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A gender-adjusted measure of literacy

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Abstract

This is a very brief note which considers how to incorporate directly into the measurement of literacy a procedure for penalizing anti-female bias in its gender-related distribution. The ‘gender-adjusted' literacy measure L* advanced in this note reflects the cost of failing to achieve equality in the gender-distribution of literacy. The argument revolves around an ‘efficiency loss' that is attributed to the shortfall of the female literacy rate from the overall literacy rate, and which arises from the presumed foregone benefits of the positive externalities to be had from female literacy. Efficiency considerations, however, are not pushed to the point where inequality against males is rewarded. The gender-adjusted literacy index has been created in such a way as to facilitate ready comprehension of its intended meaning. The information required for computing the measure is undemanding, and calculation presents no onerous difficulties. The measure can find wide application in intra- and inter-national comparisons of literacy corrected for adverse (female) gender bias.

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1. Introduction

This note advances a somewhat 'instant' index of literacy and will, for that reason, be very brief in its treatment of the subject. Its concern is to derive a headcount measure of literacy which is adjusted in such a way as to secure two ends. The first end is for the measure to reflect the widely-held empirical belief that the value of female literacy (in terms of the various positive externalities it confers on other agents within a household or in larger domains of kinship and community) is greater than that of male literacy. The second end is for the measure to penalize a literacy regime in which the extent of overall literacy is unequally distributed against women. The note draws on the insights of Basu and Foster's (1998) seminal work on literacy measurement. The Basu-Foster paper represents a consideration of issues relating to the inter-household and gender distribution of literacy against a background dealing with its external effects, and is an early effort at addressing the problem within the formal setting of measurement. Use is also made, in what follows, of a particular approach to an extension of the Basu-Foster framework undertaken in Subramanian (2000, 2004).

2. Basic Concepts

Let F and M stand for the female and male adult populations respectively, and f and m respectively for the female and male adult literate populations. Then, the 'standard' headcount measure of adult literacy would be given by

$$L = (f + m) / (F + M) = \theta\varphi + (1 - \theta)\mu , \qquad (1)$$

where θ is the proportion of adult females in total adult population, φ is the female adult literacy rate (f / F) and μ is the male adult literacy rate (m / M). In order to facilitate calibration, let us treat an adult literate male as a '*numeraire* entity', and award a value of unity to this entity. Let us, further, award a value of $\beta > 1$ to an adult literate female, to capture the notion that at the margin female literacy is more valuable than male literacy. Then, a headcount index of 'effective' literacy (a term borrowed from Basu and Foster 1998), which allows for the differential valuation of male and female literacy, would be given by

$$L_E = (\beta f + m) / (\beta F + M) = [\beta\theta\varphi + (1 - \theta)\mu] / [\beta\theta + (1 - \theta)] . \qquad (2)$$

Estimating the value of β could be a difficult empirical enterprise, and the question arises as to whether one could incorporate into the measurement of literacy the impact of the precise distribution of literacy between males and females that obtains, *without* having to estimate β. A means to this end would reside – pursuing an approach suggested by Subramanian (2000, 2004) and elaborated on in what follows – in assessing the '*efficiency loss*' entailed by a distribution of literacy which is unequally tilted against females. To see what is involved, we consider the following.

3. A Gender-Adjusted Measure of Literacy

For any actual prevailing level of female literacy φ, given that the overall 'crude' literacy rate is L, let $\hat{\varphi}$ be the female literacy rate that would obtain in a regime of equal distribution between females and males. It is obvious that

$$\hat{\varphi} = L. \tag{3}$$

For reasons that will be made transparent in a moment, it is useful now to determine the distributional pattern of male and female literacy under which the effective literacy rate will attain its lowest value. This requires a solution to the following simple minimization problem:

$$\underset{\{\varphi,\mu\}}{Minimize}\, L_E = [\beta\theta\varphi + (1-\theta)\mu] / [\beta\theta + (1-\theta)]$$

$$s.t.:$$

$$\theta\varphi + (1-\theta)\mu = L.$$

Let $\{\underline{\varphi}, \underline{\mu}\}$ be the solution to this problem. It is obvious that in order to minimize L_E, one should make as many males as possible literate, which is $(f+m)$ males if $(f+m)$ does not exceed M, and M males otherwise: this is the straightforward corner solution that would be dictated in a linear extremization problem. The implication for the minimized level of female literacy, it can now be worked out, is given by:

$$\underline{\varphi} = (L/\theta) - \min[L/\theta, (1-\theta)/\theta]. \tag{4}$$

Suppose now that the actual level of female literacy, φ, is less than $\hat{\varphi}$ (which, to recall, is the female rate that would obtain if literacy were to be equally distributed across the genders). Then, one can see that the *per caput* loss in 'efficiency' (arising from the relatively greater marginal valuation placed on female literacy) is $\beta\theta(\hat{\varphi} - \varphi)$. By the same token, the maximum possible such loss is the quantity $\beta\theta(\hat{\varphi} - \underline{\varphi})$. The ratio of the one quantity to the other then furnishes us with an expression, E, for the *normalized* loss in efficiency attributable to the shortfall of the female literacy rate from the 'fair' (that is, overall) literacy rate: notice that in the process of dividing $\beta\theta(\hat{\varphi} - \varphi)$ by $\beta\theta(\hat{\varphi} - \underline{\varphi})$, the quantity β is eliminated from further consideration, and we are left with:

$$E = (\hat{\varphi} - \varphi) / (\hat{\varphi} - \underline{\varphi}). \tag{5}$$

More generally, one should also allow for the possibility that the distribution of literacy is *unequally in favour of* females, that is, that $\varphi > L$. Equation (5) holds for the case in which $\varphi \leq L$. Whenever there is pro-female bias in the distribution of literacy, we shall take the efficiency loss from an unequal distribution of literacy across the genders to be zero, that is, properly speaking, Equation (5) should be modified to read:

$$E = \max[(\hat{\varphi} - \varphi) / (\hat{\varphi} - \underline{\varphi}), 0]. \tag{5'}$$

A 'gender-adjusted literacy measure' - call it L^* - can now be defined as some function g of both the average level of literacy L and the efficiency loss parameter E:

$$L^* = g(L, E)\,. \qquad (6)$$

To proceed further, the function g has to be equipped with more structure. Somewhat arbitrarily, but in the interests of simplicity and without compromising those of reasonableness, let us postulate that g is a linear function of its arguments:

$$L^* = aL + bE\,, \qquad (7)$$

where a and b are real numbers. By way of normalization we could take L^* to be equal to the standard literacy rate L when there is no efficiency loss. That is, if $L^* = L$ when $E = 0$, then in view of (7), one has: $a = 1$, whence

$$L^* = L + bE\,. \qquad (8)$$

When there is total efficiency loss (corresponding to a situation in which $\varphi = \underline{\varphi}$), again arbitrarily but again not unreasonably, one could pitch the value of L^* at a level less than L, say, at L^2. That is, if $L^* = L^2$ when $E = 1$, then in view of (8), one has: $b = -L(1-L)$, whence:

$$L^* = L[1 - (1-L)E]\,. \qquad (9)$$

It might be as well to emphasize here that the measure L^* has been motivated not only by considerations of any intrinsic 'fairness' in the distribution of literacy across the genders, but by instrumental, 'efficiency'-driven considerations as well. This is not to deny either (a) the obviously great value of such 'intrinsic' considerations, nor (b) the fact that equality is indeed accorded value in the present framework of discussion – both for its own sake and (a point at the heart of the original Basu-Foster thesis) as a byproduct of the pursuit of other goals.

Returning to the more formal aspects of the measure L^*, we have to distinguish three cases:

(a) When $\varphi > L$, so that $E = 0$, then $L^* = L$.

(b) When $\varphi \le L$ and $L + \theta \le 1$ (that is, $L/\theta \le (1-\theta)/\theta$), then, in view of (3), (4), (5′) and (9), some manipulation will revel that $E = (L - \varphi)/L$, and $L^* = \varphi + L(L - \varphi)$.

(c) When $\varphi \le L$ and $L + \theta > 1$ (that is, $L/\theta > (1-\theta)/\theta$), then, in view of (3), (4), (5′) and (9), some manipulation will revel that $E = \left(\frac{\theta}{1-\theta}\right)\left(\frac{L-\varphi}{1-L}\right)$, and $L^* = L\left[1 - \left(\frac{\theta}{1-\theta}\right)(\varphi - L)\right]$.

4. An Empirical Illustration

Here is a small empirical illustration of the sort of use to which the measure L^* can be put. The UNDP's annual *Human Development Report* (*HDR*) provides data on adult (age 15+) literacy rates, separately for females, males, and both genders together. Subramanian (2000) has worked out these rates for groups of countries by aggregating the country-level rates. The aggregation has been performed by employing the country-level proportions of

female and male adults in total population, data on which are available in the UNICEF's annual publication *State of the World's Children* (*SCW*). (It should be noted though that 'adult' in the *SCW* is defined as a person of age 18+.) These computations have been done by Subramanian (2000) for the year 1997, employing the 1999 *HDR* and the 1999 *SCW*. An illustrative example based on these computations is offered below.

Table 1: Grouped Data on Literacy Rates by Gender: Sub-Saharan Africa and Arab States, 1997

Country Group	Share of Females in Total Adult Population (θ)	Female Adult Literacy Rate (φ)	Male Adult Literacy Rate (μ)	Aggregate Adult Literacy Rate (L)	Efficiency Loss Parameter (E)	Gender-Adjusted Literacy Measure (L^*)
Sub-Saharan Africa	0.454	0.496	0.659	0.585	0.1783	0.542
Arab States	0.496	0.464	0.706	0.586	0.2900	0.515

Source: Computed from data in *Human Development Report 1999* (UNDP) and *State of the World's Children 1999* (UNICEF).

Table 1 presents some relevant summary statistics on literacy for two major country-groups – Sub-Saharan Africa and the Arab States. Information is available, in Table 1, for each of these groups of countries, on the proportion of adult females in the total adult population (θ), the female adult literacy rate (φ), the male adult literacy rate (μ), the aggregate adult literacy rate (L), the value of the efficiency loss parameter (E), and the value of the gender-adjusted literacy measure (L^*). Two simple points are worth noting. First, in both Sub-Saharan Africa and the Arab States, the female literacy rate is lower than the male literacy rate. This fact is penalized by the gender-adjusted literacy measure L^* which is lower, in both countries, than the respective country-specific value of L. Second, while the 'crude' literacy rate L is virtually the same for both country-groups, the unequal tilt against female literacy is larger in the Arab States than in Sub-Saharan Africa: it can be verified that the ratio of male-to-female literacy for the Arab States is 1.52, and lower, at 1.33, for Sub-Saharan Africa. This fact is reflected (a) in a larger value of the efficiency loss parameter E for the Arab States than for Sub-Saharan Africa, and (b) in a lower value of the gender-adjusted literacy measure L^* for the Arab States than for Sub-Saharan Africa.

5. Conclusion

The earlier discussion and the empirical illustration just discussed suggest that in order to compute the gender-adjusted literacy measure L^*, one only requires three items of information, relating, respectively, to the sex-ratio of a population (as captured in θ), the female literacy rate (as captured in φ), and the overall literacy rate (as captured in L). The index, thus, is quite straightforwardly understood in terms of its motivational impulses, it is economical in its demands on the data base, and it is also very easily calculated - a combination of (admittedly) small virtues which together make for a reasonably handy

measure, one which is sufficient for its purposes without being profound or startling in its import. For those who are content to measure and run, L^* - within its own context - has something in common with Mercutio's wound: "… not so deep as a well, nor so wide as a church-door; but 'tis enough, 'twill serve…".

References

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