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Human Development Index (HDI) Rank-Order Variability

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Abstract In accordance with the increasing demand for information, indices are created and national and global rankings made to represent and through which to understand and build policy related to complex situations, processes and trajectories. Different indices for a single concept are also created that have advantages or disadvantages over one another or to overcome certain calculation problems. As one such, the Human Development Index (HDI) presently lists countries according to four different criteria, and remains at the heart of democratic and humanitarian recovery efforts. This type of indicator is taken as a function of past performances, with high performances being the extreme values at positively skewed distributions. Thus, the variability of each unit's repeated measures is regarded as the result of efforts made between the measurement time points (in the HDI case, of a country to promote development). However, it is assumed that the variability of the units is not homogenous. Here, it is shown that in the HDI case, high performance units show relatively low variability, whereas the middle and middle-low performance units show a high variability. Cluster analysis and Friedman test have been used to determine the characteristics of ordered country rankings. The variability of rank-order should also be taken into account besides the location on the list by clustering the countries according to HDI.

Keywords Human Development Index · HDI rank · Order variability · Superstars theory · Friedman Chi square · Clustering

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1 Introduction

Rankings lists emerged as an important influence in many fields after the 1980s, and came to exert a contentious and largely uncontrollable external pressure over formal organizations. They appear to create a competition-based situation leading to likely reactions, such as implementations of managerial changes at the periphery of organizations by evaluations based on the rankings as a form of power involving processes of surveillance and normalization activities. Indeed, new advances in institutional theory have improved the understanding that the ranking-led changes promote tight couplings and even buffering (Sauder and Espeland 2009). Previously, in the 1970s, Foucault had proposed arguments suggesting that organizational members adopt to external pressures that may be plural, contradictory, or reinforcing. The application of Foucault's discipline to rankings complements recent studies concluding that most institutions now confront growing pressure to demonstrate accountability by formal, quantitative measures (Strathern 2000).

There are several indicators representing the social, economic, and human development levels of countries. Countries are ranked using these, and their credibility and place in the international arena is perceived accordingly. They make positive efforts to increase their position in the lists, with those that are ranked more highly using their position for promotion in national and international public opinion. However, the stars in these leagues remain unchanged, with only a few changes observable among them, as do those at the bottom; the main competition and changes is observed at medium levels. The aim of this study is to show, with basic statistical indicators, that variability of rank ordering is not homogeneous within the officially defined country groupings. The main effort of the study focused on the rank ordering variability than index numbers to present the shifting in the list, which do not show the variability of the country's shift in the order.

The research was motivated from the statistical viewpoint of the rank order variability measurement of the country rankings. There were several discussions on the HDI criticizing about what was measured with the index. The paper reviewed first the discussions on the Human Development Index to expose the grouping of the countries according to index numbers. The second reason of the review is to clarify the effects of the rankings on the countries efforts. Later a methodological literature survey has been conducted on the rank order measurement and its features.

2 HDI reviewed

For many years, the primary measure used to express economic development or the development level of countries was income (typically using national wealth averaged out, through per capita Gross Domestic Production-GDP). This came under criticism, however, as "income is an important opportunity that people want to obtain but it is not the sum of their lives" (UNDP 1998). Thus, development became a human-focused concept that goes beyond increase of income and wealth. The relationship between economic growth and development is much debated now, since the benefits of economic growth, especially in "developing countries," does not necessarily correlate with the welfare of and opportunities for the people of those countries.

With the approach to the phenomenon of development undergoing a transformation, previously little or under-emphasized topics such as the meeting of basic needs, income distribution, poverty, and unemployment, gained in importance. Nobel Prize winner

Amartya Sen, for example, introduced an alternative viewpoint to income-focused development when stating that the life people are living is more important than the commodities they obtain (see Fukuda-Parr 2003; Griffin and Knight 1992). It was in 1990 that the United Nations Development Programme (UNDP 2010) prepared the first Human Development Index (HDI), based on the premise that a range of indicators need to be bundled in order to determine the quality of life. Since then, the HDI has been published every year, with the purpose of displaying the living conditions for people in all the countries of the world, revealing the problems faced by humanity and offering suggestions on what should be done to increase living standards, or, the quality of life (UNDP 2010). The HDI can be said to function as a disciplinary that focuses on the human development dimension of competitive power. Under the HDI, countries can increase their competitive powers if they continue to grow economically, improve social and human conditions and decrease poverty, regardless of what happens in the outer world. If development is ensured nationwide and living quality is improved, the competitive power of the country will be affected positively.

According to the UNDP, the development of humanity can be achieved by increasing the options possessed by people, which is, in turn, dependent on raising the levels of skills and functions of people. The development of humanity, people's living a long, prosperous, and healthy life, is a function of their access to the resources needed to obtain modern living standards and, therefore also, to actors or agencies' (transnational bodies, states, Non-Governmental Organizations-NGO, etc.) access to information on this. Without these, the range of options and opportunities is limited. It is to this end that the HDI covers three important areas of socio-economic life covering a different aspect of economic options for welfare, namely, long life (the Life Expectancy Index), education status (the Education Index) and GDP per capita (the Welfare Index) (Hicks 1997; Noorbakhsh 1998; Fukuda-Parr 2003). Although it may represent countries with similar properties, that is, the index is unable to do this for countries with different structures (Hou et al. 2015). For this reason, Silva and Ferreira-Lopes in their Portuguese Regional Development Index (2014) added further variables. Several upgrades or renovations have been suggested for the HDI calculation such as including gender discrimination, the level of political rights and liberties, expressing human development in Inter-Governmental Review Programs (IGRs) so as to bring a global explanation to the human development of these groups and the deprivations that they face with three new experimental indexes—the Inequality-Adjusted Human Development Index (IEHDI), Social Gender Inequality Index (SGDI), and Multidimensional Poverty Index (MPI).

The (national) data used for the Life Expectancy Index comprise life expectancy at birth; for the Education Index, it is the literacy rate of adults and schooling rate; and for the Welfare Index, per capita GDP figures. Values are set between 0 and 1, with countries grouped by development level into four categories: Very High Human Development, for countries with a 0.808–1 HDI score, High Human Development (0.700–0.790), Medium Human Development (0.556–0.698), and Low Human Development (0–0.556). The variance or similar measures would likely to fail to measure ranking shifts when calculated according to the changes of these values among 0–1 interval. While the HDI is, at least, a numerical expression that is more sensitive towards the social dimension of life, with more factors than the conventional income-centered approach, the method used for calculating the HDI, its measure and scope, has frequently been criticized as insufficient in the range of aspects of development it covers. Finally, recent work on the HDI has criticized the lack of ecological aspects, especially sustainability in respect to the environment in which people live (Sagar and Najam 1998; Bravo 2014; Neumayer 2001). Looking forward, Neumayer

(2001) suggested that the indicated human development of the lowest countries is potentially unsustainable, which he characterized as "mortgaging the choices of future generations." This study also grouped countries into three categories through net and genuine savings rates according to the 'El Serafy's method (high rank 1–46, medium rank 47–139 and low rank 140–174 human development, based on the 1998 HDI data).

In terms of dynamics, the absolute scoring levels and relative movement of countries in respect of one other, for the high and medium human developing nations, the HDI rank differentials have been roughly stable. Morse (2014) evaluated the yearly change of adjusted HDI ranking and the average change in HDI rank through the years 1991–2012. Sagar and Najam (1998) discussed the evaluation of world- and country-based development over the years as stagnant and repeating the same rhetoric. MacDonald (1988) suggested that past performances are correlated with future outcomes in the economies of rising stars.

According to this last work, a stochastic dynamic study on individual production might reflect country-based performances. In equilibrium, countries that performed well in the past obtain a greater allocation of complementary factors, which supports a pattern of relative gains that overcompensates for performance differences and produces rising stars. However, this is not true for the low development group. That might indicate that the governments of low human development nations have implemented sound policies in the period, and, as a result, their HDI rankings have risen.

A second trend relates to within-group variation (Hou et al. 2015). For that, standard deviation to mean in absolute value ratio is used. Hou et al. investigated three groups: the low human development group, which presented minimum variance; the high group, which had a higher variance; and the middle group, which exhibited a much higher variance. At this point one may question the use of rank orders rather than the HDI measurements. The stability of measures standardized between a 0–1 interval for minimum and maximum values causes high parametric correlation through time points. Thus, some writers use Spearman's rank correlation also, in cases where technical measurements have been possible (Vera-Tudela and Kühn 2014).

3 Theoretical Background

While the conception of economic growth was being questioned, neo-liberal economic ideas held expectations of a predomination of catch-up or convergence. Simply, less developed countries would tend to grow more rapidly than the more developed. However, recent studies suggested divergence was more apparent, that there were winners and losers (Dunford and Smith 2000). In fact, the HDI measurements tended to converge for wealthy countries and diverge for poor countries, especially in the case of those with low HDI rankings. This pattern can be attributed to a combination of the initial level of development and the evolution of the HDI (the transfer of wealth to non-income dimensions) (Hou et al. 2015).

However, changes in the content of the index and also the number of countries included mitigate against the suggestion that the index presents relative stability in country ranking within the HDI league table. Thus, Morse (2014) suggested an adjusted ranking methodology. Rosen's (1981) "Superstars" theory suggests that the grouping among ranked items arises as a natural consequence of the process, while the constant risk aversion approach of Röell (1987) suggests that low level countries are unlikely to rise to a higher level.

Furthermore, there is financial research on those ratings effecting abnormal performances among funds in the case of rising stars (Guercio and Tkac 2008). Here, changes in rank ordering are explained by the economic dimensions of the index through international trade. The stable cross-country difference appears as a result of "symmetry-breaking" in the world economy, where some countries tends to improve, if they acquire a comparative advantage in goods associated with large agglomeration economies, while other countries decline, when acquiring a comparative advantage in goods with small agglomeration economies (Matsuyama 1996). This symmetry-breaking economic approach accepts those changes in this world trade system as economic miracles. Kohler (1991), evaluating the Hecksher–Ohlin theorem through rank order tests, concluded that the empirical results dos not support this as a whole, but the factor rankings for individual countries appear to be much more sensitive to the comparison hypotheses than the country rankings for individual factors. The phenomenon of non-robustness established in their paper might be explained by the Superstars model.

The Superstars model could be inferred from the observed economic and/or social performances of organizations or countries. The distribution of the observed attribute that is implicitly evaluated in a competitive world is derived from an information accumulation process (MacDonald 1988). Accordingly, in steady-state equilibrium, those leading actors that have been reviewed successfully in early stages earn large benefits playing to big crowds and exert control over great quantities of other inputs. This outcome supports a pattern of relative earnings that overcompensates for performance differences and produces rising stars within the competition (MacDonald 1988). Further discussions on this are available by Rosen (1981), Heckman and Scheinkman (1987).

Thus, it seems likely that there is a group of superstars competing with one other, discarding the newcomers and low performers. The members of this group are operating in coordinated or competitive fashions, building a joint operation. Such horizontal mixtures, according to Yaari (1984), may be interpreted as the comonotonic outcomes of two objects, that whenever one object **x** has a strictly higher outcome at a point t than at t − 1, this would be also the case for the other object **y** (Röell 1987).

$$(x_t - x_{t-1})(y_t - y_{t-1}) \geq 0 \tag{1}$$

One important property displayed by dual expected utility maximizers is constant risk aversion. Risk aversion denotes the aversion to a mean preserving spread in the distribution of prospects, with the requirement that the certainty equivalent of any distribution is no higher than its expectation. Constant relative, absolute, and partial risk aversion and related risk premia are the functions of the distribution of the sum of the random gain distribution (Röell 1987). According to Röell, any ordered levels $x_1 < x_2 < x_3 < \cdots < x_n$ of attribute X obtained with corresponding probabilities for $n = 3$ p_1, p_2, and p_3 summing to 1 have to obey the following equation with related risk function vp_i with v was an estimated parameter:

$$x_1 + x_2 - x_1 v p_1 + x_3 - x_2 v - p_3 = \text{constant} \tag{2}$$

This equation ends up with the equivalent common ratio effect presented as follows:

$$x_2 - x_1 v - p = x_3 - x_1 v - q; \quad q < p; \quad p + q = 1 \tag{3}$$

That might be interpreted as the likelihood of changes among the highest and lowest level attributes being less than that in lower level observations.

In spite of all the related theories, Chaisumritchoke (2007) recommended appliying "Sufficiency Economy" as the survival strategy of Thailand' King's philosophy. That is a part of Buddhist Thoughts, which comprises of three principles of moderation, rationality and self-immunity to changes. The Philosophy requires also two conditions. These include wisdom and morality. Wisdom means abilities to understand things properly and morality means moral commitment not to put burden on others. The last level of the philosophy is opposed to the contemporary economical development politics. It promotes sharing sufferings of life of others rather than sharing benefits equally.

4 Methodology

Analyses with rank order statistics are mostly required when the distribution of the underlying attribute is unknown. Pitman efficiency showed that componentwise multivariate rank tests based on medians were superior to the usual normal theory tests when the distribution is heavy and light tailed (Choi and Marden 1997). The implied distribution of returns must have positive skewness according to the Superstars theorem (MacDonald 1988; Rosen 1981). These studies were focused on independent samples tests.

However, the study intends to analyze related samples yearly rank orders for the mentioned country data. Suppose that the integers 1, 2, …, n are randomly distributed among k distinguishable classes with equal probability and without restrictions. It is natural to denote the class sums by $s_1, s_2, \ldots, s_k$ and the largest of these by S. A generating function is obtained for the upper half of the range of S, namely $\frac{n^2}{4} - 1 \leq S \leq \frac{n^2}{2} - 1$. For $k \leq 6$, this was shown to provide the usual percentage points for **n** up to and beyond 10. For $k = 2$, the distribution is that of Wilcoxon's paired sample test.

Generalized mixed models (GMM) was employed as an alternative method to estimate rank order shift between independent groups (Small et al. 2006). This suggests the application of $k = 6$ to the six possible orders of three responses. It is a possible procedure, but the peculiarities of its power are such that its use is not recommended. Further, the mathematical foundations of selecting $k = 2$ best and worst independents groups by experimental designs was introduced by Guiard (1996). However, when three treatments with a natural order are examined in randomized blocks, a significance procedure can be based on the same distribution, which is specifically sensitive to average responses in either exactly the same or exactly the opposite order as the treatments. The basic distribution used here is inappropriate for situations such as analysis of variance of ranks, where the number of ranks in each class is restricted, as by being the same in all classes (Tukey 1957). The ranking of a particular set of observations identify the hyperplanes $r_i = r_j$ $i \neq j$ by subdividing the population space into n! polyhedral cones. An observation in one of those cones yields the complete ranking associated with that cone. This is similar to the situation where intervals are identified with midpoints (Cook and Seiford 1983). If $X_t = x_{i,t}$ $i = 1, 2, \ldots, n$ and $t = 1, 2, \ldots, T$ are the rankings of n objects, then $R_t = \{r_{1t}, r_{2t}, \ldots, r_{nt}\}$, and if $\bar{R} = \{\bar{r}_i\}$ is the average of this set, then

$$\bar{r}_i = \frac{1}{T}\sum_{t}^{T} r_{i,t} \tag{4}$$

Research on HDI usually depends on rank differences and rank correlations (Noorbakhsh 1998). Some writers estimate the variability of n unique items for repeated rankings

with the known variance formula and some others (Wood 1975) used rank correlation coefficient to evaluate the independent groups' variation with repeated measurement. The data for such methods have been designed according to the following table, which assumes the groups have been determined.

As a disagreement formula

$$d_i = \sum_{i=1}^{n} |r_i - \bar{r}| \Big/ n; \quad \text{i} = 1, 2, \ldots, \text{n, for constant t} \tag{5}$$

d_i identifies absolute average distance between rank orders r_i (Lau and Lam 2002; Saisana et al. 2005). Lau and Lam (2002) proposed minimum disagreement formula for weight estimation of composite indices, while D'Agostino and Dardanoni (2009) extracted a simple formula to measure the distance between pairwise rank orders of n objects and for T = 2, which is normalized between 0 and 1 by its denominator:

$$d(R_{t=1}, R_{t=2}) = \frac{1}{(n^3 - n)/3} \sum_{i=1}^{n} (r_{i,1} - r_{i,2})^2 \tag{6}$$

Equivalent to a monotonic transformation to Spearman's rank correlation, this measure was revised also for robust weight estimation of composite indices, like HDI (Permanyer 2012). Similarly, the volatility in rank shift of a set n of items from year t − 1 to t is given by for each predetermined group k:

$$VS_{tk} = \frac{\sum_{i=1}^{n} \left| r_{i,t,k} - r_{i,t-1,k} \right|}{n}; \quad \text{i} \in \text{S}, \quad \text{t} \in \text{T} \tag{7}$$

The volatility, or average absolute rank shift, gives the gross amount of the rank change activity without regard to direction and indicates how active the group is in terms of rank changes. Higher values of VS indicate higher levels of rank shift activity and higher levels of turbulence in the set of items.

Given a transition matrix π_k, one can generate a number of measures that give information about the uncertainty associated with the rank behavior of groups of items (Table 1). Consider the simple case of τ Tau correlations at time t with each other t time points and let the matrix π_k be n_k by n_k, then

Table 1 Grouped items rank ordering for several timepoints t

Groups	Items	Rank (t = 1)	Rank (t = 2)	Rank (t = T)	$\bar{r}_i$	Without grouping $r_{i,t=1}$
1	A	1	2	1	4/3	1
	B	2	1	2	5/3	2
2	C	1	2	1	4/3	3
	D	2	1	3	6/3	4
	E	3	2	2	7/3	5
…	…					
k	X	1	1	1	3/3	n − 2
	Y	2	2	2	6/3	n − 1
	Z	3	3	3	9/3	n

$$HS_k = -\frac{\sum_i^n \sum_t^T \left(\tau_{i,t,k} \times \ln \tau_{i,t,k}\right)}{n_k \times \ln n_k} \text{ for each k} \tag{8}$$

HS_k is a measure of the relative amount of uncertainty associated with rank shifts of the group of items along dimension k based on the historical data used to generate the matrix and normalized for the number of ranks used there. HS_k ranges from 0 to 1 and can be interpreted as the fraction of the maximum possible uncertainty exhibited by the group of items (Ruefli and Wilson 1987). More generally, rank order statistics have been employed in the settings of two way layout. The Euclidian distance became the most obvious geometric interpretation of many rank-order statistics (Wu and Bill 2003). The sequence of rank order statistics might be incorporated in the construction of suitable stochastic processes, and the theoretical inferences were discussed in detail for two specific problems in nonparametric inference.

However, HDI performances have been calculated for the related year and they are not absolute measurements. Therefore, the latter developed tests should not be used in the case of yearly HDI comparison and item-based variability approximation. Page's L test equation

$$L = T \sum_i^n (x_i - \bar{r}_i)^2 \tag{9}$$

represents a sum of the Spearman correlation coefficients between $\boldsymbol{X_t}$ measurement vector and $\boldsymbol{R_{i,t}}$ rank-order matrix.

Sen (1977) considered some sequential type asymptotic nonparametric test for symmetry around an unknown origin and the problem of testing for shift at an unknown time point. This thus enables measurement of the variability of ranked objects at any time point alignment of the objects. Friedman's test has the same advantages and disadvantages at multiple comparisons, so Friedman Aligned-Ranks and Quade tests have been developed. Friedman's Chi square defined by untied rank orders (Garcia et al. 2010) has efficient estimation than median and sign tests:

$$\chi^2_{T-1} = \frac{12}{nT(T+1)} \sum_{t=1}^{T} \left(\sum_{i=1}^{n} r_{i,t} \right)^2 - 3n(T+1) = T(n-1)W \tag{10}$$

where W is Kendall's coefficient of concordance showing the rank order association. It will reach the value "1" as the volatility increased.

Since,

$$\chi^2 = \frac{v \times S^2}{\sigma^2} \tag{11}$$

is the theoretical distribution of sample variance S^2 at the $v = T - 1$ degrees of freedom, which shows the variability of the rank orders with unknown population variance σ^2 through the time period. When T is taken as a constant, n number of observations does not change the identical distribution of the Chi square, which enables the comparisons with changed number of items, countries in this study.

There are many study areas, where the data is ranked or the distribution of scaled values is not known. Many social scientists had been using questionnaire surveys mostly based on ordered variables or ordinal scales. The item responses have been assumed to approximate to interval scale. The paper proposes to use the Friedman's Chi square for the proxy

estimation of the variability of the groups of items, beside its main usage of testing central tendency of dependent samples.

5 Empirical Findings

The data consists of the UNDP HDI rankings between years 2010 to 2014. Rank orders were given in each year for 187 countries over the five years. The tied ranks were coded with their median values, which prevents changing the sum of 1 to n rank values. Then, the whole data was ordered according to the 2014 ordering. The main purpose of this was to evaluate the variability of the ranked countries.

Mean Absolute Deviation of the country's rank-orders have been calculated for each country based on the Formula (5) with a modification.

$$MAD_i = \frac{\sum_{t=1}^{T} (r_{i,t} - r_{i,med})}{T}; \quad \text{for each i} = 1, 2, \ldots, \text{n} \tag{12}$$

Five yearly change is simply $r_T - r_1$ (Fig. 1).

Libya, Cuba, Syria and Senegal were rising stars in the period covered. However, there were more countries with high mean absolute deviation to the median. Assuming three groups with high, medium, and low ranks, the countries in the middle had the highest ranking variability. There have found some countries with relevant higher MAD values but they would not able to show a consistent trend at up or down movement in the rank-order list. These measures were satisfactory for the country based variability measurement.

Spearman's Rank correlation coefficient is a generally used method to estimate paired rank orders of observations. The higher correlation shows stability of the ranking of the observed countries through the time period. The variability of the rank orders is higher when the rank correlation shows lower rates. There have been studies using square of Spearman rank correlation to compare the variability of statistically independent groups of cases similar to one-way ANOVA based on partial correlations.

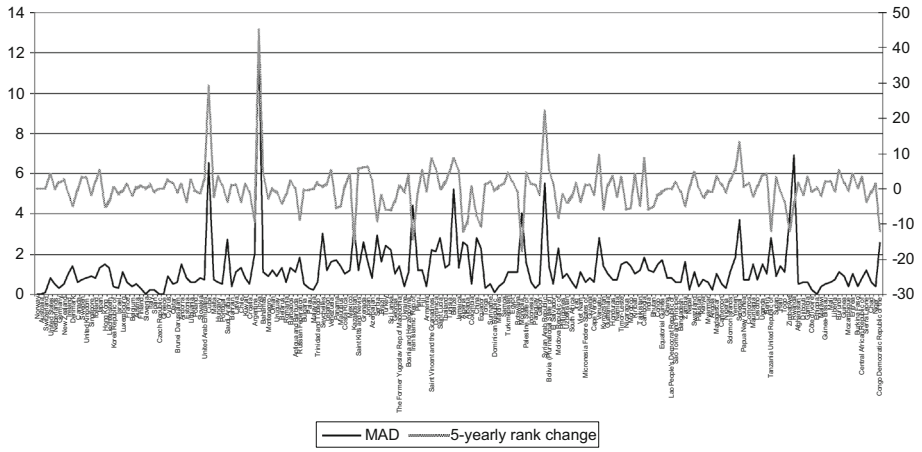

Fig. 1 Year 2014-ordered countries MAD and five-yearly rank order changes (see "Appendix 1")

Table 2 Spearman's rank correlations of observed countries and grouped according to the 'El Serafy's classification

	All 187 countries					Middle rank ordered 93 countries				
	HDI10	HDI11	HDI12	HDI13	HDI14	HDI10	HDI11	HDI12	HDI13	HDI14
HDI10	1.000	.999	.999	.998	.993	1.000	.995	.995	.993	.963
HDI11	.999	1.000	.999	.999	.995	.995	1.000	.995	.995	.975
HDI12	.999	.999	1.000	1.000	.994	.995	.995	1.000	.999	.965
HDI13	.998	.999	1.000	1.000	.995	.993	.995	.999	1.000	.972
HDI14	.993	.995	.994	.995	1.000	.963	.975	.965	.972	1.000
	Top rank ordered 46 countries					Bottom rank ordered 48 countries				
HDI10	1.000	.995	.987	.985	.982	1.000	.994	.974	.967	.952
HDI11	.995	1.000	.996	.995	.987	.994	1.000	.980	.976	.962
HDI12	.987	.996	1.000	.999	.988	.974	.980	1.000	.997	.962
HDI13	.985	.995	.999	1.000	.986	.967	.976	.997	1.000	.969
HDI14	.982	.987	.988	.986	1.000	.952	.962	.962	.969	1.000

In the results for the 187 countries in the 2010–2014 period (Table 2), all correlations are significant at a 1% level. The correlations are found to be relatively lower for the bottom ranked countries for most pairs of years, which is not the case for the top and middle ranked countries. There was stability in the orders of the top ranked countries in the years 2011, 2013 and 2014, but the middle ranked 93 countries had a lower variability in the years 2010 and 2012 than the top countries. The correlations were not evaluated for statistically difference between groups for each related pair, or among the mentioned groups. One could conclude that there has been higher competition among the countries with low HDI ratings. However this finding could also support the proposition of the rising or falling stars. During the financial crisis in 2010–2011 there might have been falling stars among the top countries (Table 2).

Next, each countries rank values were ranked throughout the five-year period. Friedman χ^2 statistics were calculated sequentially for $n = 20$ and $n = 30$ countries according to Formula (10). The calculation moved one country at each step, like simple moving averages. For the countries at the top, n became the number of the countries in the calculation. All χ^2 statistics are comparable with the same degrees of freedom, $T - 1 = 4$. At the 5% level of significance, the critical value is 9.488, so it cannot be concluded that the countries rank orders have been significantly changed.

There have seen three peaks along the 2014 ordering of the countries in the Fig. 2. The heading superstar countries showed a higher variability instead low change and moderate MAD values. These are the community of developed countries, mostly in EU. Then, the inertia began with the effect of included following countries and exclusion of the superstars. Right before the middle of the list increased the variability again. The countries at the end of the list presented the highest variability among years, which had low 5-yearly change and low MAD values.

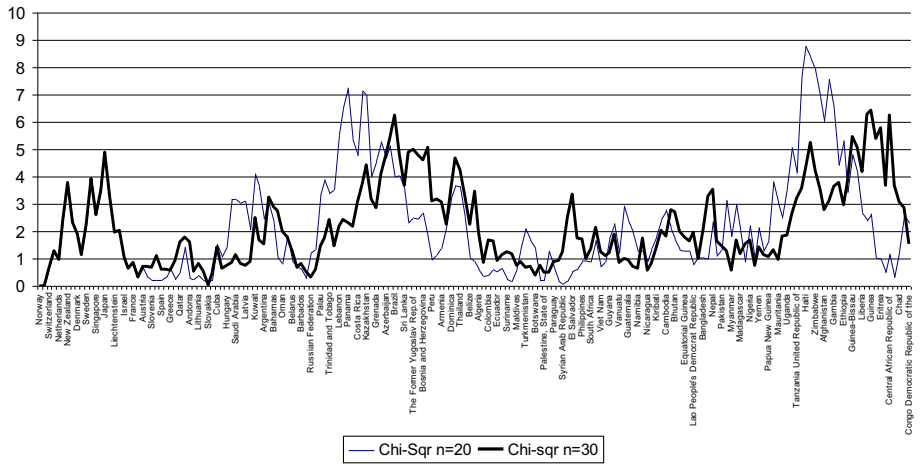

Fig. 2 n = 20 and n = 30 Moving Friedman Chi square statistics (see "Appendix 2")

This finding motivated to investigate the country clusters with the variables of the order place and country based rank-order change. Accordingly, the mean absolute deviation of each country was calculated for each year. A two-step clustering analysis was used, with yearly rank orders as categorical data. The reason of choosing this method depends on the data type, which is ordinal in this study. The algorithm of the method used uncertainty measure given in Formula (8) for the distance measurement and log likelihood measure for determination of modified cluster feature tree. Three clusters fit best to the data, according to Akaike Information Criterion (Table 3).

The cluster numbers have been presented at Fig. 3 through a chart by country rank-order according to the year 2014. That was an arbitrary selection and this selection would have an impact on the appearance of the Fig. 3. The ordering would intend to change due to year selection or 5-yearly median rank selection, which might the cluster outlier semblance at the figure. However the paper suggested 5 clusters of countries based on the moving Friedman Chi square and the cluster membership figure of the countries.

It was suggested that the countries build five groups, namely 1–20, 21–80, 81–110, 111–140 and 141–187. The statistical aim is to test the hypothesis that the rank order variability of the proposed five independent groups of countries. The Levene's test of

Table 3 Auto clustering information according to AIC

Number of clusters	Akaike's information criterion AIC	AIC change	Ratio of AIC changes	Ratio of distance measures
1	17974.683			
2	17492.778	−481.905	1.000	1.367
3	17350.784	−141.994	.295	1.937
4	17656.262	305.479	−.634	1.071
5	17993.527	337.265	−.700	1.015
6	18337.591	344.064	−.714	1.723
7	18865.883	528.292	−1.096	1.134
8	19424.272	558.389	−1.159	1.002

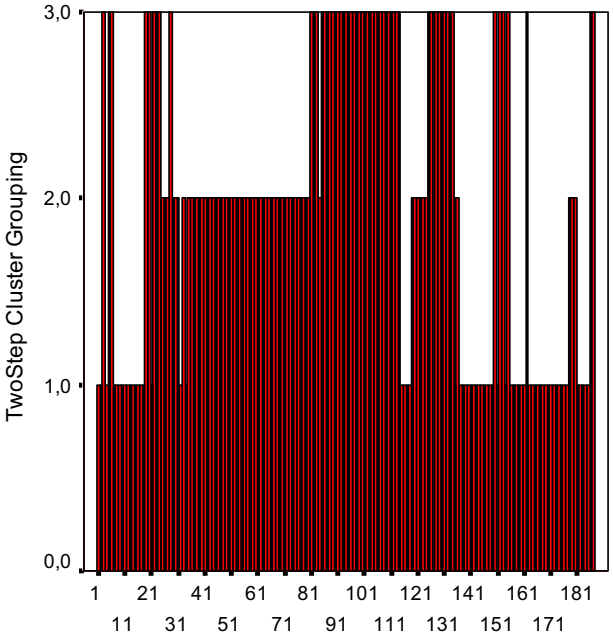

Fig. 3 Cluster number of HDI ordered countries with 2-step clustering

Table 4 Welch test for independent groups of ordered countries

MAD	Statistic	df1	df2	Sig.
Welch	5.077	4	83.641	.001

homogeneity is a method exactly like the one-way Analysis of Variance using absolute deviations of observations from their group means. As absolute deviations have been calculated in this paper, the robust Welch test was used instead of the Levene's homogeneity test, whether the variability among the groups was equal or not (Table 4).

There is significant difference between the groups ordering variability. Their group MAD means shows a type of Kuznets curve, with rising or falling stars signed as extreme MAD values.

The proposed five grouping of countries according to HDI rank ordering variability was shown in Fig. 4. The numbers of countries in the figures are the raw number in the list at "Appendices 1 and 2". The outliers could be explained by rising or falling stars theorem or the ordering of the countries.

6 Conclusion and Further Remarks

Many indices have been developed to rank countries and institutions. Index numbers are a proportion, multiplied by one hundred. Some ratings are normalized to 0–1. They represent measured monetary or social benefits. The variability in this index or measures and the

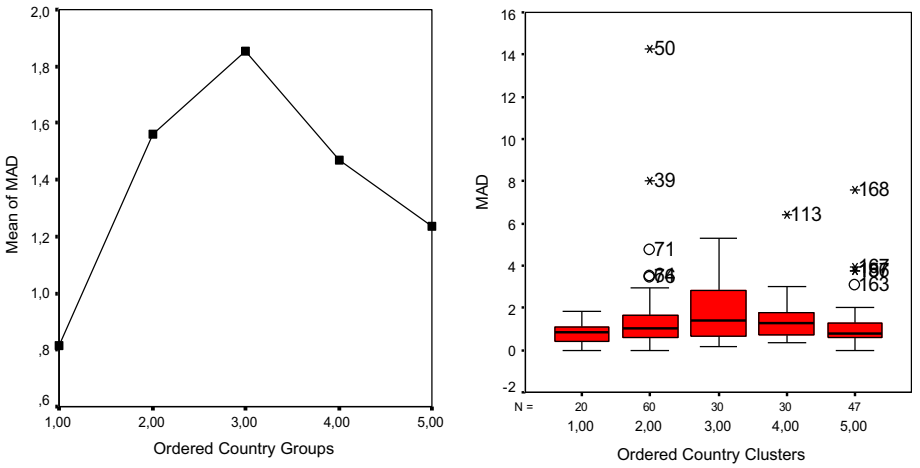

Fig. 4 Group means of MAD and *box-plot* presentation with extreme values

sequence numbers of the units ranked according to these norms will vary. This study examined the variability of countries' HDI rankings with MAD. The place in the rank ordering of some rare countries has not changed at all after 5 years in spite of their relative high MAD values. The image that is expected to emerge is similar to a single-peaked function. However, extreme MAD values were concentrated in the middle of the sequence, and at the frontiers of top and bottom ranked countries. Following this, the variability of all countries' rank orders suggested very low with the high Spearman's rank correlations in 2010–2013. This inference appeared to be valid for independent groups of countries in the classification of "Al-Serafy". As the gap between the comparative years increased, the decrease in the relationship was already an expected result. The countries in the middle group showed less variability than the top and bottom listed groups until 2014. When the same years were taken into consideration, the top group showed less variability than the bottom group. The top group showed little variability during 2011–2013 period. In 2014, the least variability was in the top group, and the variability in the bottom group was the highest.

Then, it was deemed appropriate to use the Friedman random block design test as a method to examine the time variability of the rank orders of country sequences. Since the method ranked each country according to years, their orders in the whole list lose importance. There was found any significantly different variability between years, but some rank levels reached beyond the 10% level of significance and with groups of twenty countries. The smoothing effect of moving measurement showed three peaks and two bottoms on the sequence. That leaded the questioning the number of suggested country groups. The mentioned clustering method suggest three clusters fit best the data but in an unordered sequence. The authors suggested five clusters in rank arrangement of countries according to their order and change through the period. Their homogeneity was tested statistically, and found significant differences of at least one of them. Extreme rank changing countries have been found in top second group and in the bottom group. Top 20 countries had minimum averaged MAD value (0.8), where the middle group had more than 2 times greater averaged variability.

There are rising and falling countries in the list. The rising stars are mostly post-war African countries and post USSR Asian countries. The falling countries were externally politically or militarily intervened countries, like Syria, Libya. Cuba has also fallen in the rank ordering, but the reason may internationally opening politics and consequently more valid data sharing. Friedman statistics supports the idea of stabilized HDI measurement, and it does not present country-based changes or any miracle of world economies that international statue cannot change. The countries might be evaluated in five groups according to their order and order change variability. The middle group has a relative higher volatility including mostly the developing countries. Although, middle ranked countries cluster showed high averaged MAD variability, Friedman scores gave low inertia between middle and lowest country clusters. That might an indicator of accepting King's "Sufficiency Philosophy" by some countries or behaving accordingly. They are not competing internationally but performing optimal for their own home country. Another suggested induction is that there is competition at the second top and bottom groups, with lower rank order variability. The rising and falling stars were in these two groups.

Appendix 1

Country	2010	2011	2012	2013	2014	MAD	5-Yearly rank change
Norway	1	1	1	1	1	0	0
Australia	2	2	2	2	2	0	0
Switzerland	3	3.5	3	3	3	0.1	0
United States	4	5	5	5	8	0.8	4
Netherlands	5	3.5	4	4	5	0.5	0
Germany	5	6	6	6	6.5	0.3	1.5
New Zealand	7	7	7	7	9.5	0.5	2.5
Ireland	8	8.5	8.5	11	6.5	1	−1.5
Denmark	9	10	10	10	4	1.4	−5
Canada	10	8.5	8.5	8	9.5	0.6	−0.5
Sweden	11.5	11.5	12	12	14.5	0.7	3
United Kingdom	11.5	13	14	14	14.5	0.8	3
Singapore	13	11.5	11	9	11	0.9	−2
Iceland	14	14	13	13	16	0.8	2
Japan	15	15.5	17	17	20	1.3	5
Hong Kong	17	17.5	15	15.5	12	1.5	−5
Liechtenstein	17	15.5	17	18	13	1.3	−4
Korea, Republic of	17	17.5	17	15.5	17	0.4	0
Israel	19.5	19	19	19	18	0.3	−1.5
Luxembourg	19.5	21	22	22	19	1.1	−0.5
France	21	20	20	20	22	0.6	1
Belgium	23	22	22	22	21	0.4	−2
Austria	23	23.5	22	22	23	0.5	0
Finland	23	23.5	24	24	24	0.3	1

Country	2010	2011	2012	2013	2014	MAD	5-Yearly rank change
Slovenia	25	25	25	25	25	0	0
Italy	26	26	26	26	27	0.2	1
Spain	27	27	27	27	26	0.2	−1
Czech Republic	28	28	28	28	28	0	0
Greece	29	29	29	29	29	0	0
Cyprus	30	30	32	32	32.5	0.9	2.5
Qatar	31	32	31	31	32.5	0.5	1.5
Brunei Darussalam	32	31	30	30	31	0.6	−1
Andorra	33	34	37	37.5	34	1.5	1
Estonia	34	33	33	33	30	0.8	−4
Lithuania	35	36	36	35.5	37.5	0.6	2.5
Poland	36.5	35	34.5	35.5	36	0.6	−0.5
Slovakia	36.5	37	38	37.5	35	0.8	−1.5
United Arab Emirates	38.5	39	40	40	41	0.7	2.5
Cuba	38.5	41.5	45	44.5	67.5	6.5	29
Malta	40	40	39	39	37.5	0.7	−2.5
Hungary	41	43	43	43	44	0.6	3
Portugal	42	41.5	41	41.5	43	0.5	1
Saudi Arabia	43	38	34.5	34	39	2.7	−4
Bahrain	44	45.5	45	44.5	45	0.4	1
Latvia	45	48.5	48	48	46	1.1	1
Chile	46	44	42	41.5	42	1.3	−4
Kuwait	47	47	45	46	48	0.8	1
Croatia	48	45.5	47	47	47	0.5	−1
Argentina	49.5	48.5	49	49	40	2	−9.5
Libya	49.5	68	50	55	94.5	12.6	45
Bahamas	51	50	51	51.5	55	1.1	4
Montenegro	52	51	52.5	51.5	49	0.9	−3
Oman	53	55	56	56	53	1.2	0
Uruguay	54	53	52.5	50	53	0.9	−1
Belarus	55	52	54	53	50.5	1.3	−4.5
Romania	55	54	55	54	53	0.6	−2
Barbados	55	56	58.5	59	57	1.3	2
Antigua and Barbuda	58	59	60.5	61	58	1.1	0
Russian Federation	59.5	57	57	57	50.5	1.8	−9
Bulgaria	59.5	58	58.5	58	59	0.5	−0.5
Palau	61	60	60.5	60	60.5	0.3	−0.5
Malaysia	62	61	62	62	62	0.2	0
Trinidad and Tobago	63	62.5	64	64	64.5	0.6	1.5
Seychelles	64	72	71	71.5	64.5	3	0.5
Lebanon	66	62.5	65	65.5	67.5	1.2	1.5
Venezuela	66	64	66	67	71	1.6	5
Panama	66	67	67.5	65.5	60.5	1.7	−5.5
Mauritius	68	65	63	63	63	1.4	−5

Country	2010	2011	2012	2013	2014	MAD	5-Yearly rank change
Costa Rica	69	66	67.5	68	69.5	1	0.5
Mexico	70	69.5	71	71.5	74	1.2	4
Kazakhstan	71.5	71	71	70	56	3.3	−15.5
Saint Kitts and Nevis	71.5	74	73.5	73.5	77	1.2	5.5
Grenada	73	73	78.5	80	79	2.6	6
Jordan	74	75.5	77	77.5	80	1.6	6
Azerbaijan	75.5	77	75.5	76	78	0.8	2.5
Serbia	75.5	75.5	78.5	77.5	66	2.9	−9.5
Brazil	77	78.5	80	80	75	1.6	−2
Turkey	78	69.5	69	69	72	2.4	−6
Sri Lanka	79	78.5	75.5	73.5	73	2.2	−6
Georgia	80	80	81	80	76	1	−4
Former Yugoslav Rep. of Macedonia	81	82.5	85	84.5	81.5	1.4	0.5
Ukraine	82.5	82.5	83	83	81.5	0.4	−1
Bosnia and Herzegovina	82.5	84	86	86	86	1.1	3.5
Iran, Islamic Republic of	84	81	73.5	75	69.5	4.4	−14.5
Peru	85	85	82	82	84	1.2	−1
Fiji	86	87	88	88	91	1.2	5
Armenia	87	86	87	87	86	0.4	−1
Saint Vincent and the Grenadines	89	93.5	91	91.5	97.5	2.2	8.5
Dominica	89	88.5	92	93.5	94.5	2.1	5.5
Saint Lucia	89	88.5	94.5	97	89	2.8	0
Thailand	91.5	91.5	89	89	93	1.3	1.5
Tunisia	91.5	91.5	90	90	96	1.5	4.5
Belize	93	90	84	84.5	101.5	5.2	8.5
Jamaica	94	95.5	94.5	96	99	1.3	5
Algeria	95	93.5	94.5	93.5	83	2.6	−12
Albania	96	95.5	97	95	86	2.4	−10
Colombia	97	97.5	98.5	98.5	97.5	0.5	0.5
China	99	97.5	94.5	91.5	91	2.8	−8
Ecuador	99	99	98.5	98.5	88	2.3	−11
Tonga	99	100	100	100.5	100	0.3	1
Suriname	101	101	101	100.5	103	0.5	2
Dominican Republic	102	102	102	102	101.5	0.1	−0.5
Maldives	103.5	103	103	104	104	0.4	0.5
Samoa	103.5	104.5	104.5	106	105	0.6	1.5
Turkmenistan	105	104.5	104.5	104	109	1.1	4
Egypt	106	107.5	109	110	108	1.1	2
Botswana	107	109.5	109	109	106	1.1	−1
Mongolia	109	106	106	104	91	4	−18
Palestine, State of	109	107.5	107	107	113	1.6	4
Indonesia	109	109.5	109	108	110.5	0.6	1.5
Paraguay	111	111	111.5	111	112	0.3	1
Gabon	112.5	112	111.5	112	110.5	0.5	−2

Country	2010	2011	2012	2013	2014	MAD	5-Yearly rank change
Syrian Arab Republic	112.5	113	114	118.5	134.5	5.5	22
Bolivia, Plurinational State of	114	114	113	113	119	1.4	5
El Salvador	115.5	115	115	115	117	0.5	1.5
Moldova, Republic of	115.5	116	116.5	114	107	2.3	−8.5
Philippines	117	118	118	117	115	0.8	−2
Uzbekistan	118	117	116.5	116	114	1	−4
South Africa	119.5	119	119	118.5	117	0.6	−2.5
Iraq	119.5	120	120	120	121	0.3	1.5
Viet Nam	121	121.5	122	121.5	117	1.1	−4
Micronesia, Federal States of	122	124	124	124	123	0.6	1
Guyana	123	121.5	122	121.5	124	0.8	1
Cape Verde	124	123	122	123	122	0.6	−2
Vanuatu	125	126.5	128	131	134.5	2.8	9.5
Kyrgyzstan	126	126.5	126	125.5	120	1.4	−6
Guatemala	127	125	125	125.5	128	1	1
Honduras	128	129	129.5	129.5	131	0.7	3
Namibia	129	128	127	127	126.5	0.7	−2.5
Timor-Leste	130	132	129.5	128	133	1.5	3
Nicaragua	131	131	132	132	125	1.6	−6
Morocco	132	130	131	129.5	126.5	1.4	−5.5
Kiribati	133	134	133	133.5	137	1	4
Tajikistan	134	133	134	133.5	129	1.2	−5
Cambodia	135	137	137	136.5	143.5	1.8	8.5
India	136	135	135	135	130	1.2	−6
Bhutan	137	136	136	136.5	132	1.1	−5
Congo	138	141.5	140	140	136	1.5	−2
Equatorial Guinea	139	140	141.5	144	138	1.7	−1
Ghana	140	138	138	138	140	0.8	0
Lao, People's Democrat Republic of	141	139	139	139	141	0.8	0
Sao Tome and Principe	142	143	141.5	142.5	143.5	0.6	1.5
Bangladesh	143	141.5	143.5	142.5	142	0.6	−1
Zambia	144	144	143.5	141	139	1.6	−5
Nepal	145.5	145	145	145	145.5	0.2	0
Swaziland	145.5	147	148	148	150	1.1	4.5
Pakistan	147	146	146	146	147	0.4	0
Kenya	148	148	147	147	145.5	0.7	−2.5
Myanmar	149	150	150	150	148	0.6	−1
Angola	150	149	149	149	149	0.2	−1
Madagascar	151	154	155	155	154	1	3
Cameroon	152	151	152	152.5	153	0.5	1
Nigeria	153	153	153	152.5	152	0.3	−1
Solomon Islands	154	155	157	157.5	156.5	1.1	2.5
Yemen	155	152	154	154	160	1.8	5
Senegal	156	157.5	161	163	169	3.7	13

Country	2010	2011	2012	2013	2014	MAD	5-Yearly rank change
Papua New Guinea	157.5	156	156	157.5	158	0.7	0.5
Comoros	157.5	157.5	158	159.5	159	0.7	1.5
Mauritania	159	162	159	161	156.5	1.5	−2.5
Lesotho	160.5	161	163	162	161	0.7	0.5
Uganda	160.5	160	164	164	164	1.5	3.5
Benin	162	164	165	165	166	1	4
Tanzania United Republic of	163	159	161	159.5	151	2.8	−12
Sudan	164	165	166	166.5	167	0.9	3
Haiti	165	167	168	168	164	1.4	−1
Togo	166	166	167	166.5	162	1.1	−4
Zimbabwe	167	163	161	156	155	3.8	−12
Rwanda	168.5	168	151	151	164	6.9	−4.5
Afghanistan	168.5	170	169	169	170	0.5	1.5
Djibouti	170	169	170	170	168	0.6	−2
Gambia	171	172	172	172	174	0.6	3
Côte d'Ivoire	172	171	171	171	171	0.2	−1
Ethiopia	173	173	173	173	173	0	0
Malawi	174	174	174	174	172	0.4	−2
Guinea-Bissau	175	176.5	177	177	177	0.5	2
Mali	176	175	176	176	178	0.6	2
Liberia	177	176.5	175	175	176	0.7	−1
Burundi	178	179.5	180	180	183	1.1	5
Guinea	179.5	178	178	179	181	0.9	1.5
Mozambique	179.5	179.5	179	178	179	0.4	−0.5
Eritrea	181	181	182	182	185	1	4
Burkina Faso	182	182	181	181	182	0.4	0
Central African Republic	183	184	185	185	186	0.8	3
Sierra Leone	184	185	184	183	180	1.2	−4
Chad	185	183	183	184	184	0.6	−1
Niger	186	186	186	187	187	0.4	1
Congo, Democratic Republic of the	187	187	187	186	175	2.6	−12

Appendix 2

Country	2010	2011	2012	2013	2014	Sum	Chi-Sqr n = 20	Chi-sqr n = 30
Norway	3	3	3	3	3	15	0	0
Australia	3	3	3	3	3	15	0	0
Switzerland	3.5	1	3.5	3.5	3.5	15	0.66667	0.66667
United States	5	3	3	3	1	15	1.3	1.3
Netherlands	1.5	5	3.5	3.5	1.5	15	0.96	0.96
Germany	5	3	3	3	1	15	2.4	2.4
New Zealand	3.5	3.5	3.5	3.5	1	15	3.77143	3.77143
Ireland	4	2.5	2.5	1	5	15	2.325	2.325
Denmark	4	2	2	2	5	15	1.88889	1.88889
Canada	1	3.5	3.5	5	2	15	1.16	1.16
Sweden	4.5	4.5	2.5	2.5	1	15	2.25455	2.25455
United Kingdom	5	4	2.5	2.5	1	15	3.91667	3.91667
Singapore	1	2	3.5	5	3.5	15	2.6	2.6
Iceland	2.5	2.5	4.5	4.5	1	15	3.48571	3.48571
Japan	5	4	2.5	2.5	1	15	4.90667	4.90667
Hong Kong	2	1	4	3	5	15	3.275	3.275
Liechtenstein	2.5	4	2.5	1	5	15	1.97647	1.97647
Korea, Republic of	3	1	3	5	3	15	2.04444	2.04444
Israel	1	3	3	3	5	15	1.05263	1.05263
Luxembourg	4	3	1.5	1.5	5	15	0.63	0.63
France	2	4	4	4	1	15	0.89	0.84762
Belgium	1	3	3	3	5	15	0.37	0.33636
Austria	2.5	1	4.5	4.5	2.5	15	0.67	0.71304
Finland	5	4	2	2	2	15	0.35	0.7
Slovenia	3	3	3	3	3	15	0.22	0.672
Italy	3.5	3.5	3.5	3.5	1	15	0.2	1.10769
Spain	2.5	2.5	2.5	2.5	5	15	0.2	0.62222
Czech Republic	3	3	3	3	3	15	0.31	0.6
Greece	3	3	3	3	3	15	0.63	0.57931
Cyprus	4.5	4.5	2.5	2.5	1	15	0.24	0.93333
Qatar	4	2	4	4	1	15	0.52	1.6
Brunei Darussalam	1	2.5	4.5	4.5	2.5	15	1.43	1.78667
Andorra	5	3.5	2	1	3.5	15	0.27	1.59333
Estonia	1	3	3	3	5	15	0.24	0.52667
Lithuania	5	2.5	2.5	4	1	15	0.39	0.82
Poland	1	4	5	3	2	15	0.23	0.54
Slovakia	4	3	1	2	5	15	0.13	0.04667
United Arab Emirates	5	4	2.5	2.5	1	15	0.23	0.45333
Cuba	5	4	2	3	1	15	1.55	1.41333
Malta	1.5	1.5	3.5	3.5	5	15	1.08	0.66

Country	2010	2011	2012	2013	2014	Sum	Chi-Sqr n = 20	Chi-sqr n = 30
Hungary	5	3	3	3	1	15	1.46	0.75333
Portugal	2	3.5	5	3.5	1	15	3.17	0.84
Saudi Arabia	1	3	4	5	2	15	3.19	1.13333
Bahrain	5	1	2.5	4	2.5	15	3.03	0.82667
Latvia	5	1	2.5	2.5	4	15	3.09	0.74667
Chile	1	2	3.5	5	3.5	15	2.08	0.9
Kuwait	2.5	2.5	5	4	1	15	4.11	2.48667
Croatia	1	5	3	3	3	15	3.63	1.68667
Argentina	1	4	2.5	2.5	5	15	2.48	1.53333
Libya	5	2	4	3	1	15	3.04	3.26
Bahamas	3.5	5	3.5	2	1	15	2.35	2.90667
Montenegro	2	4	1	3	5	15	1.08	2.74667
Oman	4.5	3	1.5	1.5	4.5	15	0.83	2.01333
Uruguay	1	2.5	4	5	2.5	15	1.85	1.79333
Belarus	1	4	2	3	5	15	0.92	1.27333
Romania	1.5	3.5	1.5	3.5	5	15	0.72	0.68667
Barbados	5	4	2	1	3	15	0.64	0.82
Antigua and Barbuda	4.5	3	2	1	4.5	15	0.29	0.54667
Russian Federation	1	3	3	3	5	15	1.23	0.33333
Bulgaria	1	4.5	3	4.5	2	15	1.36	0.6
Palau	1	4.5	2.5	4.5	2.5	15	3.37	1.46667
Malaysia	2.5	5	2.5	2.5	2.5	15	3.9	1.75333
Trinidad and Tobago	4	5	2.5	2.5	1	15	3.41	2.41333
Seychelles	5	1	3	2	4	15	3.55	1.45333
Lebanon	2	5	4	3	1	15	5.53	2.18667
Venezuela	3.5	5	3.5	2	1	15	6.5	2.42667
Panama	3	2	1	4	5	15	7.25	2.30667
Mauritius	1	2	4	4	4	15	5.37	2.18
Costa Rica	2	5	4	3	1	15	4.79	3.07333
Mexico	4	5	3	2	1	15	7.13	3.73333
Kazakhstan	1	2.5	2.5	4	5	15	7	4.41333
Saint Kitts and Nevis	5	2	3.5	3.5	1	15	4	3.17333
Grenada	4.5	4.5	3	1	2	15	4.57	2.86667
Jordan	5	4	3	2	1	15	5.3	4.1
Azerbaijan	4.5	2	4.5	3	1	15	4.67	4.78
Serbia	3.5	3.5	1	2	5	15	5.16	5.40667
Brazil	4	3	1.5	1.5	5	15	4.01	6.25333
Turkey	1	3	4.5	4.5	2	15	4.02	4.78667
Sri Lanka	1	2	3	4	5	15	3.54	3.66667
Georgia	3	3	1	3	5	15	2.33	4.90667
Macedonia, Former Yugoslav Rep.	5	3	1	2	4	15	2.5	4.98667
Ukraine	3.5	3.5	1.5	1.5	5	15	2.45	4.78
Bosnia and Herzegovina	5	4	2	2	2	15	2.67	4.62
Iran, Islamic Republic of	1	2	4	3	5	15	1.77	5.06667

Country	2010	2011	2012	2013	2014	Sum	Chi-Sqr n = 20	Chi-sqr n = 30
Peru	1.5	1.5	4.5	4.5	3	15	0.95	3.11333
Fiji	5	4	2.5	2.5	1	15	1.15	3.19333
Armenia	2	4.5	2	2	4.5	15	1.39	3.06667
Saint Vincent, the Grenadines	5	2	4	3	1	15	2.21	2.24667
Dominica	4	5	3	2	1	15	3.25	3.64667
Saint Lucia	3.5	5	2	1	3.5	15	3.68	4.68667
Thailand	2.5	2.5	4.5	4.5	1	15	3.65	4.25333
Tunisia	2.5	2.5	4.5	4.5	1	15	2.49	3.3
Belize	2	3	5	4	1	15	1.03	2.24667
Jamaica	5	3	4	2	1	15	0.91	3.46
Algeria	1	3.5	2	3.5	5	15	0.59	1.94667
Albania	2	3	1	4	5	15	0.35	0.84667
Colombia	5	3.5	1.5	1.5	3.5	15	0.4	1.67333
China	1	2	3	4	5	15	0.62	1.64667
Ecuador	1.5	1.5	3.5	3.5	5	15	0.55	0.92
Tonga	5	3	3	1	3	15	0.63	1.13333
Suriname	3	3	3	5	1	15	0.25	1.26667
Dominican Republic	2.5	2.5	2.5	2.5	5	15	0.19	1.17333
Maldives	3	4.5	4.5	1.5	1.5	15	0.63	0.75333
Samoa	5	3.5	3.5	1	2	15	1.35	0.9
Turkmenistan	2	3.5	3.5	5	1	15	2.11	0.67333
Egypt	5	4	2	1	3	15	1.67	0.72667
Botswana	4	1	2.5	2.5	5	15	1.36	0.39333
Mongolia	1	2.5	2.5	4	5	15	0.23	0.76
Palestine, State of	2	3	4.5	4.5	1	15	0.22	0.51333
Indonesia	3.5	2	3.5	5	1	15	1.27	0.51333
Paraguay	4	4	2	4	1	15	0.73	0.88667
Gabon	1	2.5	4	2.5	5	15	0.19	0.91333
Syrian Arab Republic	5	4	3	2	1	15	0.07	1.23333
Bolivia, Plurinational State of	2.5	2.5	4.5	4.5	1	15	0.17	2.51333
El Salvador	2	4	4	4	1	15	0.55	3.35333
Moldova, Republic of	3	2	1	4	5	15	0.61	1.74667
Philippines	3.5	1.5	1.5	3.5	5	15	0.92	1.71333
Uzbekistan	1	2	3	4	5	15	0.92	0.99333
South Africa	1	2.5	2.5	4	5	15	0.88	1.36667
Iraq	5	3	3	3	1	15	1.68	2.12667
Viet Nam	4	2.5	1	2.5	5	15	0.73	1.25333
Micronesia, Federal States of	5	2	2	2	4	15	0.9	1.09333
Guyana	2	4.5	3	4.5	1	15	1.74	1.22
Cape Verde	1	2.5	4.5	2.5	4.5	15	2.28	1.89333
Vanuatu	5	4	3	2	1	15	1.23	0.84667
Kyrgyzstan	2.5	1	2.5	4	5	15	2.93	0.99333
Guatemala	2	4.5	4.5	3	1	15	2.42	0.95333
Honduras	5	4	2.5	2.5	1	15	1.97	0.72

Country	2010	2011	2012	2013	2014	Sum	Chi-Sqr n = 20	Chi-sqr n = 30
Namibia	1	2	3.5	3.5	5	15	1.27	0.66
Timor-Leste	3	2	4	5	1	15	1.27	1.74
Nicaragua	3.5	3.5	1.5	1.5	5	15	0.9	0.58
Morocco	1	3	2	4	5	15	1.35	0.83333
Kiribati	4.5	2	4.5	3	1	15	1.81	1.39333
Tajikistan	1.5	4	1.5	3	5	15	2.44	2.02667
Cambodia	5	2.5	2.5	4	1	15	2.8	1.82667
India	1	3	3	3	5	15	2.1	2.8
Bhutan	1	3.5	3.5	2	5	15	1.73	2.71333
Congo	4	1	2.5	2.5	5	15	1.33	2.01333
Equatorial Guinea	4	3	2	1	5	15	1.28	1.8
Ghana	1.5	4	4	4	1.5	15	1.28	1.63333
Lao, People's Democrat Rep. of	1.5	4	4	4	1.5	15	0.77	1.95333
Sao Tome and Principe	4	2	5	3	1	15	1.05	1.00667
Bangladesh	2	5	1	3	4	15	1.02	2.02
Zambia	1.5	1.5	3	4	5	15	1.01	3.28667
Nepal	1.5	4	4	4	1.5	15	2.37	3.54
Swaziland	5	4	2.5	2.5	1	15	1.12	1.66
Pakistan	1.5	4	4	4	1.5	15	1.33	1.46667
Kenya	1.5	1.5	3.5	3.5	5	15	3.16	1.28667
Myanmar	4	2	2	2	5	15	1.81	0.58667
Angola	1	3.5	3.5	3.5	3.5	15	3	1.68
Madagascar	5	3.5	1.5	1.5	3.5	15	2.07	1.19333
Cameroon	3.5	5	3.5	2	1	15	0.89	1.55333
Nigeria	2	2	2	4	5	15	2.23	1.68
Solomon Islands	5	4	2	1	3	15	0.97	0.76667
Yemen	2	5	3.5	3.5	1	15	2.13	1.43333
Senegal	5	4	3	2	1	15	1.27	1.14
Papua New Guinea	2.5	4.5	4.5	2.5	1	15	1.67	1.07333
Comoros	4.5	4.5	3	1	2	15	3.81	1.32667
Mauritania	3.5	1	3.5	2	5	15	3.04	0.95333
Lesotho	5	3.5	1	2	3.5	15	2.49	1.82
Uganda	4	5	2	2	2	15	3.59	1.86667
Benin	5	4	2.5	2.5	1	15	5.08	2.66
Tanzania, United Republic of	1	4	2	3	5	15	4.14	3.21333
Sudan	5	4	3	2	1	15	7.68	3.56667
Haiti	4	3	1.5	1.5	5	15	8.8	4.28667
Togo	3.5	3.5	1	2	5	15	8.34	5.26667
Zimbabwe	1	2	3	4	5	15	7.9	4.22667
Rwanda	1	2	4.5	4.5	3	15	6.94	3.54667
Afghanistan	5	1.5	3.5	3.5	1.5	15	6.05	2.78
Djibouti	2	4	2	2	5	15	7.58	3.1
Gambia	5	3	3	3	1	15	6.51	3.64667
Côte d'Ivoire	1	3.5	3.5	3.5	3.5	15	4.43	3.8

Country	2010	2011	2012	2013	2014	Sum	Chi-Sqr n = 20	Chi-sqr n = 30
Ethiopia	3	3	3	3	3	15	5.33	2.97333
Malawi	2.5	2.5	2.5	2.5	5	15	3.42	3.83333
Guinea-Bissau	5	4	2	2	2	15	4.82	5.46667
Mali	3	5	3	3	1	15	4.14	5.08667
Liberia	1	2	4.5	4.5	3	15	2.69	4.19333
Burundi	5	4	2.5	2.5	1	15	2.4	6.27333
Guinea	2	4.5	4.5	3	1	15	2.65	6.43333
Mozambique	1.5	1.5	3.5	5	3.5	15	1.05	5.38667
Eritrea	4.5	4.5	2.5	2.5	1	15	1	5.78
Burkina Faso	2	2	4.5	4.5	2	15	0.5	3.67333
Central African Republic	5	4	2.5	2.5	1	15	1.19	6.24667
Sierra Leone	2.5	1	2.5	4	5	15	0.32	3.67333
Chad	1	4.5	4.5	2.5	2.5	15	1.27	3.08
Niger	4	4	4	1.5	1.5	15	2.6	2.87333
Congo, Democratic Rep. of the	2	2	2	4	5	15	2.3	1.52667

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