
HUMAN CAPITAL CONVERGENCE IN DISTRICTS OF PUNJAB, PAKISTAN

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ABSTRACT

Ever since the convergence hypothesis has emerged, debate on convergence has remained great concern for economists. The literature comes up with mixed evidence on convergence between economies, regions or group of economies. The main purpose of undertaking this research is to examine the convergence among human capital indicators between the districts of Punjab during 2003 to 2019. The study also finds the rate of convergence in order to know the average speed with which the human capital is merging/converging in Punjab. This study utilized data from two government surveys, MICS (Multiple indicator cluster survey) and PSLM (Pakistan social and living measurement survey). Following endogenous growth models simple OLS regressions and some other measurements like Mean, SD and CV have also been used. Results of this study witnessed the evidence of convergence in human capital indicators and hence economic growth among the districts of Punjab. As education and health are fundamental ingredients of human capital so, there is need of efficient Government policies and their proper implementation.

Keywords: Human Capital, Economic Growth, Convergence, endogenous growth models, unconditional convergence, conditional convergence.

1. INTRODUCTION

The grid electric power system consists of generation, Transmission, Sub-Transmission and Distribution.

Bulk power supply is from generation and Transmission while final means of electric power release to consumer are sub-Transmission and Distribution. The distribution delivers electric power to end-user [1]. Distribution system is the link between the utility system and the end-user, it is the most critical part of the power system and it is facing a lot of dangers that cause a power disruption to consumers, it can be stated that a great percentage of end-users' power outages are due to distribution network, it can also occur due to mal-function of the networks protection equipment [2].

Ever since the convergence hypothesis has emerged, debate on convergence has remained great concern for economists and policy makers. Numerous studies have been carried out to probe convergence in different regions. Different indicators of economic growth have been used to check convergence. This study used human capital to estimate convergence.

Human Capital holds high significance and importance in the way of Economic Growth and Economic Development as proposed by endogenous growth theory. Like Physical Capital, Human Capital serves the same purpose; it increases output of an economy. Human Capital is therefore happening to be a prerequisite to economic Growth and Development. Human Capital basically means development of skills. There is a substantial literature that proves a positive and highly significant linkage among Economic Growth and Human Capital (Ali and Padda, 2014). Education is the major indicator of Human Capital, many monetary and non-monetary returns are associated with investment in education. Human Capital has positive and significant impact on Economic growth of Pakistan (Qadri and Waheed,2011). Human Capital formulation is very essential as its numerous effects are on each sector and it is useful in reducing corruption (Haque and Hussain, 2013).

In recent years Pakistan has progressed in Human Capital. In urban regions Human Capital exists more than urban and rural areas and learning gaps exists among primary schools. Once Human Capital is formulated it increases the distribution of income. Once income distribution has been increased it is responsible for creating income inequality among regions and nations.

This study aims at examining human capital convergence in Punjab during 2003 to 2016. Education and health are considered as proxy of human capital this study chooses to select them and in addition to them housing indicators have been included as welfare/income indicators.

The objectives of the study are as follows

- To estimate sigma convergence(α) and beta (β) in human capital across districts of Punjab
- To estimate convergence in male and female literacy rates
- To estimate speed of convergence
- To give some policy implications to improve education system and hence increase in human capital.

2. DATA AND METHODOLOGY

The data for this study was drawn from three sources, MICS (Multiple Indicator survey) PSLM (Pakistan social and living measurement survey) and Punjab developmental statistical reports. All data has been published by Punjab Bureau of statistics. Human Capital comprises of two major indicators, education and health. This study uses these both variables. Table 1 shows the description of the variables used in the analysis.

Table 1: Description of Variables

Variables	Description
Primary enrolment rate female	Number of male children enrolled in primary schools divided by the total population of that age group. Age bracket for this is 5-9 years.
Secondary enrolment rate male	Number of female children enrolled in primary schools divided by the total population of that age group. Age bracket for this has been set 5 year to 9 years.
Secondary enrolment rate female	Number of male children enrolled in secondary schools divided by the total population of that age group. Age bracket is 10 years to 14 years
Higher secondary enrolment rate male	Number of female children enrolled in secondary schools divided by the total population of that age group. Age bracket is 10 years to 14 years.
Higher secondary enrolment rate female	Number of male enrolled in higher secondary schools divided by the total population of that age group. Age bracket is 14 years to 16 years.
Tertiary enrolment rate male	Number of female enrolled in tertiary education divided by the total population of that age group. Age bracket is 19 to 21 years.
Tertiary enrolment rate female	Number of female enrolled in tertiary education divided by the total population of that age group. Age bracket is 19 years to 21 years.
Gender parity index primary	The ratio of female enrolled in primary level with that of male.
Gender parity index secondary	The ratio of female enrolled in secondary level with that of male.
Gender parity index higher secondary	The ratio of female enrolled in higher secondary level with that of male.
Gender parity index tertiary	The ratio of female enrolled in tertiary level to male.
Number of hospitals per million population	Total institutions which provides health services i.e. curative and preventive to all/specific class of the public as out-door/ in-door patients.
Number of beds	Total number of beds in the institutions per million population.
Number of patients treated	Total number of patients treated in hospitals by management, division

	and district
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2.1. α -convergence/ absolute convergence

Absolute or sigma convergence has been estimated by following the measurements used by (Ingram, 1992). The mean, standard deviation and coefficient of variation for each variable has been obtained in order to probe sigma convergence in human capital across districts of Punjab.

$$\text{Formula of CV} = \text{SD/MEAN} * 100$$

2.2. β convergence

There are two types of β convergence, conditional and unconditional convergence. This study aims at estimating both kinds of beta convergence

2.3. Unconditional Convergence

As it is evident from its name “unconditional” that variable would not depend on any other variable and convergence in the variable would happen unconditionally or independently. In order to test convergence in human capital, the change in human capital is regressed on only its initial value. To examine unconditional convergence in a regression framework, the estimated model takes the following form:

$$\ln Y_{i, 2003-2011} = \text{constant} + \gamma (\ln Y)_{i, 2003} + \epsilon_i$$

2.4. Conditional convergence

To measure conditional convergence in human capital across the districts of Punjab, the study focuses primarily on the outcome variables of education, i.e. literacy rates. Additional steady-state variables are introduced on the right-hand-side of Equation to test for conditional convergence. The choice of these additional variables depends on economic theory, beliefs concerning the development process, the economic literature, and data availability (Afzal,2010; Sab and Smith, 2002; Trivedi, 2002; Afzal, 2012).

Simple OLS has been used in this study in order to get the results for conditional convergence in human capital and growth across districts of Punjab. The framework of the model to be estimated for unconditional convergence follows that of (Trivedi, 2002). It is written as follows:

$$\ln (\text{litm}_{i,t}) - \ln(\text{litm}_{i,t-t}) = \beta \ln(\text{litm}_{i,t-t}) + \sum X_i + \epsilon_i \tag{1}$$

$$\ln (\text{litfm}_{i,t}) - \ln(\text{litfm}_{i,t-t}) = \beta \ln(\text{litfm}_{i,t-t}) + \sum X_i + \epsilon_i \tag{2}$$

$$\ln (\text{Patts}_{i,t}) - \ln(\text{pat}_{i,t-t}) = \beta \ln(\text{pat}_{i,t-t}) + \sum X_i + \epsilon_i \tag{3}$$

Equation 3.5

$\ln (\text{litfm}_{i,t}) - \ln(\text{litfm}_{i,t-t})$ = dependent variable, which is log difference of female literacy rates from current to initial period.

$\ln (\text{litfm}_{i,t-t})$ = independent variable, which is the value of female literacy rates at initial period.

β = coefficient of independent variable

$\sum X_i$ = other independent variables that also affects male literacy rates but the study is not much interested in them. These are Number of patients treated and infant mortality rate.

Equation 3.6

$\ln(\text{Pat}_{i,t}) - \ln(\text{Pat}_{i,t-t})$ = dependent variable, which is log difference of number of patients treated from current to initial period.

$\ln(\text{Pat}_{i,t-t})$ = independent variable, which is the value of number of patients treated at initial period.

β = coefficient of independent variable

$\sum X_i$ = other independent variables that also affects health indicators but the study is not much interested in them. These are IMR, male literacy rate, female literacy rate.

The half-life, t^* , is the solution to $e^{-\lambda t^*} = 0.5$. Taking logs of both sides, $t^* = -\ln(0.5)/\lambda$ [8].

4. RESULTS AND DISCUSSIONS

4.1. Estimating a convergence:

This study estimated Mean, SD and CV to envisage absolute/sigma convergence in human capital. These three measures have been used in different studies to examine sigma convergence (Ingram,1992; Babini, 1991; Afzal, 2012). The results are portrayed in Table 2

Table 2: Descriptive Statistics of Variables Used in Analysis

Variables	Mean 2003	SD 2003	CV 2003	Mean 2014	SD 2014	CV 2014
Primary enrolment rate male	100.0015	15.20940	0.1520	104.6944	12.89035	0.1231
Primary enrolment rate female	87.5374	21.03005	0.2402	94.7778	14.76117	0.1557
Secondary enrolment rate male	52.1753	15.15322	0.2904	68.0278	17.11221	0.2515
Secondary enrolment rate female	42.9864	17.85897	0.4154	53.2778	21.00559	0.3943
Higher Secondary enrolment rate male	49.6691	13.19646	0.2656	27.8889	8.51814	0.3054
Higher Secondary enrolment rate female	36.9842	17.80360	0.4814	25.3611	9.83333	0.3877
Tertiary enrolment rate male	34.7857	16.63779	0.4783			
Tertiary enrolment rate female	42.1737	14.22485	0.3372			
Literacy rate male	64.1942	10.00049	0.1557	70.1389	8.89993	0.1268

Literacy rate female	40.6206	13.73461	0.3382	50.3056	12.36312	0.2457
Gender parity index primary	86.6936	10.81400	0.1247	90.3714	7.36965	0.0816
Gender parity index secondary	81.9337	21.19408	0.2586	93.8496	30.93317	0.3296
Gender parity index higher secondary	73.0798	22.93696	0.3138	93.8496	30.93317	0.3297
Gender parity index tertiary	129.7648	27.15811	0.2092			
Gender parity Literacy rate	62.1182	14.09112	0.2268	70.9916	11.21714	0.15800
number of hospitals per million population	12.3529	12.47514	1.0098	15.3333	17.01092	1.1094
number of beds per million population	1147.9063	2242.2236	1.9534	1483.0857	2646.29918	1.7843
number of patients treated	2029.8485	1510.5834	0.7442	3061.6563	3235.44853	1.8833

Source: Author's computations

The results are very favorable. The mean value for each indicator of education and health has increased over the time which simply indicates “improvement”. Mean value for both primary enrolment rate male and female has increased sharply from 2003 to 2019. SD and CV suggest that the pattern of improvement across all the districts of Punjab is alike; indication of convergence. Secondary enrolment rate male has also improved over the time and the increase is substantial i.e it has increased from 52.1753 to 68.0278 between 2003 to 2019. CV supports the hypothesis that secondary enrolment rates are converging in Punjab. On the other sides secondary enrolment rates of female have also increased in Punjab but comparatively less than that of male. The results of this study show that there has been deterioration in higher secondary enrolment rates, which could possibly the result of drop outs in secondary level. This is an alarming situation. CV suggest that there has been convergence in higher secondary enrolment rate male and as well as higher secondary enrolment rate female. Tertiary enrolment rates of both male and female are increasing over time, this means the trend of university education is increasing in Punjab. Literacy rate is an important indicator of education, the mean value of literacy rate male and female has notably increased and SD and CV postulate that literacy rate has converged. Gender Parity is very important measure of welfare as it tells the ratio of girls to boys in educational attainment levels. It can be used to know the status of woman. Gender parity for all enrolment levels (primary, secondary, tertiary) have substantially improved as well as convergence has been witnessed. Thus, the results prove that Punjab is converging in terms of education. Results of many other studies also concluded that there is convergence in educational outcomes, enrolment rates and years of education (Afzal, 2012; Ingram,1992).

This study proved included three health indicators number of patients treated, Number of hospitals per million population and number of beds per million population, mean, SD and CV for all three indicators have witnessed an improvement over the time and convergence in health in Punjab during the time. Both components of human capital; health and education are converging therefore human capital is experiencing sigma convergence in Punjab. Table 3 shows results for unconditional convergence.

Table 3: Unconditional Convergence

Independent Variables	Constant	Estimated coefficient	Standard error	R ²	Adjusted R2	F stat
Primary enrolment rate male	1.090	-0.010*	0.002	59.8%	58.5%	47.515
Primary enrolment rate female	1.149	-0.012*	0.001	68.6%	67.6%	69.996
Secondary enrolment rate male	4.975	-0.029*	0.12	57.1%	52.2%	40.781
Secondary enrolment rate female	0.756	-0.025*	0.004	56.8%	55.5%	40.712
Higher Secondary enrolment rate male		-0.016*	0.004	30.7%	28.4%	13.712
Higher Secondary enrolment rate female	2.689	-0.772**	0.147	79.2%	66.22%	38.446
Tertiary enrolment rate male	7.551	-0.440**	0.06	52%	48.7%	20.012
Tertiary enrolment rate female	6.531	-0.312**	0.03	60%	58%	7.812
Literacy rate male	0.865	-0.012*	0.002	49.1%	47.6%	32.743
Literacy rate female	1.203	-0.024*	0.003	62.2%	61.1%	55.944
Gender parity index primary	0.938	-0.010	0.001	65.6%	64.5%	61.043
Gender parity index h.secondary	45.171	-4.96***	0.331	67%	37%	4.234
Gender parity literacy rate	70.982	-1.00*	0.133	61.2%	60.1%	53.637
Number of hospitals per million population	3.876.	-0.026	0.176	34.2%	22.1%	2.234
Number of beds per million population	159.840	-1.96*	0.05	34.2%	32%	15.563
Number of patients treated	5.760	-0.635*	0.178	40%	38%	18.13

Source: Author's own calculations. Asterisks * ** and *** shows that variables are significant at 1%, 5%

and 10%

Unconditional convergence for each indicator of human capital has been tested using endogenous growth models. Each variable has converged over the period of time. Negative sign of the coefficient is indication of convergence. Above table illustrates that education and health across the districts of Punjab are converging. These both variables can be taken as indicators of welfare, developed countries are much better than developing countries like Pakistan, due to the fact that their educational system is well-established and their health status is very better.

Enrolment rates and literacy rates have been used as proxy of education. The results confirm that primary enrolment rate male and female, secondary enrolment rate male and female and enrolment to higher secondary classes of both male and female are witnessing converging province wide. Tertiary enrolment rates of both genders are also converging. All coefficients are significant. Gender Parities have been calculated for each variable of education. It lets us know that how many girls are getting educated besides their counterpart (boys). Convergence has been witnessed among gender parity indexes of primary, secondary, higher secondary and tertiary enrolment rates and literacy rates.

Health is another very important proxy of human capital. This study examined for three variables of health and the results suggested that health is converging across all the districts of Punjab. This helps to infer that Punjab has progressed a lot.

4.2. Conditional Convergence

Results of equation 3.1, 3.2, 3.3 have been given below.

Table 4: Dependent variable= Ln literacy rate male 2003-14

Independent variable	Estimated coefficient	Standard error
Ln literacy rate male 2003	-0.131**	0.216
Number of hosp	-0.410**	0.280
Number of beds	0.002**	0.002

Author's calculations

* shows that coefficient is significant at 1%. Dependent variable is log difference of independent variable.

R²= 65% F ratio= 6

Table 5: Dependent Variable = Ln literacy rate female 2003-14

Independent variables	Estimated coefficients	Standard error
Ln literacy rate female	-0.882**	0.12
Number of patients treated	0.122	0.192
Number of beds	-0.196	0.12

Source: Author's calculations

Table 6: Dependent Variable= Patients treated 2003-14

Independent variable	Estimated coefficients	Standard error
Patients treated 2003	-0.08**	0.18
Literacy rate male	-1.66**	0.11
Literacy rate female	-1.23**	0.21

Source: Author's calculations. R2 = 61%, Adjusted R2 = 60.5%

Results for conditional convergence shows that there is convergence in education and health, while testing conditional convergence focus is on the variable for which the convergence is being tested, other variables are conditioning variables, they can be selected according to theory or beliefs (Sab and Smith, 2002). Conditional convergence is tested for literacy rates male and female and number of patients treated, all variables have converged conditionally. The speed of convergence for literacy rate male is 0.21 which implies it has converged sub linearly in Punjab, the speed of convergence for that of female is 0.23%. The speed of convergence for health indicator is 0.009% which implies that it would take approximately hundred years to reach steady state. Results of this study matched with other studies (Afzal, 2012; Sab and Smith, 2002; Ingram, 1992).

5. LIMITATION OF THE ANALYSIS

The shortcomings of this research are that convergence for only tested for Punjab and not countrywide. Secondly welfare indicators other than human capital are not included in this study.

6. CONCLUSION AND POLICY RECOMMENDATION

The aim of undertaking this study was to probe convergence in human capital across all 36 districts of Punjab during 2003 and 2014. This study probed both sigma and beta convergence in human capital, the results of standard deviation and coefficient of variation supported the evidence of sigma/absolute convergence while the results from OLS regressions suggested that Punjab has witnessed beta convergence in human capital indicators. The rate of convergence also tells that there are few years to go in achieving half way to steady state in health and education. The results strongly support economic theory and growth models. Simple implication of the study is that initially backward areas have now started to catch up with that of the richer ones. The overall betterment in literacy rates, gender parity, enrolment rates, and housing conditions are great achievements in themselves It also suggest that over the passage of time the remaining gaps would be decreased more or may be would vanish, which could possibly mean that drastic changes are likely to occur in economy. Hence Punjab is leading towards development.

Education is fundamental ingredient of human capital. Government should well design and implement good education policies to improve education system. Focus should be given on creativity and broad

learning. The standard of education should be raised. Government should give incentives, soft loans and scholarships to the student to reduce the financial burden. Number and quality of hospitals should enhance so that the number of patients treated and number of beds per person increases.

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