Journal of Human Development
A Multi-Disciplinary Journal for People-Centered Development
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713431425

On the Measurement of Gender Equality and Gender-related Development Levels

Journal of Human Development
Vol. 9, No. 1, March 2008

Routledge
Taylor & Francis Group

On the Measurement of Gender Equality and Gender-related Development Levels

IÑAKI PERMANYER
Iñaki Permanyer is Associate Professor at Centre d'Estudis Demogràfics and Unitat de Fonaments d'Anàlisi Econòmica

Abstract The aim of this paper is, first, to present an overall development index corrected for gender differences — the 'Multidimensional Gender-related Development Index' (MGDI) — which can be viewed as an alternative to the Gender-related Development Index. Secondly, to present a 'Multidimensional Gender Equality Index' (MGEI) that is not influenced by overall development levels. The new MGDI and MGEI are intended to overcome some of the shortcomings that characterize both the United Nations Development Programme's gender-related indices — the Gender-related Development and the Gender Empowerment Measure — and other indices that try to measure gender inequality by itself. This is accomplished through an innovative approach in which we first outline the theoretical properties of a reasonable gender equality measure and an overall development index corrected for gender differences, and then present an appropriate measure that contains all those properties at the same time.

Key words: Gender-related Development Index, Gender Equality Index, Measurement, Absolute and relative differences

Introduction

In recent years there has been increasing concern about what might broadly be referred to as 'gender equality issues'. Significantly, the promotion of gender equality and women's empowerment have been included as part of the United Nations' Millennium Development Goals for the target year 2015. In order to monitor the evolution in countries' progress towards these Goals, yearly the Human Development Report Office releases different indicators (see, for instance, United Nations Development Programme [UNDP], 1995, 2005). Among these, the Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM) specifically focus on certain aspects of the different achievement levels between women and men. The GDI aims to measure the overall

ISSN 1464-9888 print/ISSN 1469-9516 online/08/010087-22 © 2008 United Nations Development Programme
DOI: 10.1080/14649880701811427

achievement levels of a given country corrected for gender differences in those levels, while the GEM aims to measure the extent to which women have access to certain levers of power. Some ten years following the introduction of the GDI and the GEM, the Human Development Report Office initiated a work program to critically evaluate and suggest modifications to these measures.

Selected contributions from the UNDP Expert Meeting in January 2006 were published in a special issue of the *Journal of Human Development* (volume 7(2), 2006). At the risk of oversimplification, we could classify the aforementioned (and other related) contributions into two broad groups: those that try to broaden the GDI or the GEM by including new dimensions considered relevant to better take into account the gender situations in different regions of the world (see Charmes and Wieringa, 2003; Chant, 2006; Cueva, 2006; Folbre, 2006), and those that propose alternative techniques of measuring the concepts of 'development levels corrected by gender differences' or 'gender (in)equality' by itself (see Bardhan and Klasen, 1999; Dijkstra, 2002, 2006; Klasen, 2006). Concerning the latter point, there is an increasing number of authors who have pointed out the need to have a 'true' gender equality measure that is not influenced by overall achievement levels.

This paper aims to make a contribution to certain *theoretical* aspects of the measurement of multidimensional gender (in)equality and other related issues. First, we present an innovative way of measuring existing gender equality levels in a given country through the 'Multidimensional Gender Equality Index' (MGEI). We will then measure the development levels corrected/penalized by gender inequalities by means of the 'Multidimensional Gender-related Development Index' (MGDI). It is important to emphasize that this paper will *not* be concerned with the appropriateness of the specific variables chosen. Rather, the paper is concerned with the way in which, once given, the variables should be combined to obtain a reasonable development index corrected by gender differences, as well as an overall gender equality index. Recall that, as a method that does not depend on the specific choice of variables, our proposal has the appealing property of being potentially usable in wide-ranging contexts. In particular, it can be used with GDI data, but it could also be adapted to cases in which more (and more appropriate) variables are chosen.

The process by which these new measures are arrived at is theoretical in nature. We start by specifying the mathematical properties that a reasonable gender equality measure, and an overall development index corrected by gender differences, should have, and then present some appropriate measures having all those properties at the same time. In order to make the explication clearer, we will start in the next section by analyzing the single dimensional case. We shall explore some reasonable properties one would like to impose on a gender difference measure and a development level indicator affected by gender differences. The multidimensional context will be studied in the third section. Again, we will explore both the gender difference approach *per se* and the development level affected by the gender differences approach. In the subsequent section, we present an empirical application of our results using UNDP (2003) GDI data, and we draw our conclusions in the final section.

The single-dimensional case

For ease of explication, we will start by considering the case in which we focus on a single dimension that represents the achievement of a certain functioning (for a definition of the term 'functioning', see Sen, 1992). We shall now make the assumption that the achieved functioning levels are normalized to the [0,1] scale, so the average achieved functioning levels of women and men (denoted by x and y, respectively) will be two numbers between zero and one. This normalization assumption is *not* very restrictive: recall that, for example, in order to compute the explicit value of the GDI (or the Human Development Index [HDI]), one has to convert the range of the different indicators to the [0,1] scale. The question we would like to answer is the following: if x and y are the average achieved functioning levels of women and men, how do we measure the gender difference? At this point, two equally natural answers could be given. First, we could well say that such gender difference can be measured as $G_1(x,y)=|x-y|$; that is, by taking the *absolute* value of the difference of the respective levels. Alternatively, we could also consider the *relative* difference between both levels, which is something like $G_2(x,y):=x/y$. These seemingly natural and easy ways of measuring gender differences are interesting in their own right, but they have several drawbacks we would like to highlight.

Let us start with $G_1(x,y)$. Technically speaking, G_1 is a two-dimensional real-valued function, with its arguments and images in the unit interval [0,1]. For illustrative purposes, it will be useful to consider the level contours of G_1; that is, the sets $l_c:=\{(x,y)\in[0,1]^2 \mid G_1(x,y)=c\}$ for any constant $c\in[0,1]$. One can readily verify that $l_c=\{(x,y)\in[0,1]^2 \mid y=x+c\}\cup\{(x,y)\in[0,1]^2 \mid y=x-c\}$. In Figure 1, we have plotted some such level contours: they are parallel lines of slope equal to one. Recall that, by definition, all the points over the level contour l_c have the same gender difference level (according to G_1).

The absolute difference measured by G_1 has a clear meaning but is not sensitive to the translations of both factors x and y by the same quantity. This means that

$$G_1(x,y)=G_1(x+k,y+k)$$

for any $k\in[-1,1]$ whenever $0\leqslant x+k\leqslant 1$ and $0\leqslant y+k\leqslant 1$ because both (x,y) and $(x+k,y+k)$ belong to the same level contour $l_{|x-y|}$.

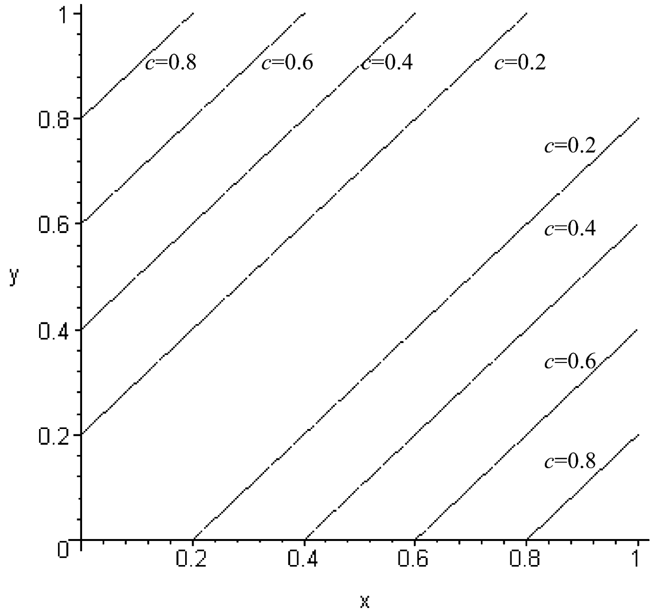

FIGURE 1. Level contours of G_1 for c=0.2, 0.4, 0.6, 0.8.

- *Example one*. Imagine that we want to compare the gender differences between two countries A and B for which one has $x_A=0.1$, $y_A=0.2$ and $x_B=0.9$, $y_B=1$. It is then clear that $G_1(x_A,y_A)=G_1(x_B,y_B)=0.1$, so both countries would be considered to have the same level of gender inequality. However, one could intuitively argue that the gender inequality situation in A is worse than in B if we now take into account a relative point of view. In country A, one has $x_A/y_A=0.5$ (i.e. women achieve only 50% of the respective level achieved by men), whereas in country B $x_B/y_B=0.9$ (so women achieve 90% of the respective level achieved by men). Thus, when the *absolute* gender difference levels for two countries are the same, one might feel tempted to conclude that the country with lower *relative* gender difference should be regarded as having less gender difference.

Let us now examine the main characteristics of the relative gender difference function $G_2(x,y)$. In this case, the domain of G_2 is $D_{G_2}=\{(x,y)|x\in[0,1], y\in(0,1]\}$ and the image corresponds to $\Re_+$. Now, for any $c\in\Re_{++}$ one can easily compute the corresponding level contour: $l_c=\{(x,y)\in D_{G_2}|y=x/c\}$. However, in the way it has been defined, G_2 has several important problems, namely non-symmetry and unboundness. Starting with the first, it is readily seen that the function G_2 is not symmetrical; that is, $G_2(x,y)\neq G_2(y,x)$ for all $x\neq y\in[0,1]$. This is not very reasonable, as it seems clear that the degree of inequality in distribution (x,y) should be the same as in (y,x). Regarding the second point, G_2 is an unbounded function over its domain because for any

$x \neq 0$, as y approaches 0 the values of $G_2(x,y)$ can be infinitely large. This is not a very desirable property because of the extreme sensitivity of G_2 to low values of y. Moreover, the fact that the set of values $\{(x,y) \in \Re^2 | 0 \leq x \leq 1, y = 0\}$ are excluded from the domain of G_2 is not very 'comfortable', as no conclusion can be reached when we have to deal with any of them.[1]

At this point, it is helpful to introduce a new function that captures the intuition behind the notion of relative difference yet at the same time avoids the aforementioned problems.

$$G_3(x,y) := \begin{cases} \frac{|x-y|}{x+y} & \text{if} \quad (x,y) \neq (0,0) \\ 0 & \text{if} \quad (x,y) = (0,0) \end{cases}$$

It can readily be seen that this function is symmetrical and bounded, because $|x-y| \leqslant x+y \ \forall \ (x,y) \in [0,1]^2 \backslash (0,0)$. In fact, the values of G_3 fall within [0,1], so we can say that $G_3 : [0,1]^2 \rightarrow [0,1]$, which are the same domain and range as in the case of absolute difference G_1. The level contours of G_3 for a given $c \in [0,1]$ are given by $l_c = \{(x,y) \in [0,1]^2 \backslash (0,0) | y = x(1-c)/(1+c)\}$ U $\{(x,y) \in [0,1]^2 \backslash (0,0) | y = x(1+c)/(1-c)\}$. These are lines directed at the origin of slopes m and $1/m$ for $m \in \Re_+$. Several of them are plotted in Figure 2. As we can see, the level contours of G_3 are similar to those of G_2 because they consist of straight lines directed to the origin. Henceforth, when we talk about relative gender difference, we will be implicitly assuming that we are using the definition of G_3.

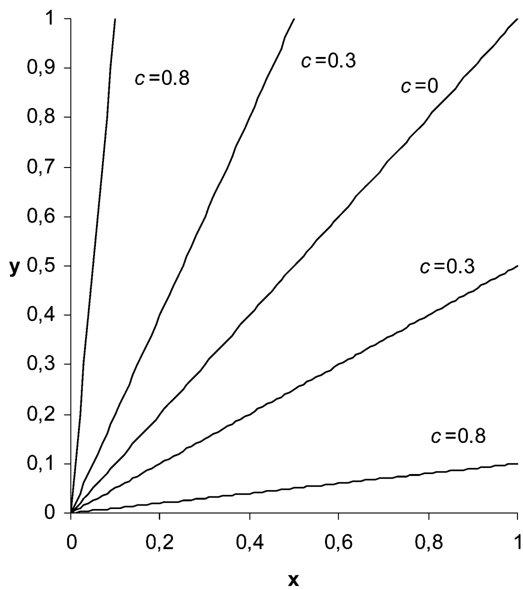

FIGURE 2. Level contours of G_3 for $c=0$, 0.3, 0.8.

- *Example two*. Let us again consider the situation in which we want to compare the gender differences of two countries A and B with their respective female and male achievement levels (x_A, y_A) and (x_B, y_B). Imagine that these values are (0.5,1) for country A and (0.01,0.02) for country B. According to the relative gender difference function G_3, both countries should be considered equally unequal, because $G_3(0.5,1)=G_3(0.01,0.02)=1/3$. However, given the fact that the respective absolute differences ($1-0.5=0.5$ and $0.02-0.01=0.01$) are so disparate, one could argue that gender inequality is lower in country B than in country A. Thus, when the *relative* gender difference levels for two countries are the same, one might feel tempted to conclude that the country with lower *absolute* gender difference should be regarded as having less gender difference.

As we have seen in the above discussion, both absolute and relative gender difference measures are interesting in their own right, but they have certain limitations. However, it seems that one measure complements the other should one of them fail to give 'reasonable' rankings (see examples one and two). These intuitions lead us to propose another gender difference measure that *tries to capture both the absolute and relative points of view at the same time*. Such a measure should satisfy the following properties that reflect the intuitions behind the aforementioned examples:

- *Decreasing with (increasing) absolute translation* (DAT): For any $(x,y) \in [0,1]^2$, one has $G(x,y)>G(x+\varepsilon,y+\varepsilon)$ for any $\varepsilon>0$, such that $(x+\varepsilon,y+\varepsilon) \in [0,1]^2$. This property is verified by G_3 but not by G_1.
- *Increasing with (increasing) relative translation* (IRT): For any $(x,y) \in [0,1]^2$, one has $G(x,y)<G(\lambda x,\lambda y)$ for any $\lambda>1$ such that $(\lambda x,\lambda y) \in [0,1]^2$. This property is verified by G_1 but not by G_3.

In addition to DAT and IRT, we would also like our gender difference measure to have the following reasonable properties:

- *Extreme Inequality* (EI):

$$\max_{(x,y)\in[0,1]^2} G(x,y)=G(0,1)=G(1,0)=1$$

  That is, when either all women or all men fully achieve a certain functioning, and all members of the opposite sex do not achieve it, we have the most extreme case of gender inequality. In that case, the function takes the highest possible value of one. This property is verified by G_1 and G_3.
- *Extreme Equality* (EE):

$$\min_{(x,y)\in[0,1]^2} G(x,y)=G(a,a)=0 \quad \forall a\in[0,1]$$

  That is, when women and men achieve the same average level for a certain functioning (no matter how high or low), this is a case of extreme equality. In that case, the function takes the lowest possible value of zero. This property is verified by G_1 and G_3.

- *Continuity* (CONT): $G(x,y)$ is a continuous function for all $(x,y) \in [0,1]^2$. This property ensures that small changes in (x,y) do not suddenly change the values of $G(x,y)$. It is verified by G_1 but not by G_3 (should the function fail to be continuous at (0,0)).

A new gender difference measure

In this section, we shall present a new gender difference function that satisfies DAT, IRT, EI, EE and CONT at the same time. However, the process by which this new measure is arrived at is a bit lengthy and technical, and therefore might distract us from our main line of argument. In order not to overburden the text, we will not present it here.[2]

Definition 1

For any $(x,y) \in [0,1]^2$, we define the function

$$G_{\alpha,\beta}(x,y) := \begin{cases} \frac{|x-y|^{\alpha}}{(x+y)^{\beta}} & \text{if} \quad (x,y) \neq (0,0) \\ 0 & \text{if} \quad (x,y) = (0,0) \end{cases}$$

in which α and β are two non-negative real numbers. Recall that when $\alpha=1$ and $\beta=0$ we have $G_{1,0}=G_1$, and when $\alpha=1$ and $\beta=1$ then $G_{1,1}=G_3$, so the 'traditional' absolute and relative gender difference measures can be seen as a particular case of the new measure $G_{\alpha,\beta}$.

Proposition 1

The gender difference function $G_{\alpha,\beta}$ satisfies DAT, IRT, EI, EE and CONT if and only if $\alpha>0$, $\beta>0$ and $\alpha>\beta$.

Proof

The proof is quite straightforward and will not be presented here. It is available upon request for anyone who might be interested.

Let us now see how the level contours of $G_{\alpha,\beta}$ look and what can we say about them when $\alpha>0$, $\beta>0$ and $\alpha>\beta$. By definition, for a given $c \in [0,1]$, $l_c=\{(x,y) \in [0,1]^2 \backslash (0,0) \mid |x-y|^{\alpha}/(x+y)^{\beta}=c\}$. This is an implicit equation in which it is not possible to write y in terms of x with an explicit function. However, many computer programs can numerically solve these equations and plot the level contours. In Figure 3, we have plotted some level contours of $G_{\alpha,\beta}$ for $\alpha=1$ and $\beta=0.5$.

As we can see from the level contours in Figure 3, the gender difference function $G_{\alpha,\beta}$ is a sort of intermediate case between G_1 and G_3, and by choosing the appropriate values for α and β it can resemble any of the two extremes. In general, for any two distributions (x_0,y_0), (x_1,y_1) in the same level contour (i.e. showing the same degree of gender inequality

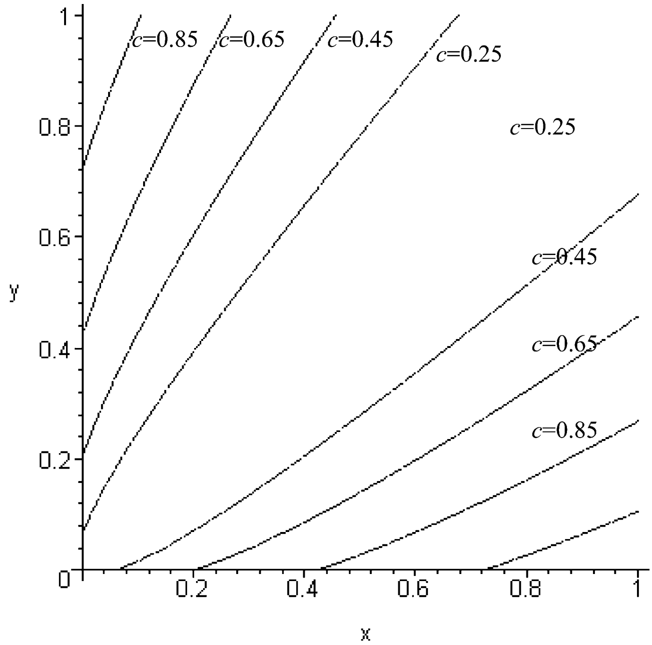

FIGURE 3. Level contours for $G_{\alpha,\beta}$ with $\alpha=1$, $\beta=0.5$ for $c=0.25$, 0.45, 0.65, 0.85.

according to $G_{\alpha,\beta}$), one of them will have a higher absolute difference and a lower relative difference than the other, and *vice versa*.

Development level affected by gender differences

In the previous section, we introduced different functions for measuring the extent to which there is a gender difference in the achievement levels of a certain functioning. It is very important to note that these functions are essentially *comparing* two groups of people without regard to the average achieved levels. Thus, the distributions (0,0) and (1,1) are judged to be optimal from a purely gender equality standpoint, as women and men have exactly the same performance levels. We maintain that these gender difference functions are independent of achievement levels. However, from a socio-economic development standpoint, the latter distribution, in which all women and men completely achieve a certain important functioning, is clearly preferable to the former, in which nobody achieves it at all. It could then be reasonably argued that, apart from gender equality, it is also important to take into account the overall functioning achievement level. In other words, apart from the equality aspects, we can also focus attention on the aggregative aspects of the evaluative exercise.

Before proceeding, it is important to bear in mind that, by trying to include both aspects, some conflicts may inevitably arise. Consider the following illustrative example: suppose that x_A measures the proportion of literate women and y_A the proportion of literate men in country A, and x_B and y_B are the corresponding proportions for country B. We will consider a situation in which the population shares for women and men are equal to 0.5. What is to be judged as being better: country A with $(x_A,y_A)=(0.4,0.5)$ or country B with $(x_B,y_B)=(0.6,0.9)$? Country A has a lower gender inequality level than country B (in both absolute and relative terms: $G_1(x_A,y_A)=0.1<G_1(x_B,y_B)=0.3$ and $G_3(x_A,y_A)=1/9<G_3(x_B,y_B)=1/5$), but country B has a higher mean percentage level of literate people than country A: 75% against 45%. Clearly some kind of compromise has to be found between these two conflicting points of view. This point will be further developed in the following section.

The Gender-Related Development Index approach

Before presenting our proposal, it might be interesting to closely examine the approach taken by the UNDP in respect of the GDI. In the theoretical foundations of the GDI, there is a practical compromise to show the existing trade-offs between gender equality and aggregation. Anand and Sen suggest using what they call a ''(1–ε)-average'', which is defined as

$$X_{ede} := \left(p_f x^{1-\varepsilon} + p_m y^{1-\varepsilon}\right)^{1/(1-\varepsilon)}$$

in which $\varepsilon \geqslant 0$, $p_f = n_f/(n_f+n_m)$ and $p_m = n_m/(n_f+n_m)$ are the population shares of women and men (Anand and Sen, 1995). This definition is derived from an approach explored by Atkinson, in which X_{ede} is the level of achievement, which, if attained equally by women and men, as in (X_{ede},X_{ede}), would be judged to be exactly as socially valuable as the actually observed achievements (x,y) by a certain social valuation function (Atkinson, 1970, p. 250; for more details see Anand and Sen, 1995). In other words, X_{ede} can be thought of as the *overall functioning achievement level corrected by gender differences*. This ''(1–ε)-average'' satisfies the following properties.

1) $\min(x,y) \leqslant X_{ede} \leqslant \max(x,y)$.
2) The larger ε, the smaller X_{ede}. In fact, $\lim_{\varepsilon \to \infty} X_{ede} = \min(x, y)$.
3) $X_{ede} \leqslant A(x,y)$ for all $\varepsilon \geqslant 0$, with equality holding for $\varepsilon = 0$.

Here, $A(x,y) := (n_f/(n_f+n_m))x + (n_m/(n_f+n_m))y$ is the average achievement level for the whole country. The value of ε measures the degree of aversion to inequality. When $\varepsilon=0$, there is no aversion to inequality, so the overall achievement level corrected by gender differences will just be equal to the average population achievement level $A(x,y)$. In general, when $\varepsilon>0$, there is some degree of aversion to inequality, so the value of X_{ede} is lower than that of $A(x,y)$.

Having defined X_{ede}, Anand and Sen proceed to (implicitly) define what they call ''something like a gender equality index'', $E := X_{ede}/A(x,y)$, which can vary from zero to one as equality increases (1995,). According to this definition, one could write

$$X_{ede} = EA(x, y), \tag{1}$$

thus expressing in a single simple equation the interaction between gender equality (E) and aggregation (A) to obtain an overall functioning achievement level corrected by gender differences function.

Even if this approach has some attractive features, there is a specific point that deserves special attention. Recall that the gender equality index E is implicitly obtained as a by-product once the overall functioning achievement level corrected by gender differences function (X_{ede}) has been defined by other procedures. Consequently, one may lose control over the properties one would like a gender difference function to have. In particular:

$$E(x, y) = \frac{\left(p_f x^{1-\varepsilon} + p_m y^{1-\varepsilon}\right)^{1/(1-\varepsilon)}}{p_f x + p_m y}$$

Then,

$$E(\lambda x, \lambda y) = \frac{\left(p_f (\lambda x)^{1-\varepsilon} + p_m (\lambda y)^{1-\varepsilon}\right)^{1/(1-\varepsilon)}}{p_f \lambda x + p_m \lambda y}$$

$$= \frac{\left(\lambda^{1-\varepsilon}\left(p_f x^{1-\varepsilon} + p_m y^{1-\varepsilon}\right)\right)^{1/(1-\varepsilon)}}{\lambda\left(p_f x + p_m y\right)} = E(x, y)$$

in which $\lambda \in \Re_{++}$. This means that the IRT property is not met. In the following section, we shall present an alternative way of defining an overall functioning achievement level corrected by gender differences function that overcomes these limitations.

Gender-corrected achievement level and penalization functions

Instead of taking the GDI approach, in which no control exists over the implicitly defined gender equality measure (E), we believe it is more expedient to obtain an overall achievement level corrected by gender differences function from a gender equity measure with desirable properties. Our approach is based on the following argument. Firstly, let us denote a generic gender equity measure by $G(x,y)$, the average achievement level for the whole country we presented before by $A(x,y)$ and an overall achievement level corrected by gender differences measure by $D(x,y)$. By definition, $G(x,y), A(x,y), D(x,y) \in [0,1]$ $\forall$ $(x,y) \in [0,1]^2$ and $D(x,y) \leqslant A(x,y)$ $\forall$ $(x,y) \in [0,1]^2$. That is, the overall achievement level corrected by gender differences should never exceed the value of the average achievement level for the entire country. It is natural to assume that the extent to which these two measures differ should be *directly related* to the existing gender difference; that is, to the value of the function $G(x,y)$. Then, all else being equal, the higher the value of $G(x,y)$, the higher the difference between $D(x,y)$ and $A(x,y)$ should be, and *vice versa*. Now, when it comes to measuring the existing difference between $D(x,y)$ and $A(x,y)$ we are faced with a situation similar to the one presented in the second section, when we had to decide on the gender difference between women and men if their average achievement levels were x and y, respectively. In this situation, we could again consider either the absolute difference — that is, $A(x,y)–D(x,y)$ — or the relative difference — that is, $D(x,y)/A(x,y)$ — but, as we previously indicated, these two measures have drawbacks: they do not simultaneously verify the properties equivalent to the ones we presented in the second section (DAT, IRT, EI, EE and CONT). To avoid this kind of problem, we could then define a 'penalization function' that attempts to capture both the absolute and relative points of view at the same time. Let us call such a function $P_k(A,D)$. From the aforementioned, one can impose the following relation.

$$\gamma G(x, y) = P_k(A(x, y), D(x, y)), \tag{2}$$

in which $\gamma \in \Re_{++}$. That is, the penalization to the distribution (x,y) — measured by $P_k(A(x,y),D(x,y))$ — should be directly proportional to the corresponding gender differences $G(x,y)$. Now, as the explicit formulation of $G(x,y)$ has been presented earlier and the value of $A(x,y)$ is $p_f x+p_m y$, one could deduce from Equation (2) the explicit formulation of the overall achievement level corrected by gender differences function $D(x,y)$. Following this procedure, we can be sure that the function $D(x,y)$ has the desirable properties we did not found in X_{ede}.

Let us now define the penalization function $P_k(A(x,y),D(x,y))$ that takes into account *both* the absolute and relative approaches to measure the existing difference between $A(x,y)$ and $D(x,y)$. For ease of notation, we will sometimes simply write A instead of $A(x,y)$ and D instead of $D(x,y)$. We will use the same kind of arguments as the ones presented in the earlier section '*A new gender difference measure*' but with several important differences. Firstly, recall that, as $D(x,y) \leqslant A(x,y)$ $\forall$ $(x,y) \in [0,1]^2$, the function $P_k(A,D)$ does *not* have to be symmetrical. At the same time, the domain we should consider is $\{(A, D) \in [0,1]^2 | D \leqslant A\}$. Secondly, the relative difference in function D/A is no longer unbounded and it takes values on the interval [0,1]. In this way, we do not need to transform it as we did in the second section with G_2 and G_3. Bearing these differences in mind, we can now proceed analogously as before and present the following function

$$P_k(A, D) = \frac{A-D}{A^k} \tag{3}$$

in which $k \in (0,1)$. If k were 0, $P_0(A,D)$ would be the absolute difference, and if k were 1, $P_1(A,D)$ would be the relative difference. Such a function has a series of properties that are straightforward analogues of DAT, IRT, EI, EE and CONT adapted to the present context. Having defined the penalization function $P_k(A,D)$, one can now substitute Equation (3) with

Equation (2) to obtain:

$$D(x,y)=A(x,y)-\gamma A^{k}(x,y)\frac{|x-y|^{\alpha}}{(x+y)^{\beta}} \tag{4}$$

in which we have taken $G(x,y)=G_{\alpha,\beta}(x,y)$ with $\alpha>\beta>0$, $k\in(0,1)$, $\gamma>0$. In order to make this formula somewhat more operational we shall make the following assumptions concerning the values of α, β, γ and k. Recall that α and β determine the precise way the gender difference function $G_{\alpha,\beta}$ takes into account both the absolute and relative points of view at the same time. Analogously, k plays exactly the same role for the penalization function P_k. It then seems reasonable to impose a certain relation between both α, β and k, as both sets of parameters play the same role in their respective contexts. For example, if $\alpha=1$, $\beta=0$, then the gender difference function would be the absolute difference function. It would then be coherent to choose $k=0$, so that the penalization function P_0 would also be the absolute difference function. Analogously, if $\alpha=\beta=1$, the coherent choice for k would be 1. In order to measure differences with the same yardstick (whether gender differences or differences between A and D), we should impose the following restriction:

$$\frac{1}{k}=\frac{\alpha}{\beta}.$$

Moreover, we should also specify the interpretation of γ in Equation (4) and the range of values it can take. Concerning its interpretation, from Equations (2) and (4) one can see that γ measures the extent to which a country is going to be penalized because of the existent gender inequality levels. If $\gamma=0$, there would be no penalization at all and $D(x,y)$ would be equal to $A(x,y)$. Conversely, higher values of γ correspond to higher penalizations because of gender inequalities. However, it is important to realize that the values of γ cannot be arbitrarily high since, beyond a certain upper limit, the values of $D(x,y)$ in Equation (4) could even be negative, and hence a meaningless result. This means that the values of γ should fall somewhere between zero and a certain upper limit $u>0$ which will depend on the specific values of α and β. The explicit computations of this upper limit u are somewhat technical and involved, and would distract us from our main line of argumentation, so they will not be presented here.[3] For the purpose of this paper, suffice it to say that when, for example, $\alpha=2$ and $\beta=1$, then the range of admissible values for γ is [0,1/3].

A measure of achieved development levels corrected by gender differences

Based on the discussion in the previous section, we can now present different ways of measuring the achieved development levels corrected by gender differences. Essentially, we will be using Equation (4) for certain values of α, β and γ. Before presenting our results, it is interesting to note that the GDI approach proposed by Anand and Sen with $\varepsilon=2$, is one particular case of our family of measures (1995,). Recall that when $p_f=p_m=0.5$, $X_{ede}=(0.5x^{-1}+0.5y^{-1})^{-1}=2xy/(x+y)$. Now, if $\alpha=\beta=2$ and $\gamma=0.5$, Equation (4) is rewritten as

$$D(x,y)=\frac{x+y}{2}-\frac{1}{2}\frac{|x-y|^2}{(x+y)^2}=\frac{2xy}{x+y}=X_{ede}.$$

When one has to choose the values of α, β, γ in Equation (4), there is obviously a certain degree of arbitrariness due to the number of admissible choices for these parameters. This is similar to the GDI approach, in which a precise value of the degree of aversion to inequality ε has to be given in order to compute the corresponding development levels. In that case, a reasonable and intermediate value of $\varepsilon=2$ is taken, showing a moderate degree of aversion to inequality. In our context, we will take a similar approach, choosing intermediate values that define functions which are neither too simple nor too 'wild'. For example, by taking a positive but very small value for γ, the effect of the penalization function almost vanishes, as most of the weight is placed on the average achievement level $A(x,y)$, thus producing an exceedingly simple function. Consider now the case in which one chooses 'big' values for α and β. In that case, the $|x-y|\alpha/(x+y)^\beta$ term becomes increasingly small, thus again placing most of the weight on the average achievement level $A(x,y)$, which produces an overly simplified function. We will present the intermediate case, which we regard as more interesting, and plot its corresponding level contours.

Definition 2
If we take the values of $\alpha=2$, $\beta=1$ and $\gamma=1/3$ in Equation (4), we obtain our measure of achieved development level corrected by gender differences

$$D_1(x,y)=p_fx+p_my-\frac{1}{3}\sqrt{p_fx+p_my}\frac{|x-y|^2}{(x+y)} \tag{5}$$

In order to better understand the behavior of this function, we can plot several of its level contours for different values of $c\in[0,1]$, when the population shares p_f,p_m are equal to 0.5 (see Figure 4).

As we see in Figure 4, D_1 does *not* have any L-shaped level contours, as does X_{ede} when $c=0$. In general, D_1 does not penalize (as X_{ede} does) those countries with high relative gender inequality as heavily.

The multidimensional case

So far, we have been concerned with the gender difference and the development levels corrected by this gender difference in a single dimension. Clearly, however, if we want to assess overall development

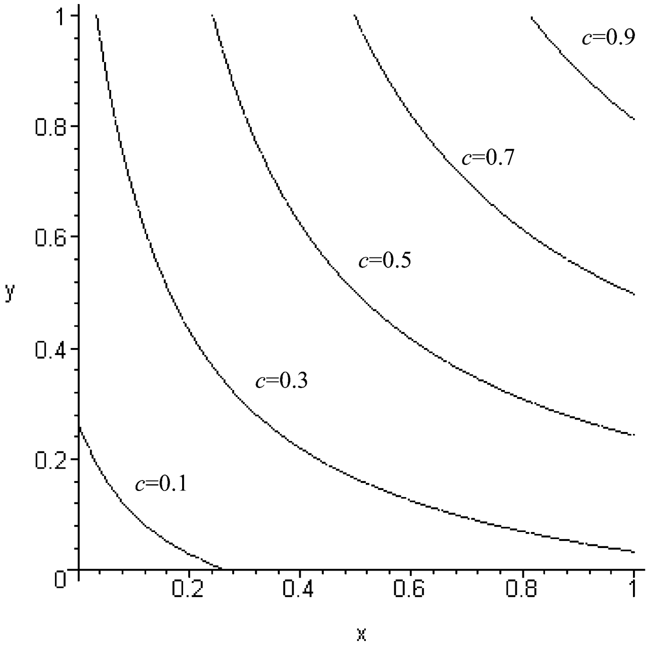

FIGURE 4. Level contours of D_1 for c=0.1, 0.3, 0.5, 0.7, 0.9.

levels or gender difference levels in entire countries, we would have to take several important functionings into account. In this section, we will propose one way of dealing with the multidimensional context that differs from the approach taken in the GDI. We contend that an important drawback of the GDI is its lack of sensitivity to the direction of the gender gaps in each of the analyzed dimensions. To clarify this concept, let us use $((x_1,y_1),(x_2,y_2),(x_3,y_3))$ to denote the achievement levels for women and men in three different development dimensions. It is then clear that the GDI cannot distinguish between any of the following distributions: $\delta_a=((0.2,0.4),(0.5,0.8),(0.7,1))$, $\delta_b=((0.4,0.2),(0.8,0.5),(1,0.7))$, or $\delta_c=((0.2,0.4),(0.8,0.5),(0.7,1))$. Even if the GDI value for all of them is exactly the same (when p_f and p_m are equal to 0.5), in δ_a men have a higher achievement level than women in all three dimensions, in δ_b one has the opposite situation, and in δ_c we have a mixed case in which women perform better than men in one dimension but worse in the other two.

A development level corrected by gender differences should be sensitive to the degree to which there is a certain balance between dimensions of the most highly achieving sex, and thus conclude that the distribution δ_c is preferable to δ_a and δ_b. In the ensuing sections of this paper, we shall extensively use the term 'balance' in an attempt to distinguish between such different distributions. Roughly speaking, when the gender gaps go in the same direction for *all* dimensions, we talk about 'imbalanced distributions' (as in δ_a and δ_b); and when this dominance occurs just in *some* of them (as in δ_c), we talk about 'balanced distributions'. Obviously, there are different *degrees* of balance/imbalance that will have to be appropriately measured (see Equation (6) below). The GDI's lack of sensitivity to the degree of balance/imbalance of the distributions has only recently been pointed out (see Dijkstra, 2002; Klasen, 2006). These authors suggest that some kind of compensation between dimensions should be allowed, even if they acknowledge that this can lead to the undesirable result of being unable to distinguish between a country with full gender equality and another with dramatic but equally large gender gaps in opposite directions. In this paper, we propose a solution to this problem by *not* allowing for compensation between dimensions but by penalizing heavier those countries showing higher degrees of imbalance in their distributions (see later).

Another interesting aspect that is not dealt with in the *Human Development Reports*' summary indices is the creation of an index that summarizes the overall gender differences in the different dimensions of human development, abstracting from its achievement levels. To date, although there have been some attempts to compute such an index, all of them miss some measurement aspects that we consider important. White (1997) defined a Gender Equality Index as GDI/HDI, while Forsythe *et al.* (1998) define a Gender Inequality index as (HDI – GDI)/HDI. By construction, these two indices suffer from the limitations inherent to the GDI presented earlier in the section '*Gender-related Development Index approach*'; namely, they implicitly measure gender differences from a relative standpoint without taking into account the absolute perspective. Another attempt to create such an index was proposed by Dijkstra and Hanmer (2000), who present "An index of gender inequality that abstracts from absolute levels of well-being" (Relative Status of Women [RSW]), defined as

$$RSW := \frac{1}{3}\left(\frac{x_1}{y_1} + \frac{x_2}{y_2} + \frac{x_3}{y_3}\right).$$

Following the arguments presented in the second section, the RSW is defined on a weak methodological basis, as it is uses the relative gender difference measure — which, as we have seen above, is asymmetrical, unbounded and not defined when any of the y_i is equal to zero. Dijkstra (2002) presents another index called the Standardized Index of Gender Equality. By definition, the Standardized Index of Gender Equality is an unweighted average of five different standardized indices. However, three of these indices are measured on a relative scale, and the other two are female shares in parliament and in technical, professional, administrative and management positions. Thus, this index also measures the gender differences from a relative standpoint without taking into account the absolute perspective. In the following section, we present an alternative way of constructing a conceptually similar index that overcomes the aforementioned limitations.

An overall gender equality indicator

Here we introduce a summary index that strives to measure the overall gender equality in a given country, abstracting from its development levels. This index will obviously depend on the existing gender differences in each of the corresponding dimensions we will examine. The basic idea is to summarize the set of gender inequality levels of each dimension into a single index by means of a function that takes into account the direction of the gender gaps.

We start by introducing some notations that will be used throughout the section. From now on, $n \in N$ will be the number of distinct dimensions we will be taking into account; $(x_i, y_i) \in [0,1]^2$ will denote the degree of achievement in dimension i for women and men, respectively, for all $i \leqslant n$. The easiest way to define an average level of gender inequality would be to compute

$$\overline{G} := \sum_{i=1}^{n} w_i G_{\alpha,\beta}(x_i, y_i)$$

in which $\Sigma_i w_i = 1$. However, as mentioned above, we would like our indicator to be sensitive to a balanced distribution between dimensions. Clearly, this is not the case for $\bar{G}$. We will now introduce several concepts to detect the (im)balanced distributions between different dimensions.

Let us define the sets $I := \{1, \ldots, n\}$, $I_W := \{I \in I | x_i > y_i\}$, and $I_M := \{I \in I | y_i > x_i\}$. I_W is the list of dimensions for which, on average, women perform strictly better than men, whereas I_M denotes the set of dimensions for which, on average, men perform strictly better than women. Now, we can define

$$\Gamma_W := \sum_{i \in I_W} w_i G_{\alpha,\beta}(x_i, y_i),$$

$$\Gamma_M := \sum_{i \in I_M} w_i G_{\alpha,\beta}(x_i, y_i).$$

By definition, $\Gamma_W + \Gamma_M = \bar{G}$ and $\Gamma_W, \Gamma_M \in [0,1]$. Thus, Γ_W measures the extent to which the average gender inequalities ($\bar{G}$) are due to inequalities favoring women, whereas Γ_M gives the analogous result for men. The overall gender equality index corrected by (im)balanced distributions between dimensions we shall introduce in this section (from now on: $\bar{G}_c$) must satisfy the following conditions: first, when Γ_W and Γ_M are equal to $\bar{G}/2$, then $\bar{G}_c = \bar{G}$ (roughly speaking, when women and men 'benefit' as a group by the same amount of the existing overall gender inequality ($\bar{G}$), then no modification is introduced); and second, when Γ_W and Γ_M are not equal to $\bar{G}/2$, then $0 < \bar{G} < \bar{G}_c$. In other words, when a certain degree of imbalance between dimensions exist, then the corrected index $\bar{G}_c$ will be increased with respect to $\bar{G}$.

At this point, we should specify precisely how to measure the degree of balance between dimensions, and how the given degree of (im)balance affects the value of $\bar{G}_c$. The second point will be implicitly answered when we present our indicator $\bar{G}_c$. With respect to the first point, we will use the following indicator

$$B\left(\Gamma_W, \overline{G}\right) := \begin{cases} \Gamma_W / \overline{G} & \textit{if} \quad \overline{G} \neq 0 \\ 1/2 & \textit{if} \quad \overline{G} = 0 \end{cases} \tag{6}$$

By definition, $B(\Gamma_W, \bar{G})$ (or B for short) $\in [0,1]$. If $B=0.5$ we have the highest possible degree of balance, and if $B=0$ or 1 we have the highest possible degree of imbalance.

We can now present our overall gender equality corrected by imbalance between the dimensions indicator for any distribution $((x_1,y_1), \ldots, (x_n,y_n))$, which will be called the Multidimensional Gender Equality Index (MGEI, or $\bar{G}_c$ for short).

$$\overline{G}_c((x_1, y_1), \ldots, (x_n, y_n)) := \left(\sum_{i=1}^{n} w_i \left(G_{\alpha,\beta}(x_i, y_i) \right)^{1+f(\varepsilon,B)} \right)^{1/(1+f(\varepsilon,B))} \tag{7}$$

in which $f(\varepsilon,B) := \varepsilon(2B-1)^2$, with $\varepsilon>0$. The value of ε measures the usual degree of aversion to inequality and must somehow be arbitrarily chosen. According to Equation (7), when a given distribution $((x_1,y_1), \ldots, (x_n,y_n))$ is perfectly balanced (i.e. $B=0.5$), then $\bar{G}_c$ is just the 'non-corrected' average $\bar{G}$. When some degree of imbalance exists (i.e. $B\neq 0.5$), then $\bar{G}_c$ is a generalized mean, whose power will depend on the value of B and ε. If $B\neq 0.5$, as $\varepsilon \to \infty$, then $\bar{G}_c \to \max\{G_{\alpha,\beta}(x_1,y_1), \ldots, G_{\alpha,\beta}(x_n,y_n)\}$.

An overall development index corrected by gender differences

This section presents an overall development level index corrected by the existing gender differences, related to the GDI but differing in several important ways. As in the GDI, our indicator starts by measuring the development level for each dimension by penalizing the distributions presenting gender differences within each dimension (see second section). Once the corrected development levels for each dimension are computed, the GDI averages them to obtain the overall development index corrected by gender differences. We contend that, when averaging between dimensions, special attention should also be paid to the existing imbalances of gender inequalities between them. In other words, all else being equal, a distribution in which women fare better than men in *all* dimensions should not be treated the same as a distribution in which women fare better than men in *some* dimensions and worse in the others; that is, in which a certain degree of balance between dimensions exist. In order to make our indicator sensitive to such differences we will make use of a generalized mean whose power will depend on the degree of balance between dimensions.

Recall that, given the achievement levels of women and men (x and y, respectively) in a given dimension, we computed the overall achievement level corrected by gender differences in that particular dimension by means of $D_1(x,y)$. Now, if we consider n different dimensions, the easiest way to compute the overall achievement level would be to define

$$\overline{D} := \sum_{i=1}^{n} w_i D_1(x_i, y_i),$$

in which $\Sigma_i w_i=1$. We will now present an overall development indicator corrected by imbalanced distributions between dimensions (denoted by $\bar{D}_c$) which satisfies the following properties: when $\gamma_W=0$ or $\bar{G}$, then $\bar{D}_c=\bar{D}$ (i.e. for the most unbalanced distributions we use the usual mean); and when $0<\gamma_W<\bar{G}$ and $0<\gamma_M<\bar{G}$, then $0\leqslant\bar{D}\leqslant\bar{D}_c$. This means that the distributions showing a certain degree of balance between dimensions will benefit from an increase in its overall development level with respect to $\bar{D}$.

Our overall development indicator corrected by gender differences will be called the Multidimensional Gender-related Development Index (MGDI, or $\bar{D}_c$ for short), and is defined as

$$\overline{D}_c((x_1, y_1), \ldots, (x_n, y_n)) := \left(\sum_{i=1}^{n} w_i (D_1(x_i, y_i))^{1+g(\varepsilon,B)}\right)^{1/(1+g(\varepsilon,B))} \tag{8}$$

in which $g(\varepsilon,B):=4\varepsilon B(1–B)$, with $\varepsilon>0$. As before, ε measures the degree of aversion to inequality and its value must be (arbitrarily) fixed in order to explicitly compute $\bar{D}_c$. According to this indicator, when a given distribution $((x_1,y_1), \ldots, (x_n,y_n))$ is completely imbalanced (either $x_i>y_i$ or $y_i>x_i$ for all i), we simply obtain the average value $\bar{D}$. If our distribution shows a certain degree of balance ($B\neq0,1$), then $\bar{D}_c$ is a generalized mean whose power will depend on the values of B and ε. When $B\neq0,1$, as $\varepsilon\to\infty$, then $\bar{D}_c\to\max\{D(x_1,y_1), \ldots, D(x_n,y_n)\}$.

Some empirical results

We now present an empirical application of the previous results by computing our indicators for a set of different countries. In this section, we shall present empirical results for the 2003 GDI data.[4] With these data, we can compute our own indicator $\bar{D}_c$, and with these results we can rank the different countries. It will then be of great interest to compare this ranking with the one produced by the GDI. Moreover, by computing the overall gender equality indicator $\bar{G}_c$ we obtain a third ranking that can be compared with the other two. Finally, it will also be interesting to compare $\bar{G}_c$ with the RSW presented in Dijkstra and Hanmer (2000), as both of them are measures of gender inequality *per se*.

In the UNDP data set, 140 countries have the data required to compute the GDI. Thus, we can immediately compute our gender difference indicators $G_{\alpha,\beta}(x_i,y_i)$ (with the values $\alpha=2$, $\beta=1$) and development level indicators $D_1(x_i,y_i)$ for $i\in\{1,2,3\}$. In order to compute the overall development indicator corrected by gender differences $\bar{D}_c$ and the overall gender equality indicator $\bar{G}_c$, we will choose the GDI assumptions of $w_1 = w_2 = w_3 = 1/3$ and $\varepsilon = 2$.

It is now interesting to compare the new rankings generated by $\bar{D}_c$ and $\bar{G}_c$ with the one generated by the GDI. In Figure 5 we have a scatter plot that compares the GDI ranking with the $\bar{D}_c$ ranking for each of the 140 countries.

As we can see from Figure 5, there are no dramatic changes in the rankings of the different countries. One could even compute the linear regression closeness of fit coefficient R^2 and obtain the near-one result of 0.996. This is not very surprising, as we are using the *same* data set and both indices aim to measure the *same* concept. Other rankings could arise if the set of variables included to measure the development levels were of a different nature (see, for example, Dijkstra and Hanmer, 2000; Charmes and Wieringa, 2003) or for an alternative list of variables.

Let us now turn to the scatterplot comparing the GDI ranking with the $\bar{G}_c$ ranking (see Figure 6) for each country. In this case, the values of the ranking are completely different. Even though we can observe a positive correlation between the two rankings, the degree of dispersion is now much higher than before (in this case, $R^2 = 0.49$). This means that our indicator $\bar{G}_c$ reveals much gender inequality information that was not properly detected by the GDI. This is a very interesting result as it once again emphasizes that there is a real need to make a clear distinction between overall development levels and gender difference levels.

Finally, let us compare the rankings of the 140 countries when we use two measures of gender equality *per se*: the RSW and $\bar{G}_c$ (see Figure 7). The scatterplot in Figure 7 shows a closer fit in the rankings between both

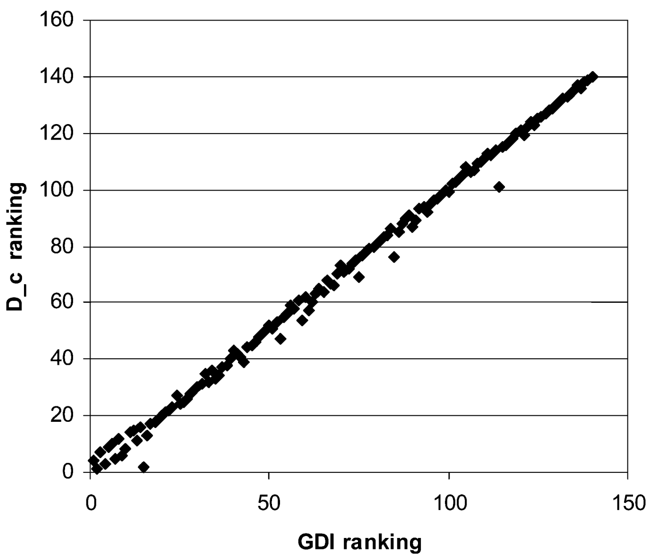

FIGURE 5. Scatterplot of GDI ranking against $\bar{D}_c$ ranking

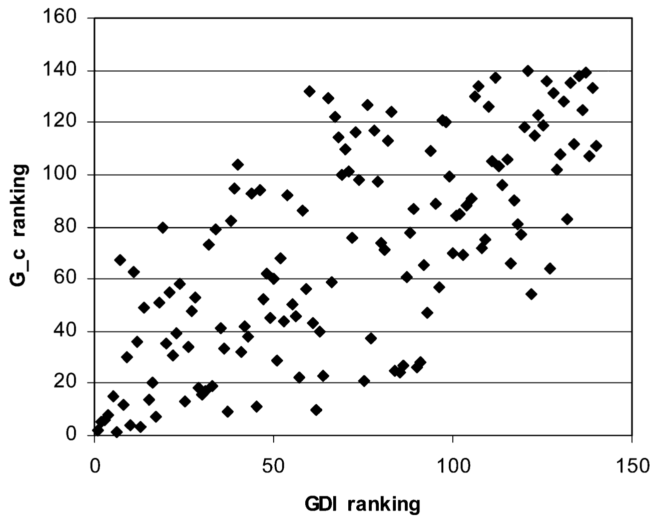

FIGURE 6. Scatterplot of GDI ranking against $\bar{G}_c$ ranking.

gender difference measures (RSW and $\bar{G}_c$) than in the previous case (when we compared the GDI with $\bar{G}_c$, see Figure 6). Even though this is an expected result (to the degree that both measures try to focus on the same concept), the R^2 coefficient is not as extremely high (R^2=0.76) as in our first example (see Figure 5), thus indicating a significant degree of variability between both measures due to the completely different ways in which both indices try to measure the concept of gender inequality levels.

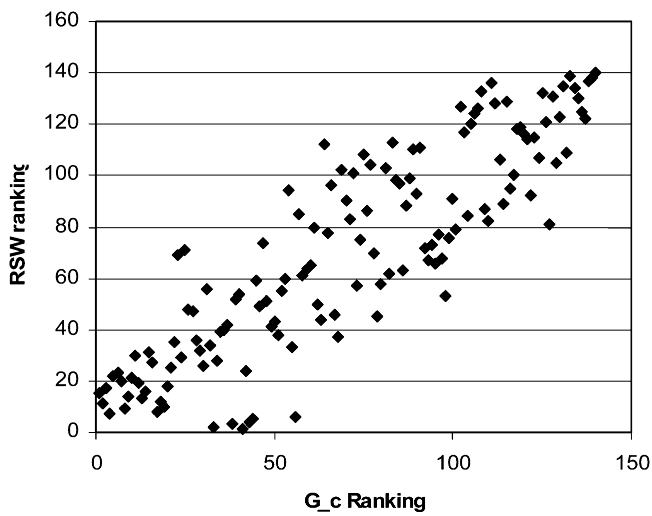

FIGURE 7. Scatterplot of $\bar{G}_c$ ranking against RSW ranking.

Concluding remarks

The GDI has proven to be a very useful tool that has spurred an important debate concerning, among other things, the issue of measuring gender differences. In this paper, we make a constructive critique of the GDI by focusing on certain methodological aspects of the measurement of gender differences. One of our main contributions is defining a function ($G_{\alpha,\beta}$) that takes both the absolute and relative measures of inequality into account and overcomes their respective limitations. We contend that gender differences can be more properly measured this way.

In this paper, we also present a new index (denoted by the MGDI or $\bar{D}_c$) of overall development levels corrected by gender differences. As we have seen, the GDI's *implicit* gender equality measure (E) is of relative nature and does not take into account the differences in absolute achievement. On the other hand, our $\bar{D}_c$ index *explicitly* penalizes more heavily those countries showing a higher degree of gender difference according to the new measure $G_{\alpha,\beta}$. In this way, the effect of gender differences on the development levels is under 'direct control'.

The empirical results found in this and other related papers show the need to develop a gender equality measure *per se*: there is much gender inequality that cannot be detected by the GDI or even the MGDI that deserves special attention. The third important contribution we make in this paper is defining such an index (denoted by the MGEI or $\bar{G}_c$), which is based on our new gender difference measure $G_{\alpha,\beta}$. We contend that this way of measuring the existing gender differences is an improvement with respect to other conceptually related indicators that have been presented during the past few years.

The lack of sensitivity of some multidimensional measures (like the GDI or the GEM) to the direction of the gender gaps in the different dimensions favoring either males or females is an important issue pointed out by Dijkstra (2002) and Klasen (2006). This problem has been taken into account in the definition of the MGDI and the MGEI: instead of allowing for compensation between different dimensions, these indicators penalize more heavily those countries in which the gender gaps favor mostly the same sex.

Finally, it is important to emphasize that these indices have not been created with a specific list of variables in mind. Quite the contrary, as no restriction is imposed on the nature of the variables (apart from being measured in the [0,1] scale), our indicators are flexible enough to be useful for a wide range of contexts. This flexibility can be very useful if one has to work in certain emerging research issues in which the chosen variables can be different from the 'classical' ones found in the GDI.

Notes

1 It could be argued that, in many empirical cases, the functioning achievement level variable for men (y) is not usually close to zero, so that the unboundness of $G_2=x/y$ is

not likely to be problematic. However, it should be borne in mind that the functionings that could be taken into account in an assessment of the existing gender differences in a given society might eventually be very different from the classical ones in which males predominate. As the list of potentially relevant functionings is open-ended, it might well be that one includes some new dimensions in which men (or women) perform very poorly. In that case, G_2 could take distortedly high values, a problem that is avoided by introducing G_3. I am grateful to an anonymous referee for this observation.

2 However, the process is available upon request from the author for anyone who might be interested.

3 Available from the author upon request.

4 Can be located online [http://www.undp.org].

References

Anand, P. and Sen, A. (1995) Gender inequality in human development: theories and measurement, *Human Development Report Office Occasional Paper No. 19*, UNDP, New York.

Atkinson, A.B. (1970) 'On the measurement of inequality', *Journal of Economic Theory*, 2(3), pp. 244–263.

Bardhan, K. and Klasen, S. (1999) 'UNDP's gender-related indices: a critical review', *World Development*, 27(6), pp. 985–1010.

Chant, S. (2006) 'Re-thinking the ''feminization of poverty'' in relation to aggregate gender indices', *Journal of Human Development*, 7(2), pp. 201–220.

Charmes, J. and Wieringa, S. (2003) 'Measuring women's empowerment: an assessment of the gender-related development index and the gender empowerment measure', *Journal of Human Development*, 4(3), pp. 419–435.

Cueva, H. (2006) 'What is missing in measures of women's empowerment?', *Journal of Human Development*, 7(2), pp. 221–241.

Dijkstra, A.G. (2002) 'Revisiting UNDP's GDI and GEM: towards an alternative', *Social Indicators Research*, 57(3), pp. 301–338.

Dijkstra, A.G. (2006) 'Towards a fresh start in measuring gender inequality: a contribution to the debate', *Journal of Human Development*, 7(2), pp. 275–283.

Dijkstra, A.G. and Hanmer, L. (2000) 'Measuring socio-economic gender inequality, towards an alternative to the UNDP Gender-Related Development Index', *Feminist Economics*, 6(2), pp. 41–75.

Folbre, N. (2006) 'Measuring care: gender, empowerment and the care economy', *Journal of Human Development*, 7(2), pp. 183–199.

Forsythe, N., Korzeniewick, R.P. and Durrant, V. (1998) 'Gender inequalities, economic growth and structural adjustment: A longitudinal evaluation', paper presented to the *XXI Conference of the Latin American Studies Association (LASA)*, Washington, D.C., 24–26 September.

Klasen, S. (2006) 'UNDP's gender-related measures: some conceptual problems and possible solutions', *Journal of Human Development*, 7(2), pp. 243–274.

Sen, A. (1992) *Inequality Reexamined*, Clarendon Press, Oxford.

United Nations Development Programme (1995) *Human Development Report 1995*, Oxford University Press, New York and Oxford.

United Nations Development Programme (2003) *Human Development Report 2003. Millennium Development Goals: A Compact Among Nations to End Human Poverty*, Oxford University Press, New York and Oxford, [http://www.undp.org].

United Nations Development Programme (2005) *Human Development Report 2005. International Cooperation at a Crossroads: Aid, Trade and Security in an Unequal World*, UNDP, Oxford University Press, New York.

White, H. (1997) 'Patterns of gender discrimination: an examination of the UNDP's Gender Development Index' Mimeo, Institute of Social Studies, The Hague.