

Measuring Impact of Socioeconomic Factors on Schooling in Sindh: An Application of Censored Ordered Probit Modeling

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Abstract

This study aimed to explore the socioeconomic determinants of child education in Sindh, Pakistan. This study is based on the sample of 50,016 children aged 3-17 years, extracted from the micro-data of Sindh MICS 2018-19. The censored Ordered Probit Model is applied to calculate the impact of different socioeconomic factors on a child's educational attainment. Estimation on an aggregated level (Sindh) explains that gender and urban-rural variables are positively associated with child education means females are more deprived than males, and the children who are inhabitants of rural areas are more deprived more than children of urban areas. The impact of family size on child education is negative and significant. The findings of the urban-rural model show that children of poor households are less likely to get an education, and the family size in rural areas is a significant barrier to child education. The gender-based model identifies household economic status and area of residency (urban) are major sources of gender disparity. The model of big cities and the rest of Sindh explains that poverty and residence (rural) are the main causes of regional disparity.

Keywords: Child Education, Censored Ordered Probit, Socioeconomic Factors, Sindh MICS

1 Introduction

A worker with higher education and greater skill are defined as the human capital and the human and physical stock are main factors of economic development of a country (Becker, 1964). Human capital can be produced by providing education and different needful skills to the children with

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the postulation that today's educated child will be a skillful employee in future. In the scenario of Sindh province, which is the second most populated province of the Pakistan. The population of Sindh is 47.9 million, of which 46.9% population of Sindh are under the age of 18. As per United Nations (UN) Convention on the Rights of the Child, any individual who does not attain the age of 18 years is defined as a child. As far as education is concerned, pre-schooling starts at the age of 3, so the target population of this study are children aged from 3 to 17 years, which means children who are older than 35 months and under the age of 18 years will be included in this research. The share of children aged 3-17 in a total population of Sindh is 39.1%. This shows that the substantial portion of Sindh's population will be covered in the study's target population. The findings of this research can be useful for strengthening the child education system in Sindh, Pakistan.

In order to explore the causal factor of child education in Sindh, there is a need to understand the education levels first. Early Childhood Education (ECE), which is the foremost level of child education, starts from the age of 3 years and ends at age 5. ECE was initially (i.e. 1970) demi-officially organized in Pakistan and named Katchi/ Pakki. These classes were systematised in primary schools on a regular basis. Katchi/ Pakki, which are also termed Nursery/ KG, were officially suspended in the 1980s. After numerous discussions and dialogues during the formulation of national education policy, ECE was reinstated in 1992 and in 2003, the national plan of the government of Pakistan reconsidered that early childhood education (ECE) was a priority gap in the education system. (Ahmad, 2011). As the current study focuses on child education the child education starts from ECE; however, ECE is not the mandatory step to enter into the education system, primarily students get admission from grade-one, especially in the rural context. The ECE is the best indicator to judge school readiness among children and their parents, and it has also been observed from the data that where the school readiness indicator is better, the child's educational attainment is high in those areas (Sindh MICS, 2018-19).

Education gives economic and social benefits, which can be explained with the help of the concepts of private and external benefits. Educated citizen of a country has diverse economic opportunities to spend their life in a well-manner. Knowledgeable workers charge high wage rates and try to maximise their private benefits. As far as external benefits are concerned, education also derives external benefits. Educated persons try to get jobs according to their qualifications and, contribute to the country's economic output and increase the economy's growth. This economic growth further increases the welfare of the society (Becker, 1964). The significance of education from a social and economic standpoint, Tomul and Polat (2013) emphasised the importance of education and its role in achieving community-level goals such as a high-quality workforce, social development, and civic awareness. From an economic standpoint, a skilled workforce will continue to grow, enhancing a country's competitive power and capacity in the global market.

This increase in the overall population of Sindh leads to the burden of new students continuously increasing with time. The last population census of Pakistan was conducted in 2017; the population of Pakistan was 207.7 million, and the population of Sindh was reported to be 23% of the total population of Pakistan. For the current study, the population of Sindh is estimated using district-wise population annual growth rates, and it is found that the population of Sindh has increased from 47.9 million to 52.6 million during the last four years (2017-2021). Sindh's education system includes more than 63,000 schools up to the higher secondary level and has around 250,000 teachers. Despite the large layers of the education system of the Sindh government along with enough schools and teachers, the education indicators of the province need to show a better trend. Comparative findings of Sindh MICS 2014 and MICS 2018-19 show that the net-attendance ratios at primary and secondary levels and completion rates for primary and secondary are declining. It stimulates the author to explore the causes behind the declining situation of educational attainment in Sindh.

1.1 Research Purpose and Hypotheses

This study is designed to estimate the impact of socioeconomic factors on child educational attainment in Sindh. Generally, socioeconomic factors comprise the individual characteristics of the child, parental education and the household's economic status.

Considering the explanatory factors of the human capital model, education's role is quite significant. Sindh is the second most populated province in Pakistan, comprising more than 50 million populations. Having a large population, Sindh can yield huge amounts of skilled labor at the country level. However, the socioeconomic survey report released by the Planning & Development Department, Govt. of Sindh, presents a substantial decline in significant education indicators at the provincial level. The current study is based on the hypotheses that H_0 : There is no Impact of Familial and Economic Variables on Child Education Attainment; as an alternative, H_1 : Familial and Economic Variables have a Significant Impact on Child Educational Attainment. By using the econometrical modelling on the primary data of Sindh, if we reject the null hypothesis, we may conclude that the socioeconomic variables significantly explain the child's education attainment.

Moreover, this study examines the regional and gender-wise inconsistencies. Sindh province has significant regional heterogeneity, such as the lifestyle of developed cities like Karachi and Hyderabad are reasonably different from the less developed areas of Sindh. In this connection, this study also tests the hypotheses of whether region-wise and gender-wise disparities significantly affect child education.

2 Literature review

In this section, different research studies on the matter of education and its relevant indicators have been referred to. Noble laureate Becker (1964) presented the first educational attainment model in his theory of Human Capital. He identified that education cost is considered an investment, and the primary purpose of making this investment is to become an educated and skilled worker. Their parents and caretakers decide the best level of education for any child, and these decisions are taken based on cost/ benefit analysis. Every additional level of schooling is profoundly affected by the cost of education, which can be direct cost or indirect (opportunity) education cost.

Becker (1965) extended the Human Capital model, and demand for child education was re-examined at the household level instead of the individual level. His extended model is based on the assumption that education is part of the household utility function and a child's education level is considered a commodity of utility function. Every household attempts to maximise its utility, which depends on different economic indicators, mainly the price level of a set of other commodities commonly used in households and have some utility. Common commodities are classified as clothing, food, etc. He concluded in his research that the optimal level of child schooling is associated with the decision of parents or caretakers to allocate household resources under limited income.

Becker's (1964) hypothesis was questioned by Heckman (1976) because it relied on financial phenomena to gauge educational attainment. He incorporates the consumer aspect of education into the human capital model. He concludes that the usage of education also plays a significant role in determining the number of years a child will spend in school. That demand for education rises as returns on education rise. Rehman et al. (2015) studied the economic impact of literacy in Pakistan by province. They compared literacy rates in India, Bangladesh, Nepal, and Bhutan to those in other Asian nations. Pakistan's literacy rate was ranked 113 out of 120 countries, putting it at the bottom of the list. Their descriptive and qualitative analyses concluded that education in Pakistan is purposefully overlooked both inside and outside Pakistan.

Smith and Todaro (2020) researched gender differentials regarding educational attainment and found that girls receive less education than boys in developing and under-developed countries. Significant gender inequalities are reported in the indicator of school completion rate; this gap is predominantly large in rural areas. Kazeem et al. (2010) highlighted that in developing countries, males are more preferred than females for schooling. Parent believes that the females who receive an education cannot participate in the labour market due to some social barriers, and those educated girls take part in the labour market but get low wages compared to males.

Culture is a significant contributor to gender discrimination; it is evident that many developing nations, particularly the least developed ones, have a culture that prevents women from pursuing higher education. In addition, parents prefer their children to pursue an education for boys over girls because they believe boys will provide them with more financial returns in the future and assist them financially in their later years (Roby et al., 2016).

Patrinos and Psacharopoulos (1997) estimated the impact of family size and child labour on child schooling in Peru. They selected data from the Living Standard Survey (LSS), Peru-1991, and their study shows that the size of a household is a crucial accelerating component that impacts child education negatively.

Khan and Ali (2003) researched factors affecting child schooling in the rural areas of Pakistan; the authors' findings show that maternal education plays a much stronger effect on children's educational attainment. Children from large families are less likely to attend school up to a higher level. Besides this, the household income or the economic status of the household has a much more significant and more beneficial impact on school attendance.

Different research articles are reviewed to examine the association between parents' education and children's educational attainment. In a study conducted in Bangladesh by Maitra (2003), he studied the relationship between educational attainment and socioeconomic characteristics. The censored ordered probit model was employed to attain the highest-level grade, and the regression results demonstrate a substantial difference in educational attainment between females and boys. It is also found that the impact of a mother's education is far more significant than that of a fathers. Regarding parents' education, Sajid and Khan (2016) investigated the impact of poverty on basic-level school enrollment in Pakistan. The study's results reveal a significant and negative influence of poverty, family size and distance to school variables on primary school enrollments. They empirically proved that the impact of parental education and the gender of a child has a positive effect on a child's educational attainment, and the positive association between gender and educational attainment shows that boys are preferred to girls for receiving education.

Another study which specifies the importance of parents' education was conducted by Li and Qiu (2018) in China. They examined the impact of family background on child schooling from the evidence of China. The study's findings show that high-quality education for the parents smooths the way for improved educational opportunities for their children.

Tomul and Celik (2009) examined the impact of domestic variables on students' academic attainment in Turkey. They found that the effects of socioeconomic variables on child educational attainment are quite significant, and regional disparity creates vast inequality. The child's education decreases as the regional development decreases.

In Pakistan, Khan and Khan (2016) calculated the influence of remittances on children's schooling. This analysis was based on the PSLM survey 2010-11. The study's findings show that families that receive remittances are more likely to enrol their children in school. From the gender lens analysis, the model coefficients of remittance as an independent variable are sensitive for girls. In contrast, in regional analysis, the model coefficients of remittance as an independent variable are very sensitive for rural.

A research study is carried out on the socioeconomic factors of child educational attainment in Pakistan. An econometric model of the censored ordered-probit model is applied. Research results show that household income level, annual school fees, and regional disparity are the leading causes of Pakistan's declining educational attainment (Iqbal et al., [2020](#)).

In Northwest China, an under-developed province, the determinants of essential school attainment were explored by Zaho and Gleww ([2010](#)). A censored ordered probit regression model uses completed years of schooling as the dependent variable. Different familial variables such as household income, child nutrition and parental education are taken as independent variables in the study. The study's results show positive and significant associations between child nutrition, household income and essential school attainment. However, the mother's education toward the basic school attainment of children has a direct and significant impact.

Rafique et al. ([2020](#)) conducted a Punjab study using the data from Sindh MICS, 2014. They empirically analysed and found the impact of socioeconomic elements on primary school attendance in Punjab, Pakistan. Findings reveal that, along with other socioeconomic factors, the wealth quintiles are the significant determinant of school attendance in Punjab. The relationship between socioeconomic factors and child education has been studied in developing and under-developed countries. At the Pakistani level, some studies by Khan and Ali (2003), Sajid and Khan (2016) and Iqbal et al. (2020) have been carried out on the issue of child education about socioeconomic factors.

At the provincial level, only a study was conducted by Rafique et al. (2020) using data from Punjab MICS 2014. However, the object of this study was different in that it was focused on child school attendance and limited to primary-aged children from 5 to 9 years. However, studies on the socioeconomic determinants of child schooling have yet to be undertaken in Sindh. The current research will look into the declining trend of child education in Sindh and other socioeconomic factors that influence child education. This study will fill a gap in understanding the relationship between socioeconomic determinants and child schooling achievement in Sindh.

2.1 Problem Statement

Economic Literature confirms that the role of human capital is quite significant in the economic growth of any country. In the function of human capital, the education level of their country is a vital domain variable. Considering the large size of the population in Sindh, this province of Pakistan can produce a huge quantity of skilled labour for its country. The Planning & Development Department report of the Govt. of Sindh displays a significant decline in major education indicators. This research is based on the statement about whether familial and economic variables affect child education in Sindh.

The second aspect of the study is to examine the regional and gender disparities. Sindh has enormous regional heterogeneity among its districts as well as divisions. The socioeconomic indicators of major cities like Karachi, Hyderabad and Sukkur are quite different from other city districts of Sindh. Similarly, many socio-economic indicators also show gender-wise disparities.

3 Research data and methodology

The current study used a quantitative approach to determine the relationship between child education and socioeconomic factors in Sindh, Pakistan. Cross-sectional data on children's educational achievement and socioeconomic factors were taken from a survey conducted jointly by UNICEF and the Government of Sindh in 2018-19.

3.1 MICS Sampling

The MICS survey uses advanced-level complex sampling techniques to conduct the cross-sectional

data collection; the sample was drawn at 29 cross-sectional units, which are the district of Sindh province. The household frame population census 2017 is used for sample design by PBS, and the district-wise enumeration blocks are used; each enumeration block consists of 200-250 households on average. In MICS, Two-Stage Stratified sampling is used, and urban-rural are taken as strata. In the first stage, primary sampling units (PSUs) are selected at the district level because the domain of results in MICS is a district, and in the second stage, secondary sampling units (SSUs) are set in each PSU.

MICS's total sample size (n) is 20,540 households from 1,027 enumeration blocks in all six divisions and 29 districts of Sindh, Pakistan. From which 20,212 households were found occupied, and from occupied households, 20,030 households were interviewed, so the response rate of the MICS survey was 99.1%. Crosstab of total sample size according to number of children age 3-17 and their gender with respect regional disparities is presented in Table 1.

Table 1: Study Sample Size with urban-rural, gender and regional bifurcation

Sindh	Children (age 3-17)	
	(Count)	(%)
Urban	22,697	45.4
Rural	27,319	54.6
Boys	26,151	52.3
Girls	23,865	47.7
Big Cities (Karachi, Hyderabad & Sukkur)	14,275	28.5
Rest of Sindh	35,741	71.5
Total	50,016	100.0

Source: Sindh MICS (2018-19)

3.2 Explanation of Variables

Three different vectors of variables are taken for the current analysis of the child's educational attainment, which are children's characteristics, parental characteristics and housing characteristics. Characteristics-wise variables listed along with their literature significance with references are mentioned in Table 2.

Table 2: Variables Definitions and Explanations

Variable	Symbol	Explanation
Child Education Level	E_i	Children's education is divided into five different levels. It is an ordinal variable; these levels are in order and range from 0 to 4, '0' means no education, '1' shows primary, '2' middle, '3' secondary, and '4' indicates higher secondary. This variable is used in the research of Maitra (2003) and Rafiq et al. (2020)
Child Age	Age_i	It measures the child's age in years (completed), and the nature of the variable is discrete. As per survey methodology, a child is considered to be of age 1 when they met 365 days; otherwise, their age is reported as 0 years (less than one year). Modified from this variable is used in this study, which is referenced from Zaho and Gleww (2010) and Raifq et al. (2020)
Child Gender	Gen_i	It refers to the gender of the child, which is taken as a dummy variable (1, 0). '1' is assigned for boys/males and '0' for girls/females.

		The child gender is tested as a primary source of disparity, which is referenced by Smith and Todaro (2020) and Roby et al. (2016).
Mothers Education	ME_i	Mothers' education level is the categorical variable divided into five categories ranging from 0 to 4, where 0 = None, 1 = Primary, 2 = Middle, 3 = Secondary and 4 = Higher Secondary and above.
Fathers Education	FE_i	Fathers' education level is the categorical variable divided into five different categories ranging from 0 to 4, where 0 = None, 1 = Primary, 2 = Middle, 3 = Secondary and 4 = Higher Secondary and above. Parents' education variables are used in the research of Maitra (2003), Sajid and Khan (2016), and Li and Qiu (2018).
Household Head Education	HE_i	The level of education for the household head is divided into five different categories as classified for parent's education. The author added it to examine the source of disparity caused by HH Head's literacy.
Family Size	$Size_i$	Total number of members in a dwelling/ family This variable is referenced from the research of Patrinos and Psacharopoulos (1997)
Dependency Ratio	DR_i	Dependent members are those younger than 15 years or older than 64 years ³ . Modified from this variable is referenced from Iqbal et al. (2020).
Wealth Quintiles	WQ_i	It is a wealth index which is computed by composite indicators of wealth. The wealth of a household is estimated by assets and the physical structure of a household, which classifies a household into five different classes of wealth. Wealth quintiles are constructed by using principal components analysis (PCA). Five wealth classes are from 1 to 5 where 1 = Poorest, 2 = Lower Middle, 3 = Middle, 4 = Upper Middle, and 5 = Richest. The author added it to examine the source of disparity caused by income inequality.
Area of Residence	UR_i	Area of residence is introduced as a dummy variable (1, 0) if the child is a resident of an urban area coded as "1" and if the child resides in a rural area coded as "0". Residence variable is used in the research of Khan & Ali (2003), Tomul & Cliek (2009), and Iqbal et al. (2020).

3.3 Censored Ordered-Probit Modeling

A child's education is measured by the last grade completed by the child, and then the completed grade of the student confirms their level of education. $DR = \frac{(\text{members} \leq 15 \text{ yrs} \ \& \ \geq 64 \text{ yrs})}{\text{Total members}}$

To model the impact of socioeconomic variables on the child's education, different socioeconomic variables are taken, which explanation is given in the above section. The analysis of completed years of schooling is considered a complex phenomenon, because the maximum grade attained by a student is reported in the discrete number and creates the problem of probability-spikes and right-censoring. Those children enrolled or studying in a particular grade cannot be treated as equivalent to those who have completed that grade because the equal consideration may yield biased results (Holmes, 1999).

The latent variable of child education is established, and observations are censored according to education levels. The regression model of the current study is given below:

$$E_i = \alpha + \beta_1 Age_i + \beta_2 Gen_i + \beta_3 ME_i + \beta_4 FE_i + \beta_5 HE_i + \beta_6 Size_i + \beta_7 DR_i + \beta_8 WQ_i + \beta_9 UR_i + u_i$$

The model presented in equation (1) is the modified form of the model, which is used by Zaho and Glewwe (2010) and Iqbal et al. (2020). Where E represents the child's level of education for i th child, child characteristic includes two variables (age and gender) and variables related to the parents and Head of Household educational level. In our case, the dependent variable E_i is the multinomial variable, which is a latent variable that is incompletely observable, so a simple probit model cannot model the equation (1). The dependent variable E_i is an ordinal variable that means orders of levels of education, such as the rank of primary is lower than the middle school, the rank of the middle is lower than the secondary level, and so on. Originally, the censored ordered probit model was developed by King and Lillard (1987). After this, many economists/researchers used it and estimated multinomial probit models in different research areas.

3.4 Model Derivation

A latent variable is an index of the unobserved propensity for the event of interest to occur. To derive our research model, let E^* be a latent variable (unobserved), and it can be estimated by the regression model given as under:

$$E^*_i = \beta X_i + u_i \quad (2)$$

Under the postulation, the desired level of schooling is a continuous variable that depends on the number(s) of regressors X , and the error term is denoted by u_i (Cameron and Trivedi, 2005). However, the desired level of schooling E^* is not observable, so the equation (2) model cannot be estimated directly. Instead, we observe a discrete level of completed education; a latent variable E^* may be constructed across a series of increasing unknown thresholds as we move up the ordering of alternatives. Such as, for very low or no education level, E^* is nil, for $E^* > e_0$ educational level improves to fair, for $E^* > e_2$ it improves further to good, and so on. For generalization n alternative ordered values, we define:

$$E_i = j \quad \text{if } e_{j-1} < E^* \leq e_j \quad (3)$$

$$three E_i = \begin{cases} 0 & \text{if } E^* \leq e_0 \\ 1 & \text{if } e_0 < E^* \leq e_1 \\ 2 & \text{if } e_1 < E^* \leq e_2 \\ 3 & \text{if } e_2 < E^* \leq e_3 \\ \vdots & \\ n & \text{if } e_{j-1} \leq E^* \end{cases} \quad (4)$$

Where e_j are cutoffs, showing the transition of children from lower grade to higher grade. To make a more meaningful ordinal form of child education as the dependent variable, cap E_i is categorized into five different categories, which are also synced with existing education levels defined by the government.

$$\begin{aligned} l_0 &= 0 \text{ if } E^* \leq e_0 \\ l_1 &= 1 \text{ if } e_1 \leq E^* \leq e_5 \\ l_2 &= 2 \text{ if } e_6 \leq E^* \leq e_8 \\ l_3 &= 3 \text{ if } e_9 \leq E^* \leq e_{10} \end{aligned} \quad (5)$$

$$tenl_4 = 4 \text{ if } e_{10} < E^*$$

Equation (5) defines the five levels of education ranging from 0 to 4. First, e_0 shows those children who never attended schools or studied just pre-schooling, denoted by l_0 . For children who attended school and fall between e_1 to e_5 , their level of education is primarily denoted by l_1 ; for those who fall between e_6 to e_8 , their education level is middle, denoted by l_2 , and for the secondary level, which is denoted by l_3 , the for children For's For educational For attainment For found between e_9 to e_{10} . If a child educational attainment is more than grade 10 other words $[>e]_{10}$, their education level is called higher secondary & above, denoted by l_4 . Data is censored for the children (age 3-17 years) who were ever enrolled/ attended at the time of the survey to develop a latent desired variable for educational attainment. It is important to note that the desired level of education is unknown, but if we know the current level of education, then it is assumed that they will complete at least that level of education in which they are studying.

To find out the probabilities of the five different outputs of latent desired variable E_i through the ordered probit model, equations can be formulated as:

$$\begin{aligned} r(E = 0) &= \Phi(l_0 - \beta X_i) \\ \Pr(E = 1) &= \Phi(l_1 - \beta X_i) - \Phi(l_0 - \beta X_i) \\ \Pr(E = 2) &= \Phi(l_2 - \beta X_i) - \Phi(l_1 - \beta X_i) \\ \Pr(E = 3) &= \Phi(l_3 - \beta X_i) - \Phi(l_2 - \beta X_i) \\ \Pr(E = 4) &= 1 - \Phi(l_3 - \beta X_i) \end{aligned} \quad (6)$$

Under the assumption of ordered probit model u_i from equation (6) are normally distributed and here, l_i are the different levels of education and Φ represents the cumulative density function (CDF).

3.5 Diagnostics for Model Adequacy

According to Amemiya (1981) and Maddala (1983) there is no single diagnostic for non-linear regression modeling, which can be professed as the best diagnostic. Different non-linear models can be used to fit on the same data. The Likelihood function for n observations for the case of multinomial responses may be written as $L_n = \prod_{i=1}^n \prod_{j=1}^m p(y)_{ij}$ where subscript (i) shows the data observations up to n and subscript (j) shows the m alternatives for the multinomial responses. The statistic of log-Likelihood function is computed as by addition of all log-probabilities for i th observations and the alternatives as $\mathcal{L} = \ln L_n = \sum_{i=1}^n \sum_{j=1}^m y_{ij} \ln p_{ij}$. Greater the value of Log Likelihood between two models shows the best fit model, as the value of Log-Likelihood reported in negative numbers so in term of absolute value the lower the value of log-likelihood confirms the best fit model.

Another diagnostic for the non-linear model is goodness of fit, it measures coefficient of determination Pseudo- R^2 means it gives the quasi look of R-square. Pseudo- R^2 does not necessarily have the properties of lying between 0 and 1 (Cameron and Trivedi, 2005).

McFadden (1974) presented formula for Pseudo R-square for binary model is bit simpler than the formula was presented by McFadden (1973) for multinomial regression analysis. For the case of multinomial nonlinear regression $R^2 = 1 - \ln L_{fitted} / \ln L_0$ where log-likelihood given in numerator is of fitted model and for denominator, log likelihood ratio of intercept only model. Pseudo- R^2 has a number of interpretations; most commonly, it yields the fraction that shows how much the given model is fitted because it is estimated by a maximum potential gain in log-

likelihood that is achieved by the fitted model.

The model is overall best-fit or significance is tested by the Log-Likelihood ratio (LR) as we test the overall significance of the model by F-Test in the linear regression model. The LR test examines whether all the regressors have significant impact on the model's regressand. This test statistic approximates the Chi-square distribution with degree of freedom observations minus the number of parameters estimated.

3.6 Residual Analysis

The micro-econometrical analysis is based on the cross-sectional micro data sets, where the sample size is comparatively larger. Therefore, it pays little attention to the residual analysis compared to the other statistical modelling. Residuals analysis becomes great matter of concerns in case of small sample size and model results may be sensitive in case of uncorrected errors. So, if the data set is significantly large or even large to analysis of residuals may be redundant or it may have negligible impact on results.

Heteroscedasticity is assumption of non-constant variance usually arise in the cross-sectional data analysis. Dealing in non-linear model, the scalar dependent variable y_i with fitted value $\hat{y}_i$ and the raw residuals may expressed as $u_i = y_i - \hat{y}_i$, the conditional variance of the dependent variable σ^2_i . Pearson Residual statistic $p_i = (y_i - \hat{y}_i) / \hat{\sigma}_i$ follows the chi-square probability distribution and test the null hypothesis of the regression model is good-fit or valid.

Deviance residual test has the same features like Pearson test it has the same null hypothesis and also follows the chi-square distribution. The test statistic of deviance residual $d_i = \text{sign}(y_i - \hat{y}_i) \sqrt{2(l(y_i) - l(\hat{y}_i))}$ is the more refined because it is the generalization for model of Linear Exponential Family (LEF) models of sum residuals in the linear model. It has attraction that transform the dependent variable closely to the normal standard variable.

4 Results & discussion

Necessary tools of descriptive statistics to measure the central tendencies and dispersion of data set such as minimum, maximum, arithmetic mean and standard deviation are estimated and presented in Table-3. The mean age of children is above 9 years with standard dispersion of 4.23 years.

Table 3: Descriptive Statistics of all variables at overall (Sindh) level

Variable	Scale/ Unit	Min	Max	Avg	SD
Age	Years	3	17	9.34	4.23
Gen	Nominal	0	1	0.52	0.49
ME	Ordinal	0	4	0.68	1.25
FE	Ordinal	0	4	1.39	1.59
HE	Ordinal	0	4	1.28	1.55
Size	Numbers	2	41	8.67	4.17
DR	Percent	0	100	54.17	16.59
WQ	Ordinal	1	5	2.69	1.34
UR	Nominal	0	1	0.45	0.49
Sample Size (n)	50,016				

The central response of the variable of the gender of child is 0.52 that displays there are 52% children are boys, means boys are more than girls. Parents education and head of household education show that the mean qualification of the mothers is less than primary level (0.68) in other words, most of the mothers are have no education or they have education less than grade 5. The average education level of father and head of household is greater than primary which shows most

of the fathers and household heads have primary and middle-level qualifications.

The dependency ratio and the other is the size of the household. The range of dependency ratio is from 0% to 100%, zero shows that there is no member in the household is of age under or equal to 15 years or above 64 years and the dependency ratio is equal to 100% shows its vice versa. According to the table-3 mean of the dependency ratio is 54% which shows that on average 54% members of every household are below or equal to 15 years or above 64 years with deviations of 16.59.

The average household size in Sindh, given that the households have children aged 3-17 is 8.67 persons with the standard variation of 4.17 persons. In our sample, minimum household size is reported as 2 persons while the maximum size of the household is reported as 41 persons per household. The wealth quintile is an ordinal variable which shows the economic status of household, categories of this variable go from 1 to 5 which are labeled as poorest to richest. The average rank of wealth quintiles at an aggregate level (Sindh) is 2.7 which is in between the 2nd to 3rd quintile (Lower middle class to Middle class). The average response of urban-rural is 0.45 that shows in Sindh 45% children aged 3-17 live in urban areas and rest are in rural areas. In the correlation matrix given in table-4, some variables have negative relationships and some have positive thus most of the correlation coefficients are very low which shows there is no substantial problem of multicollinearity among regressors.

Table 4: Bivariate Correlations between all Variables at overall (Sindh) level

Variable	Age	Gen	ME	FE	HE	Size	DR	WQ	UR
Age	1	0.000	-0.043	-0.031	0.014	0.005	-0.270	0.063	0.042
Gen		1	-0.008	-0.007	-0.008	-0.010	-0.015	-0.010	-0.001
ME			1	0.523	0.484	-0.141	-0.111	0.566	0.378
FE				1	0.885	-0.002	-0.095	0.482	0.238
HE					1	-0.054	-0.083	0.452	0.224
Size						1	0.039	-0.076	-0.123
DR							1	-0.242	-0.135
WQ								1	0.601
UR									1

Sample Size (n) = 50,016

The variables of father's education and head of household's education are showing considerable correlations among them; however, this expected issue of multicollinearity will not be problematic because of the large sample size.

4.1 Results of Censored Ordered Probit Model at Sindh Level

The results of censored ordered probit model and diagnostic tests are used at Sindh level are shown in the table-9. There is positive and significant relationship found between the age of children and their education levels, the plausible cause of this relationship is that, when age increases the education level also increases keeping other things constant and positive. The coefficient of child gender is significant and has positive relationship with dependent variable which concludes that in Sindh, boys are chosen in getting education than girls. The results are consistent with Maitra (2003), Kazeem et al. (2010), Roby et al. (2016) and Iqbal et al. (2020).

Moreover, gender coefficient of current study is aligned with the hypothesis of gender inequality was given by Smith and Todaro (2020) in the book of economic development that, the males are preferred in providing education than females in developing and least-developed countries.

The effect of parent's education is found highly significant and positively related with child

educational attainment, so the likelihood of getting education of child is more when its parents are educated. Positive and significant association of parents' education with child educational attainment are aligned with the studies conducted by Zaho and Gleww (2010), Sajid and Khan (2016), Khan and Khan (2016) and Li and Qiu (2018).

Table5: Results of Censored Ordered Probit Model at overall (Sindh) Level

Explanatory Variable	Coefficient	SE	Prob.
Age	0.212	0.002	0.000
Gen	0.299	0.012	0.000
ME	0.052	0.006	0.000
FE	0.124	0.008	0.000
HE	0.053	0.008	0.000
Size	-0.003	0.001	0.070
DR	0.000	0.000	0.177
WQ	0.280	0.006	0.000
UR	0.070	0.014	0.000
Sample Size (n)	50,016	Log Likelihood	-40477.51
Model Fitting Diagnostics			
LR Chi-sq (9)	28,393.97	LR Chi-sq: P-value	0.000
Pseudo R-Square			
Cox and Snell	0.433	McFadden	0.260
Residual Analysis for Model Validity with Homoscedastic Errors			
Pearson chi-sq (p-val)	113091.1 (1.000)	Deviance chi-sq (p-val)	63846.6 (1.000)

Impact of household size found negative on the educational attainment and this negative association between child education and household size is also concluded by Patrinos and Psacharopoulos (1997), Khan and Ali (2003) and Sajid and Khan (2016). The dependency ratio shown no impact on child education and it is found insignificant; similar results are unveiled by Iqbal et al. (2020). In our model the household economic situation is measured by the wealth quintiles which show positive and significant relationship with dependent variable. Similar to our results have also been established by Asghar et al. (2009), Iqbal et al. (2020) and Rafiq et al. (2020).

This positive association shows both variables move in same direction the variable of urban-rural goes for 0 to 1 labeled as rural to urban and the children education levels goes from 0 to 4 labeled as none to higher. It may be explained as the children are living in urban areas are more likely and have more opportunities than those are living in rural areas to receive a higher education.

Pseudo R-square, Log likelihood and Likelihood Ratio test are used as diagnostic measures of the nonlinear regression model. In table-5, Pseudo-R square by McFadden is 26.0% and by Cox-Snell is 43.3%. Residual analysis for model validity and the correction of errors from hetroscedasticity are tested by Deviance and Pearson chi-square tests. The p-val. of both tests are aligned and concluded that the model is valid and error are homoscedastic. For the overall significance of the

model the Likelihood Ratio test is used and it is concluded that model is best fit.

4.2 Results of Urban-Rural Model

Bringing the hypothesis of the urban-bias from the literature of economic development which is major cause of the regional disparities, disaggregated empirical analysis is carried out at urban-rural based. In order to discuss the disparities between urban and rural models, the age-factor is effective in urban than rural in other words, the chance of getting education with the passage of time increases more rapidly in the urban areas than rural areas. In both urban and rural areas of Sindh, boys are more preferred than girls in provision of education; however, this biasedness is much higher in rural areas than urban. Our results endorse the findings of Maitra (2003), Khan and Khan (2016), Sajid and Khan (2016) and Iqbal et al. (2020).

Very interesting story is observed for the variable of household size, the average household size is negatively and significantly correlated with the child educational attainment for the case of rural areas. It shows that adding of an additional member in household in the rural areas of Sindh will significantly decrease the chances of receiving education by children of that household. As far as urban areas are concerned the family size does not play significant role and the probable reason of this insignificance is that the urban has small family size than rural not a barrier to get education. Our findings are partly consistent with Sajid and Khan (2016).

Table 6: Results of Censored Ordered Probit Model at Urban Rural Level

Explanatory Variable	Urban (Model)		Rural (Mode)	
	Coefficient	Prob.	Coefficient	Prob.
Age	0.269	0.000	0.167	0.000
Gen	0.051	0.002	0.556	0.000
ME	0.080	0.000	0.095	0.000
FE	0.098	0.000	0.142	0.000
HE	0.061	0.000	0.046	0.000
Size	0.002	0.409	-0.008	0.000
DR	0.001	0.182	0.000	0.467
WQ	0.253	0.000	0.317	0.000
Sample Size (n)	22,697		27,319	
Model Fitting				
Log Likelihood	-20396.127		-19171.538	
LR Chi-sq (9)	16702.531	0.000	10647.870	0.000
Pseudo	Cox & Snell	0.521	Cox & Snell	0.323
R-square	McFadden	0.291	McFadden	0.217
Residual Analysis for Model Validity with Homoscedastic Errors				
Pearson Chi-sq	232897.015	1.000	39442.146	1.000
Deviance Chi-sq	34128.534	1.000	27898.327	1.000

Results of the estimated model of urban-rural reflect that economic status contributed as an

important factor and has a positive and significant impact on child education. However, the likelihood of getting an education of children will notably increase in rural areas as the household's wealth quintile improves; results supported the finding of Iqbal et al. (2020).

All the diagnostics are found adequate, Pseudo R-square for both McFadden and Cox-Snell are higher for urban results than rural and according to residual analysis both models are valid and their errors are homoscedastic.

4.3 Results of Gender Based Model

Estimated coefficients of the variable of mother's education explains that females whose mothers are more educated get more education as compared to those females whose mothers are less educated. Comparable findings are given by Sajid and Khan (2016), Khan and Khan (2016) and Li and Qiu (2018).

Table 7: Gender Based Results of Censored Ordered Probit Model.

Variable	Male		Female	
	Coefficient	P-value	Coefficient	P-value
Age	0.231	0.000	0.193	0.000
ME	0.031	0.000	0.068	0.000
FE	0.129	0.000	0.123	0.000
HE	0.069	0.000	0.039	0.001
Size	0.003	0.134	-0.010	0.000
DR	0.001	0.030	-0.001	0.279
WQ	0.225	0.000	0.358	0.000
UR	-0.050	0.011	0.212	0.000
Sample Size (n)	26,151		23,865	
Model Fitting				
Log Likelihood	-22169.102		-17844.47	
LR Chi-sq (9)	15592.494	0.000	13344.947	0.000
Pseudo	Cox & Snell	0.449	Cox & Snell	0.428
R-square	McFadden	0.260	McFadden	0.272
Residual Analysis for Model Validity with Homoscedastic Errors				
Pearson Chi-sq	57231.751	1.000	56850.947	1.000
Deviance Chi-sq	33602.568	1.000	29316.107	1.000

For the model of male education, the size of the family does not impact male education significantly. Still, a significant and negative association is found between family size and girls' education, which explains that if one member increases the size of the family, so the chances of getting an education for girls are reduced by 1%.

The wealth quintile has a significant and positive relationship with both male and female

education. It is important to note that the sign coefficient of urban-rural for male-model is negative, which explains that variables move in opposite directions and chances of getting an education for boys are higher in rural areas, showing biasedness toward the rural girls. The estimated results for the female model show that girls are more preferred in urban constituencies. Similar findings are reported by Maitra (2003) and Sajid and Khan (2016). All the indicators of model adequacy show satisfactory results.

4.4 Model Results at Regional Level (Big Cities and Rest of Sindh)

To sightsee the regional disparities, the disaggregated analysis between developed and less-developed areas of Sindh is performed.

Table 8: Results of Censored Ordered Probit Model at Regional Level

Variable	Big Cities		Rest of Sindh	
	Coefficient	P-value	Coefficient	P-value
Age	0.295	.000	0.183	.000
ME	0.118	.000	0.054	.000
FE	0.114	.000	0.122	.000
HE	0.026	.078	0.057	.000
Size	-0.010	.007	-0.006	.000
DR	0.001	.189	0.001	.187
WQ	0.277	.000	0.309	.000
UR	-0.062	.078	0.110	.000
Gen	-0.030	.139	0.449	.000
Sample Size (n)	14275		35741	
Model Fitting				
Log Likelihood	-12537.053		-27091.792	
LR Chi-sq (9)	11797.902	0.000	16291.139	0.000
Pseudo R-square	Cox & Snell	0.562	Cox & Snell	0.366
	McFadden	0.320	McFadden	0.231
Residual Analysis for Model Validity with Homoscedastic Errors				
Pearson Chi-sq	764404.281	1.000	68723.592	1.000
Deviance Chi-sq	21712.963	1.000	42725.123	1.000

To discuss the sources of inequality in both models, it is found that the impact of the change of wealth quintile will be higher for the children living in less developed cities of Sindh than the children residents of big cities. In big cities, the variable of urban-rural was found to be statistically insignificant. Conversely, the children living in urban areas of under-developed cities (the rest of Sindh) are more likely to get an education than those living in rural areas. It is important to note that a child's sex is irrelevant to determining child education in the case of big cities, which elaborates that the gender of the child is not the matter or not the causal factor in the developed cities of Sindh. In Contrast, child gender was found to be highly significant for the case of less-

developed areas of Sindh, and it may be interpreted as boys being more favoured in under-developed regions of Sindh. No problem was reported in the diagnostic analysis.

5 Conclusion and recommendations

The findings of Sindh-Model enable us to conclude that a child's characteristics, including age and gender, parental characteristics, including the education of the mother and father, the education of the head of household, place of residence, household size, and wealth, are statistically significant aspects in determining the child's educational attainment. Although the significance of household size with inverse relation to the dependent variable shows that the likelihood of a child receiving education is higher in small families, the variable of dependency ratio is found to be statistically insignificant in our model, which may be concluded as the counts of dependents in a household are not considered to be a barrier for the child's education.

The results of the urban-rural model indicate that the late enrollments in the Rural-Sindh make the influence of age variable minimal. The coefficient of the gender variable is also more significant in the rural model, indicating that rural areas have a higher gender gap in access to education. Although family size has a significant negative impact on schooling for children in rural Sindh, it is not shown to be a significant obstacle for children in urban Sindh. Instead, household size is irrelevant in the case of urban Sindh. The children of the lowest wealth quintiles possess very low chances of receiving education, and the impact becomes severe for the children of rural areas.

According to the gender-lensed analysis, family size is irrelevant in the case of boys' education. However, the family size is significant and inversely related to child education for the female sample. Poverty is an imperative problem in getting education for the children of Sindh. Moreover, girls living in the poorest wealthy quintiles are more affected by poverty than boys. Similarly, girls are more deprived in rural areas.

In the regional analysis, the data is divided into two samples: the major cities of Sindh (Karachi, Hyderabad, and Sukkur) and the rest of Sindh to capture the city-level variability. The findings show that poverty is a more severe issue for less-developed cities of Sindh in getting an education; children of less developed cities living in the poorest wealth quintiles are found deprived of education compared to the children of the lowest wealth quintiles of the developed cities.

The fact that the variables of gender and urban-rural for the sample of big cities, statistical insignificance indicates that neither child sex nor the urban-rural constituencies impact Sindh's developed cities' approaches to education for children. Boys are more likely than girls to acquire an education, and children in urban areas are more likely to do so than those in rural Sindh.

5.1 Policy Recommendations

Study findings, such as the age variable presented in Table 5, converge that the delayed entry of children into the education system reduces the chances of higher education. The government should enhance the preschool system and arrange sensitisation programs for parents. The government may initiate a policy of targeted and conditional food support programs for children attending school; this act will enhance the interest of children and their parents and improve children's nutrition.

Low-income households, area differential (urban-rural), and the societal mindset are the underlying causes of gender inequality concerning educational attainment, as the difference can be observed in the urban-rural findings presented in Table 6. The family size has a much adverse impact in rural areas, while the variable of wealth quintile is much more sensitive for the rural models than urban ones. Financial assistance may be provided to female students through a stipend to address this issue. This aid will support low-income families and motivate them towards female education, and this act will reduce gender inequality. Community-level awareness is required to

change the mindset of parents regarding the higher education of female students; parents usually do not show their interest in investing in girls for their higher education with an assumption that females would not be able to serve their parents in their old ages conversely, they invest more on boys to get relief from them in their old ages. Civil societies, NGOs and government organisation's may play a role to mend parents' behaviour and promote the narrative that education is proper, not a privilege.

Solid and practical school inspection and monitoring systems should be employed to enhance the performance of public sector schools. Simultaneously, adequate funds should be allocated, and its utilisation should be monitored through third-party audit firms. There is a huge need for improvement in the government's infrastructure of Sindh schools; many schools in Sindh lack basic facilities like electricity, water and toilets, which creates a sense of insecurity in children and teachers, especially females, who attend the schools. The government must initiate development schemes to improve the infrastructure of public sector schools so the attendance of students and teachers may be enhanced. Similarly, teachers' training programs are not very effective in Sindh, and the trained teachers must have the competencies to teach children according to the modern teaching system. Government should intervene to take up this issue on a priority basis. The public sector has yet to learn of Parents Teaching Meeting (PTM). However, it is a powerful instrument which joins parents and teachers, and both have honours in discussing education-related issues. Government departments should formulate a PTM policy in public sector schools.

6 References

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