THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

The Humane Face of Indian Society in Terms of Sex Ratio as a Linear Function of Income and Literacy Growth

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Abstract:
In most of the social science literature women biological status is best exposed in terms of sex ratio. In decennial census report of India sex ratio is expressed as the number of alive female members against per thousand alive male. When differentiated as per age groups it becomes a time trend reflector of biological status of women. Sex ratio is comparable across time and space and also used as the humane face of a society. Much evidence is there that income and literacy growth do not match with sex ratio variance. Is it absolutely, universally or partially true in a developing country like India is a matter of concern. The simple statistical tools such as Karl Pearson correlation coefficient and coefficient of determination are sufficient to dig out the primary face of this fact. With this statistical exercise on census data of India with reference to the state of Assam and some case studies in the district of Jorhat, this paper is an attempt to that end and comes to the conclusion that the human face of Indian society is not universally saved in terms of sex ratio as a linear function of income and literacy.

1. Introduction

Women's empowerment and the promotion of gender equality are keys to achieving sustainable development. Greater gender equality can enhance economic efficiency and improve other development outcomes by removing barriers that prevent women from having the same access as men to human resource endowments, rights, and economic opportunities (World Bank, 2012). According to Sen (1990) women allegedly make up the majority of the world's population, even though this is not the case throughout every country. While there are typically more women than men in European and North American countries (at around 0.98 to 1 for most of them), the sex ratio of developing countries in Asia, as well as the Middle East, is much lower. This runs contrary to research that females tend to have better survival rates than males, given the same amount of nutritional and medical attention. Study shows that Indian women face the risk of excess mortality at every stage of their lives and that excess female mortality in adulthood is as serious a problem in India as missing girls who are never born or die prematurely in childhood.

In most of the social science literature women biological status is exposed in terms of sex ratio. Sex refers to a person's biological status and is typically categorized as male, female, or intersex (American Psychological Association, 2011). Of course, in calculating sex ratio, because of nominal in number, the third category of sex is ignored and in decennial census of India it is expressed as the number of alive female members against per thousand alive male members. Demographic studies shows that at birth the normal sex ratio range is 934 -961 (Ganatra, 2008) and it increases with the increase of age as the chance of dying of male is higher than that of female of same age group (Waldron I., 1998). Thus, the normal range of sex ratio for the population of all age is 1040–1050 (Sen, 1992). When differentiated as per age groups the difference of actual sex ratio from normal sex ratio becomes a time trend reflector of biological status of women. The number of women less than normal ones is known as *missing women* (Sen, 1992).

Sex ratio is comparable across time and space and also used as the humane face of a society. Normal sex ratio is the reflector of gender equality, at least biologically; is a norm of civilized society and so to say is expected to ensure with income and literacy growth. But much evidence is there that income and literacy growth are not being translated effectively into gender equality or the root causes of gender inequality lye somewhere else other than economic backwardness and ignorance. Is it absolutely, universally or partially true in a developing country like India is a matter of concern. Working in this area Chakraborty and Sinha (2006) conclude that higher socio-economic characteristics such as female literacy, female work force participation and economic growth are not helping in female sustenance and in removal their survival disadvantages. Even the economic growth shows an inverse relation with the juvenile sex ratio. Molina, (2009), in her thesis, examining the case of Haryana, India, rejects the hypothesis that there is reciprocal relationship between gender inequality and economic development. Here she comes to the conclusion that, neither the income growth, nor the improvement of female literacy matters in gender equality but the net cost of sons relative to daughters, as perceived by their parents, plays an important role in determining sex ratios, and therefore must be considered in any policy discussion aimed at alleviating gender bias in India. Even some studies show negative correlation between female literacy and sex ratio (Aktar, 2013; Godase et al. 2014; Chakraborty, 2012; Sethi, 2011). But these studies do not reveal to what extent the variance of sex ratio is predictable or explainable in terms of income and literacy.

On this backdrop, this paper is an attempt to make a simple statistical exercise on the relationship of sex ratio with income and literacy growth taking India as a whole, the state Assam in particular added with four case studies in the district of Jorhat. Assuming a linear relationship between sex ratio and income growth/literacy growth, the method of Karl Pearson correlation coefficient has been used to trace the degree and direction of the so called relationship and the method of coefficient of determination to measure how far the variance of sex ratio is explainable/predictable in terms of income and literacy. Secondary data sources are government census and economic survey reports. The results show that the human face of Indian society, so far the sex ratio/gender equality is concerned, is universally saved neither by income growth nor by literacy enhancement.

2. Objectives

The broad objective of this paper is to test human face of Indian society in terms of sex ratio as a linear function of income and literacy development which can be specifically divided as -

- To examine whether sex ratio variance in India and Assam is matched with its income and literacy growth variance.
- To measure the extent of sex ratio variance that can be explained by the variance of income and literacy growth.
- To examine whether literacy variance is equally responsive to both income and gender status.

3. Methods

This paper has been designed on the basis of following four assumptions on three types of relationship.

- Sex ratio is a linear function of economic growth (R_1) and literacy status (R_2).
- Women empowerment is a linear function of female literacy (R_3).
- Economic development is a linear function of literacy status (R_4).

Per capita income has been considered in this study as the reflector of economic growth, total literacy rate as the main indicator of literacy status of the society whereas female literacy rate as the main indicator of women empowerment. Normal sex ratio, that is, gender equality has been considered here as the human face of the society. To estimate the degree and direction of relationship the method of Karl Pearson correlation coefficient and to estimate the explained variation the coefficient of determination has been used. Sources of secondary data are census and survey reports of the government of India. To substantiate the findings derived from secondary data four case studies have been made in four development blocks of Jorhat district representing different eco-climatic zones and ethnic habitations. These development blocks are - Majuli, Kaliapani, Dhekargara and Baghsung. Considering the district as universe, as per the sampling technique, required primary information was collected directly from 150 households in each of these development blocks and thus total sample size being 600 households.

4. Discussion

4.1. The Case of India as a Whole

Table 1 gives the mapping of Indian states occupying 1st 6 ranks in per capita income, sex ratio, total literacy and women literacy. It shows that apart from Kerela, the sex ratio ranks of the states do not match with the ranks of total literacy and female literacy. Similarly, the ranks of per capita income do not match with the ranks of sex ratio and literacy rate. It gives a firsthand observation that income and literary growth do not ensure gender equality.

Indicators	States with ranks					
	1st	2nd	3rd	4th	5th	6th
Sex ratio	Kerela	Puduchery	Tamilnadu	AP	Manipur	Meghalaya
Per capita income	Goa	Delhi	Chandigar	Haryana	Puduchery	Maharastra
Total Literacy rate	Kerela	Mizoram	Tripura	Goa	Delhi	Andaman and Nikobar
Female literacy rate	Kerela	Mizoram	Tripura	Andaman & Nikobar and Goa	Chandigarh	Puduchery

Table 1: Mapping of Indian states occupying first 6 ranks in some indicators

On the basis of cross section data of the Indian states, table 2 records partial Karl Pearson correlation coefficient and coefficient of determination for the relationships - sex ratio and income (R_1), sex ratio and total literacy (R_2), sex ratio and female literacy (R_3) and income and literacy (R_4). The negative r_1 implies that the more is per capita income the more is missing women in the society. But the variance of missing women can be explained only by 6 percent in terms of income. Of course, R_2 and R_3 show that number of missing women decreases with the increase of both total literacy and female literacy. However, the variance of sex ratio can only be explained by 6 percent in terms of general literacy and 3 percent in terms of female literacy. R_4 being moderately positive implies that literacy is serving the economic development and vice versa. The variance of income can be explained by 18 percent in terms of literacy. It also reflects that literacy helps more in increasing income than decreasing premature death of women.

Relationships	Correlation Coefficient (r)	Coefficient of Determination (r^2)
R_1	- 0.24213 (= r_1)	0.058628 = (r_1^2)
R_2	0.242973 (= r_2)	0.059036 = (r_2^2)
R_3	0.169459 (= r_3)	0.028716 = (r_3^2)
R_4	0.427732 (= r_4)	0.182954 = (r_4^2)

Table 2: Cross section partial correlation coefficient and coefficient of determination in case of India as a whole

Time series data, for the period of 1961 to 2011, for the country as a whole shows that sex ratio is positively related with per capita income ($r_1 = 0.28$) and 8 percent variation of the former can be explained in terms of the later. r_2 being negative implies that number of missing women is increasing with the increase of total literacy. The variance in missing women can be explained only by 3 percent in terms of general literacy. Contrary to this, r_3 being 0.96 implies that female literacy is closely and directly related with sex ratio. Female literacy can explain 92 percent variation of sex ratio.

4.2. The Case of Assam
On the basis of time series data for the state Assam, during the period 1951 – 2011, table 3 records partial Karl Pearson correlation coefficient and coefficient of determination of the four types of relationship under study. All the correlation coefficients being positively closer to 1 imply that, in the state of Assam, gender equality extends with same degree and direction of inter temporal progress in income and literacy. Here inter temporal sex ratio variation is almost fully explainable in terms of economic development and literary literacy enhancement.

Relationships	Correlation coefficient (r)	Coefficient of determination (r^2)
R_1	0.9323	0.8692
R_2	0.9635	0.9282
R_3	0.9762	0.9530
R_4	0.9557	0.9133

Table 3: Time series partial correlation coefficient and coefficient of determination in case of Assam.

Table 4 records Karl Pearson partial correlation coefficient and coefficient of determinations of the four relationships under study based on district wise cross section data of Assam for the year 2011. First three correlation coefficients, shown here, being negative implies that area specific variation in per capita income, total literacy and female literacy in Assam do not match with premature death of women. The more is the development of the district in terms of per capita income and rate of literacy the less is chances of women to enjoy longevity. The fourth correlation coefficient being positive implies that, though unable to improve the cause of women living, the growth of literacy helps in earning more. Though income can explain 21 percent cross section variance of sex ratio, total literacy can explain only 6 percent and female literacy can explain only 8 percent variation of sex ratio. Contrary to this, literacy can explain 39 percent variation of income.

Relationships	Correlation coefficient (r)	Coefficient of determination (r^2)
R_1	-0.4675	0.2186
R_2	-0.2452	0.0601
R_3	-0.2864	0.0820
R_4	0.6259	0.3918

Table 4 : Cross section partial correlation coefficient and coefficient of determination in case of Assam

4.3. The Case of Jorhat District
Table 5 gives a comparative picture of sex ratio, per capita income and literacy rate as per different censuses and also it records decadal percentage change of these variables in the district of Jorhat. It shows that sex ratio decreased by 10 points from 1991 to 2001 whereas it increased by 49 points (6%) in 2011. But general literacy and female literacy increased much more than sex ratio.

Census	Sex ratio	Per capita Income (Rs.)	General literacy	Female Literacy	Decadal % change			
					SR	PCI	GLR	FLR
1991	913	5715*	66.00	57.00	-	-	-	-
2001	903	5785**	76.34	68.49	-1.10	1.22	15.67	20.16
2011	962	-	82.15	76.45	6.53	-	7.61	11.62

Table 5: Relative position of sex ratio, per capita income and literacy rate across the censuses
* data for the year 1993-94; ** data for the year 1999-2000. Source : Economic survey 2002-03

To substantiate the findings on the basis of secondary data, four case studies in four development blocks of Jorhat district were undertaken during December 2012 (namely Majuli, Dhekorgara, Baghsung and Kaliapani) purposively selected to have representation of ethnic and other locality differentials. Table 6 records cross-section partial correlation coefficient and coefficient of determinations of the three relationships under study. It is to be noted here that, in case studies, only the total literacy of household heads was taken into consideration. Female literacy was not estimated here separately.

Development blocks	Relationships	Correlation Coefficient (r)	Coefficient of Determination (r^2)
Majuli	R_1	-0.22	0.05
	R_2	-0.09	0.01
	R_4	0.38	0.14
Dhekorgara	R_1	-0.13	0.02
	R_2	0.29	0.09
	R_4	0.01	0.00
Baghsung	R_1	0.10	0.01
	R_2	0.08	0.01
	R_4	0.70	0.49
Kaliapani	R_1	-0.06	0.00
	R_2	0.17	0.03
	R_4	0.22	0.05

Table 6: Cross section correlation coefficient and coefficient of determination in case of four case studies in Jorhat district.

Table 6 shows that income growth does not match with the change of gender equality in the case study areas except Baghsung. But growth of literacy of household heads matters here except in Majuli. Literacy growth of household heads, though is not matching with the change in gender equality in all four cases of Jorhat district, yet it is universally matching with increasing earning capability. Whatever is the closeness of sex ratio with income and literacy, the later can nominally help in explaining the variations of the former in all four cases under study. The same happens in explaining variations of per capita income in terms of literacy of household heads except in Baghsung. It implies that factors other than literacy implicate more in the variation of both income and gender equality.

5. Conclusion
- Comparing the time series results with that of cross section ones, for the country as whole, it has been observed that they are unable to reflect a unique pattern of sex-ratio as a linear function of income and literacy. Cross section data are subject to locality variance affected by so many locality-specific eco-politico and socio-cultural colours whereas time series data is affected by inter temporal quality change of the country on average. In improving sex ratio inter temporal social change matters better than the difference in eco-politico and socio-cultural set ups in India. So, literacy and income growth of same degree cannot be expected to bring gender equality of same extent irrespective of those differences. Of course, for the country as whole, sex ratio variation is better explained in terms of female literacy than that of income and general literacy.
- Sex ratio is closely connected with per capita income and literacy rate only in case of Assam, when the relationship is considered in terms of time series data. Contrary to this, in almost all cases, as per cross section studies, sex ratio is less connected, rather in some cases negatively connected, with income and total literacy growth than that of growth in female literacy. Increase of total literacy helps in the increase of income more than strengthening sex ratio. Of course, in most of the cases female literacy matters in the increase of sex ratio. So, as a policy measure, to reduce the premature death of women, female literacy is to take care of.
- The variance of sex ratio is not significantly and universally explained by the variance of literacy rate and per capita income. It is truer in case of cross section studies than time series information. Time series average cannot reflect the true picture of the relationship of sex ratio with per capita income and literacy rate. Thus, the causes of premature death of women are lying neither in under-literacy nor in under-economic development, but somewhere else, to explore them separate study is required. It also implies that mere increase of income and literacy cannot reduce the cause of premature death of women. Here female literacy is to consider only as immediate measure, not as an ultimate measure.
- On the basis of the observations made above it can broadly be concluded that the humane face of Indian society is not saved universally in terms of sex ratio as a linear function of income and literacy.

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