.69	0.78	0.66	1.00	-0.78	-0.62	0.76	0.78
MORT	-0.84	-0.90	-0.87	-0.78	1.00	0.67	-0.89	-0.71
B WT	-0.53	-0.58	-0.53	-0.62	0.67	1.00	-0.57	-0.52
SURV (F)	0.84	0.98	0.95	0.76	-0.89	-0.57	1.00	0.71
ENROLL	0.77	0.74	0.67	0.78	-0.71	-0.52	0.71	1.00

Source: UNDP and author's calculations

Table 4								
Matrix of Correlations								
	INCOME	LE (F)	LE (M)	LIT	MORT	B WT	SURV (F)	ENROLL
INCOME	1.00	0.62	0.63	0.53	-0.62	-0.40	0.61	0.65
LE (F)	0.62	1.00	0.98	0.77	-0.92	-0.64	0.99	0.75
LE (M)	0.63	0.98	1.00	0.73	-0.91	-0.63	0.97	0.72
LIT	0.53	0.77	0.73	1.00	-0.80	-0.64	0.77	0.80
MORT	-0.62	-0.92	-0.91	-0.80	1.00	0.65	-0.91	-0.78
B WT	-0.38	-0.64	-0.63	-0.64	0.65	1.00	-0.64	-0.60
SURV (F)	0.61	0.99	0.97	0.77	-0.91	-0.64	1.00	0.74
ENROLL	0.65	0.75	0.72	0.80	-0.78	-0.60	0.74	1.00

Source: UNDP and author's calculations

LU	50,061	CL	9,417	TM	3,956	NP	1,327
US	34,142	ZA	9,401	GT	3,821	UG	1,208
NO	29,918	MY	9,068	UA	3,816	CF	1,172
IE	29,866	PL	9,051	SR	3,799	TJ	1,152
IS	29,581	UY	9,035	JM	3,639	MM	1,027
CH	28,769	MX	9,023	EG	3,635	KE	1,022
CA	27,840	TT	8,964	SY	3,556	BJ	990
DK	27,627	CR	8,650	MA	3,546	BF	976
BE	27,178	RU	8,377	LK	3,530	RW	943
AT	26,765	HR	8,091	AL	3,506	NG	896
JP	26,755	BZ	7,625	EC	3,203	YE	893
AU	25,693	GD	7,580	ID	3,043	TD	871
NL	25,657	LY	7,570	AZ	2,936	MZ	854
HK	25,153	BY	7,544	VU	2,802	MG	840
DE	25,103	BW	7,184	KG	2,711	ER	837
FI	24,996	LT	7,106	GE	2,664	CG	825
SE	24,277	LV	7,045	ZW	2,635	ML	797
FR	24,223	TK	6,974	AM	2,559	ZM	780
IT	23,626	NA	6,431	HN	2,453	CD	765
UK	23,509	RO	6,423	UZ	2,441	GW	755
SG	23,356	TH	6,402	BO	2,424	NE	746
CY	20,824	TN	6,363	DJ	2,377	ET	668
IL	20,131	CO	6,248	NI	2,366	MW	615
NZ	20,070	GA	6,237	IN	2,358	BI	591
ES	19,472	DO	6,033	PG	2,280	TZ	523
QA	18,789	PA	6,000	AO	2,187	SL	490
AE	17,935	IR	5,884	MD	2,109		
KR	17,380	DM	5,880	LS	2,031		
SI	17,367	KZ	5,871	VN	1,996		
PT	17,290	VE	5,794	GN	1,982		
MT	17,273	BG	5,710	GH	1,964		
BS	17,012	LC	5,703	PK	1,928		
BN	16,779	BZ	5,606	CU	1,800		
GR	16,501	VC	5,555	SD	1,797		
KW	15,799	DZ	5,308	ST	1,792		
BB	15,494	MK	5,086	MN	1,783		
BH	15,084	WS	5,041	CM	1,703		
GQ	15,073	CV	4,863	MR	1,677		
CZ	13,991	PE	4,799	GM	1,649		
OM	13,356	FJ	4,668	SB	1,648		
KN	12,510	SV	4,497	CI	1,630		
SC	12,508	SZ	4,492	BD	1,602		
HU	12,416	MV	4,485	KM	1,588		
AR	12,377	PY	4,426	LA	1,575		
SA	11,367	LB	4,308	SN	1,510		
SK	11,243	CN	3,976	HT	1,467		
AG	10,541	PH	3,971	KH	1,446		
EE	10,066	JO	3,966	TG	1,442		
MU	10,017	GY	3,963	BT	1,412		

Source: UNDP

Table 6							
Countries listed by descending life expectancy (in years), 2000							
JP	81	SC	73	KG	68	TZ	51
SE	80	MX	73	VN	68	CD	51
HK	80	MY	73	TJ	68	CM	50
NO	79	DM	73	NI	68	CI	48
CA	79	MK	73	SB	68	GN	48
AU	79	LC	73	MA	68	BF	47
IS	79	VE	73	VU	68	LS	46
CH	79	LB	73	MV	67	GM	46
FR	79	AM	73	DO	67	TD	46
IT	79	GE	73	MD	67	NA	45
ES	79	AL	73	EG	67	AO	45
IL	79	LT	72	RU	66	GW	45
BE	78	SA	72	TM	66	NE	45
NL	78	AZ	72	ID	66	SZ	44
FI	78	LK	72	HN	66	UG	44
UK	78	HU	71	KZ	65	CF	44
AT	78	EE	71	GD	65	ET	44
DE	78	BG	71	ST	65	ZW	43
NZ	78	LY	71	GT	65	DJ	43
GR	78	MU	71	GY	63	ZM	41
SG	78	CO	71	MN	63	BI	41
CY	78	SR	71	IN	63	BW	40
MT	78	OM	71	BO	62	RW	40
US	77	CN	71	BT	62	MW	40
LU	77	SY	71	YE	61	MZ	39
IE	77	KN	70	KM	60	SL	39
BB	77	QA	70	PK	60		
DK	76	LV	70	NP	59		
PT	76	RO	70	BD	59		
SI	76	TH	70	GH	57		
BN	76	TK	70	PG	57		
CR	76	PY	70	MM	56		
KW	76	VC	70	KH	56		
CU	76	EC	70	SD	56		
KR	75	TN	70	LA	54		
CZ	75	JO	70	BJ	54		
CL	75	CV	70	GA	53		
AE	75	SV	70	HT	53		
JM	75	DZ	70	MG	53		
UY	74	BS	69	SN	53		
HR	74	BY	69	ZA	52		
TT	74	FJ	69	TG	52		
AG	74	PH	69	NG	52		
PA	74	PE	69	MR	52		
BZ	74	UZ	69	ER	52		
AR	73	IR	69	ML	52		
SK	73	WS	69	GQ	51		
PL	73	BZ	68	KE	51		
BH	73	UA	68	CG	51		

Source: UNDP

Table 7							
Countries listed by descending rates of adult literacy (in percent), 2000							
SI	100	CY	97	ZA	85	LA	54
SK	100	AR	97	MM	85	HT	53
PL	100	CU	97	DO	84	MG	53
EE	100	MV	97	CN	84	TG	52
LT	100	AZ	97	GQ	83	NG	52
LV	100	KG	97	ST	83	MA	49
BY	100	CL	96	LS	83	BI	48
RU	100	CR	96	KW	82	CI	47
UA	100	DM	96	NA	82	CF	47
NO	99	TH	96	KE	82	UG	44
SE	99	IL	95	QA	81	MZ	44
CA	99	BS	95	CG	81	DJ	43
BE	99	PH	95	LY	80	TD	43
AU	99	HK	94	WS	80	AO	42
US	99	TT	94	SZ	80	ML	42
IS	99	MK	94	SV	79	GN	41
NL	99	SR	94	ZM	78	MR	40
JP	99	GD	94	SB	77	GW	39
FI	99	BZ	93	BW	77	ET	39
CH	99	VE	93	AE	76	SN	37
FR	99	FJ	93	SA	76	BJ	37
UK	99	PY	93	IR	76	GM	37
DK	99	VN	93	CM	76	SL	36
AT	99	SG	92	HN	75	VU	34
LU	99	PT	92	TZ	75	BF	24
DE	99	MT	92	CV	74	NE	16
IE	99	BN	92	SY	74		
NZ	99	PA	92	OM	72		
CZ	99	CO	92	GH	72		
HU	99	LK	92	TN	71		
GE	99	EC	92	GA	71		
UZ	99	MX	91	GT	69		
GY	99	LC	90	KH	68		
MD	99	JO	90	DZ	67		
TJ	99	PE	89	NI	67		
MN	99	VC	89	RW	67		
IT	98	ZW	89	PG	64		
ES	98	BH	88	BT	62		
KR	98	SC	88	YE	61		
BB	98	MY	88	CD	61		
UY	98	AG	87	PK	60		
KN	98	JM	87	MW	60		
HR	98	ID	87	NP	59		
BG	98	LB	86	BD	59		
RO	98	BO	86	IN	57		
AM	98	MU	85	KM	56		
KZ	98	BZ	85	SD	56		
TM	98	TK	85	ER	56		
GR	97	AL	85	EG	55		

Source: UNDP

Table 9				
Dominating and dominated countries's share of global inequality in various dimensions				
Case	Singular Pivot	Dimension	Gamma-1 statistics	Gamma-2 statistics
Case 2A	BO	INC	0.79	0.18
		LE	0.72	0.13
Case 2A	ID	INC	0.72	0.20
		LE	0.66	0.13
Case 2A	IN	INC	0.84	0.19
		LE	0.79	0.14
Case 2A	GT	INC	0.66	0.18
		LE	0.61	0.11
Case 2B	GT	INC	0.66	0.16
		LIT	0.85	0.20
Case 2C	BO	LE	0.33	0.13
		LIT	0.63	0.25
Case 2C	DO	LE	0.33	0.33
		LIT	0.64	0.26
Case 2C	FJ	LE	0.32	0.32
		LIT	0.65	0.25
Case 2C	ID	LE	0.34	0.34
		LIT	0.65	0.26
Case 3	BO	INC	0.61	0.17
		LE	0.29	0.11
		LIT	0.58	0.24
Case 3	ID	INC	0.54	0.17
		LE	0.25	0.10
		LIT	0.50	0.21
Case 3	LK	INC	0.41	0.16
		LE	0.19	0.08
		LIT	0.39	0.15

Source: Author's calculations

Table 10

3-Tiered Grouping of the Countries of the World

Case	Pivot Set (Pivot 1, Pivot 2)	I-1 statistics	I-2 statistics	Class I	Class II	Class III
Case 2A (Real Income, Life Expectancy)	(CR, KH)	68.8	71.8	AT, AU, BE, CA, CH, CY, DE, ES, FI, FR, GR, HK, IL, IS, IT, JP, LU, MT, NL, NO, NZ, SE, SG, UK, US	AL, AM, AZ, BD, BG, BO, BR, BY, BZ, CN, CO, CU, CV, DM, DO, DZ, EC, EG, FJ, GD, GE, GH, GT, GY, HN, HR, ID, IN, IR, JM, JO, KG, KM, KZ, LB, LC, LK, LT, LV, LY, MA, MD, MK, MN, MU, MY, NI, PA, PE, PG, PH, PK, PY, RO, RU, SB, SR, ST, SV, SY, TH, TK, TM, TN, UA, UZ, VC, VE, VN, VU, WS	BF, BI, BJ, CD, CF, CG, ER, ET, GW, KE, MG, ML, MM, MW, MZ, NE, NG, RW, TD, TG, TZ, UG, ZM
Case 2A (Real Income, Life Expectancy)	(AR, SD)	75.7	63.2	AE, AT, AU, BB, BE, BH, BN, CA, CH, CY, CZ, DE, DK, ES, FI, FR, GR, HK, IE, IL, IS, IT, JP, KN, KR, KW, LU, MT, NL, NO, NZ, PT, SE, SI, UK, US	AG, AL, AM, AZ, BG, BO, BR, BY, CN, CO, CY, DM, DO, DZ, EC, EG, FI, GD, GE, GH, GT, GY, HN, ID, IN, IR, JO, KG, KZ, LB, LC, LK, LT, LV, LY, MA, MD, MK, MU, MY, MX, MY, NI, PE, PG, PH, PL, PY, RO, RU, SA, SK, SR, SV, SY, TH, TK, TM, TN, UA, UZ, VC, VE, VN, VU, WS	BF, BI, BJ, CD, CF, CG, CI, CM, ER, ET, GM, GW, HT, KE, LA, MG, ML, MR, MW, MZ, NE, NG, RW, SL, SN, TD, TG, TZ, UG, ZM
Case 2B (Real income, Literacy)	(MX, SD)	56.1	85.5	AR, AT, AU, BB, BE, BN, BS, CA, CH, CL, CY, CZ, DE, DK, EE, ES, FI, FR, GR, HK, HU, IE, IL, IS, IT, JP, KN, KR, LU, MT, NL, NO, PL, PT, SE, SG, SI, SK, UK, US, UY	AL, BO, BR, CN, CV, DO, DZ, GA, GH, GT, GY, HN, ID, IN, IR, JM, JO, LB, LC, LS, LY, NA, NI, PE, PG, PK, SV, SY, SZ, TK, TN, VC, WS, ZW	BF, BI, BJ, CF, CI, ER, ET, GM, GW, HT, KM, LA, MG, ML, MR, MZ, NE, NG, SL, SN, TD, TG, UG
Case 2C (Life Expectancy, Literacy)	(LC, ZA)	47.4	27.6	AR, AT, AU, BB, BE, BN, BZ, CA, CH, CL, CR, CU, CY, CZ, DE, DK, ES, FI, FR, GR, HK, HR, IE, IL, IS, IT, JP, KN, KR, LU, MT, NL, NO, NZ, PA, PT, SE, SG, SI, TT, UK, US, UY	AG, BO, ID, JO, LB, MY, PE, VC	AO, BF, BI, BW, CD, CF, CG, CI, CM, DJ, ER, ET, GM, GN, GQ, GW, KE, LS, MI, MR, MW, MZ, NA, NE, NG, NP, RW, SL, SZ, TD, TZ, UG, ZM
Case 3 (Real Income, Life Expectancy, Literacy)	(KR, JO)	46.8	38.7	AT, AU, BE, CA, CH, DE, DK, FI, FR, IE, IS, IT, JP, LU, NL, NO, NZ, SE, UK, US	AR, BZ, CO, LC, MK, MX, PA, TT, UY, VE	AO, BD, BF, BI, BJ, BO, BT, CD, CF, CG, CI, CM, DJ, EG, ER, ET, GH, GM, GN, GR, GT, GW, HN, HT, ID, IN, KE, KH, KM, LA, LS, MA, MG, ML, MM, MR, MW, MZ, NE, NG, NI, NP, PG, PK, RW, SB, SD, SI, SN, ST, TD, TG, TZ, UG, VU, YE, ZM, ZW
Case 3 (Real Income, Life Expectancy, Literacy)	(CY, AL)	42.2	43.4	AU, BE, CA, CH, FR, IS, IT, JP, NL, NO, SE, UK, US	AR, BH, BN, BZ, CL, CR, JM, LC, PA, PT, SC, TT	AO, BD, BF, BI, BJ, BT, CD, CG, CI, CM, DJ, ER, ET, GH, GM, GN, GW, HN, HT, IV, KE, KH, KM, LA, LS, MG, ML, MR, MW, MZ, NE, NG, NI, NP, PG, PK, RW, SB, SD, SI, SN, ST, TD, TG, TZ, UG, VU, YE, ZM

Source: Author's calculations

Table 11	
Additional Dimensions	
1	Probability at birth of not surviving to age 40 (percent of cohort)
2	Probability at birth of not surviving to age 60 (percent of cohort)
3	Population not using improved water sources (percent)
4	Underweight children under age five (percent)
5	Population using adequate sanitation facilities (percent)
6	Population using improved water sources (percent)
7	Population with access to essential drugs (percent)
8	One-year olds fully immunized against tuberculosis (percent)
9	One-year-olds fully immunized against measles (percent)
10	Oral re-hydration therapy use rate (percent)
11	Contraceptive prevalence rate (percent)
12	Births attended by skilled health staff (percent of total births)
13	Physicians per 100,000 people
14	Undernourished people (as a percentage of total population)
15	Children under-weight for age (percentage under age 5)
16	Children under-height for age (percentage under age 5)
17	Tuberculosis cases (percent)
18	Under-five mortality rate (per 1,000 live births)
19	Maternal mortality ratio (per 100,000 live births)
20	Net primary enrollment ratio (percent)
21	Net secondary enrollment ratio (percent)

Source: UNDP

Hasse Diagrams

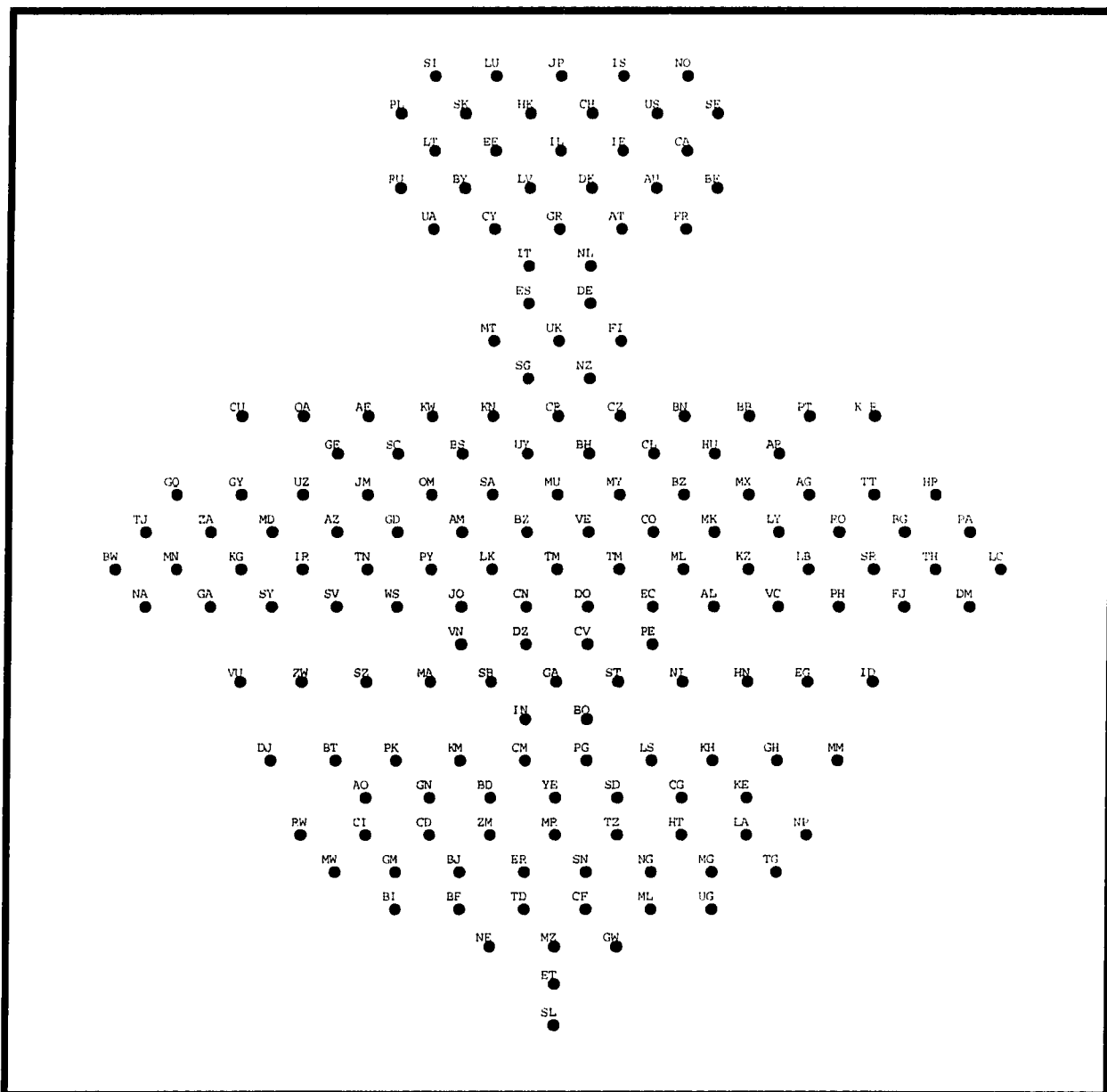


Figure [A3.1]: Hasse diagram with \geq and the following *four* dimensions: per capita real income; life expectancy (female); life expectancy (male); and adult literacy. Countries fall into 26 tiers. The *maximal elements* are: IS, JP, LU, NO, and SI; and the *minimal elements* are: MZ, NE and SL.

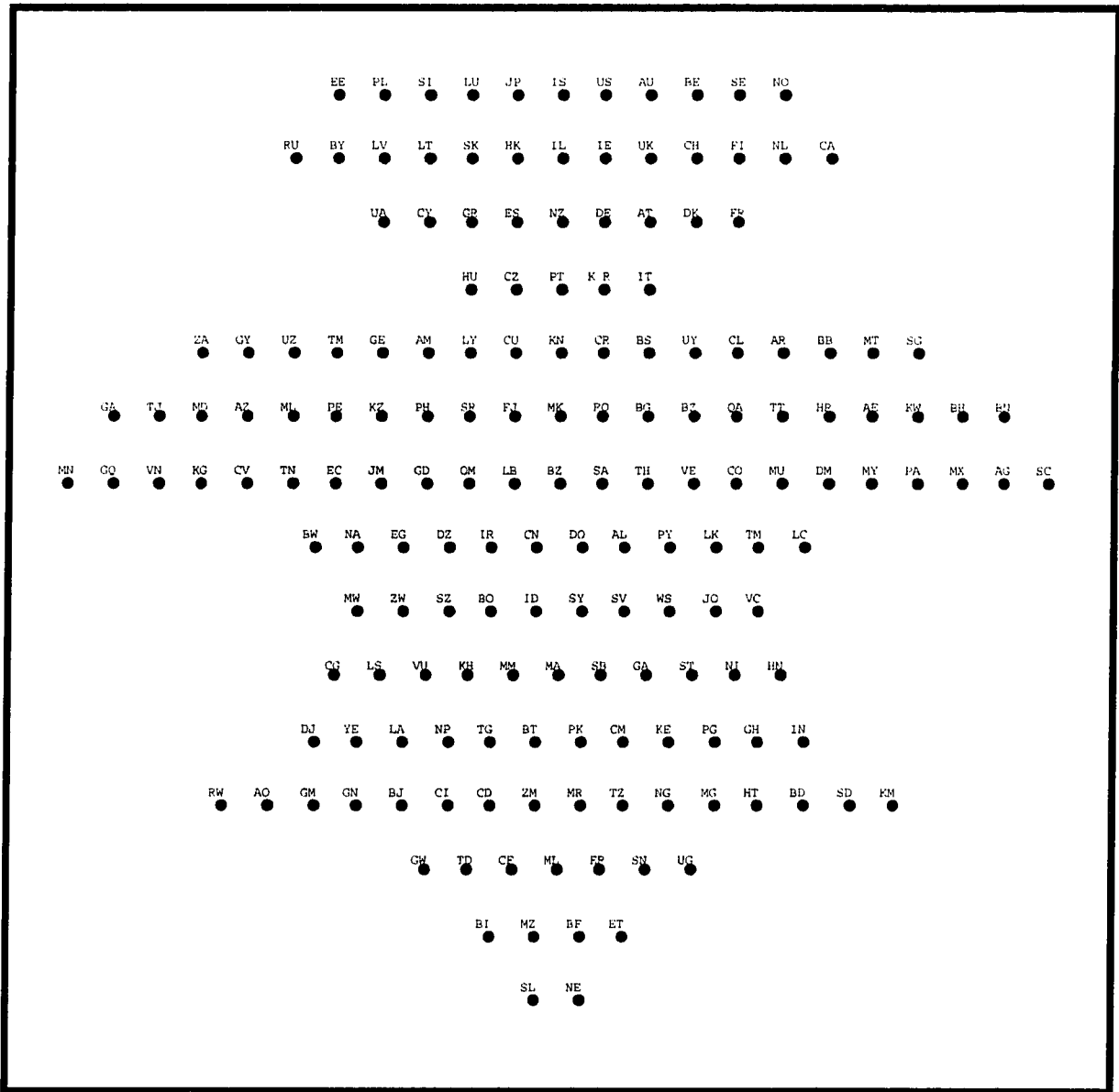


Figure [A3.2]: Hasse diagram with \geq and the following *five* dimensions: per capita real income; life expectancy (female); life expectancy (male); adult literacy; and enrollment. Countries fall into 15 tiers. The *maximal elements* are: AU, BE, EE, IS, JP, LU, NO, PL, SE, SI, and US; and the *minimal elements* are: AO, NE and SL.

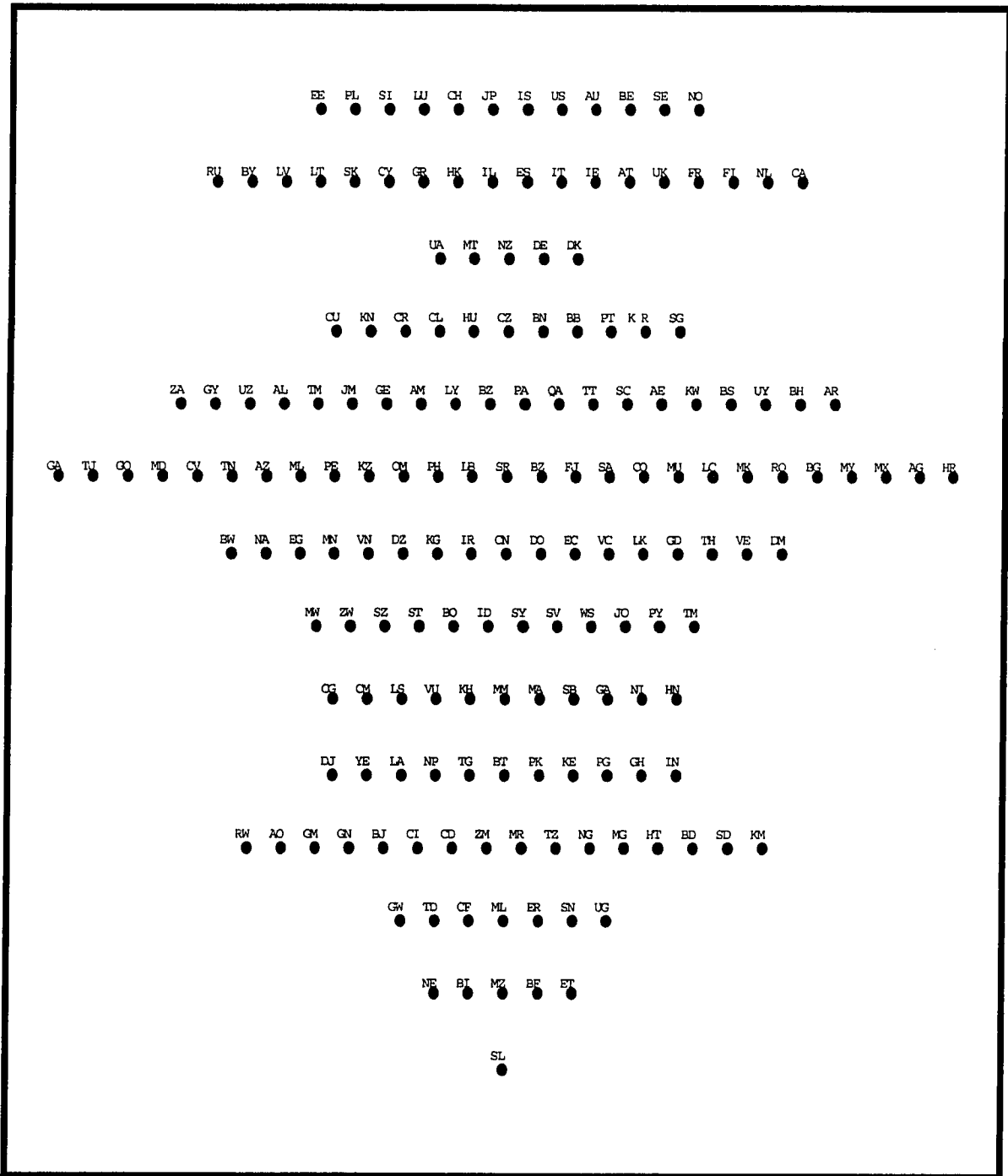


Figure [A3.3]: Hasse diagram with \geq and the following *six* dimensions: Per capita real income; life expectancy (female); life expectancy (male); adult literacy; enrollment; and survival (female). Countries fall into 14 tiers. The *maximal elements* are: AU, BE, CH, EE, IS, JP, LU, NO, PL, SE, SI, and US; and the *minimal elements* are: AO, MZ, RW, and SL.

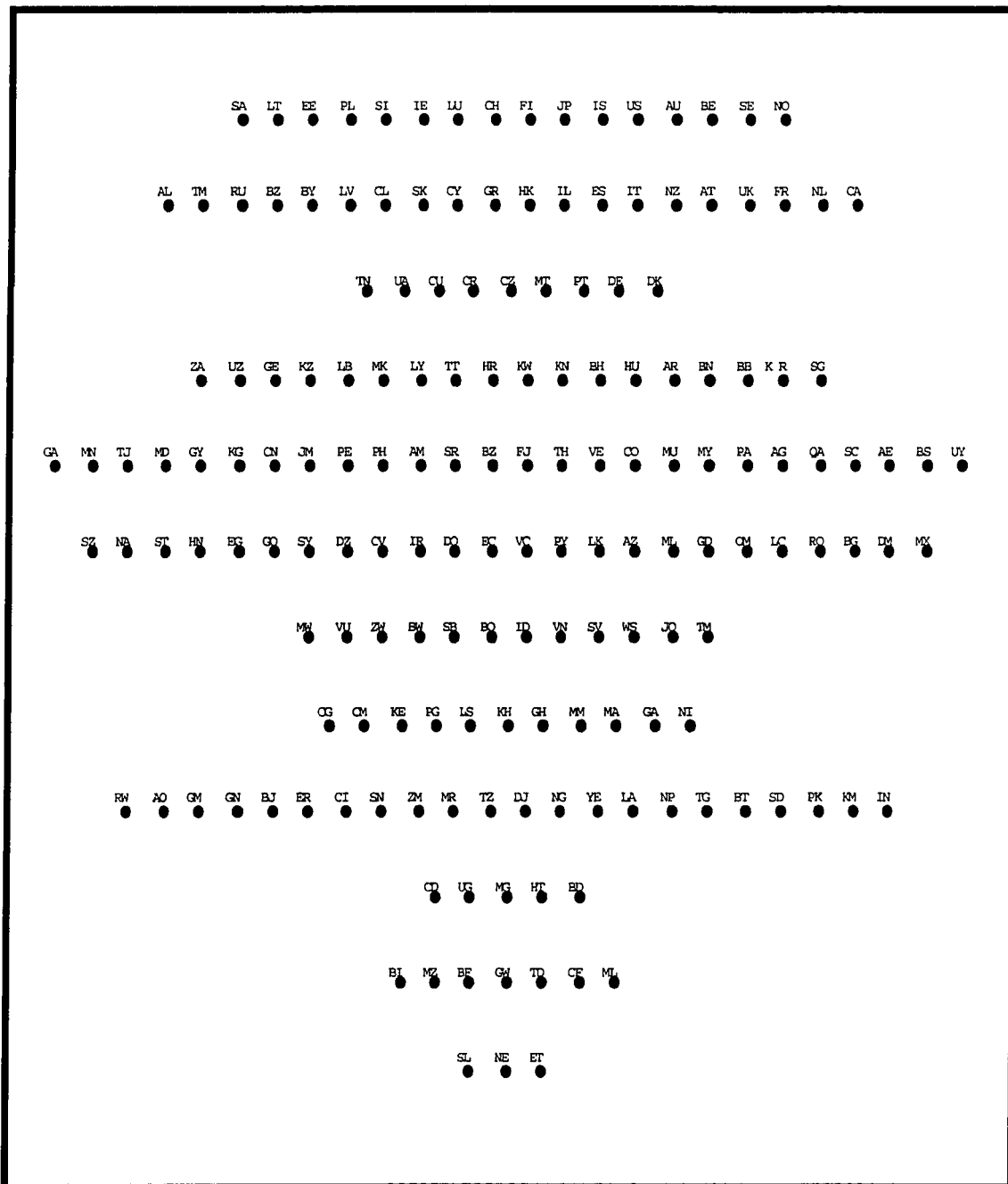


Figure [A3.4]: Hasse diagram with \geq and the following *seven* dimensions: per capita real income; life expectancy (female); life expectancy (male); adult literacy; enrollment; survival (female); and birth weight. Countries fall into 12 tiers. The *maximal elements* are: AU, BE, CH, EE, FI, IE, IS, JP, LT, LU, NO, PL, SA, SE, SI, and US; and the *minimal elements* are: AO, CF, ET, NE, RW, and SL.

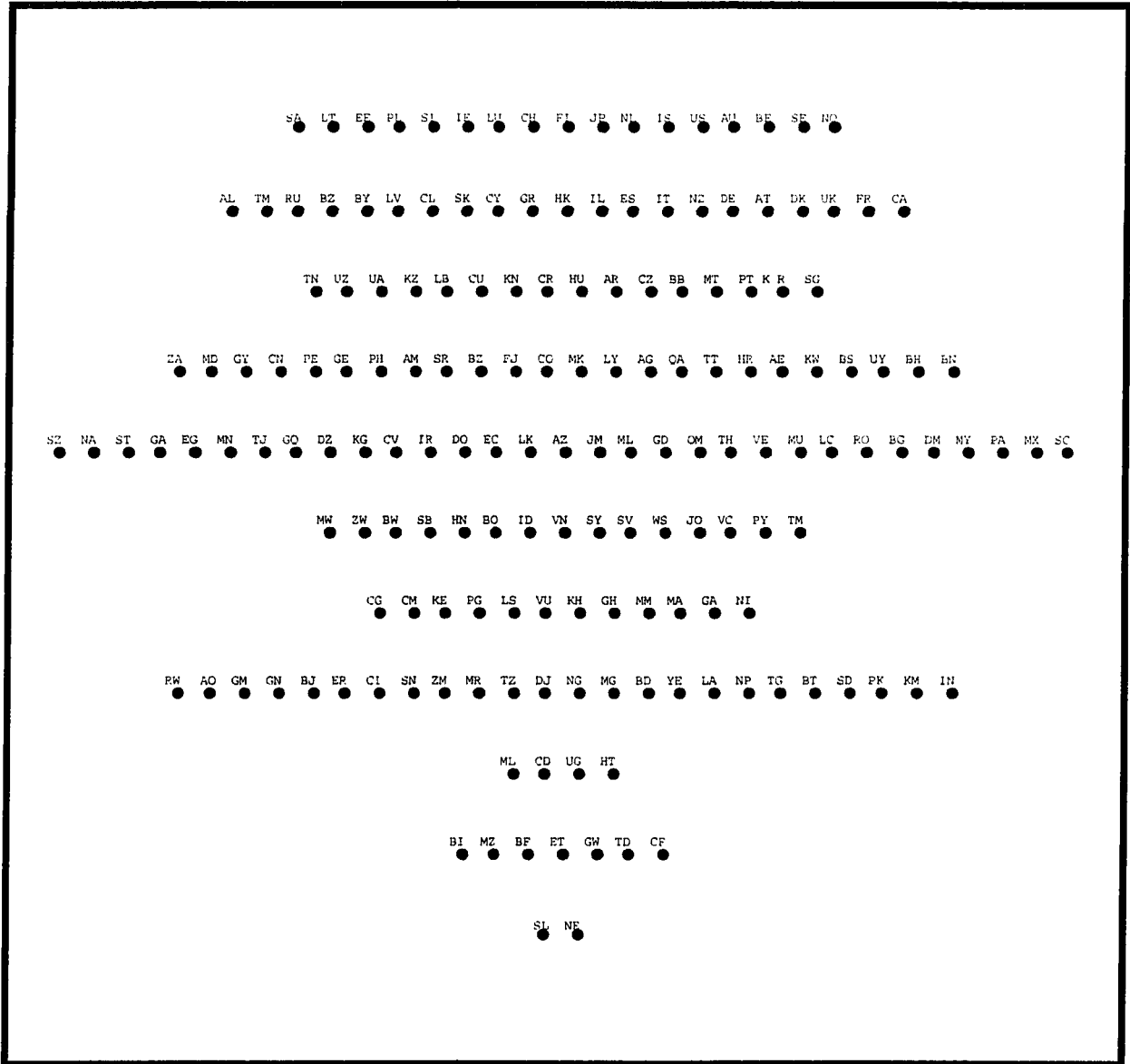


Figure [A3.5]: Hasse diagram with \geq and the following *eight* dimensions: Per capita real income; life expectancy (female); life expectancy (male); adult literacy; enrollment; survival (female); birth weight; and infant mortality. Countries fall into 11 tiers. The *maximal elements* are: AU, BE, CH, EE, FI, IE, IS, JP, LT, LU, NL, NO, PL, SA, SE, SI, and US; and the *minimal elements* are: AO, CF, NE, RW, and SL.

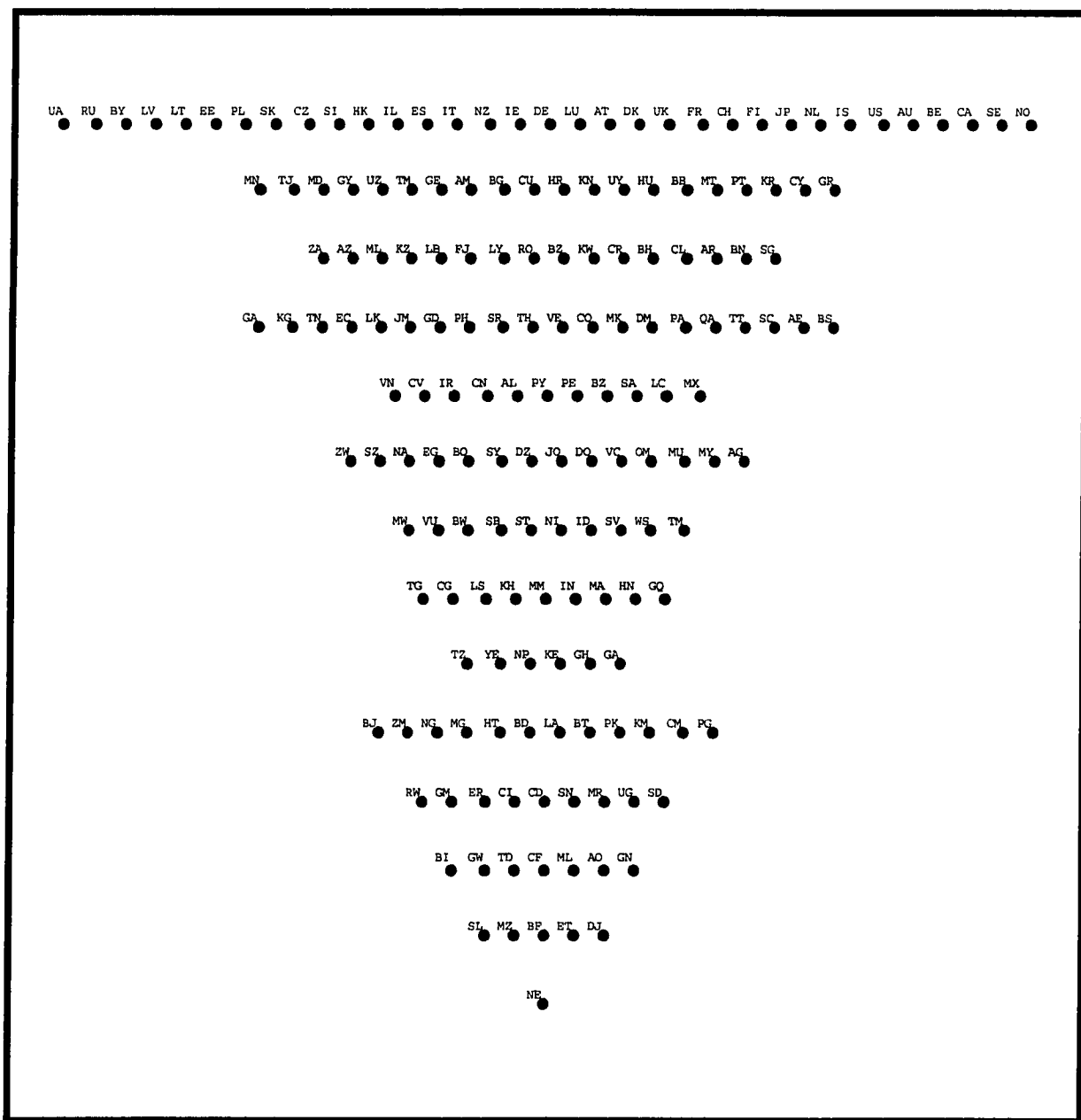


Figure [A3.6]: Hasse diagram with $>$ and the following *four* dimensions: life expectancy (male); life expectancy (female); adult literacy; and enrollment. Countries fall into 14 tiers. The *maximal elements* are: AT, AU, BE, BY, CA, CH, CZ, DE, DK, EE, ES, FI, FR, HK, IE, IL, IS, IT, JP, LT, LU, LV, NL, NO, NZ, PL, RU, SE, SK, SI, UA, UK, and US; the *minimal elements* are: AO, DJ, ET, MZ, NE, and SL.

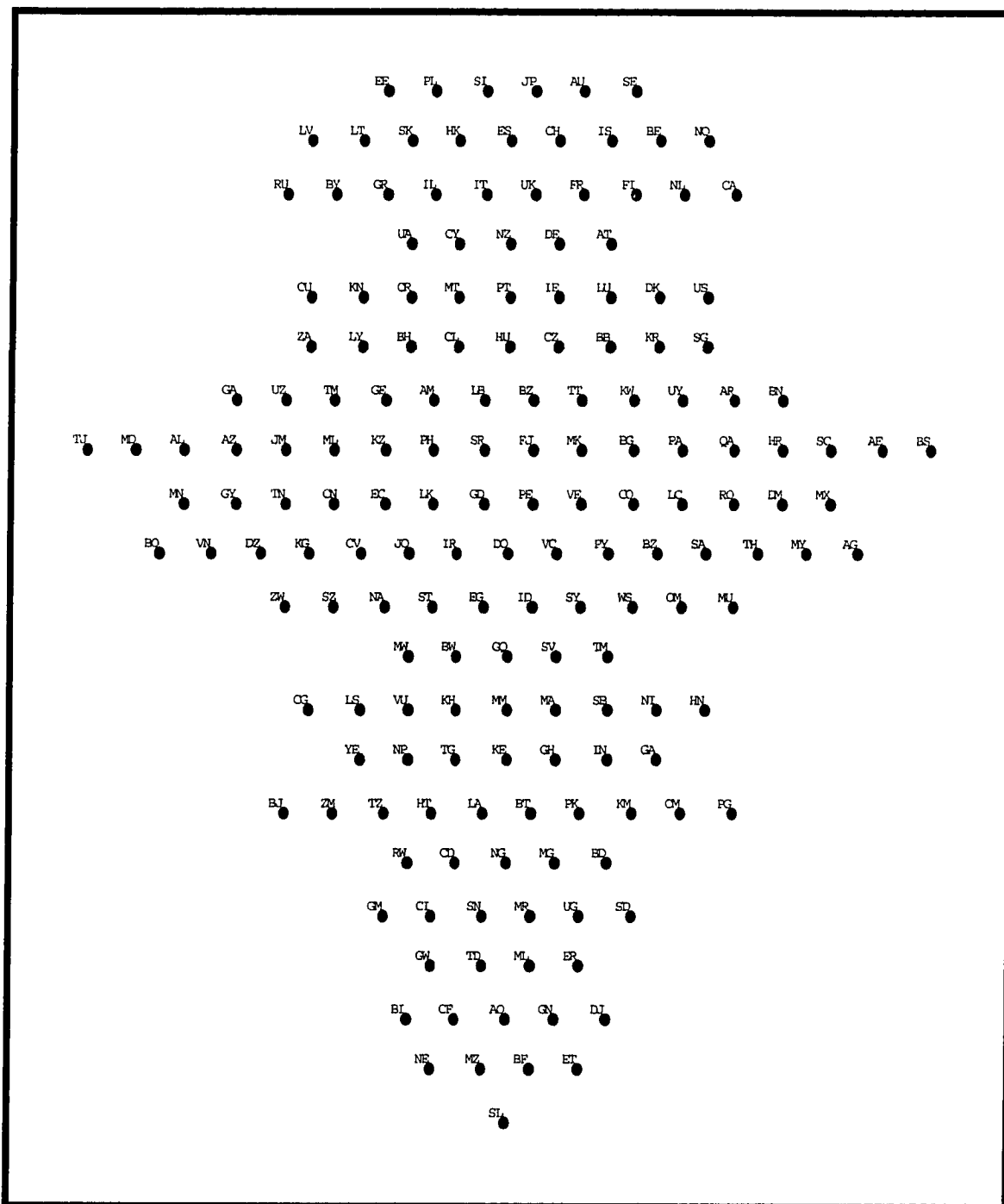


Figure [A3.7]: Hasse diagram with \geq and the following *five* dimensions: life expectancy (male); life expectancy (female); adult literacy; enrollment; and survival (female). Countries fall into 21 tiers. The *maximal elements* are: AU, EE, JP, PL, SE, and SI; and the *minimal elements* are: BI, BF, DJ, MZ, NE, and SL.

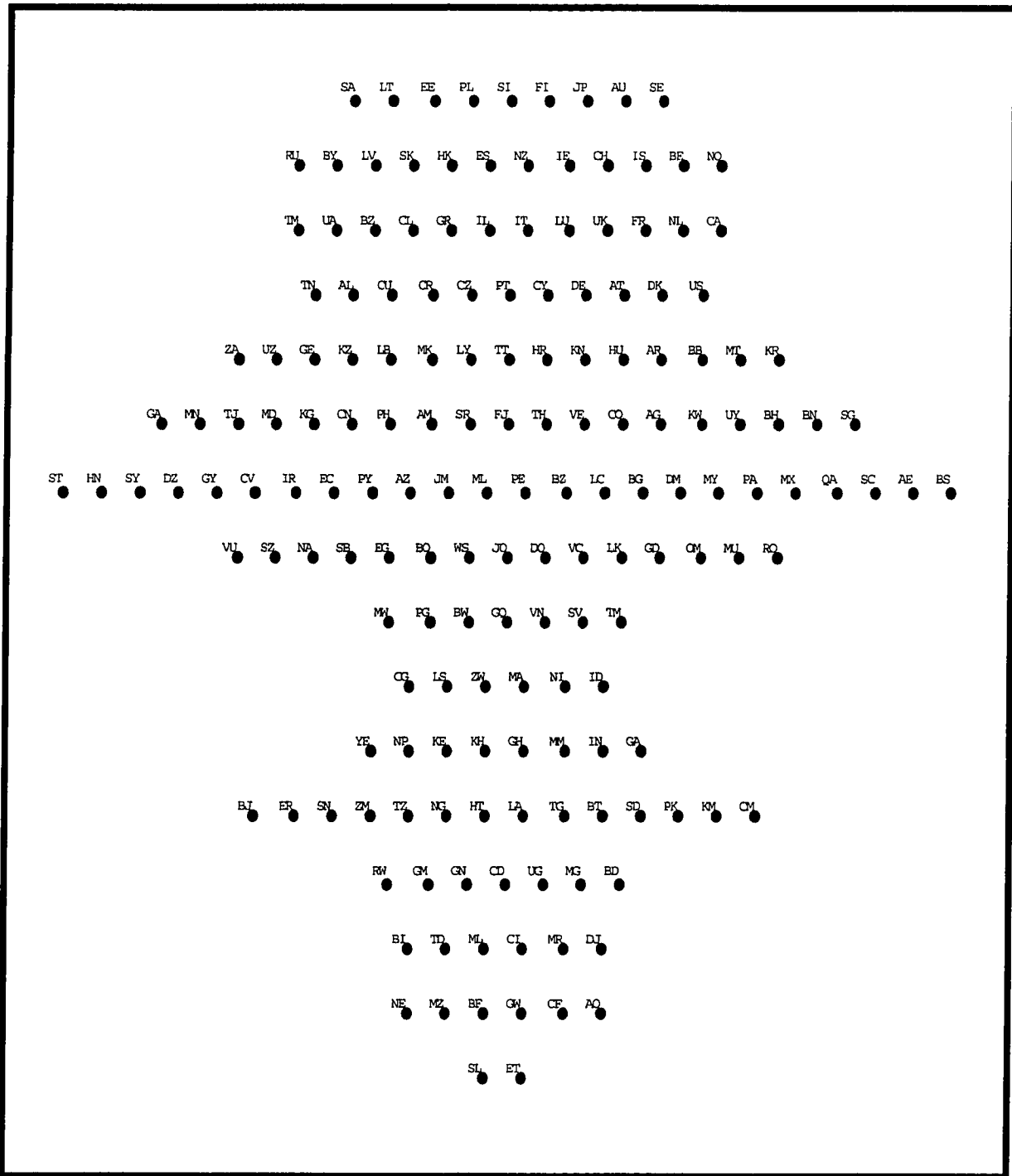


Figure [A3.8]: Hasse diagram with \geq and the following six dimensions: life expectancy (male); life expectancy (female); adult literacy; enrollment; survival (female); and birth weight. Countries fall into 16 tiers. The *maximal elements* are: AU, EE, FI, JP, LT, PL, SA, SE, and SI; and the *minimal elements* are: AO, CF, ET, NE, and SL.

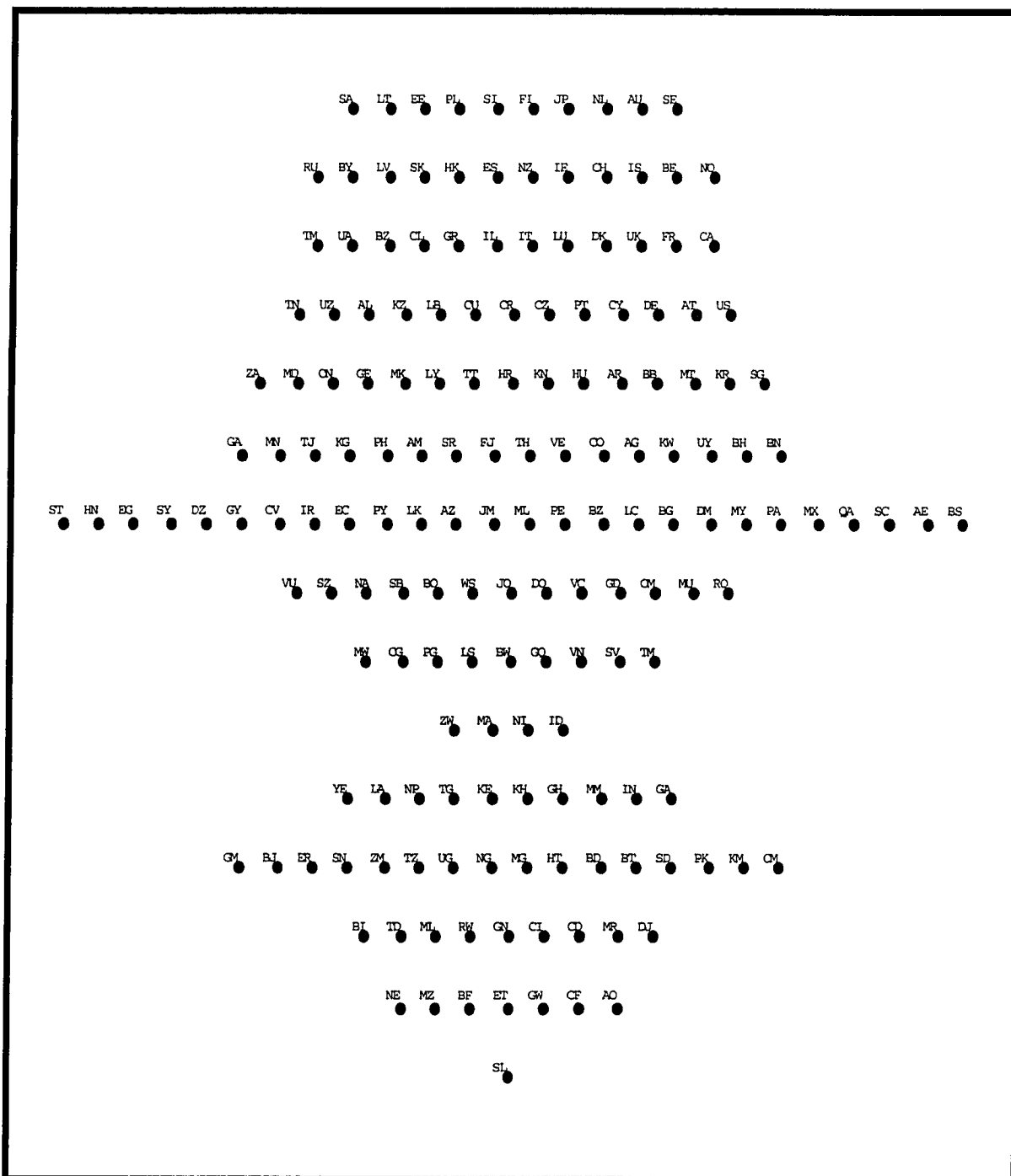
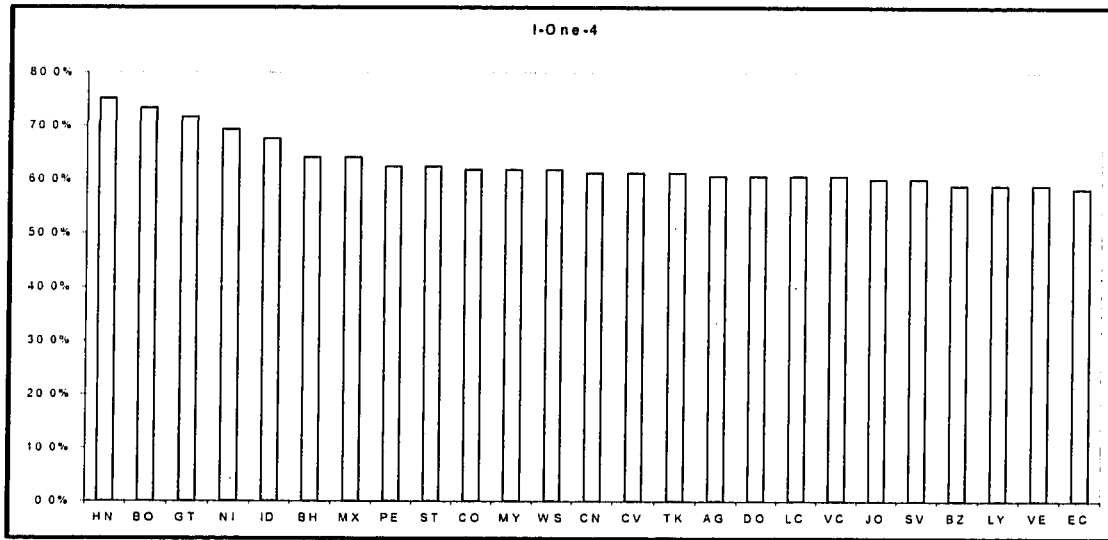


Figure [A3.9]: Hasse diagram with \geq and the following *seven* dimensions: life expectancy (female); life expectancy (male); adult literacy; enrollment; survival (female); low birth weight; and infant mortality. Countries fall into 15 tiers. The *maximal elements* are: AU, EE, FI, JP, LT, NL, PL, SA, SE, and SI; and the *minimal elements* are: AO, BI, CF, DJ, NE, and SL.

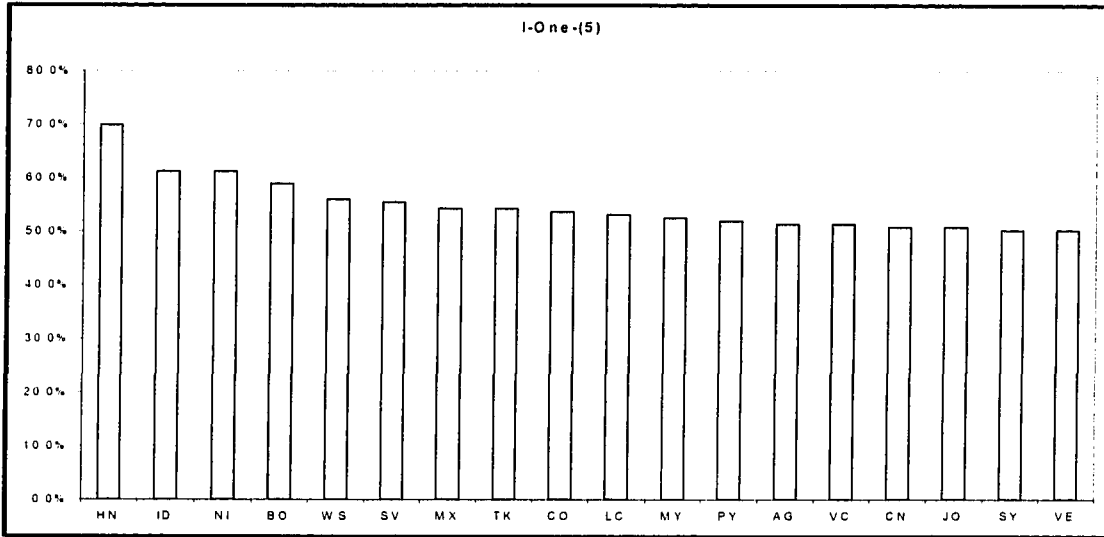
Information Statistics

The following figures present the $I_1(\kappa)$ information statistics for the top 25 countries for the respective dimensions.

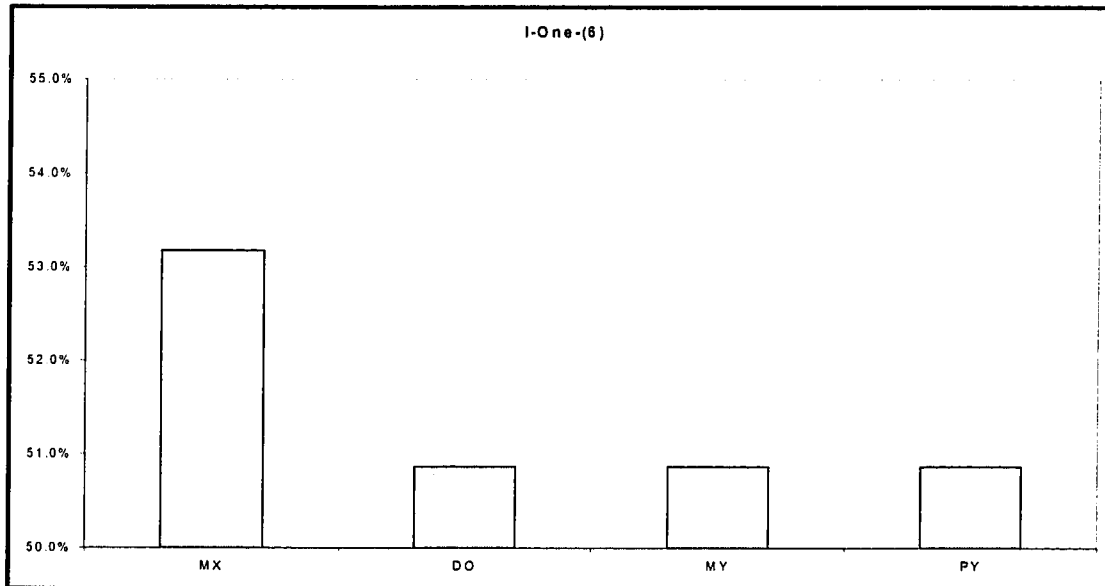


Case: $\kappa = 4$ with the additional restrictions: $n[U_i] = 40$, and $n[D_i] = 40$

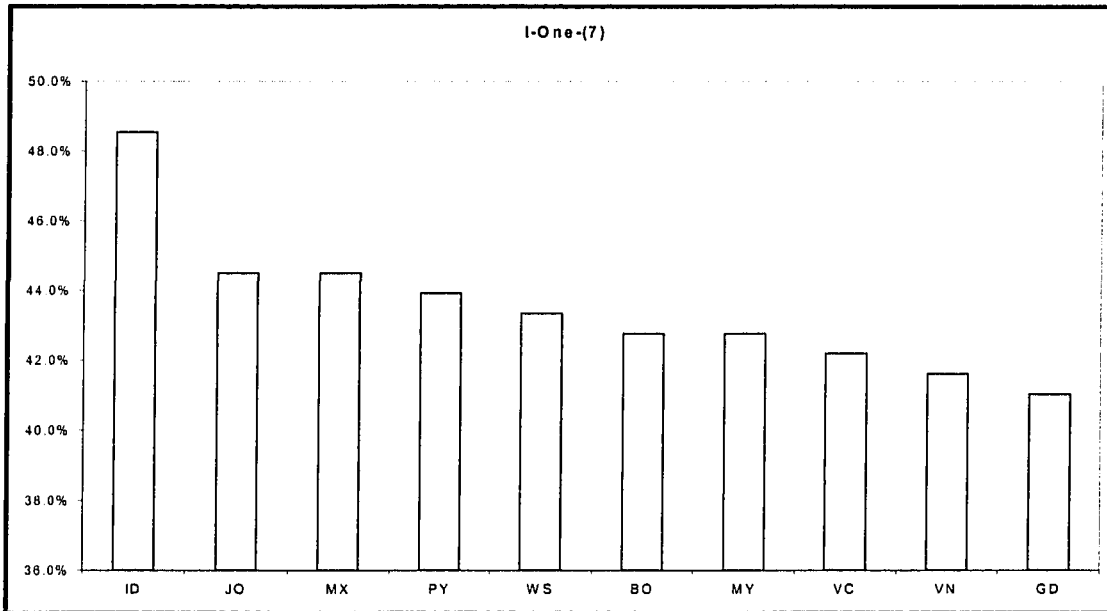
Case: $\kappa = 5$ with the additional restrictions: $n[U_i] = 40$, and $n[D_i] = 40$



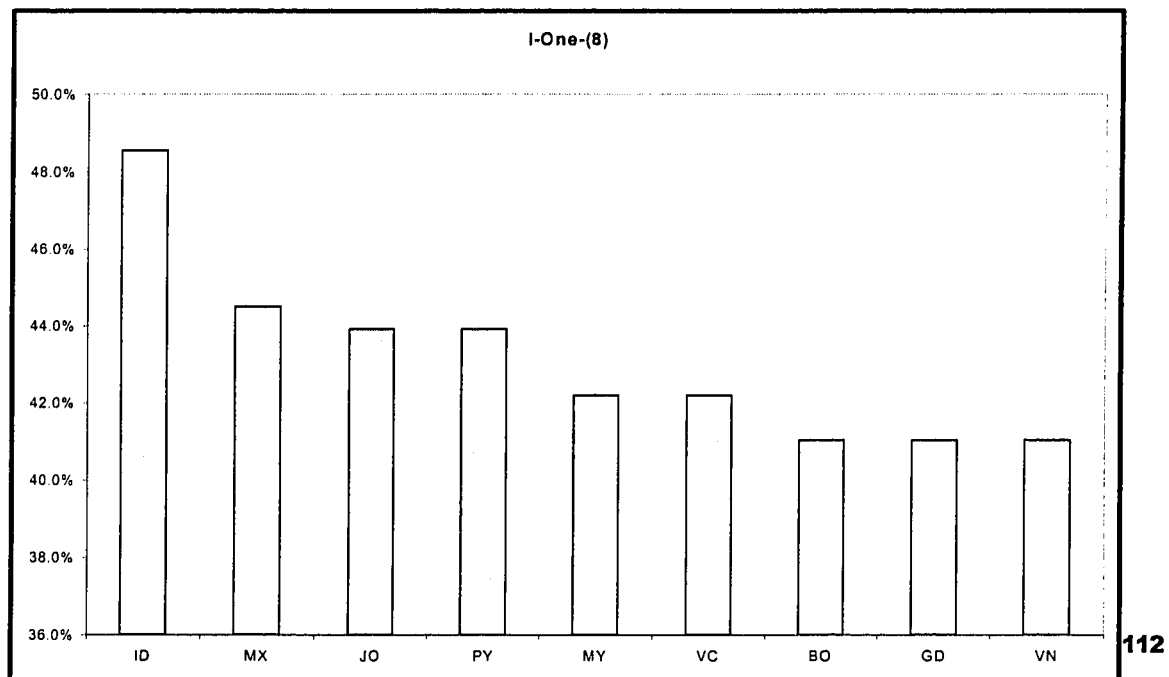
Case: $\kappa = 6$ with the additional restrictions: $n[U_i] = 40$, and $n[D_i] = 40$



Case: $\kappa = 7$ with the additional restrictions: $n[U_i] = 40$, and $n[D_i] = 40$



Case: $\kappa = 8$ with the additional restrictions: $n[U_i] = 40$, and $n[D_i] = 40$



Appendix 4: Concerns about Dispersion and Volatility of the Data

This Appendix addresses concerns related to the dispersion and volatility of the data. Firstly, the methods to address concerns about data dispersion are discussed. Secondly, the dispersions of the data are provided here.

Methods to Address Concerns about Data Dispersion

The data dispersion and volatility of the indicators may be dealt with in any one of the methods mentioned below. Which specific method is chosen may depend on the nature of the dispersion of data, the availability of data, and the quality of data.

Weighted Average of Indicators

One can use the weighted average or the moving average of indicators instead of using indicators from a single year of observation. Using weighted average or moving average would enable the evaluator to obtain smoothing of the data.

Partial Ordering of Indicators

One can use partial ordering of indicators. Hence country A's income would be considered greater than country B's income if and only if its income was higher in all years in the data. A partial ordering approach may help address the dispersion and volatility of the data.

Weighting of Indicators

One can assign different weights to given indicators based on their dispersion and volatility in the data. As mentioned in the text, in construction of $I_2(\kappa)$ statistics the β_i parameters will convey much how much importance the evaluator gives to the description of different indicators. The values given of β_i parameters may depend on data dispersion, limitations, errors and the questions to be addressed.

The Dispersions of the Data

Using data for per capital real income (PPP adjusted), life expectancy, and adult literacy from 1998 to 2002, one can calculate for each country the mean, the standard deviation, and the co-efficient of variation of each of these indicators.

The means of the coefficient of variation of these indicators are given in the following Table:

Indicators	Average of coefficient of variation (standard deviation of coefficient of variation)
Per capital real income	0.07 (0.05)
Life Expectancy	0.005 (0.007)
Adult Literacy	0.002 (0.001)

As expected the dispersions of the indicators (as measured by the average of coefficient of variation) in descending order are as follows: per capital real income, life expectancy, and adult literacy. Details of the calculation, including Tables, are available upon request.

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PART B: ESSAYS ON BANGLADESH

Publicly Subsidized Privatization

A Simple Model of Dysfunctional Privatization

TANWEER AKRAM^Σ

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^Σ *Academic Address:* Department of Economics, Columbia University, New York, NY 10027, USA. *Correspondence Address:* 362 Riverside Drive, Apt 10A2, New York, NY 10025, USA. *E-mail:* ta63@columbia.edu.

Publicly Subsidized Privatization

A Simple Model of Dysfunctional Privatization

Abstract

This paper points out the limitations of the privatization program in Bangladesh, with particular reference to the debt-default status of privatized firms. Firstly, detailed analysis of the debt-default status of privatized firms is presented using data obtained from the central bank. Secondly, a simple model of dysfunctional privatization is constructed to show that perverse outcomes of privatization are possible. The experience of developing economies, such as Bangladesh, lends credence to the results of this model. Finally, various types of privatization are classified following Bhagwati's (1982) typology of directly unproductive profit-seeking activities. (JEL L33, H20)

Keywords: Privatization, Bangladesh, Firm Behavior, Development, Subsidies

Publicly Subsidized Privatization

A Simple Model of Dysfunctional Privatization

I. INTRODUCTION

A key justification for privatizing public enterprises in Bangladesh is to reduce the fiscal burden that their losses and subsidization impose on the state. The losses of public enterprises are substantial. In 1996-97 the aggregated losses of public manufacturing enterprises was Taka 8.23 billion (\$175 million) and the aggregated losses of public enterprises was Taka 14.12 billion (\$300 million). In 1997-98 the aggregated losses of public manufacturing enterprises was Taka 5.49 billion (\$116 million) and the aggregated losses of public enterprises was Taka 7.55 billion (\$160 million).^{1,2} Public enterprises receive little direct subsidies and grants from the state budget: In 1996-97, direct subsidies amounted to Taka 610 million (\$12 million) and in 1997-98 it was Taka 634 million (\$13 million). Public enterprises rely on indirect funding in the form of equity injections from the state and continued borrowings from the nationalized commercial banks. Public enterprises received Taka 11.59 billion (\$247 million) in 1996-97 and Taka 17.44 billion (\$394 million) in 1997-98 as equity and borrowed Taka 16.59 billion (\$352 million) in 1996-97 and Taka 18.53 billion (\$394 million) in 1997-98 as loans from the banks. In December 1997, the outstanding loans of public enterprises amounted to nearly Taka 42.99 billion (\$915 million) of which Taka 15.06 billion (\$320 million) was overdue.³ The public enterprises paid Taka 1.88 billion (\$40 million) in 1996-97 and Taka 1.65 billion (\$35 million) in 1997-98 as dividends, most of which originated from profits of the state monopolies in the oil and gas sector. For most public enterprises, the rate of return on capital or the rate of profit is either fairly low or negative.

Private ownership is supposed to lead to better management. Privatization in Bangladesh can be regarded as successful if it raises the firm-level efficiency and improves profitability. If, under private management, the loss-making enterprise starts earning profits, it would be able to borrow on a commercial basis and raise equity from the capital market. Successful privatization would reduce, if not eliminate, the need for continued subsidized credit from the public banks, and the reliance on the state for continued equity injections; thus freeing the state to devote its resources for social expenditure.

This paper examines some of the limitations of the privatization program, with particular reference to the debt-default status of privatized firms, in Bangladesh. In Section II, the debt-default status of the nearly 200 privatized firms is presented using recently available information obtained from the country's central bank. It shows that many privatized firms rely on state-financed subsidy from the banking sector. In section III, a simple model of dysfunctional privatization is constructed. Finally, in Section IV, following Bhagwati (1982) this paper provides a welfare-theoretic typology for analyzing privatization.

II. THE DEBT-DEFAULT STATUS OF PRIVATIZED FIRMS

The state-owned banks, which have been the most important source of credit to the public enterprises and the private firms in Bangladesh, are beset with bad loans. Table 1 provides the time series of the stock of outstanding loans of the scheduled banks in Bangladesh from December 1991 to June 1997. With growth of the private sector, credit advanced to the private sector has grown rapidly, whereas credit advanced to the public sector has been stagnant. Table 2 shows that both the level and the share of private sector investment have increased rapidly. Whereas in 1990-91, private investment constituted only 5.8 percent of GDP in 1990-91, it

amounted to 10.2 percent of GDP in 1997-98. Table 3 gives the summary position of outstanding and overdue loans of over Taka 100 million (\$2 million) and above to the public sector and the private sector in Bangladesh as of March 31, 1998. The total amount of outstanding loans greater than or equal to Taka 100 million (\$2 million) to the public sector is Taka 25 billion (\$532 million) of which Taka 20 billion (\$426 million) is overdue, and the total outstanding loan to the private sector is Taka 43.7 billion (\$930 million) of which Taka 36.7 billion (\$781 million) is overdue. The aggregated debt-default ratio of the private sector is not lower than that of the public sector, which *prima facie* may suggest that in Bangladesh the private sector is no better than the public sector in repaying credits obtained from financial system.

[Insert Table 1 here]

[Insert Table 2 here]

[Insert Table 3 here]

The classification of non-performing debt in Bangladesh does not meet Basle standards generally accepted among international banks. Thus, the list of firms with overdue loans is constructed on the basis of fairly 'liberal' and lax standards. If more conservative principles of loan classification are applied, a larger number of privatized firms would be regarded as defaulters and the volume of classified loans would be higher. Firms that already have overdue debt may be unable to service their outstanding loans. Hence, incidences of both outstanding and overdue loans of privatized firms are reported here. The set of privatized firms chosen for investigation is the same set and subsets of firms used in Sen's (1997) survey of privatized firms in Bangladesh. The set, consisting of 201 firms, covers all the major industrial (manufacturing) firms privatized from 1979 to 1995.

Data provided by the Credit Information Department of Bangladesh Bank, the country's central bank, shows that as of December 31, 1997, out of 201 privatized firms, information is available on 128 firms. Of these 128 firms, 77 firms have overdue and outstanding loans; 33 firms have outstanding loans but no overdue loans; and only 18 firms have neither outstanding nor overdue loans, as given in Table 4. Table 5 provides the subclass interval range of outstanding and overdue loans, and reveal that a few privatized firms have substantial amount of overdue and outstanding loans.

[Insert Table 4 here]

[Insert Table 5 here]

Earlier data was collected on the 88 privatized firms that are reported in Sen's survey (1997) as currently operating after privatization. As of June 30, 1997, of these 88 firms, information concerning 72 firms are available; and information on the remaining 16 firms are not available. Out of these 72 firms, 42 firms have overdue loans, 21 firms have outstanding loans but no overdue loan, and only 9 firms have neither overdue nor outstanding loans as shown in Table 6. The distributions of outstanding loans and overdue loans are given in Table 7.

[Insert Table 6 here]

[Insert Table 7 here]

The World Bank (Dowlah 1997) recently conducted a study of selected 13 privatized firms. Although that Bank study regards the privatization experience in Bangladesh as successful and Bank's economic advice to the authorities endorses rapid and extensive privatization, Dowlah's (1997) study does not analyze the debt-default status of privatized firms. This is a rather serious gap since loan defaulting is

an important phenomenon in Bangladesh. Thus, here information, as of March 31, 1998, concerning those firms are given in Tables 8 and 9.

[Insert Table 8 here]

[Insert Table 9 here]

The authorities recently published, in response to a parliamentary question, a list of 2,117 defaulters, each with overdue loans of at least Taka 10 million (approximately \$200,000). The set of 201 privatized firms is also available. Intersecting these two sets shows that out of the 201 privatized firms, 63 firms are in the list of defaulters. The author submitted to the central bank the list of such 63 firms to analyze their debt-default status. As of March 31, 1998, according to the central bank, information on 59 out of 63 firms is available, and information on 4 firms is not available, as shown in Table 10. Of these 59 firms, 51 firms have both outstanding and overdue loans, 8 firms have outstanding loans but no overdue loans, and there is no firm in the set without either outstanding or overdue loans.

[Insert Table 10 here]

The data on the overdue and outstanding loans to privatized firms indicates that inability to repay loans is a major problem of privatized firms in Bangladesh. The accumulation of overdue loans implies the inability and/or the unwillingness of the firms to service their loans. These firms are unwilling or unable to service their loans due to either the failure to realize profits, managerial inefficiency, or diversion of profits for personal gains rather than serving debts. In itself, high debt level does not signal firm inefficiency. If the firm has marketable collateral that can be sold to meet its obligations, then it should be able to sell debts (bonds), or secure loans from commercial banks or the capital market. Even if the firm does not have any

marketable collateral, but if the investors expect the firm to generate sufficient profits, then they would be willing to lend. Firms with the potential to earn future profits are able to obtain funds by issuing high interest-bearing 'junk' bonds or by relying on venture capital. The debt holders of such firms assume a high risk because of the possibility of good returns.

Some owners of privatized firms have often argued that they are unable to service the firm's debt because it was accumulated under public ownership. Since they are not responsible for borrowing prior to privatization or for public sector inefficiency, they cannot be held accountable for debt incurred in the past. They claim that they are neither obliged nor willing to repay such loans. However, this claim ignores the fact the sale price reflects the servicing cost of its debts.

Defaulting state loans is an ingrained *rentier* propensity of a powerful segment of Bangladeshi capitalists. If the firm's management expects that the banks will not force it to repay, then it has no incentive to repay its debt. The authorities have been, for the most part, either unwilling or unable to retrieve debts from firms that have borrowed heavily and exceeded the time limit to repay. The failure to recover loans has hurt the reputation of the bank authorities. The lack of credible threats prompt firms to default loans because they know that such default will impose little or no penalty.

The firm is privatized precisely because of the authorities' conviction that the firm would be better managed under private ownership, and subject to capital market discipline and the possibility of bankruptcy. If the state continues to subsidize the private owner, not only would this be the transfer of public wealth to private agents, but also undermine the objectives of privatization. A firm that has perpetual access to state funds is not subject to hard budget constraint, capital market

discipline, the threat of takeover, and the possibility of bankruptcy. The management of public leveraged privatized firm has little incentive to improve performance because it has such easy access to state funds and it does not have to compete in the loan funds market. Where the owner of privatized firms bought public enterprises with borrowed public funds, it can be regarded as publicly-sponsored leveraged privatization of public enterprises. Both publicly-sponsored leveraged buyout of public enterprise, or publicly leveraged privatized firms are contrary to the essence of privatization since the objectives of privatization are to reduce the state's fiscal burden and state subsidies; and the role of the state in the economy. Publicly sponsored-leveraged buyout and cheap public credit for privatized firms not only distort the markets but are contrary to the objectives of privatization. Such state interventions are likely to promote *rentier* class than productive activity. Unless compelling evidence to the contrary are provided, the rationale for the state in Bangladesh to use its scarce resources for publicly leveraged-buyouts or public leverage of privatized firms remains suspect.

The absence of financial sector discipline is a major stumbling block to successful privatization and private sector development in Bangladesh. Establishing financial sector discipline would set the ground for obtaining the benefits of private ownership of the means of production and shrink the opportunities for rent-seeking activities. The appropriate action on the part of the authorities would be to compel the firm to meet its obligations to its creditors, employees, suppliers, and customers in accordance with the law. If the firm is unable to meet its obligations, then it should, after due process, be sold-off to (a) pay its creditors and employees; and (b) transferred to its new buyers who expect to provide the firm a more effective management and, thus, realize positive profits. If the firm cannot be sold because it

is not economically viable, it ought to be liquidated in accordance with the standard practice of market economies.

III. A SIMPLE MODEL OF DYSFUNCTIONAL PRIVATIZATION

Boycko, Shleifer, and Vishny (1996) try to explain the cause of public sector inefficiency and argue that performance improves after privatization. Privatization, they hold, can de-politicize the firm. In their model, after privatization there is a greater restraint on the authorities to tamper with the firm's expenditure plans because the political cost of subsidizing the private firm is higher than the political cost of squandering firm's profits in a public enterprise regime. In their view privatization generates efficiency by raising the cost of political interference. The *institutional change* caused by the transfer of ownership brings about efficiency gains.

The case of Bangladesh, however, suggests that the Boycko, Shleifer, and Vishny's (1996) model is far from encompassing. Privatization can increase state directed credit and the volume of subsidies in a regime with weak institutions and bad governance. The politician's cost of subsidizing a private firm can be less than the cost of subsidizing public activity. Arguably even in advanced capitalist countries, despite the relative autonomy of the body politic and well-developed institutions, it is more to the self-advantage of the politician to subsidize private firms rather than public firms. Defense procurement, which provides a huge subsidy to the military industrial complex in the United States, in the guise of public well-being or security, illustrates this.

Privatized enterprises can continue to rely on state subsidies because the owner profits more from rent-seeking activities rather than productive activities. In a society where vertical class ties are very strong and the peasantry and the working class are disorganized, the political cost of subsidizing privatized

enterprises need not necessarily be less than the political cost of subsidizing public enterprises. Under a privatized regime, the authorities may enable the management to secure more loan capital than the optimal level from the planner's viewpoint. The volume of politically directed credit for privatized enterprises in Bangladesh testifies to this.

A simple model is presented below to demonstrate that after privatization the volume of credit provided by the banking system to the firms might not decrease. Non-performing loans and misallocation of resources can still prevail after the transfer of ownership of the firms rendering privatization dysfunctional.

There are two players: The authorities and the manager of the firm. Suppose $\alpha \in (0,1)$ is the share of the private ownership of the firm. As $\alpha \rightarrow 0$, the firm is under state ownership; as $\alpha \rightarrow 1$, the firm is under private ownership. Here α can be interpreted in two alternative ways. In 'micro' terms, it is the private sector's share of a particular firm; in 'macro' terms, it is the share of firms in the private sector. Correspondingly $(1-\alpha)$ is the public sector's share of a particular firm, or alternatively public sector's share of the total number of firms. The 'micro' interpretation is more natural here. Privatization is simply the increase of α , that is, the transfer of ownership such that the control of the firm's managerial decisions passes from the public to the private sector.

Preferences

Under public enterprise regime, the manager just chooses the level of loan capital, or loan, D . The levels of loan are restricted to two, $D = \{D_L, D_H\}$; where $D_H > D_L > 0$. Let $\Delta D = D_H - D_L$. The authorities and the manager have preferences over the level of loan.

Let the state-authorities' utility function be $U_a = -\rho(1-\alpha)D$; and the firm manager's utility function be $U_m = \mu D - \alpha \lambda D$ where D is the level of loan. Their utility functions are given in dollar (currency) terms.

Left to themselves, the authorities will set $D=D_L$, whereas the management will set $D=D_H$. Why? The authorities have alternative and better uses of loan either by spending money on goods that benefits them directly or by spending money on projects that increases their likelihood of being reelected. For instances, the authorities can build presidential palaces, give employment subsidies, fund the army, or run food for work programs. The authorities will choose D_L because they have alternative uses of funds that are more rewarding to them. For the manager, it is best to get as high a loan as possible from state-owned banks for various reasons. The higher amount of loan can be used for over-invoicing, capital flights, conspicuous consumption, empire building, and so forth. The rate of interest can be below the market rate of interest. The state banks are unlikely to press for bankruptcy if the firm fails to repay. State banks care little about their asset quality in 'crony' capitalism. The manager does not worry about the foregone social cost of state loans.

For state authorities the benefit of an extra dollar of loan is $\alpha\rho$ and the cost of an extra dollar of loan is ρ . For the manager the benefit of extra dollar of loan is $\mu < 1$. However, an extra dollar of loan reduces the value of the firm's profit because the shareholders may rebuke her for incurring costs and losing money. But she does not directly care about foregone firm profits as a result of high loan. The cost to the manager as a result of loan accumulation per dollar is $\lambda < 1$ because she cares less about the firm's profit than obtaining bank loans. It is natural to set $\lambda < 1$ if the manager borrows below subsidized interest rate, the conditions for servicing the loan is flexible and can be renegotiated, or there are some possibility of loan-forgiveness or re-capitalization by the state. The collateral used as a mortgage for obtaining the loan can be of dubious value. As long as the authorities are not fully credible as loan collectors, or the credit collection mechanism is weak and ineffective, the manager's cost of an extra dollar of loan

is less than a dollar of loan. $\lambda < 1$ creates a bias for too much loan if the manager controls loan. The manager's cost of an extra dollar of loan is $\alpha\lambda$.

Control over loan is vital in this model. When the firm is under public enterprise regime, the firm's manager determines the level of loan. Thanks to the entrenched power of the bureaucracy the state-owned financial institutions oblige as is all often the case for public enterprises in economies with poor financial sector discipline. Thus, if the manager controls loan, she chooses $D=D_H$.

Public Enterprise Regime under 'Soft' Government

Suppose, under public enterprise regime, the firm manager controls D . She chooses $D=D_H$. Therefore, it must be the case that

$$\mu > \alpha\lambda \text{ (A)}$$

Specification (A) states the manager's private benefit of extra loan exceeds her cost of per dollar of profits foregone by the firm from such borrowing. The manager's control of loan leads to higher level of debt at public expense. This demonstrates the effect of lax financial discipline on the manager's behavior. Over borrowing leads to an inefficient level of loans at the expense of the public and other shareholders.

The authorities may bribe or offer some reward to induce the manager to set $D=D_L$. Assuming transferable utility functions, the authorities pay some amount, π , to have the manager borrow at the efficient level. π is the side payment under a performance contract that the authorities offer to induce an efficient outcome. It can be thought of as a bribe for efficient behavior.

The utility functions of the authorities and the manager are as follows:

$$U_a = -\rho(1-\alpha)D - \pi$$

$$U_m = \mu D - \alpha\lambda D + \pi.$$

The manager chooses the lower loan, D_L , if the combined utility is greater with the lower loan, D_L , than the combined utility with the higher loan, D_H .

Thus,

$$\rho(1-\alpha)+\alpha\lambda>\mu \text{ (B)}$$

If (B) holds, then the outcome with lower debt is realized. In condition (B) the left-hand side is the sum of the authorities' and the manager's benefit of lower debt and the right-hand side is the manager's cost of lower debt. If the sum of the authorities' and the manager's benefit of lower debt is greater than the manager's cost of lower debt, then an incentive scheme can lower the level of debt. Thus, with the incentive scheme, it is possible for the authorities to 'buy' an efficient level of loan.

(A) and (B), can be satisfied at the same time. However, if $\rho(1-\alpha)+\alpha\lambda\leq\mu$, then the efficient outcome is not realized.

The use of an incentive scheme, such as a transfer of π , is problematic due to the unenforceable nature of contracts in the public sector under 'soft' government. The record of successful application of performance contracts is rare. 'Soft' regimes have a notorious profile of failing to implement state edicts, little credibility and poor reputation. Consequently the manager would choose D_H , despite the contract, without fear for any reappraisal or any credible threat from the authorities.

Privatization Regime under 'Soft' Government

Does privatization bring about a radical change in outcome? After privatization, the state authorities rather than the firm management decide the level of loan: A high loan is approved if and only if the authorities approve. If the authorities set the level of loan, they would choose $D=D_L$. It may, thus, appear that after privatization the level of loans would decrease because the manager requires the authorities' approval to get loans from the state banks.

However, she can then simply 'buy' her way to higher loan. The manager is willing to give a 'gift' to the authorities of an amount M to get to a higher level of loan, D_H , rather than D_L .

$$M = \alpha M + (1 - \alpha)M$$

The net payment to the state authorities is αM . The cost to the manager for giving the gift is $\kappa \alpha M$. Here, $\kappa < 1$ because gift-giving from loan received is less expensive for the manager than paying from her own pocket. If the manager's cost of gift-giving is equal to paying for her own pocket, then $\kappa = 1$.

For the manager there are two parameters representing foregone profits, λ and κ . The first parameter measures the manager's cost of foregone firm profit and the second measures the manager's cost of the 'gift' to the authorities. If it is easier for the manager to lose the firm's profit than the sacrifice made to the authorities by giving the 'gift' then $\lambda < \kappa$, otherwise $\lambda \geq \kappa$. It is assumed here that $\lambda < \kappa$.

With such payments the utility functions of the authorities and the manager are respectively as follows:

$$U_a = -\rho(1 - \alpha)D + \alpha M$$

$$U_m = \mu D - \alpha \lambda D - \kappa \alpha M$$

Nash Bargaining

The authorities and the privatized firms engage in bargaining to set M . The bargain notion used here is that of Nash (1950 and 1953). Incremental utilities of switching from D_L to D_H for the authorities and the manager respectively are as follows,

$$\Delta U_a = -\rho(1 - \alpha)\Delta D + \alpha M$$

$$\Delta U_m = \mu \Delta D - \alpha \lambda \Delta D - \kappa \alpha M$$

$$M^* = (\Delta D)[\rho \kappa(1 - \alpha) + \mu - \alpha \lambda] / [2\kappa \alpha]$$

M^* is the optimal 'gift' level. The amount of 'gift' increases as the difference between high and low level of loan capital increases, as the authorities' marginal cost of loan increases, and the higher is the manager's marginal benefit of loan. But the higher the manager's firm profit, the higher cost of 'gift,' and higher the private sector's share of firm, the lower is the amount of 'gift.'

Plugging in the value of M^* obtains the following inequalities:

$$\kappa\rho(1-\alpha)+\alpha\lambda\geq\mu \text{ (C)}$$

$$\kappa\rho(1-\alpha)+\alpha\lambda<\mu \text{ (D)}$$

In (C) and (D) the left-hand side is the sum of the authorities' marginal cost of higher loan, adjusted by the cost of 'gift,' and the manager's cost of foregone firm profit and the right-hand side is the manager's benefit of higher loan. There is no bargaining if either party or both parties are worse off with $D=D_H$ and bribe payment. (C) implies that if the sum of the authorities' marginal cost of higher loan, adjusted by the 'gift' parameter, and the manager's marginal cost of foregoing firm profit is greater than or equal to the manager's marginal benefit of the higher loan then the 'gift' payment will not secure the higher loan. It can be called the ineffectual corruption inequality. If this inequality holds privatization works because it reduces the volume of state loans to the privatized firms. (D) implies that if the sum of the authorities' marginal cost of higher loan, adjusted by the gift parameter, and the manager's marginal cost of foregoing firm profit is less than to the manager's marginal benefit of higher loan then the 'gift' payment will secure the higher loan. It can be called the dysfunctional privatization inequality. If it holds, privatization fails to bring about any effective change and reproduces the inefficiency of public enterprises. In developing economies, it is possible that (D) rather than (C) holds. For realistic values of parameters dysfunctional privatization prevails over ineffectual corruption condition.

In a regime of 'soft' governance, the higher the authorities' reservation bribe payment, the more likely is an efficient outcome. The authorities with higher reservation bribe will demand a bribe payment that is too expensive for the manager. As a result, she will not pay. Hence, the authorities will refuse a higher loan, which results in a socially optimum outcome. The lower the authorities' reservation bribe payment, the less likely is an efficient outcome. The authorities with lower bribe reservation will demand a bribe that the manager can afford. As a result, the manager will agree to pay. Thus, the authorities will approve a higher loan, which results in a socially inefficient outcome.

Comparing (D) to (A) shows that (D) has the term $\kappa\rho(1-\alpha)$ which the authorities' marginal cost of sanctioning higher loans adjusted by the gift parameter.

Comparing (D) to (B) shows that (D) has the term $\kappa\rho(1-\alpha)$ while (B) has the term $\rho(1-\alpha)$. Since $\kappa\rho(1-\alpha) < \rho(1-\alpha)$, (D) may hold when (B) does not.

Interpretation

The results here demonstrate the importance of institutions and social rules. For a large subset of privatized firms, the results of the model are applicable in a regime of poor financial discipline and 'soft' governance, as is typical of developing economies. In many economies the ownership of the manufacturing firm is a means for acquiring state subsidized loans and politically directed credit, access to hard currency, import permits, licenses, and quotas, and so forth. Hence, when the state institutes 'reforms' there may not be any substantial improvement of the performance of firms but may be to be the same. A worsening of performance is possible too. Far from driving a wedge between the firm and the politician, privatization may not decrease corruption, lobbying, and nepotism. If the private manager has the politician in her pockets

or payroll, then the volume of directed credit may not subside and, as a result, resources can still be misdirected and misallocated. Hence, the level of public financing for the firm may persist after privatization. The unimpressive loan-repayment profile of privatized firms in Bangladesh would seem to vindicate a theory of dysfunctional privatization and the persistence of *rentier* industrial firms. The dysfunctional model of privatization may well be a reasonable account of the outcome of reforms in such context. A large number of reforms fail because they do not alter the fundamental institutional structures that perpetuate inefficiency.

IV. WELFARE THEORETIC TYPOLOGY FOR PRIVATIZATION

Following Bhagwati (1982), it will be argued here that privatization is not invariably welfare-enhancing. Although there are welfare gains that private ownership can bring about, privatization can be accompanied by various phenomena, such as under valuation of the net worth of the firm; tax evasion and avoidance; publicly leveraged buyouts of privatized firms; subsidized credit for the operation of privatized enterprises; exploitation of market power; protectionism; and 'insider' loans and trading, and so forth. All these activities are classic examples of profitable activities for the private agent without being directly productive. The private agent may earn economic incomes, using real resources, without contributing to output that enters into the social welfare (or utility) function by engaging in the above mentioned activities. An example of such directly unproductive activities in Bangladesh is the widespread tax non-registration following privatization, given in Akram (1998). An earlier section of this paper documents public subsidies for privatized firms through the banking system: Since firms are not being forced to repay money owed to public commercial banks, loans to defaulter firms are *de facto* transfer of public funds to private agents.

Table 11 provides a typography for analyzing the welfare consequence of privatization, considering the possibility of directly unproductive profit-seeking activities of agents in the economy.

[Insert Table 11 here]

If prior to privatization the economy is distorted but it remains so even after privatization, it is unclear whether there is any welfare gains (**Case I**). If the economy is distorted before privatization, but becomes distortion free after privatization, then privatization is welfare enhancing (**Case II**). If the economy is distortion free, but becomes distorted after privatization, then there is welfare loss (**Case III**). If a distortion free economy after privatization remains distortion free, then the welfare consequences are again ambiguous (**Case IV**). Privatization may be coupled with increased directly unproductive profit-seeking activities, which paradoxically can lead to outcomes that are welfare reducing. Privatization is welfare improving if and only if a set of conditions is fully satisfied. Privatization schemes can be classified from the viewpoint of social welfare into the following categories: (i) Welfare-enhancing privatization; (ii) welfare-neutral privatization; and, (iii) welfare-reducing privatization.

Privatization does not foreclose the possibility for welfare loss. Therefore, to ensure success, privatization must be accompanied by a host of policy measures, such as proper valuation and assessment; financial sector discipline; enforcement of bankruptcy laws; effective tax administration; elimination of tax breaks, concessions, and subsidies; regulation of oligopoly markets; trade liberalization; and so forth, which promote market discipline, competition, and accountability of the privatized firm. ■

FOOTNOTES

1. Monitoring Cell, Finance Division, Ministry of Finance, Government of Bangladesh (1998).
2. US\$1 = Taka 50 (May 1998).
3. Bangladesh Bank (1998).

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	Dec-91	Jun-92	Dec-92	Jun-93	Dec-93	Jun-94	Dec-94	Jun-95	Dec-95	Jun-96	Dec-96	Jun-97
Public Sector												
Government	2,014.8	2,413.3	1,776.2	1,347.0	1,697.1	1,727.5	1,649.5	2,071.9	1,983.6	4,374.7	3,017.2	4,853.4
Autonomous and Semi-Autonomous Bodies	4,627.6	4,736.4	5,260.3	5,536.8	6,327.5	5,666.3	6,548.6	8,686.9	5,749.4	5,694.6	5,999.8	8,077.7
Financial Institutions	42.2	422.2	30.5	1,351.7	39.8	1,341.7	403.4	28.5	163.3	44.3	130.2	1,795.5
Non-Financial Public Enterprises	37,093.9	39,026.8	35,696.0	43,150.4	45,646.8	32,550.6	30,908.6	35,193.0	30,315.3	27,933.7	29,483.6	32,807.9
Nationalized Sector Corporations	36,203.9	38,120.0	34,773.4	42,371.3	44,742.8	31,888.6	29,747.2	33,840.1	28,625.4	25,987.8	27,599.7	30,458.2
Others	890.0	906.8	922.6	779.1	904.0	66.2	1,161.4	1,352.9	1,689.9	1,945.9	1,883.9	2,349.7
Local Authorities	434.8	516.1	352.2	463.0	434.1	1,193.7	605.9	632.2	718.7	715.2	1,676.8	1,798.8
Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	44,213.3	47,114.8	43,115.2	51,848.9	54,145.3	42,478.9	40,116.0	46,612.5	38,930.3	38,762.5	40,307.6	47,333.3
Private Sector												
Agriculture	31,955.8	36,117.3	37,607.0	38,672.9	40,040.9	42,867.5	45,012.3	47,593.6	49,338.2	53,005.3	53,726.0	55,403.2
Manufacturing	59,892.4	62,237.7	71,388.1	72,863.3	75,837.9	83,614.9	87,889.8	94,567.5	106,942.9	116,779.8	124,215.4	133,160.3
Commerce & Trade	57,403.4	63,018.4	67,935.7	74,035.8	78,501.3	78,745.8	90,078.9	98,134.2	108,379.7	114,300.3	122,203.2	123,227.2
Transport & Storage	4,105.7	4,780.3	4,394.1	4,325.6	4,307.6	2,573.4	3,993.2	5,729.0	5,723.1	11,516.0	6,464.6	7,036.7
Construction	5,725.2	6,330.5	6,448.6	6,810.9	7,278.4	7,930.4	8,527.8	7,946.9	8,236.8	8,595.6	9,110.4	9,092.8
Private Trust Fund & Non-Profit Organizations	683.3	686.6	715.3	799.4	761.5	336.8	298.8	256.4	169.7	155.5	148.9	100.8
Financial Institutions	1,698.1	1,780.5	2,188.8	2,146.2	2,350.6	2,820.9	3,899.2	4,802.3	5,451.2	4,417.6	6,127.0	5,538.4
Professionals & Self-Employed	5,368.5	5,730.6	6,049.3	6,835.1	8,044.1	7,648.7	8,097.8	8,742.1	8,567.6	11,076.0	11,673.9	13,495.0
Foreign Official Sector & Foreign Firms	2,899.1	2,722.9	2,627.8	2,575.5	2,888.1	3,088.1	3,684.9	3,808.2	3,836.4	3,729.7	4,005.5	3,639.6
Others	5,660.6	5,175.9	6,628.9	7,380.1	7,978.1	11,166.0	11,403.0	11,601.9	13,109.3	9,322.1	17,702.4	19,618.6
Total	174,892.1	188,580.7	205,984.0	216,444.8	227,988.5	240,792.5	262,885.7	283,182.1	309,754.9	332,897.9	355,377.3	370,312.3
Grand Total	219,105.4	235,695.5	249,099.2	268,293.7	282,133.8	283,271.4	303,001.7	329,794.6	348,685.2	371,660.4	395,684.9	417,645.6
Ratio of PE/PvtManf Credit (in percent)	61.9	62.7	50.0	59.2	60.2	38.9	35.2	37.2	28.3	23.9	23.7	24.6
Ratio of Public/Private Credit (in percent)	25.3	25.0	20.9	24.0	23.7	17.6	15.3	16.5	12.6	11.6	11.3	12.8

Source: Bangladesh Bank, various years

	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
<i>In Million Tk</i>								
Investment	95,955	109,851	135,214	158,927	194,651	221,200	242,427	250,507
Private	48,562	60,063	74,406	80,676	110,172	139,343	151,263	157,064
Public	47,393	49,788	60,808	78,251	84,479	81,857	91,164	93,443
As percent of Gross Domestic Product								
Investment	11.50	12.12	14.26	15.42	16.63	16.99	17.29	16.26
Private	5.82	6.63	7.85	7.83	9.41	10.71	10.78	10.19
Public	5.68	5.49	6.41	7.59	7.22	6.29	6.50	6.06

Source: Bangladesh Bureau of Statistics, various years.

Table 3				
Summary Position of Outstanding and Overdue Loans Taka 100 Million & above				
<i>In Million Taka</i>				
Sector	No of Borrowers	Total Outstanding	Total Overdue	Share of Overdue
<i>Public</i>	27	24,970	20,550	82.3
<i>Private</i>	165	43,720	36,720	84.0
Total	192	68,690	57,270	83.4
Source: Bangladesh Bank (1998)				

Table 4			
Debt-Default Status of Privatized Firms			
<i>In million Taka</i>			
	No of Firms	Loan Amount	Av. Amount
Total number of firms	201		
Firms for which information is unavailable	73		
Firms for which information is available	128		
Firms with overdue loans	77	12,652.0	164.31
Firms with outstanding but no overdue loans	33	2,697.8	81.75
Firms with neither overdue nor outstanding loans	18	0.0	0.0
Firms with overdue and outstanding loans	110	15,349.8	139.54
Source: Bangladesh Bank (1997)			

Table 5			
Outstanding and Overdue Loans of Privatized Firms			
<i>In million Taka</i>			
Range	No of Firms	Amount Outstanding	Av. Amount
<i>Outstanding Loans</i>			
1.0 - 5.0	13	28.2	2.17
5.1 - 10.0	4	29.4	7.35
10.1 - 20.0	11	164.8	14.98
20.1 - 50.0	15	497.7	33.18
50.1 - 100.0	19	1,495.7	78.72
100.1 - 500.0	44	10,522.4	239.15
500.1 - 1,000.0	4	2,611.6	652.90
Total	110	15,349.8	139.54
<i>Overdue Loans</i>			
Up to 5.0	10	26.3	2.63
5.1 - 10.0	11	79.2	7.20
10.1 - 20.0	7	105.8	15.11
20.1 - 50.0	20	720.4	36.02
50.1 -100.0	15	1,057.3	70.49
100.1 -500.0	14	3,707.5	264.82
500.1 - 1,000.0	0	0.0	na
Total	77	5,696.9	73.99
Source: Bangladesh Bank (1997)			

Table 6			
Debt-Default Status of Operational Privatized Firms			
<i>In million Taka</i>			
	No of Firms	Loan Amount	Av. Amount
Total Number of Firms	88		
Firms for which information is unavailable	16	na	na
Firms for which information is available	72	na	na
Firms with overdue loan	42	7,547.7	179.71
Firms with outstanding but not overdue loan	21	2,468.7	117.56
Firms with neither overdue nor outstanding loans	9	0.0	0.00
Firms with overdue & outstanding loans	63	10,016.4	158.99
Source: Bangladesh Bank (1997)			

Table 7			
Outstanding and Overdue Loans of Operational Privatized Firms			
<i>In Million Taka</i>			
Range	No of Firms	Amount Outstanding	Av. Amount
<i>Outstanding Loans</i>			
1.0 to 5.0	2	6.4	3.20
5.1 to 10.0	2	13.7	6.85
10.1 to 20.0	7	100.0	14.29
20.1 to 50.0	6	220.2	36.70
50.1 to 100.0	14	1,120.1	80.01
100.1 to 500.0	30	6,989.0	232.97
500.1 and above	2	1,567.0	783.50
Total	63	10,016.4	158.99
<i>Overdue Loans</i>			
1.0 to 5.0	8	23.5	2.94
5.1 to 10.0	8	57.8	7.23
10.1 to 20.0	5	74.9	14.98
20.1 to 50.0	13	418.4	32.18
50.1 to 100.0	2	130.2	65.10
100.1 to 500.0	6	1,601.5	266.92
Total	42	2,306.3	54.91
Source: Bangladesh Bank (1997)			

Table 8			
Debt-Default Status of Selected 13 Firms			
<i>In million Taka</i>			
	No of Firms	Amount	Av. Amount
Total number of firms	13		
Firms for which information is not available	2		
Firms for which information is available	11		
Firms with overdue loans	5	814.7	162.94
Firms who have outstanding loans but not overdue	3	189.8	63.27
Firms with neither outstanding or overdue loans	3	0.0	0.00
Total	8	1,004.5	125.56
Source: Bangladesh Bank (1998)			

Table 9			
Outstanding and Overdue Loans of Selected 13 Firms			
<i>In million Taka</i>			
Range	No of Firms	Amount	Av. Average
<i>Outstanding Loans</i>			
1 to 5	0	0	0
5.1 to 10	1	8.4	8.40
10.1 to 20.0	1	13.8	13.80
20.1 to 50.0	2	75.5	37.75
50.1 to 100.0	1	61.4	61.40
100.1 to 500.0	2	338.0	169.00
500.1 to 1,000	1	507.4	507.40
Total	8	1,004.5	125.56
<i>Overdue Loans</i>			
Upto 5.0	2	3.6	1.8
5.1 to 10.0	0	na	na
10.1 to 20.0	0	na	na
20.1 to 50.0	0	na	na
50.1 to 100.0	1	61.4	61.4
100.1 to 500.0	1	223.7	223.7
500.1 to 10,000.0	1	504.2	504.2
Total	5	792.9	158.58
Source: Bangladesh Bank (1998)			

Table 10			
Debt-Default Status of Selected Privatized Firms			
<i>In million Taka</i>			
	No of Firms	Amount of Loans	Av. Amount
Total number of firms	63		
Firms for which information is not available	4	na	na
Firms for which information is available	59	na	na
Firms who have overdue loan	51	9,433.0	184.96
Firms who have outstanding but not overdue loan	8	875.3	109.41
Firms who have neither overdue not outstanding loan	0	na	na
Total	59	10,308.3	174.72
Source: Bangladesh Bank (1998)			

Net Entry & Net Exit Patterns of Bangladesh's Manufacturing Industries

Tanweer Akram*

Draft: January 28, 2001

* Department of Economics, Columbia University, New York, NY 10027, USA.
Email: ta63@columbia.edu

Net Entry & Net Exit Patterns of Bangladesh's Manufacturing Industries

Abstract

This paper provides an empirical analysis of net entry & net exit patterns of manufacturing industries in Bangladesh. The analysis is based on a panel data set consisting of five census years' three-digit level data from the Bangladesh Census of Manufacturing Industries. (JEL L60, D21)

Keywords: Entry, Exit, Bangladesh

Net Entry & Exit Patterns of Bangladesh's Manufacturing

Industries

Introduction

This paper analyzes the net entry and net exit of manufacturing establishments in Bangladesh. Section I describes the data source, the data set, and the variables used in the paper. It also explains how net entry & net exit of manufacturing establishment are calculated. Section II reports the findings of the study.

(I) Calculating Net Entry & Exit of Manufacturing Establishments

This paper uses a panel or longitude data set of three-digit manufacturing establishments in Bangladesh. The panel data is based on Bangladesh Bureau of Statistics' *Bangladesh Census of Manufacturing Industries* and *Statistical Yearbook of Bangladesh* (Bangladesh Bureau of Statistics, various years). The industries are classified according to Bangladesh Standard Industrial Classification (BSIC) as maintained by the Bangladesh Bureau of Statistics (BBS).

The Bangladesh Bureau of Statistics is the main state organization responsible for collecting data and publishing national statistics. It is authorized under Industrial Statistics Act (1942) to conduct the census. Until 1988-89, the census solely covered all industrial units regulated by the Factories Act and registered with the Chief Inspector of Factories. However, since 1988-89, the coverage of the census was extended to incorporate all manufacturing units,

even those not registered with the Chief Inspector of Factories. As a result of the extension of the census coverage, the number of units whose data are reported increased sharply in recent censuses.

Industry Code (IND CODE) is the three-digit classification of industries in accordance with Bangladesh Standard Industrial Classification maintained by the Bangladesh Bureau of Statistics.

Establishment (ESTB) is a unit or plant engaged in the production of homogenous group of goods at a single physical location. A single owning or controlling entity operates an establishment.

Establishments are classified according to the form of ownership into three groups: 'Public,' 'private,' and 'joint ventures.' 'Public' designates state-owned enterprises. 'Private' means establishments under private ownership. 'Joint ventures,' are, either fully or partially, foreign-owned establishments.

The paper reports the net entry and net exit patterns of three-digit manufacturing industries in Bangladesh for five census years: 1985-86, 1986-87, 1987-88, 1990-91, and 1990-92. Since the coverage of establishments was increased in the census after 1989-90, the census years are placed into two groups into order to make meaning comparisons. The years 1985-86, 1986-87, and 1987-88 constitute the first group. The years 1990-91 and 1991-92 constitute the second group. For both groups, the net change and the percentage of net change in the

number of establishments per year are calculated. These calculations are provided for each three-digit industry by different forms of establishment ownership. In sectors where there were no establishments before and none has entered subsequently, the absence of change is designated as no entry (ne); and where at least one establishment subsequently entered in a sector where there was no establishment before, the change is designated as entry (e).

(II) Findings and Interpretations

The findings of study are reported in Table 1 for the census year 1985-86, 1986-87, and 1987-88 and in Table 2 for the census years 1990-91 and 1991-92. Table 1 provides the net entry & net exit data for 35 manufacturing industries and Table 2 gives the net entry & exit data for 39 manufacturing industries.

During the census years 1985-86 and 1986-87, the net increase in the number of establishments was only 46 (1 percent) raising the total number of establishments from 4,473 to 4,519. During the following census year, the net increase in the number of establishment was 274 (6.1 percent) raising then number of establishments to 4,793. The number of private establishment increased the most. The net increase of private establishments was 47 (1.1 percent) between 1985-86 to 1986-87 and 272 (6.3 percent) the following census year. However, the rate of net entry was higher for joint ventures. The net entry of joint ventures was 3 (12 percent) between 1985-86 and 1986-87 and 5 (18

percent) between 1986-87 and 1987-88. The net exit of public establishments between 1985-86 and 1986-87 was 4 (2.3 percent) and between 1986-87 and 1987-88 was 3 (1.8 percent).

{Insert Table 1 here}

During the census years 1990-91 and 1991-92, the net increase in the total number of establishments was 556 (2.1 percent) from 25,890 to 26,446. The highest net increase of establishments was in the private sector, 548 (2.1 percent); but the rate of net entry was higher for joint ventures 28 (55 percent). Between 1990-91 and 1991-92, the net exit of public establishments was 20 (8.7 percent).

{Insert Table 2 here}

The number of establishments in Bangladesh's private sector has increased due to greater private participation in the economy, deregulation, liberalization, and privatization. The number of public sector's manufacturing establishments has been curtailed because of few shutdowns and closures and some privatization. There has been an increase in the number of joint ventures in manufacturing sector, reflecting policy changes that removed restrictions to foreign investors and external manufacturing collaborators in Bangladesh.

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Table 1									
CMI	Ind Code	Industry	Number of Firms						
			1985-86	1986-87	1987-88	1985-86 to 1986-87	1985-86 to 1986-87	1986-87 to 1987-88	1986-87 to 1987-88
			ESTB	ESTB	ESTB	Change	%Change	Change	%Change
	311	Food Manufacturing							
		Public	5	4	3	-1	-20.0	-1	-25.0
		Private	323	320	319	-3	-0.9	-1	-0.3
		Joint Venture	0	0	0	0	ne	0	ne
	312	Food Manufacturing							
		Public	29	30	28	1	3.4	-2	-6.7
		Private	269	277	284	8	3.0	7	2.5
		Joint Venture	1	0	1	-1	-100.0	1	e
	313	Beverage Industry							
		Public	2	2	1	0	0.0	-1	-50.0
		Private	4	4	5	0	0.0	1	25.0
		Joint Venture	0	0	0	0	ne	0	ne
	314	Tobacco Manufacturing							
		Public	1	0	0	-1	-100.0	0	ne
		Private	20	17	19	-3	-15.0	2	11.8
		Joint Venture	4	5	4	1	25.0	-1	-20.0
	315	Animal Feeds/byproducts							
		Public	0	0	0	0	ne	0	ne
		Private	3	3	3	0	0.0	0	0.0
		Joint Venture	0	0	0	0	ne	0	ne
	321	Manufacture of Textile							
		Public	72	74	77	2	2.8	3	4.1
		Private	1,755	1,770	2,028	15	0.9	258	14.6
		Joint Venture	0	0	0	0	ne	0	ne
	322	Manufacture of Textile							
		Public	2	2	2	0	0.0	0	0.0
		Private	219	211	209	-8	-3.7	-2	-0.9
		Joint Venture	0	0	0	0	ne	0	ne
	323	Wearing Apparel							
		Public	0	0	0	0	ne	0	ne
		Private	42	78	81	36	85.7	3	3.8
		Joint Venture	2	1	3	-1	-50.0	2	200.0
	324	Leather and its Products							
		Public	0	0	0	0	ne	0	ne
		Private	140	136	132	-4	-2.9	-4	-2.9
		Joint Venture	0	0	0	0	ne	0	ne
	326	Ginning & Pressing							
		Public	2	2	2	0	0.0	0	0.0
		Private	21	21	20	0	0.0	-1	-4.8
		Joint Venture	0	0	1	0	ne	1	e

331	Wood & Cork Products							
	Public	3	4	4	1	33.3	0	0.0
	Private	30	28	28	-2	-6.7	0	0.0
	Joint Venture	0	0	0	0	ne	0	ne
332	Furniture Manufacturing							
	Public	7	6	7	-1	-14.3	1	16.7
	Private	11	11	11	0	0.0	0	0.0
	Joint Venture	0	0	0	0	ne	0	ne
341	Paper & its Products							
	Public	5	5	5	0	0.0	0	0.0
	Private	23	23	23	0	0.0	0	0.0
	Joint Venture	0	0	0	0	ne	0	ne
342	Printing & Publishing							
	Public	2	2	2	0	0.0	0	0.0
	Private	180	177	178	-3	-1.7	1	0.6
	Joint Venture	0	0	0	0	ne	0	ne
351	Drugs & Pharmaceuticals							
	Public	1	1	1	0	0.0	0	0.0
	Private	177	176	176	-1	-0.6	0	0.0
	Joint Venture	10	9	9	-1	-10.0	0	0.0
352	Industrial Chemicals							
	Public	7	7	6	0	0.0	-1	-14.3
	Private	17	17	18	0	0.0	1	5.9
	Joint Venture	0	1	1	1	e	0	0.0
353	Other Chemical Products							
	Public	3	3	3	0	0.0	0	0.0
	Private	209	210	211	1	0.5	1	0.5
	Joint Venture	4	5	5	1	25.0	0	0.0
354	Petroleum Products							
	Public	1	1	1	0	0.0	0	0.0
	Private	0	0	0	0	ne	0	ne
	Joint Venture	0	0	0	0	ne	0	ne
355	Misc. Petroleum Products							
	Public	1	1	1	0	0.0	0	0.0
	Private	12	12	12	0	0.0	0	0.0
	Joint Venture	0	0	0	0	ne	0	ne
356	Mfg. of Rubber Products							
	Public	1	1	1	0	0.0	0	0.0
	Private	33	33	34	0	0.0	1	3.0
	Joint Venture	0	0	0	0	ne	0	ne
357	Mfg. of Plastic Products							
	Public	2	1	1	-1	-50.0	0	0.0
	Private	43	43	42	0	0.0	-1	-2.3
	Joint Venture	0	0	0	0	ne	0	ne
361	Pottery and Chinaware							
	Public	0	0	0	0	ne	0	ne
	Private	6	6	6	0	0.0	0	0.0
	Joint Venture	0	1	1	1	e	0	0.0
362	Glass and its Products							
	Public	0	0	0	0	ne	0	ne

	Private	35	32	32	-3	-8.6	0	0.0
	Joint Venture	0	0	0	0	ne	0	ne
369	Non-Metal Mineral Product							
	Public	2	2	2	0	0.0	0	0.0
	Private	16	17	18	1	6.3	1	5.9
	Joint Venture	1	1	1	0	0.0	0	0.0
371	Iron & Steel Basic Industry							
	Public	4	4	4	0	0.0	0	0.0
	Private	56	54	56	-2	-3.6	2	3.7
	Joint Venture	0	0	0	0	ne	0	ne
372	Non- Ferrous Metal Inds							
	Public	1	1	1	0	0.0	0	0.0
	Private	1	1	1	0	0.0	0	0.0
	Joint Venture	0	0	0	0	ne	0	ne
381	Structural Metal Product							
	Public	2	2	1	0	0.0	-1	-50.0
	Private	179	180	181	1	0.6	1	0.6
	Joint Venture	0	0	1	0	ne	1	e
382	Fabricated Metal Product							
	Public	2	2	2	0	0.0	0	0.0
	Private	143	146	147	3	2.1	1	0.7
	Joint Venture	0	0	0	0	ne	0	ne
383	Non-Electrical Machinery							
	Public	4	3	4	-1	-25.0	1	33.3
	Private	121	123	120	2	1.7	-3	-2.4
	Joint Venture	0	1	1	1	e	0	0.0
384	Electrical Machinery							
	Public	8	5	3	-3	-37.5	-2	-40.0
	Private	64	71	74	7	10.9	3	4.2
	Joint Venture	3	4	5	1	33.3	1	25.0
385	Transport Equipment							
	Public	5	5	5	0	0.0	0	0.0
	Private	39	41	43	2	5.1	2	4.9
	Joint Venture	0	0	0	0	ne	0	ne
386	Scientific, Precision Inst., etc							
	Public	0	0	0	0	ne	0	ne
	Private	2	2	1	0	0.0	-1	-50.0
	Joint Venture	0	0	0	0	ne	0	ne
387	Photographic, Optical							
	Public	0	0	0	0	ne	0	ne
	Private	6	6	6	0	0.0	0	0.0
	Joint Venture	0	0	0	0	ne	0	ne
393	Other Manufacturing Ind.							
	Public	0	0	0	0	ne	0	ne
	Private	61	61	63	0	0.0	2	3.3
	Joint Venture	0	0	0	0	ne	0	ne
394	Other Manufacturing Ind.							
	Public	0	0	0	0	ne	0	ne
	Private	9	9	7	0	0.0	-2	-22.2
	Joint Venture	0	0	0	0	ne	0	ne

Total	Public	174	170	167	-4	-2.3	-3	-1.8
	Private	4,274	4,321	4,593	47	1.1	272	6.3
	Joint Venture	25	28	33	3	12.0	5	17.9
	Gr. Total	4,473	4,519	4,793	46	1.0	274	6.1

Note: e: Entry, ne: No Entry

CMI	Ind Code	Industry	Number of Firms			
			1990-91 ESTB	1991-92 ESTB	1990-91 to 1991-92 Change	1990-91 to 1991-92 % Change
	311	Food Manufacturing				
		Public	10	5	-5	-50.0
		Private	4,077	4,008	-69	-1.7
		Joint Venture	6	20	14	233.3
	312	Food Manufacturing				
		Public	25	22	-3	-12.0
		Private	1,600	1,673	73	4.6
		Joint Venture	10	8	-2	-20.0
	313	Beverage Industry				
		Public	0	1	1	e
		Private	9	11	2	22.2
		Joint Venture	0	0	0	ne
	314	Tobacco Manufacturing				
		Public	0	0	0	ne
		Private	417	465	48	11.5
		Joint Venture	1	1	0	0.0
	315	Animal Feed/Byproduct				
		Public	0	0	0	ne
		Private	9	8	-1	-11.1
		Joint Venture	0	0	0	ne
	321	Manufacture of Textile				
		Public	97	113	16	16.5
		Private	11,069	11,212	143	1.3
		Joint Venture	0	1	1	e
	322	Manufacture of Textile				
		Public	4	3	-1	-25.0
		Private	1,421	1,482	61	4.3
		Joint Venture	0	0	0	ne
	323	Wearing Apparel				
		Public	0	0	0	ne
		Private	722	676	-46	-6.4
		Joint Venture	0	9	9	e
	324	Leather and its Products				
		Public	0	0	0	ne
		Private	311	309	-2	-0.6
		Joint Venture	0	0	0	ne
	325	Footwear Except Rubber				
		Public	0	0	0	ne

	Private	74	77	3	4.1
	Joint Venture	0	0	0	ne
326	Ginning & Pressing				
	Public	9	3	-6	-66.7
	Private	40	43	3	7.5
	Joint Venture	0	0	0	ne
327	Embro. Of Textile Good				
	Public	0	0	0	ne
	Private	21	7	-14	-66.7
	Joint Venture	0	0	0	ne
331	Wood & Cork Products				
	Public	7	1	-6	-85.7
	Private	954	1,136	182	19.1
	Joint Venture	0	0	0	ne
332	Furniture Manufacturing				
	Public	7	3	-4	-57.1
	Private	250	223	-27	-10.8
	Joint Venture	0	0	0	ne
341	Paper & its Products				
	Public	7	3	-4	-57.1
	Private	51	88	37	72.5
	Joint Venture	0	0	0	ne
342	Printing & Publishing				
	Public	1	0	-1	-100.0
	Private	663	744	81	12.2
	Joint Venture	0	0	0	ne
351	Drugs & Pharmaceuticals				
	Public	4	5	1	25.0
	Private	180	223	43	23.9
	Joint Venture	10	3	-7	-70.0
352	Industrial Chemicals				
	Public	10	10	0	0.0
	Private	42	38	-4	-9.5
	Joint Venture	4	3	-1	-25.0
353	Other Chemical Products				
	Public	3	3	0	0.0
	Private	287	289	2	0.7
	Joint Venture	3	3	0	0.0
354	Petroleum Refining				
	Public	1	1	0	0.0
	Private	0	0	0	ne
	Joint Venture	0	0	0	ne
355	Misc. Petroleum Products				
	Public	0	0	0	ne
	Private	4	6	2	50.0
	Joint Venture	0	0	0	ne
356	Mfg. of Rubber Products				
	Public	1	1	0	0.0
	Private	127	178	51	40.2
	Joint Venture	1	1	0	0.0

357	Mfg. of Plastic Products				
	Public	1	1	0	0.0
	Private	199	166	-33	-16.6
	Joint Venture	0	0	0	ne
361	Pottery and Chinaware				
	Public	0	0	0	ne
	Private	418	349	-69	-16.5
	Joint Venture	0	0	0	ne
362	Glass & its Products				
	Public	27	1	-26	-96.3
	Private	1	21	20	2,000.0
	Joint Venture	0	3	3	e
369	Non-Metal Mineral Product				
	Public	1	3	2	200.0
	Private	522	590	68	13.0
	Joint Venture	1	1	0	0.0
371	Iron & Steel Basic Industry				
	Public	10	10	0	0.0
	Private	191	175	-16	-8.4
	Joint Venture	0	7	7	e
372	Non-Ferrous Metal Industry				
	Public	0	0	0	ne
	Private	3	11	8	266.7
	Joint Venture	0	0	0	ne
381	Structural Metal Product				
	Public	3	1	-2	-66.7
	Private	649	615	-34	-5.2
	Joint Venture	0	0	0	ne
382	Fabricated Metal Product				
	Public	3	1	-2	-66.7
	Private	323	335	12	3.7
	Joint Venture	0	0	0	ne
383	Non-Electrical Machinery				
	Public	3	7	4	133.3
	Private	111	139	28	25.2
	Joint Venture	0	0	0	ne
384	Electrical Machinery				
	Public	6	3	-3	-50.0
	Private	390	385	-5	-1.3
	Joint Venture	6	12	6	100.0
385	Transport Equipment				
	Public	15	9	-6	-40.0
	Private	168	167	-1	-0.6
	Joint Venture	1	1	0	0.0
386	Scientific Precision Inst. Etc.				
	Public	0	0	0	ne
	Private	10	9	-1	-10.0
	Joint Venture	0	0	0	ne
387	Photographic, Optical Goods				
	Public	0	0	0	ne

	Private	44	14	-30	-68.2
	Joint Venture	0	0	0	ne
389	Steel & Iron Manufacturing				
	Public	0	0	0	ne
	Private	0	28	28	e
	Joint Venture	0	0	0	ne
391	Decorative Handicrafts				
	Public	0	0	0	ne
	Private	12	10	-2	-16.7
	Joint Venture	0	0	0	e
393	Other Manufacturing Ind.,				
	Public	0	0	0	ne
	Private	192	228	36	18.8
	Joint Venture	0	0	0	e
394	Other Manufacturing Ind.,				
	Public	0	0	0	ne
	Private	19	19	0	0.0
	Joint Venture	0	0	0	na
Total	Public	230	210	-20	-8.7
	Private	25,609	26,157	548	2.1
	Joint Venture	51	79	28	54.9
	Gr. Total	25,890	26,446	556	2.1
Note: e: Entry; ne: No Entry					

PART C: FOREIGN AID REGIME

The International Foreign Aid Regime

Who Gets Foreign Aid and How Much?

Tanweer Akram*

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* *Correspondence Address:* 5550 Columbia Pike, Apt 803, Arlington, VA 22204, USA. *Academic Affiliation:* Department of Economics, Columbia University, 420 W 118th St., New York, NY 10027, USA. *Email:* ta63@columbia.edu.

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The International Foreign Aid Regime

Who Gets Foreign Aid and How Much?

Abstract

This paper analyzes the data on international foreign aid. It examines the basic data on who gets foreign aid, how much, how aid dependent are the recipient countries, and how the international foreign aid regime has evolved. It is argued that the pattern of the flow of foreign aid suggests that aid provided has little relationship to human needs in developing and transitional countries. (JEL F35, O1, O10, O19)

Keywords: Foreign aid, official development assistance, official aid, unilateral transfers

The International Foreign Aid Regime

Who Gets Foreign Aid and How Much?

Introduction

International donors claim that they provide foreign aid to developing and transitional countries in order to assist these countries in raising the level of per capita income through economic growth, improvement of infrastructure and industry, strengthening of administrative capability, and so on. This paper examines the simple empirics of who gets foreign aid, how much and how the international foreign aid regime has evolved. In particular, it ranks countries in terms of volume of foreign aid and per capita foreign aid received. It then proceeds to rank countries' aid dependency according to the level of foreign aid received in comparison to recipient countries' central government expenditure, gross capital formation, trade, and gross national income. It is argued that the data shows that the overall flow of foreign aid bears no relationship to human needs in developing and transitional countries.

Although there is an earlier literature on foreign aid (such as Friedman 1958), various debates in the literature on international foreign aid regime received stimulus from Boone's (1994 and 996) findings that foreign aid is often

used for wasteful public consumption. Alesina and Dollar (2000) examine who gives aid to whom and why. They report that disbursement of aid follows the strategic consideration of donor countries rather than the needs of the recipient countries. Alesina and Weder (2002) show that corrupt governments receive more aid than less corrupt ones.

This essay contributes to the literature by examining the evolution of international foreign aid regime and showing that the pattern of aid disbursements do not seem to have any ties with needs in developing and transitional economies. It uses a more comprehensive data set than the one used in Alesina and Dollar's (2000) study. It also examines how aid dependency has evolved over time. Whereas Alesina and Dollar's objective is to discern what are the determinants of foreign aid disbursement, the objective of this essay is to assess whether aid disbursement is allocated to those countries that need it the most.

The essay is organized as follows. Section I discusses the questions of interest in this essay. Section II presents the data. Section III discusses the evolution of international foreign aid regime by looking at key indicators of foreign aid and aid dependency. Section IV discusses empirically whether the per capita income in recipient countries influences the level of aid received. The last section concludes.

Section I: Questions

The questions that are asked here are: Who gets foreign aid? Do more needy countries receive more or less foreign aid than the less needy? How aid dependent are the countries? How has the international foreign aid regime evolved over time? Are aid recipient countries becoming less dependent over time? Raising these questions may help one to understand the evolution and the efficacy of international aid regime.

Section II: Data

Data on foreign aid is obtained from the World Bank's (2002) *World Development Indicators* database from 1960-2000 (41 years) for all countries and territories on which data is available.

Foreign aid consists of net official development assistance and net official aid. Net official development assistance consists of disbursements of loans made under concession terms (net of repayment of principal) and grants by official agencies of the member countries of Development Assistance Committee (DAC), by multilateral agencies, and by non-DAC countries. This includes loans with a grant element of at least 25 percent, and technical cooperation and assistance. Net official aid refers to aid flows, net of repayments, to transitional economies. Official aid is provided under terms and conditions similar to those for official development assistance.

It may be noted that foreign aid is not just official development assistance and official aid but involves military aid, tax deductible contributions through the donations of private and public institutions, special grants, subsidies, services and various economic concessions, such as low cost equipment. However, the data set available from the World Bank only covers official development assistance and official aid. In this essay, therefore, analysis of foreign aid is restricted to official development assistance and official aid.

Section III: Evolution of International Foreign Aid Regime

The evolution of international foreign aid regime can be understood by looking at how key variables, such as volume of foreign aid, per capita foreign aid, and aid dependency ratios have changed over time.

Volume of Foreign Aid

Volume of foreign aid includes both official development assistance and official aid. Table [1] provides the list of top ten recipient countries of foreign aid (official development assistance and official aid) in 1960, 1970, 1980, 1990, and 2000. It gives a brief overview of the evolution of the main recipients of aid over time. A number of countries have remained persistent beneficiaries of aid, such as India, Egypt, and Indonesia. Vietnam and South Korea, which were large recipients of aid in 1960 and 1970, were no longer among the top ten recipients of aid in 1980, 1990 or 2000. Pakistan was also in the list in 1960, 1970, and 1980 but

not in 1990 or 2000. Bangladesh has been in the list in 1980, 1990, and 2000.

China and Poland were among the major recipients of aid in 1990 and 2000 but not before. The listing show that some countries like India, Egypt, and Indonesia still require a large volume of aid, whereas a country like South Korea no longer requires aid flow.*

[Insert Table [1] here]

Per Capita Foreign Aid

Aid per capital includes both official development assistance and official aid. Table [2] provides a list of countries ranked in terms of foreign aid per capita in 1960, 1970, 1980, 1990 and 2000, along with the amount of aid per capita received in those years. The countries with highest per capita foreign aid are small countries in the Pacific, such as New Caledonia, French Polynesia, Marshall Islands, Micronesia, Aruba, and a few small African countries, such as Seychelles, Sao Tome & Principe, Djibouti, Cape Verde, and Tonga. In 1960s, a few Middle Eastern and Mediterranean nations, such as Jordan, Israel, Cyprus, Malta, Algeria, and Libya, had the highest foreign aid per capita. Jordan remained in the list in 1970.

[Insert Table [2] here]

* South Korea did have to rely on IMF loans during the Asian Financial Crisis.

Aid Dependency Ratios

Aid dependency ratios are calculated using values in US dollars converted at official exchange rates. These ratios indicate how dependent the recipient countries are on foreign aid. Data on several key aid dependency ratios are provided. These are: (a) aid as a percentage of central government expenditure; (b) aid as a percentage of gross capital formation; (c) aid as a percentage of international trade; and (d) aid as a percentage of gross national income.

Aid as a Percentage of Central Government Expenditure

Central government expenditure includes both current and capital expenditures. It does not include government lending or repayments to the government or government acquisition of equity for public purposes. Table [3] gives a list of top ten countries in terms of aid as a percentage of central government expenditure in 1980, 1990, and 2000. Most of the countries with high aid dependency are small African countries. Among the non-African countries in the list of top ten of the most aid dependent were Bangladesh and Jordan in 1980; and Vanuatu, Nepal, and Bolivia in 1990. By 2000, transition countries, such as Tajikistan, Kyrgyz Republic, Mongolia, Georgia, and Moldova, and other non-African countries, such as Nicaragua, Haiti, and Nepal, rather than smaller African countries, were among the most aid dependent countries.

[Insert Table [3] here]

Aid as a Percentage of Gross Capital Formation

Gross capital formation consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Table [4] gives a list of top ten countries in terms of aid as a percentage of gross capital formation in 1960, 1970, 1980, 1990, and 2000. African countries dominate this list as well. The non-African countries in the top ten are: Pakistan, South Korea, Malta, and Haiti in 1960; Papua New Guinea, Nepal, and Suriname in 1970; Kiribati, Solomon Islands, and Tonga in 1980; Nicaragua and Tonga in 1990; and Kyrgyz Republic and Yugoslavia in 2000.

[Insert Table [4] here]

Aid as a Percentage of International Trade

Trade is the sum of exports and imports of goods and services. Table [5] gives a list of top ten countries in terms of aid as a percentage of trade in 1980, 1990, and 2000. African countries are among the most aid dependent when aid dependency is measured as a percentage of trade. There are a few non-African countries among the top ten in the list: Kiribati, Jordan, Bangladesh, and Nepal in 1980; none in 1990; and none in 2000.

[Insert Table [5] here]

Aid as a Percentage of Gross National Income

Gross national income is derived as the sum of GNP and the terms of trade adjustment. Table [6] gives a list of top ten countries in terms of aid as a percentage of gross national income in 1960, 1970, 1980, 1990, and 2000. This list is dominated by African countries. There are a few non-African countries among the top ten in the list: Malta, South Korea, and Belize in 1960; Papua New Guinea, Jordan, and Belize in 1970; Kiribati, Vanuatu, Jordan, and Dominica in 1980; Guyana, Kiribati, and Nicaragua in 1990; and Marshall Islands, Micronesia and Nicaragua in 2000.

[Insert Table [6] here]

Section V: Foreign Aid and Human Needs

The analysis begins with a measure of total aid received by developing and transitional countries. Table [7] shows the results of total aid allocation for different periods. The dependent variable is the log of total foreign aid. Income per capita figures both in linear and quadratic forms. The first box shows the results for 1970-2000, the second for 1980-1990, and the third for 1990-2000. In the first box, the coefficients on per capita income imply that aid is insensitive to the per capita income among low-income countries but it drops off sharply as countries move to middle-income status. The coefficients on population imply that more populated countries receive more aid but it drops off gradually as

countries increase in population. In the second box, the same results hold. In the third box, the coefficients on income are as before but not statistically significant. The coefficient on log of population is positive and significant at 1 percent, but the coefficient on log of population squared is zero and yet insignificant.

[Insert Table [7] here]

Table [8] shows the result of several regressions on per capita aid. The dependent variable is log of per capita aid. Per capita income figures both in linear and quadratic forms. The first box shows the results for 1970-2000, the second for 1980-1990, and the third for 1990-2000. In the first box, the coefficient on per capita income implies that aid disbursement per capita is not sensitive to per capita levels of income of countries but it drops off sharply as countries move to middle income status. In the second box, the same results hold. In the third box, these results no longer hold. The coefficients are of the opposite signs than in the earlier two boxes but are not statistically significant. These imply that aid disbursement per capita is sensitive to per capita income but does not drop as countries move to middle income status.

[Insert Table [8] here]

Table [9] gives the aggregated trend growth rate aid dependency ratios for aid recipient countries. The first column gives the trend growth rate for 1970-2000, the second column for 1980-1990, and the third column for 1990-2000.

Between 1970-2000, ratios of aid as a percentage of gross capital formation and as a percentage of GNI grew, but ratios of aid as a share of government expenditure and as a share of trade fell. During 1980-1990, all the four aid dependency ratios increased. However, during 1990-2000, all these aid dependency ratios declined.

[Insert Table [9] here]

The empirical results of the above regressions show that the level of per capita income of a country does not seem to have any effect on the volume of aid provided or the level of per capita aid received. The flow of aid in either volume of aid or per capita of aid is not geared to those countries with the most urgent need for foreign assistance and aid. The trend growth rate of aid dependency ratios in 1980-1990 was positive, but in 1990-2000 was negative.

Section V: Conclusion

The flows of foreign aid to developing countries in volume and in per capita terms are ranked. Aid dependency in developing and transitional countries are ranked by comparing aid flow as a percentage of central government expenditure, gross capital formation, volume of international trade, and gross national income. By correlating the volume of aid and per capita foreign aid with per capita income in recipient countries, it is shown that the flow of foreign aid seems to have little apparent relationship to human needs in developing and transitional countries. If the rationale for disbursing foreign aid

is to enable the development of recipient countries, it would be directed towards the poorest countries. However, the findings of this essay indicate that the flow of aid does not seem to be in favor of the poorest of the least developed and transitional countries. To the extent that the findings show a pattern of misalignment of human need and the actual allocation of foreign aid, it raise some concern and skepticism about the efficacy of the international foreign aid regime.

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Table 1
Official Development aid and official aid
In US dollars

1960		1970		1980		1990		2000	
India	727,209,984	India	825,030,016	India	2,193,370,112	Egypt	5,437,479,936	China	1,735,040,000
Algeria	355,100,000	Indonesia	465,280,000	Syria	1,696,499,968	Bangladesh	2,095,040,000	Indonesia	1,731,049,984
Pakistan	252,170,000	Vietnam	436,560,000	Egypt	1,386,840,064	China	2,083,869,952	Vietnam	1,699,529,984
South Korea	250,460,000	Pakistan	421,220,000	Bangladesh	1,280,509,952	Indonesia	1,741,580,032	Indonesia	1,564,569,984
Vietnam	191,380,000	South Korea	274,849,984	Jordan	1,275,709,952	India	1,406,800,000	India	1,487,209,984
Egypt	170,590,000	Brazil	188,580,000	Pakistan	1,183,110,016	Israel	1,371,890,048	Poland	1,396,189,952
Turkey	136,160,000	Turkey	175,880,000	Turkey	954,169,984	Poland	1,321,080,064	Egypt	1,328,380,032
Israel	104,960,000	Egypt	172,310,000	Indonesia	949,489,984	Philippines	1,276,429,952	Bangladesh	1,171,480,064
Indonesia	81,200,000	Colombia	160,350,000	Morocco	897,539,968	Turkey	1,218,659,968	Yugoslavia	1,134,770,048
Congo	71,450,000	Papua New Guinea	147,660,000	Israel	897,209,984	Kenya	1,185,820,032	Tanzania	1,044,609,984

Source: World Bank, 2002

Table 2
Evolution of foreign aid per capita (current US\$)

1960		1970		1980		1990		2000	
Jordan	82.0	New Caledonia	211.8	New Caledonia	1,384.4	New Caledonia	1,800.1	Palau	2,059.5
Israel	49.6	French Polynesia	178.1	French Polynesia	1,056.0	French Polynesia	1,318.1	French Polynesia	1,713.1
Cyprus	41.9	Netherlands Antilles	172.3	Jordan	584.9	Seychelles	513.4	New Caledonia	1,646.3
Malta	37.5	Djibouti	76.3	Netherlands Antilles	555.0	Sao Tome & Principe	475.5	Marshall Islands	1,100.6
Algeria	32.9	Seychelles	75.0	Bahrain	467.1	Aruba	458.0	Micronesia	860.5
Libya	31.2	Suriname	68.0	Vanuatu	382.3	Djibouti	412.3	Netherlands Antilles	823.0
Suriname	30.3	Papua New Guinea	61.0	Seychelles	337.4	Vanuatu	337.9	Mayotte	711.7
Swaziland	26.0	Malta	60.1	Kiribati	329.9	Cape Verde	316.0	Sao Tome & Principe	236.3
Seychelles	25.9	Jordan	53.2	Djibouti	243.6	Tonga	309.1	Vanuatu	232.5
Belize	19.8	Solomon Islands	51.1	Suriname	231.7	Netherlands Antilles	306.8	Seychelles	225.0

Source: World Bank, 2002

Table 3
Aid as a percent of central government expenditure

1980		1990		2000	
Maldives	157.2	Gambia, The	132.5	Tajikistan	144.6
Solomon Islands	102.2	Sierra Leone	112.5	Kyrgyz Republic	87.2
Burkina Faso	101.8	Malawi	105.0	Uganda	76.8
Bangladesh	98.8	Vanuatu	86.0	Mongolia	76.5
Rwanda	93.3	Chad	82.7	Nicaragua	56.5
Tonga	83.9	Madagascar	80.7	Haiti	54.2
Jordan	77.9	Burkina Faso	79.9	Madagascar	48.7
Mali	76.9	Ghana	72.1	Nepal	45.6
Gambia, The	71.3	Nepal	70.2	Georgia	45.4
Burundi	59.4	Bolivia	68.6	Moldova	32.2

Source: World Bank, 2002

Table 4

Aid as a percent of gross capital formation									
1960	1970	1980	1990	2000					
Lesotho	211.55	Burundi	162.0	Kiribati	207.1	Sao Tome & Principe	610.7	Sierra Leone	358.5
Botswana	187.74	Rwanda	140.6	Central African Republic	198.7	Somalia	347.2	Guinea-Bissau	210.8
Swaziland	126.34	Lesotho	114.0	Guinea-Bissau	190.7	Equatorial Guinea	264.5	Malawi	200.5
Somalia	123.08	Somalia	73.5	Somalia	169.3	Mozambique	261.1	Sao Tome & Principe	191.4
Rwanda	104.31	Papua New Guinea	55.0	Uganda	148.3	Niger	197.3	Burundi	150.2
Burundi	61.31	Niger	49.6	Comoros	105.7	Guinea-Bissau	176.2	Zambia	149.5
Pakistan	58.86	Malawi	49.4	Solomon Islands	105.3	Nicaragua	170.8	Rwanda	118.1
South Korea	56.92	Burkina Faso	47.1	Tonga	104.7	Burundi	160.5	Niger	108.8
Malta	40.03	Nepal	45.6	Mali	96.7	Tonga	141.6	Kyrgyz Republic	102.9
Haiti	39.02	Suriname	45.2	Mauritania	94.3	Gambia, The	140.0	Djibouti	100.3
Uganda	32.77	Togo	44.5	Burundi	91.9	Cape Verde	139.1	Yugoslavia	93.6

Source: World Bank, 2002

Table 5

Aid as a percent of international trade					
1980		1990		2000	
Comoros	126.1	Sao Tome and Principe	244.7	Sao Tome and Principe	176.1
Somalia	80.2	Guinea-Bissau	116.4	Rwanda	75.0
Cape Verde	73.6	Ethiopia	89.0	Sierra Leone	68.6
Kiribati	64.3	Uganda	88.7	Guinea-Bissau	67.2
Jordan	51.5	Mozambique	86.2	Burundi	55.9
Mali	49.8	Malawi	78.8	Mozambique	49.7
Bangladesh	48.8	Burundi	77.4	Burkina Faso	49.1
Tanzania	48.1	Rwanda	76.7	Zambia	48.7
Rwanda	46.4	Cape Verde	70.5	Tanzania	48.6
Nepal	44.3	Tanzania	70.5	Central African Republic	47.2

Source: World Bank, 2002

Table 6

Aid as percent of Gross National Income									
1960		1970		1980		1990		2000	
Swaziland	25.3	Comoros	32.0	Somalia	71.9	Sao Tome & Principe	104.2	Sao Tome & Principe	80.4
Libya	12.6	Papua New Guinea	23.6	Guinea-Bissau	56.8	Guyana	61.3	Marshall Islands	56.5
Somalia	11.9	Seychelles	21.9	Kiribati	50.1	Somalia	59.1	Micronesia	39.6
Algeria	11.0	Botswana	14.1	Vanuatu	45.9	Guinea-Bissau	55.1	Guinea-Bissau	39.6
Suriname	10.4	Malawi	13.0	Solomon Islands	41.3	Equatorial Guinea	49.2	Sierra Leone	29.6
Botswana	10.0	Jordan	12.2	Comoros	34.9	Mozambique	43.2	Zambia	28.5
Seychelles	9.0	Belize	11.6	Jordan	31.8	Kiribati	36.0	Malawi	26.8
Malta	8.6	Suriname	11.4	Dominica	29.8	Cambodia, The	34.0	Nicaragua	26.6
South Korea	6.5	Rwanda	9.9	Mauritania	26.2	Nicaragua	33.6	Eritrea	25.3
Belize	6.4	Lesotho	8.6	Cambodia	23.0	Cape Verde	31.7	Mozambique	24.9

Source: World Bank, 2002

Table 7

Official Foreign Aid and Per capita Income in Recipient Countries, 1970-2000				
Time Period 1970-2000				
Dependent Variable: LOG(Aid)				
Independent Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	4.11	1.59	2.59	0.01
LOG(Per Capita Income)	1.55	0.32	4.90	0
LOG(Per Capita Income) ²	-0.12	0.02	-5.90	0
LOG(Population)	0.78	0.13	6.11	0
LOG(Population) ²	-0.01	0.00	-2.34	0.02
Adjusted R ²	0.45			
S.E. of regression	1.2			
F-statistic	612.6			
Number of Countries	142			
Number of Observations	2,964			

Time period: 1980-1990				
Dependent Variable: LOG(Aid)				
Independent Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	3.54	2.68	1.32	0.19
LOG(Per Capita Income)	1.59	0.56	2.85	0.00
LOG(Per Capita Income) ²	-0.13	0.04	-3.63	0.00
LOG(Population)	0.93	0.20	4.69	0.00
LOG(Population) ²	-0.02	0.01	-2.44	0.02
Adjusted R ²	0.46			
S.E. of regression	1.22			
F-statistic	245.60			
Number of Countries	123			
Number of Observations	1164			

Time period: 1990-2000				
Dependent Variable: LOG(AID)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	12.44	2.37	5.25	0.00
LOG(Per Capita Income)	0.26	0.48	0.53	0.59
LOG(Per Capita Income) ²	-0.05	0.03	-1.52	0.13
LOG(Population)	0.46	0.17	2.66	0.01
LOG(Population) ²	0.00	0.01	0.14	0.89
Adjusted R ²	0.52			
S.E. of regression	1.10			
F-statistic	397.24			
Number of Countries	142			
Number of Observations	1477			

Table 8

Official Per Capital Foreign Aid and Per capita Income in Recipient Countries				
<i>Method: GLS (Cross section weights)</i>				
Time period 1975-2000				
Dependent Variable: LOG(Per CapitaAid)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-5.07	0.87	-5.82	0
LOG(Per Capita Income)	2.32	0.23	9.91	0
LOG(Per Capita Income) ²	-0.16	0.02	-10.20	0
Adjusted R ²	0.82			
S.E. of regression	1.53			
F-statistic	6,728.8			
Number of Countries	142			
Number of Observations	2,964			

Time Period 1980-1990				
Dependent Variable: LOG(Per CapitaAid)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-5.02	1.33	-3.77	0.0002
LOG(Per Capita Income)	2.35	0.37	6.44	0
LOG(Per Capita Income) ²	-0.16	0.03	-6.57	0
Adjusted R ²	0.94			
S.E. of regression	1.61			
F-statistic	9,568.3			
Number of Countries	123			
Number of Observations	1,166			

Time Period 1990-2000				
Dependent Variable: LOG(Per Capita Aid)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	6.59	1.11	5.95	0
LOG(Per Capita Income)	-0.54	0.29	-1.85	0.0651
LOG(Per Capita Income) ²	0.02	0.02	0.82	0.4144
Adjusted R ²	0.95			
S.E. of regression	1.44			
F-statistic	13932.54			
Number of Countries	142			
Number of Observations	1,477			

Table 9

Trend Growth Rates of Aid Dependency Ratios in Different Periods			
<i>In percent</i>	1970-2000	1980-1990	1990-2000
Aid as a percent of GCF	0.33	3.87	-0.05
Aid as a share of GNI	1.26	3.80	-2.96
Aid as share of Government expenditure	-3.44	0.24	-9.39
Aid as share of trade	-1.50	3.55	-8.18