Return to Education of Rural Male Wage-earners: Evidence from the Bangladesh Integrated Household Survey, 2011-2019

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Abstract:

This article estimates the returns to education for male wage earners in rural Bangladesh using nationally representative survey data spanning three rounds from 2011 to 2019. Unlike previous studies, which did not utilize these datasets, this research captures temporal changes in the returns to education over an extended period. Consequently, this study provides a more comprehensive picture of the educational returns over eight years. The findings reveal substantial heterogeneity in educational returns across various dimensions. Notably, returns are significantly lower in rural areas, whereas the non-agricultural sector offers considerably higher returns compared to the agricultural sector. Additionally, returns vary depending on individual characteristics such as religious affiliation and other socio-demographic factors. To address the potential endogeneity of education, the study employs instrumental variable techniques, using dummy variables for different levels of mothers' education as instruments. This approach is a novel departure from earlier research, providing a more accurate estimate of the association between education and wages, though utilizing different levels of mothers' education as the instrument. Ordinary Least Squares (OLS) estimates (3.75%, 2.36%, and 4.23% for 2011-12, 2015, and 2018-2019) tend to undervalue the returns to education relative to the Instrumental Variable (IV) regression (6.44%, 4.73%, and 6.45% for 2011-12, 2015, and 2018-2019), primarily due to negative "ability" or "motivation" bias, which suggests that unobserved factors influence both educational attainment and earnings potential. By addressing these issues, the government can more effectively leverage education as a tool for poverty reduction, rural development, and long-term economic growth.

Keywords: Return to education, male wage earners, schooling years, annual income, different levels of mother's education, rural Bangladesh.

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1.0 Introduction

A comprehensive understanding of educational development offers critical insights into a country's economic growth. Bangladesh, a developing nation, has committed significant investments in education with the strategic aim of transitioning from a labour-intensive economy to a knowledge-based one. Assessing the return on educational investment is, therefore, crucial to policy formulation and human capital development.

Although several studies have explored the broader relationship between education and economic outcomes, limited attention has been given to the specific context of male wage earners in rural Bangladesh. Notably, no prior research has systematically analyzed the return to education using the longitudinal cross-sectional data from the Bangladesh Integrated Household Survey (BIHS) covering the period from 2011 to 2019. This study, therefore, seeks to fill this gap by estimating the economic return to an additional year of schooling among rural male wage earners through Ordinary Least Squares (OLS) regression analysis. Understanding these returns is crucial, as human capital investment in rural populations plays a pivotal role in shaping the trajectory of national economic development. Thus, the study captures a more comprehensive picture of educational returns over 8 years, which is highly relevant for the policy formulation for the development of the Bangladesh economy.

Bangladesh achieved a remarkable GDP growth of 7.86% in 2017–2018, rising to a record 8.15% in 2018–2019. However, the COVID-19 pandemic led to a decline to 3.5% in 2019–2020, according to the Asian Development Bank. A recovery followed, with the economy growing by 7.1% in 2021–2022, fuelled by remittance inflows and a thriving garments sector. For sustainable growth, it is vital to analyze how education and social attributes—such as age, gender, and employment experience—influence income. As noted by Dorset et al. (2010), investments in education contribute to higher wages and reduced inequality, while social factors support well-being and dignity.

Research by Ashenfelter (1991) and Conlon and Patrignani (2013) highlight that higher education levels yield higher economic returns. Psacharopoulos (1994), Bhutoria (2016), and Benhabib and Spiegel (1994) confirm the positive association between educational attainment and income levels. These findings suggest that tertiary education provides the greatest wage returns, although returns vary based on age, experience, training, and gender. Meulemeester and Rochat (1995) emphasize the positive causal relationship between schooling and economic performance, and

Hanushek (2013) cautions that without quality improvements, education alone may not sustain long-term growth.

Scully (2002) argued that human capital directly influences economic growth, as measured by investments in education. Similarly, Keller and Nabil (2002) found that enhanced education and skills led to improved income distribution and poverty reduction. Empirical research from Nigeria (Augustine, 2009) using OLS regression indicates that education has a strong positive impact on long-run output. In China, Su and Heshmati (2013) observed that education significantly affects household income in urban areas, whereas tertiary education benefits low-income rural households more. Ning (2010) found lower returns to education among low-income Chinese groups. In Pakistan, Maria Javed (2013) observed that health expenditure has short-term growth effects, while education produces sustained economic benefits.

Bhattacharya and Sato (2017) revealed that while primary and secondary education in India had positive returns, tertiary education was not significantly beneficial; however, caste, tribe, and religion had little influence on wage disparities. Appleton (2000) and Leeuwen and Foldvari (2011) reported contrary evidence of diminishing returns to education in some contexts. Kalwij (2000) used IV methods and panel data to estimate a 15% return for Dutch men. Moretti (2004), using NLSY and U.S. Census data, found that a 1% rise in the proportion of college-educated workers increased wages across all educational groups. Warunsiri and McNown (2010) studied pseudo-panel data in Thailand and found 14–16% returns to education. Himaz and Aturupane (2016) conducted pseudo-panel analysis in Sri Lanka, identifying 5–9% returns.

In Bangladesh, researchers such as Chowdhury et al. (2018), Alam et al. (2009), and Sharif (2013) confirmed a strong positive link between education and growth. Asadullah (2006) conducted a detailed analysis showing the overall return to education along with the male-female return to education, finding a 7.1% return to education, higher in urban regions. Hussain (2000) estimated a 10% return focusing on HIES data with different sample sizes and structures. Rahman and Al-Hasan (2018) found that there is a lack of uniformity between schooling and wage distribution. They noted that the return to schooling inclines towards being low in the lower percentile and high in the higher percentile. They also suggested that social understanding is required to unveil the reasons for this phenomenon. Additionally, the return to education varies depending on several factors such as location, gender, private or public education, type of occupation, religion, social and cultural norms,

etc. Rahman and Al-Hasan (2018), utilizing a cross-sectional dataset, concluded that men earn slightly higher than women when undertaking OLS regression; however, the average rate of return to education for females was higher in their studies. Mohammad and Inaba (2020), however, identified lower overall returns, especially in rural regions.

This study offers a novel contribution by employing three rounds of longitudinal data from IFPRI's Bangladesh Integrated Household Survey (BIHS) — conducted in 2011–12, 2015, and 2018–2019 — to estimate the returns to education among rural male wage earners in Bangladesh. By addressing potential endogeneity concerns through the use of maternal education as an instrumental variable, this research applies a methodological approach not previously utilized in this specific context. While traditional Ordinary Least Squares (OLS) estimates are susceptible to downward bias due to omitted variables such as individual ability, the instrumental variable strategy strengthens the validity of the findings. Consequently, this study provides a more reliable and policy-relevant assessment of educational returns, offering critical insights for targeted human capital investment and evidence-based economic planning in rural Bangladesh.

2.0 Data and variables

2.1 Source of data

The data used for this study were collected from the three-round panel survey, Bangladesh Integrated Household Survey (BIHS), designed and supervised by the International Food Policy Research Institute (IFPRI). It is the only nationally statistically representative survey of rural Bangladesh. It is representative of rural areas of each of the seven (now eight) administrative divisions: Barishal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet. The first round of the survey was conducted from November 2011 to March 2012. Then IFPRI conducted the second round of BIHS from January to June 2015, and the third round was from January to June 2019. These were administered to the same sample of households surveyed in 2011 and 2015. Thus, making a three-round panel or longitudinal survey.

The BIHS sample consists of 6500 households for the first and second rounds and 5604 households in the third round in 325 primary sampling units (PSUs) or villages located across the seven divisions of the country. The sample design of BIHS follows a two-stage stratified sampling method: selecting Primary Sampling Units (PSUs) and selecting households within each PSU using the sampling frame based on the community series of the 2001 Population and Housing Census of Bangladesh.

The working age population comprises 1796 in the first round, 2119 in the second round, and 1772 in the third round, with males aged 14 or higher currently under no education program. The domain of the survey was the rural areas covering the whole country.

2.2 Attrition and Split Households

From the sample survey from Round 1 of 2011/12 to Round 3 of 2019, the attrition rate is found to be 13.82% which is consistent with the paper by Islam et al. (2023), where they found the attrition rate to be 13.78%. Our paper analyzed all three datasets. However, Ahmed and Tauseef (2022) underestimated the attrition rate to be 8.78%. Table 1 shows the status of households interviewed in three rounds.

Table-1

Status of households surveyed in 2011/12, 2015 and 2019

Interview Status	Frequency (number of households)	Percentage of Round 1	Cumulative percentage
Completed in 2019 (round 3)	5,604	93.23	93.23
Refused	16	0.27	93.5
Not at home	24	0.4	93.89
Migrated	360	5.99	99.88
Partially completed	1	0.02	99.9
Other(specify)	6	0.1	100
Completed in 2015 (round 2)	6,436	95.85	95.85
Refused	12	0.18	96.02
Not at home	30	0.45	96.47
Migrated	237	3.53	100
Surveyed in 2011/12	6503	100	
Surveyed in 2015 (with split)	6,715		

Source: Author's calculation according to the BIHS dataset 2011-12, 2015, 2019

2.3 Variable Selection

The dependent variable is the wage income of the male labor market, where income from self-employment and transfer payments is excluded. For better comparison with the yearly return to education, the monthly income provided by BIHS is converted into annual income, which is multiplying the monthly income by 12.

In prior literature, years of schooling have been widely used to measure education. Some papers also tried to use other approaches, such as using grade point average or results to measure the return to education. However, this paper aims to use the standard approach of defining education as years of schooling completed at the time of the survey; additionally, return to different levels of education will also be analyzed (Appendix A 4). Data on direct work experience were not available; thus, following past research, the formula was taken as a proxy. Additionally, the squared value of the working experience is also included as the quadratic term. This paper tries to understand the return on different sectors of employment, such as manufacturing, agriculture, and service. As BIHS mainly focuses on rural Bangladesh, thus, data on the agricultural sector provides the opportunity to categorize the occupational sectors.

This research categorizes these into two broad sections, agriculture and non-agriculture, where the agricultural sector has been taken as the base dummy. The total number of hours worked in a week is included in the regression to evaluate the return to education based on the hours dummy. Whether the respondents are working more than 40 hours a week is taken into consideration. The agricultural sector in Bangladesh varies in different regions depending on the wage rate, types of crops, policies, subsidies provided, and the overall level of socioeconomic development. Additionally, labor unions are heterogeneous in their characteristics depending on each region. Therefore, this variation is controlled by creating dummy variables for the geographic and administrative divisions of Bangladesh: Barishal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet, where Barishal is the base category. Several authors have also included division dummies in analyzing the return to education in Bangladesh.

To have a clearer understanding of the return to education in Bangladesh, additional control variables such as marital status, location (urban or rural), and religion have been included in the analysis. Previous literature also suggests that the addition of different variables as a control provides a more precise estimation of the result. Marital status has been taken for further precision of the estimation. Unmarried, married, widowed/widower, divorced/ separated, and deserted are categorized in the BIHS data. Here, for a better understanding of the effect of marital status, these categories are converted into dummies, married and never married, with married being the reference category. Urban and rural are two dummies for the control variables, location, formulated from the survey questionnaire, which enables researchers to control for and show the impact of urban or rural areas on return to education. Religion was also included in the regression to assess the impact of

education on different religions in Bangladesh. Bangladesh is mainly a religiously homogenous country where the majority of the population is Muslim. Muslim is taken as the base dummy for the analysis. Moreover, gender is also taken as a control variable to compare between return to education of both genders and the economic return from only male education. This provides insight into the return to female and male education separately, shown in Table 6 (Appendix A5 provides a detailed list of the variable measurements).

Many studies have used different instruments to analyze the endogeneity of education. There are several generations of instruments that are used to address the endogeneity of education with economic returns. From using IQ score (Griliches, 1976), college tuition (Kane and Rouse, 1993), quarter of birth (Angrist and Kruger, 1991), proximity to college (Card, 1999), parents' education (Card, 1995) to brother's schooling and/or father's schooling (Ashenfelter and Zimmerman, 1997), many types of instruments have been in the interest of researchers to address the endogeneity issue of education.

Moniruzzaman and Emran (2021) utilized proximity (distance and distance squared from educational institutions) as their instrument in their longitudinal study in Bangladesh. Even though using parents' education as IV is a fairly old process, many researchers are still undertaking it due to its cogency in the context of Bangladesh. Kolstad et al. (2014) focused on the endogeneity of education in Bangladesh using fathers' and mothers' education as instruments. Rahman and Al-Hasan (2018) used only the father's schooling as the instrumental variable. Mamun et al. (2021) used parents' education as an instrument to find the endogeneity of education. Their number of observations in the OLS regression was 8655, reduced to 6820 while analyzing the IV method.

Drawing on insights from the existing literature, the study initially considered variables such as proximity to educational institutions and parental education as potential instruments within the BIHS dataset. Table 2 presents the number of observations corresponding to the Ordinary Least Squares (OLS) and Instrumental Variable (IV) regression analyses for each candidate instrument. It is evident from the table that the number of valid observations declines substantially when proximity is used as an instrument, leading to concerns over data sufficiency and estimation precision. Consequently, proximity was excluded as a viable instrumental variable. Consistent with prior studies (Rahman and Al-Hasan, 2018; Mamun et al., 2021), parental education—particularly father's education—was also examined as a potential instrument. However, father's education was not selected due to its likely

direct influence on children's earnings, which may violate the exclusion restriction necessary for valid instrumentation. Instead, maternal education, categorized into different levels, was retained as the primary instrument, as it demonstrated stronger statistical relevance and is less likely to exert a direct influence on the wage outcomes of the children beyond its effect through schooling.

Therefore, categorical dummy variables representing different levels of maternal education are employed, using mothers with no formal education as the reference group. These instruments are deemed most appropriate for addressing the endogeneity of education due to their strong relevance and exogeneity. Furthermore, the limited availability of alternative valid instruments within the BIHS dataset reinforces the selection of maternal education as the primary instrument.

Table-2

Comparison between candidates of the instrument

Number of observations	2011/12			2015			2019		
	OLS		IV	OLS		IV	OLS		IV
	Both	Male		Both	Male		Both	Male	
	2244	1796		2722	2119		2619	1772	
Proximity			123			535			498
Father's education			996			1341			864
Mother's level of education (dummy variables)			1796			2119			1772

Source: Author's calculation according to the BIHS dataset 2011-12, 2015, 2019

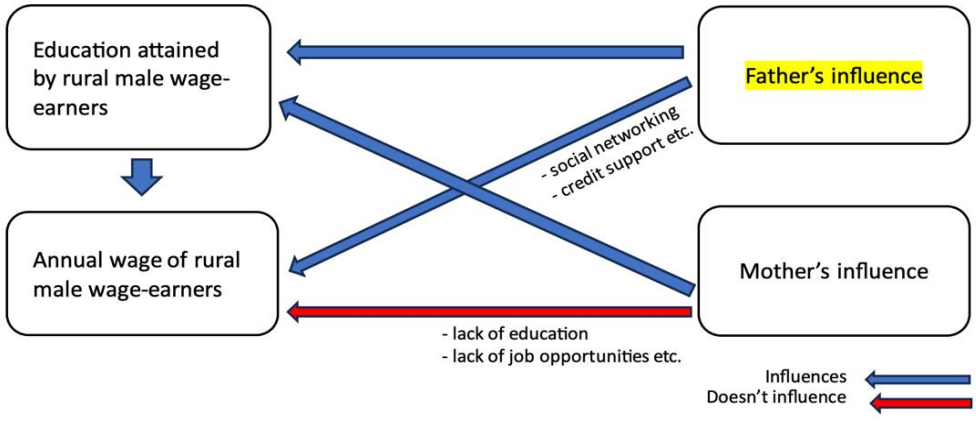
Additionally, with slight modifications from previous pieces of literature, this paper uses different levels of the mother's education as the instrumental variable in place of the individual's education level. Dummies of mothers' primary, secondary, HSC, and tertiary education and missing observations of mothers' education against observations of mothers with no education were formulated to address the endogeneity of education.

Gong (2019), utilizing the Chinese Household Income Project (CHIP) and the China Family Panel Studies (CFPS), pointed out that parents' education, especially the father's education, can impact the child's income through social networking, family

networking (guanxi) and connection. However, the mother's education is correlated to one's education, but doesn't directly impact one's income. In other words, the logic of using these as the instrumental variables is that, there is a high correlation between an individual's education level and his/her mother's education level however, it is unlikely to have a direct effect on the mother's education on the individual's income, which is mainly due to the cultural and economic situation of rural Bangladesh.

Figure-1

Comparison between father's and mother's influence on son's education and income.



The rural context of Bangladesh illustrates that mothers with limited or no formal education often prioritize and influence their sons' educational attainment, aiming to ensure that the next generation becomes educated. However, due to their predominantly unemployed status or employment limited to family businesses, these mothers have little capacity to impact their sons' employability and earnings directly. As shown in Table 7, none of the mothers in the sample has achieved HSC (Higher Secondary Certificate) or tertiary education. Figure 1 provides a graphical representation of the influence of fathers and mothers on the sons' educational attainment and thus on the earning capacity of them, where fathers can influence the income of sons by providing social networking and credit support to the son but mothers in the rural setting of Bangladesh are unable to do so due their lack of education and job which further creates networking and opportunities to influence. This lack of advanced education limits their access to influential job opportunities, further constraining their ability to affect their sons' income levels. To ensure the robustness of these findings, this study also validates the instruments used. Given the utilization of multiple instruments, over-identification tests are conducted to evaluate their reliability and consistency.

3.0 Analytical Framework

3.1 Ordinary Least Squares Regression

To conduct the research, secondary data were collected from the Bangladesh Integrated Household Survey (BIHS) by the International Food Policy Research Institute (IFPRI) in 2011-2012, 2015, and 2018-2019. This paper utilizes the cross-sectional dataset to understand the changes in the impact of education over these years. The analysis was conducted using the Mincerian wage function. Here,

$$\ln y_i = \alpha + \beta_1 syears_i + \beta_2 wyear_i + \beta_3 wyear_i^2 + \sum_{j=1}^{k} \beta_{4,j} x_{ij} + u_i \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where, $\ln y_i$ is the natural logarithm of observed annual wages; $syears_i$ is the schooling years for *i* individuals; $wyear_i$ is the work experience of *i* individuals[2] x_{ij} denotes the control variables used in the regression for *i* individuals, and u_i denotes the error term.

3.2 Instrumental Variables Regression

To address the endogeneity of the schooling variable in the education function, we commenced instrumental variable regression. Different levels of mothers' education were taken as the instruments to address the endogeneity issues. Mothers' education at primary, secondary, HSC, tertiary, and mothers with missing education were the dummy variables with the reference group of mothers with no education. A two-stage least square IV regression is set up in the following way:

First stage:

$$syears_i = \alpha + \sum_{l=1}^{m} \pi_l LME_{li} + \beta_2 wyear_i + \beta_3 wyear_i^2 + \sum_{j=1}^{n} \beta_{4,j} x_{ij} + u_{1i} \quad \ldots\ldots\ldots\ldots (2)$$

Second stage:

$$\ln y_i = \alpha + \beta_1 \widehat{syears}_i + \beta_2 wyear_i + \beta_3 wyear_i^2 + \sum_{j=1}^{n} \beta_{4,j} x_{ij} + u_{2i} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

In equation 2, LME_{li} is the Level of Mothers' Education dummy for *i* individual and *l* levels is the identifying exogenous variable for the logarithmic form of the annual income equation (Eq.3). u_{1i} and u_{2i} are normally distributed error terms. $\widehat{syears}_i$ is the predicted value of $syears_i$ where there is a correlation between LME_{li}, and $syears_i$, and there is no correlation between LME_{li} and $\ln y_i$[3].

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[2] Working years is defined as age subtracting 6 and schooling years.

[3] Mothers with no education are the reference group, creating a baseline against which other education levels are compared; thus, the mothers receiving a specific educational level category are the dummies. This coding allows each category's effect to be estimated relative to the reference group (no education). Further description has been provided in Appendix A5

4.0 Findings and Discussion

4.1 Descriptive Statistics

The data collected from IFPRI are sorted, taking only those utilizable for education. The overall sample sizes for 2011/12, 2015, and 2019 were 2244, 2722, and 2619, respectively. From these samples, 1796 for 2011/12, 2119 for 2015, and 1772 for 2019 were taken for analysis as these samples are only male and comprised of all the factors that this research is utilizing.

Table-3

Descriptive statistics of the sample of 2011/12

Variable	Obs	Mean	Std. dev.	Min	Max
Ln of annual income	1,796	10.72	0.68	7.78	13.41
Schooling years	1,796	3.5874	3.984	0	16
Experience	1,796	24.354	15.19	0	79
Experience^2	1,796	823.74	953.8	0	6241
Married	1,796	0.2784	0.448	0	1
40hrs plus	1,796	0.681	0.466	0	1
Non-agriculture	1,796	0.5095	0.5	0	1
Urban	1,796	0.1693	0.375	0	1
Chittagong	1,796	0.1269	0.333	0	1
Dhaka	1,796	0.2494	0.433	0	1
Khulna	1,796	0.1464	0.354	0	1
Rajshahi	1,796	0.1091	0.312	0	1
Rangpur	1,796	0.1063	0.308	0	1
Sylhet	1,796	0.1604	0.367	0	1
Barishal	1,796	0.1013	0.302	0	1
Muslim	1,796	0.8686	0.338	0	1
Hindu	1,796	0.1297	0.336	0	1
Christian	1,796	0.0017	0.041	0	1

Source: Author's calculation based on BIHS 2011-12[4]

[4] The observation counts for the regional variables—such as Urban, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, Sylhet, and Barishal—represent the total number of sampled respondents in each respective region for a given survey year. The mean values reported in Column 3 of Tables 3, 4, and 5 indicate the proportion of respondents from these regions who meet the inclusion criteria for the regression models. These means thus reflect the share of the regression-eligible sample drawn from each administrative division.

Table-4
Descriptive statistics of the sample of 2015

Variable	Obs	Mean	Std. dev.	Min	Max
Ln of annual income	2,119	11.022	0.675	6.61	13.56
Schooling years	2,119	3.7688	3.922	0	16
Experience	2,119	25.847	15.38	0	79
Experience^2	2,119	904.39	972.5	0	6241
Married	2,119	0.2445	0.43	0	1
40hrs plus	2,119	0.6579	0.475	0	1
Non-agriculture	2,119	0.5555	0.497	0	1
Urban	2,119	0.1383	0.345	0	1
Chittagong	2,119	0.1307	0.337	0	1
Dhaka	2,119	0.2662	0.442	0	1
Khulna	2,119	0.1656	0.372	0	1
Rajshahi	2,119	0.092	0.289	0	1
Rangpur	2,119	0.093	0.29	0	1
Sylhet	2,119	0.1548	0.362	0	1
Barishal	2,119	0.0977	0.297	0	1
Muslim	2,119	0.8636	0.343	0	1
Hindu	2,119	0.1331	0.34	0	1
Christian	2,119	0.0033	0.057	0	1

Source: Author's calculation based on BIHS 2015

Table-5

Descriptive statistics of the sample of 2019

Variable	Obs	Mean	Std. dev.	Min	Max
Ln of annual income	1,772	11.39	0.706	8.189	13.8
Schooling years	1,772	4.314	4.242	0	16
Experience	1,772	25.13	15.47	0	81
Experience^2	1,772	870.4	954.8	0	6561
Married	1,772	0.223	0.416	0	1
40hrs plus	1,772	0.688	0.463	0	1
Non-agriculture	1,772	0.641	0.48	0	1
Urban	1,772	0.164	0.371	0	1
Chittagong	1,772	0.151	0.358	0	1
Dhaka	1,772	0.269	0.444	0	1
Khulna	1,772	0.097	0.296	0	1
Rajshahi	1,772	0.105	0.307	0	1
Rangpur	1,772	0.113	0.317	0	1
Sylhet	1,772	0.194	0.395	0	1
Barishal	1,772	0.071	0.257	0	1
Muslim	1,772	0.863	0.344	0	1
Hindu	1,772	0.133	0.339	0	1
Christian	1,772	0.005	0.067	0	1

Source: Author's calculation based on BIHS 2019

The average years of schooling are steadily on the rise. During the first round, 2011/12 the average years of availed education was 3.578 years (Table 3), which increased to 3.769 years during the second round (2015) (Table 4), which is roughly similar to research conducted by Asadullah (2006), on 11740 individuals using Household Income and Expenditure Survey (HIES) by Bangladesh Bureau of Statistics (BBS), 1999/2000. He found 3.522 years of average years of education, where both wage and self-employment earnings were utilized for the research. However, in another research by Kolstad et al. (2014), the average years of education were found to be 5.88 years, as they had focused on non-agricultural self-employment and focused both on urban and rural data from a survey conducted by the Center for Policy Dialogue (CPD) in Dhaka and Chr. Michelsen Institute in Bergen, Norway, where their sampling was based on HIES (2015), from which they

took 427 entrepreneurs as their targeted sample size. Thus, naturally, when focusing on self-employment in both urban and rural areas, the average years of education increase.

During the third round of the survey, the average education attained increased to 4.314 years (Table 5). Mamun et al. (2021) found the average schooling years to be 3.974, which is slightly lower than our findings, as they focused on the private return to education using BIHS, 2019 data. It is also important to note that a significant portion (37.95% in 2011/12, 34.47% in 2015, and 31.21% in 2019, Appendix A 1) of the male respondents didn't receive any formal education; however, the percentage receiving no education is on a steady decline throughout these years. The percentage of the respondents who availed of primary, secondary, and higher secondary (HSC) education was almost similar throughout the years. However, the percentage of students who have had their tertiary education has risen over the past years. Since 2011, the number of men who went for tertiary education doubled, from 2.73% of the respondents to 4.41% (Appendix A 2).

There has been a growth in the average monthly income (nominal) of the working-age men in our paper. During the years 2011-12, the average monthly income was BDT 3787.31 or USD 53.78 according to the dollar-to-taka exchange rate of January 1st, 2011(exchangerates.org.uk, 2011). Then in 2015, the average monthly income increased to BDT 5185.61 or USD 66.38, according to the exchangerates.org.uk (2015), with the dollar-to-taka exchange rate of $1 for BDT 0.0128 at the beginning of the year 2015. The average monthly income during the year 2018-19 was Bangladeshi Taka 7891.75, which is equivalent to USD 94.7 according to the exchange rate of January 01, 2019 (exchangerates.org.uk, 2019). The nominal income indicates that the wages of men from 2011/12 have doubled by 2019. However, adjusting for real income, the increase in wages is around BDT 1000. During the year 2011/12, the real income of the male wage earners in Bangladesh was BDT 3399.74; it increased to BDT 3586.18 in 2015 and BDT 4391.62 in 2019 (The World Bank, 2023).

The average years of experience had been relatively consistent throughout these years, at around 24-27 years. According to IFPRI, the Bangladesh Integrated Household Survey (BIHS) 2011/12, 2015, and 2019 are highly rural representative, thus more than 88% of the sample is working in rural areas.

As the sample is predominantly male in the workforce of rural areas of Bangladesh, this research mainly uses male data to analyze the return to education. Also, as females are encouraged and assumed to take in the responsibility of working at home

to take care of the family, including them would not give a clearer picture of rural Bangladesh. Even if they participate in their family's agricultural work, their financial contribution is unrecognized.

4.2 Ordinary Least Squares Regression

The OLS estimation of the return to education is presented in Table 6 for all three rounds, 2011/12, 2015, and 2019, exploiting both return to education for both males and females (columns 1, 3, and 5) and return to education for only males (columns 2, 4, and 6). Table 6 concentrates on the overall return to education for an additional year of schooling. In Appendix A.4, the return to education for different levels for both genders and specified only for males is shown.

Table-6

The OLS estimates of the wage equation.

variables	2011/12		2015		2019	
	(1)	(2)	(3)	(4)	(5)	(6)
	Ln of annual income (Both)	Ln of annual income (Male)	Ln of annual income (Both)	Ln of annual income (Male)	Ln of annual income (Both)	Ln of annual income (Male)
Schooling years	0.0281***	0.0375***	0.0194***	0.0236***	0.0318***	0.0423***
	(0.0058)	(0.0048)	(0.005)	(0.0047)	(0.006)	(0.00448)
Experience	0.0287***	0.037***	0.0148***	0.0280***	0.0201***	0.0396***
	(0.0067)	(0.0052)	(0.006)	(0.0042)	(0.0062)	(0.0044)
Experience^2	-0.0004***	-0.0005***	-0.00020**	-0.0004***	-0.0002**	-0.0005***
	(0.00008)	(0.00007)	(0.000078)	(0.000059)	(0.0000873)	(0.000065)
Female	-1.785***		-1.775***		-2.125***	
	(0.050)		(0.0438)		(0.048)	
Married	-0.109*	-0.095*	-0.195***	-0.209***	-0.245***	-0.077
	(0.065)	(0.049)	(0.064)	(0.043)	(0.075)	(0.049)
40hrs plus	0.551***	0.246***	0.688***	0.400***	0.802***	0.380***
	(0.045)	(0.039)	(0.037)	(0.031)	(0.045)	(0.037)
Non-agri	0.470***	0.152***	0.485***	0.104***	0.742***	0.107***
	(0.043)	(0.038)	(0.039)	(0.033)	(0.048)	(0.042)

Urban	-0.058	0.0014	0.0476	0.0938**	0.060	0.140***
	(0.057)	(0.046)	(0.056)	(0.044)	(0.064)	(0.046)
Chittagong	0.105	0.186***	-0.005	-0.006	-0.065	-0.015
	(0.09)	(0.063)	(0.074)	(0.058)	(0.097)	(0.092)
Dhaka	-0.012	0.070	0.038	-0.030	-0.143	0.081
	(0.073)	(0.059)	(0.064)	(0.055)	(0.087)	(0.078)
Khulna	-0.036	-0.061	0.020	-0.075	-0.156	0.012
	(0.074)	(0.076)	(0.069)	(0.058)	(0.099)	(0.095)
Rajshahi	-0.355***	-0.016	-0.107	-0.078	-0.187*	0.096
	(0.081)	(0.085)	(0.079)	(0.065)	(0.098)	(0.092)
Rangpur	-0.128	0.089	-0.058	-0.095	0.060	-0.0099
	(0.084)	(0.058)	(0.079)	(0.074)	(0.097)	(0.093)
Sylhet	-0.016	-0.014	0.069	0.011	-0.015	0.056
	(0.078)	(0.074)	(0.072)	(0.077)	(0.092)	(0.099)
Hindu	-0.076	-0.108**	0.005	-0.146***	0.221***	-0.055
	(0.055)	(0.060)	(0.050)	(0.064)	(0.056)	(0.071)
Christian	-1.148***	-0.776**	-0.401	-0.185	-0.238	-0.009
	(0.435)	(0.39)	(0.284)	(0.151)	(0.305)	(0.314)
Constant	9.717***	9.864***	10.05***	10.38***	9.998***	10.31***
	(0.121)	(0.104)	(0.121)	(0.090)	(0.143)	(0.113)
Obs.	2,244	1,796	2,722	2,119	2,619	1,772
R-squared	0.537	0.166	0.538	0.200	0.657	0.208

Note: Robust standard error clustered at the village level appears in parentheses. (*** p<0.01, ** p<0.05, * p<0.1)

The single measurement system of measuring the return to education is initially undertaken to understand the overall financial impact of education. During round 1 (shown in column 1), the return to an additional year of education for both genders was 2.81% meaning that for every one year of extra education, the return to wage would increase by 2.81% in the year 2011/12. The return to male education was 3.75% providing a higher return to male education for an additional year of schooling. As this research mainly utilizes rural-level data, the rate of return varies with previous literature by Asadullah (2006), who exploits data from both rural and

urban cohorts through HIES samples and found return to education to be 7%, another paper by Hussain (2000) used the data of 1995-1996 with the absence of individual-level wage data, pointed the return to education in Bangladesh was 10%. He also noted that the male return to education was 6.2% for an additional year of schooling.

During the year 2015, the return to education for an additional year of schooling was 1.94% (column 3), and for males, it was 2.36% (column 4). Even though 95.85% (Table 1) of the households responded in this round, the return decreased. Rahman and Al-Hasan (2018) used Quarterly Labor Force Survey (2015-2016) data from the Bangladesh Bureau of Statistics, and found the average rate of return of schooling for males in rural Bangladesh is 2.7%. This result is consistent with our findings for Round 2. Mohammad and Inaba (2020) used HIES 2016 data to explore the return to education at different levels and found that the overall rate of return for each additional year of education was 5.4% however, the return to male education was 4.9%. As HIES is representative of the whole nation, this includes the urban areas, which causes the discrepancy between their findings and our findings.

For the third round, 2019, the return to education for both genders was 3.18% and the return for male education was 4.23%. Mamun et al. (2021) exploited the BIHS 2019 dataset to look into the private return to education in Bangladesh, for this purpose, they took individuals with both wages and earnings from self-employment as the target population, due to this reason their private return to education became 13.2% which shows the highest return among any previous pieces of literature, however, the return to male education was similar to other studies.

Moniruzzaman and Emran (2021) undertook BIHS data for 2011/12 and 2015 to find the return to education in rural Bangladesh to be 4.00% in the year 2011/12 and 2.00% in 2015. They noted that since BIHS only covers rural areas, the magnitude of these analyses can be underestimated. Additionally, educated households in rural areas are not concentrated and are usually dispersed in different locations. Moreover, they noted that once families receive a certain amount of education, they tend to migrate from that location as there is a lack of formal employment opportunities in rural areas. Our paper also reflects the same understanding of the education and economic situation of rural areas of Bangladesh.

From Table 6, it can be said that the return of experience for every additional year of work is positive and significant throughout the years for both genders and males. When analyzing the returns based on different types of sectors, the agricultural

sector was taken as the reference category against the non-agricultural sectors dummy. This paper finds that the return from the non-agricultural sector was 15.20% in 2011/12, 10.40% in 2015 and 10.70% in 2019 for male samples. This is due to the government-led initiative and investments in IT sectors in rural areas which enable the rural population to find alternative, non-agricultural employment opportunities (Hoque and Sorwar, 2015).

This sheer scale of difference is mainly because Bangladeshi rural society is highly male-dominated with little to no working opportunities for women to work outside their homes. Bangladesh, having a patriarchal society, has strict role identification, especially in rural areas, where socio-cultural norms and values also play vital roles in disabling women from entering the workforce (Akter, 2018). Women are mainly responsible for taking care of their household chores, taking care of the family, and rearing children. Even though many women work in agricultural sectors, this is only limited to working in family-owned agricultural businesses or lands. Additionally, their financial contribution is unrecognized and not adequately paid, if they are paid. Table 6 also shows that the difference between male and female wages has increased in 2019.

It is noteworthy that the return to education for Hindu and Christian individuals became better throughout the years. During the year 2011/12, a Christian male earned 77.6% less than a Muslim man, but the situation was massively improved by 2019, when a Christian individual man earned only 0.90% less. Additionally, the economic situation became somewhat better for a Hindu male. In the first round, a Hindu male earned 10.8% less than a Muslim man, but by round three, he could earn 5.5% more than a Muslim man. However, when we focus on both genders, the return to education for Hindu individuals was 7.6% less than a Muslim individual but by round 3, the Hindu individual was earning 22.1% more than a Muslim. An OLS regression was run taking only females as the sample size, pointing out that Hindu women earned 56% in 2015 and 48% higher in 2019 than Muslim women (18.71% of the female respondents in 2015 and 19.14% of the female respondents in 2019 were Hindu). This might indicate the cultural constraints that a Muslim woman finds in the workforce in rural areas of Bangladesh (Appendix A.3).

To understand the return to education at different levels, Appendix A.4 provides another Mincerian wage equation and the OLS regression result where no education has been taken as the reference category for primary (5 years), secondary (5 years), higher secondary (HSC) (2years) and tertiary (3 years or more). Compared to no education, the return to male education at the primary and secondary levels is lower.

During 2011/12 and 2015, the rate of return was around 0.88% and 3.94% consecutively in the primary level, but the return decreased in 2019, where a male with only primary education would earn 3.22% less than an individual with no education. This phenomenon is highly relevant in the dataset we used for this research where we focus only on rural wage workers. Agricultural and non-agricultural workers (especially farmers and sharecroppers) value experience more than education at this level. Alam et al. (2009) noted that the different levels of education and categories have a different focus. In Bangladesh, primary education is mainly aimed toward the development of social freedom whereas tertiary education is mainly focused on availing economic return. In their research, they also found that primary and secondary graduates do not need most of the contents of education to perform the job they receive after completing these levels. The return to secondary education for male wage earners was significantly positive but low. The returns for men were 15.3% in 2011/12 and 14.1% in 2019 but the return dropped in 2015 to 6.36%. Alam et al. (2009) noted that child labor and under-age employment are an ongoing reality in Bangladesh; the students enrolled in primary and secondary education do not receive rigorous involvement in family employment and miss out on the experience that their counterparts with no education receive.

However, the return changes drastically once they receive higher secondary education and tertiary education. Throughout the three rounds, HSC graduates earned 55% (2011/12), 23.1% (2015), and 62.4% (2019) higher compared to the base category. Also, the return to male tertiary education is 91.2% higher compared to the base level in round 1. However, this rate was reduced to 64.2% in round 2 but increased again in round 3 to 77.9%. It can be observed that the returns to male education at all levels in the second round were lower compared to other levels, which is consistent with the findings from overall schooling years in Table 6.

One of the explanations for the reduced rate of return to education compared to the reference point was some political and social turmoil that Bangladesh faced during the second round. Bangladesh had its general election during 2013-14 where the turnout rate was 39.58% with boycotts and violence in the country at that time (Barry, 2014). Other political unrests such as Shahabag protests, Shapla Square protests were significant during that time. Also, the infamous Rana Plaza collapse was in the year 2013, which led to the death of 1134 workers. All these incidents lead to decreased GDP. The GDP growth rate of 2013 was the lowest (6%) between 2011 to 2019 (The World Bank, 2023). Additionally, the unemployment rate also increased in 2013, becoming 4.43% from 4.10% in 2012 (Macrotrends, 2023). According to BBS, Labor Force Survey (2011), the unemployment rate of higher

educated persons (HSC and above) was 23.65% for rural males in Bangladesh. However, the rate of unemployed educated rural males (HSC and above) rose to 38.84% during the year 2015/2016 (BBS, Quarterly Labor Force Survey, 2017). This higher rate of unemployment among educated youth can be a reason for a reduced level of return to education during the second round.

4.3 Instrumental Variable Regression

Many unobserved factors, such as individual abilities, that influence education are embedded in the error term of a linear regression. This situation renders education an endogenous variable, introducing potential biases in the estimation of its effects. The Sargan tests are done to check the exogeneity of the instruments, with the null hypothesis that the instruments are uncorrelated with the error term. To check the endogeneity of education of males, the Wu-Hausman test and the Durbin-Wu-Hausman test are conducted on the level of educational attainment of individuals in the wage function. For this research, multiple instrumental variables of the mother's education were utilized. Dummy variables for the mother's education were formulated based on different levels of education: primary, secondary, HSC, tertiary, and missing values for mothers' education, with the reference category of mothers with no education. However, only primary, secondary, and missing values of the mother's education were used as instruments, as HSC and tertiary levels were dropped (Table 7), as no mothers of the respondents received HSC and tertiary education. The results for the validity of this instrumental variable are shown here, along with testing for over identification.

To check the validity or the endogeneity of the instruments Wu-Hausman and Durbin test was conducted, where the null hypothesis, H_o*:* Regressor (schooling years) is exogenous. As multiple categories of mothers' education were undertaken as instruments, overidentification tests were also conducted such as Sargan and Basmann tests, to check if these instruments were overidentified, with the null hypothesis to be the instruments being exogenous. Cragg-Donald Wald F statistic is also conducted to check for weak identification tests where the 5% critical value is 13.91, thus proving that the instruments used here are strong predictors of the endogenous problem.

Table-7

Instrumental Variable estimates (first stage of two-stage least squares)

Variables	(2011/12) Schooling years	(2015) Schooling years	(2019) Schooling years
Mother's edu.: primary	2.61***	2.363***	2.046***
	(0.416)	(0.317)	(0.495)
Mother's edu.: secondary	3.742 ***	2.452***	3.109***
	(0.909)	(0.755)	(1.031)
Mother's edu : HSC	-	-	-
Mother's edu: tertiary	-	-	-
Mother's edu: missing	0.0779	-0.245	-0.655***
	(0.179)	(0.209)	(0.233)
Experience	-0.373***	-0.374***	-0.373***
	(0.025)	(0.022)	(0.024)
Experience^2	0.004***	0.0037***	0.003***
	(0.0003)	(0.0003)	(0.0003)
Married	-2.812***	-2.990***	-2.917***
	(0.294)	(0.223)	(0.272)
40hrs plus	0.049	0.157	0.327**
	(0.179)	(0.150)	(0.186)
Non-agri	1.41***	1.119***	1.576***
	(0.192)	(0.155)	(0.183)
Urban	0.863***	1.035***	0.863***
	(0.270)	(0.247)	(0.252)
Chittagong	0.393	-0.089	0.001
	(0.360)	(0.298)	(0.522)
Dhaka	-0.245	-0.225	-0.311
	(0.325)	(0.317)	(0.488)
Khulna	0.976***	0.334	0.158
	(0.388)	(0.356)	(0.548)

Rajshahi	-0.0835	-0.569*	-0.235
	(0.376)	(0.380)	(0.619)
Rangpur	-0.347	-0.695*	-0.495
	(0.395)	(0.383)	(0.536)
Sylhet	-0.643**	-1.144***	-0.877**
	(0.357)	(0.329)	(0.506)
Hindu	1.397***	1.40***	1.247***
	(0.285)	(0.268)	(0.379)
Christian	2.886	-0.837	-0.174
	(0.818)	(0.70)	(0.589)
Constant	8.963***	9.936***	10.417***
	(0.532)	(0.50)	(0.646)
Weak identification test: Cragg-Donald Wald F statistic	30.03	34.20	23.14
Weak identification test: Kleibergen-Paap rk LM statistic	30.027	25.49	14.703
Endogeneity test: Wu-Hausman (F-statistics)	2.253 F (1,1779)	3.629 F (1,2102)	0.9823 F (1,1755)
Endogeneity test: Wu-Hausman (p-value)	0.1335	0.0569	0.322
Endogeneity test: Durbin $\chi^2(1)$ $chi^2(1)$	2.27197	3.652	0.9913
Endogeneity test: Durbin $\chi^2(1)$ (*p-value)*	0.1317	0.056	0.319
Observations	1796	2119	1772

Note: Robust standard error clustered at the village level appears in parentheses. (*** p<0.01, ** p<0.05, * p<0.1)

Table-8
Instrumental Variable estimates (Two-stage Least Squares)

Variables	(2011/12) ln of annual wage	(2015) ln of annual wage	(2019) ln of annual wage
Schooling years	0.0644***	0.0473**	0.0645***
	(0.019)	(0.018)	(0.022)
Experience	0.0471***	0.0364***	0.047***
	(0.0087)	(0.0072)	(0.0086)
Experience^2	-0.00062***	-0.0005***	-0.0006***
	(0.0001)	(0.00008)	(0.00009)
Married	-0.0147	-0.134*	-0.011
	(0.074)	(0.072)	(0.082)
40hrs plus	0.244***	0.397***	0.373***
	(0.039)	(0.032)	(0.037)
Non-agri	0.179***	0.001	-0.009
	(0.045)	(0.038)	(0.054)
Urban	0.083	-0.018	0.094
	(0.063)	(0.046)	(0.047)
Chittagong	-0.082	-0.077	0.013
	(0.063)	(0.059)	(0.090)
Dhaka	-0.0077	-0.056	0.108
	(0.059)	(0.064)	(0.077)
Khulna	0.106	-0.071	0.0075
	(0.060)	(0.057)	(0.097)
Rajshahi	0.009	0.046	0.082
	(0.063)	(0.069)	(0.095)
Rangpur	-0.021	0.068	0.120**
	(0.047)	(0.076)	(0.093)
Sylhet	-0.147***	-0.179***	-0.084
	(0.054)	(0.058)	(0.101)
Hindu	-0.876**	-0.181	-0.012
	(0.372)	(0.063)	(0.071)
Christian	0.112**	0.076**	0.0714
	(0.046)	(0.149)	(0.303)
Constant	9.613***	10.14***	10.09***
	(0.215)	(0.201)	(0.253)
Over identification test: Sargan test (*p-value)*	0.113	0.082	0.720
Over identification test: Sargan test (*Chi^2 value)*	4.368	5.009	0.658
Over identification test: Hansen J statistics	5.219	4.567	0.754
Over identification test: Hansen J statistics (Chi2 p-value)	0.0736	0.1019	0.6858
Observations	1,796	2,119	1,772
R-squared	0.149	0.187	0.197

Note: Robust standard error clustered at the village level appears in parentheses. (*** p<0.01, ** p<0.05, * p<0.1)

To take into account the endogeneity and selection bias, different levels of mothers' education are taken as the instrumental variable along with other covariates. The estimates of these IVs are reported based on three rounds; the first stage is shown in Table 7 and the two-stage least squares are shown in Table 8. In the year 2011/12, the return to education for every additional year of education was 6.44%. In 2015, the return became lower to 4.73%. However, in round three, during 2019, the return increased to 6.45%. Mamun et al (2021) found the return to education in the IV method using BIHS data 2015 was 18% which was very high compared to other papers, primarily because they used data representing the whole nation, both urban and rural. Also, they used wages and non-wage earnings for their research, which results in higher returns.

Table-9

Comparison between OLS and IV regression (coefficients of return to male education for an additional year of schooling)

variable	2011/12	2015	2019
OLS regression	0.0375***	0.0236***	0.0423***
IV regression	0.0644***	0.0473**	0.0645***

Note: Robust standard error clustered at the village level appears in parentheses. (*** p<0.01, ** p<0.05, * p<0.1)

From Table 9, we can see, the OLS regression is underestimated, meaning the unobservable factors of the return have a negative relation with education. It can be interpreted as the ability and/or motivation bias that affects the return to education. Griliches (1977) researched ability bias to find out the return to education. He focused on "ability bias" to directly estimate the earnings. He found that if individuals are more able to convert and utilize their education to real-life scenarios and job opportunities, then their income is higher than those who can't convert the knowledge. Thus, we can say that the OLS returns are underestimated as men are less able to properly utilize their education in real-life job requirements. Also, Griliches (1977) pointed out "energy" or "motivation", the unobservable latent variable that drives people to get more schooling and earn more, enables them to have better results. In our research, unobservable factors of the return have a negative relation with education which might be due to the negative motivation bias of individuals. Our research seems to suggest that ability and/or motivation negatively impact the return to education.

5.0 Conclusion

Although the returns to education have been extensively studied by development economists globally, the topic remains a subject of ongoing debate in economic literature due to varying contexts and methodologies. While considerable attention has been given to understanding the returns to education internationally, it is crucial to examine this issue in the context of developing economies like Bangladesh, where labor market dynamics and educational quality differ significantly from those in developed countries. This paper aims to estimate the economic returns to an additional year of schooling for male wage earners in rural Bangladesh, using data from three rounds of nationally representative household surveys covering the period from 2011 to 2019. By analyzing these datasets, the study captures a more comprehensive picture of educational returns over an 8-year span.

The estimated annual returns to education for male respondents using Ordinary Least Squares (OLS) regression were 3.75% in 2011-12, 2.39% in 2015, and 4.32% in 2019. To ensure robustness, the analysis controlled for a range of individual and labor market characteristics, including work experience, marital status, geographic location, hours worked, administrative divisions, sector of employment, and religious affiliation. The findings indicate that returns to education in the non-agricultural sector are significantly higher compared to the agricultural sector across all years. This trend reflects the ongoing investments in infrastructure and information technology in rural areas over the past decade, which have enhanced productivity and wage prospects in non-agricultural employment. In contrast, investments in the agricultural sector have lagged, limiting its capacity to generate comparable returns.

This paper addresses the issue of endogeneity by using dummy variables representing different levels of mothers' education as instruments, a strategy that has not been previously explored in the literature on rural Bangladesh. Comprehensive validity and over identification tests were conducted to ensure the suitability of these instrumental variables. The estimated rates of return to an additional year of schooling for male respondents, derived from Two-Stage Least Squares (2SLS) regression, were 6.44%, 4.73%, and 6.45% for the years 2011-12, 2015, and 2019, respectively. These results indicate that the returns to education for men in rural areas of Bangladesh are underestimated by Ordinary Least Squares (OLS) methods, largely due to a negative "ability" or "motivation" bias.

The negative bias is driven by the poor quality of education and the limited practical application of skills acquired in rural schools, which prevents men from leveraging

their education in the labor market. Furthermore, unobserved factors, such as a lack of motivation to pursue higher education due to limited economic opportunities, exacerbate this bias. As a result, individuals may opt for lower educational attainment and seek alternative income-generating activities. Moreover, the datasets used in this study focus exclusively on the rural segment, where educational attainment is generally low, labor force participation is limited, and employment opportunities are scarce. Consequently, these conditions may further distort the true returns to education, as individuals often migrate to urban areas once they reach a certain level of education, leaving rural areas underdeveloped.

The findings underscore the critical need for regionally differentiated education and employment policies aimed at improving the quality and labor-market relevance of rural education—particularly within low-return sectors such as agriculture. Enhancing vocational education, fostering non-agricultural employment opportunities, and addressing socio-demographic disparities are essential to maximizing the impact of educational investments in rural Bangladesh. These results call for targeted interventions that not only improve educational access and outcomes but also facilitate sector-specific economic diversification to bridge the return gap between agricultural and non-agricultural employment. Furthermore, there is a pressing need to strengthen the quality of education through curricula that emphasize practical skills and real-world applications, thereby enabling individuals to translate educational attainment into meaningful labor market outcomes.

While this study provides important insights, its scope is limited to rural male wage earners. Future research should broaden the analytical lens to include all labor segments, regardless of gender, location, or employment type, to ensure a more inclusive understanding of the return to education. Additionally, further exploration of endogeneity concerns through alternative instrumental variable strategies, along with the use of panel data, would yield more nuanced and causally robust findings. Special attention could also be given to informal and self-employment sectors, as well as to the gender wage gap, to comprehensively assess the heterogeneous nature of educational returns in rural Bangladesh.

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https://dataverse.harvard.edu/dataset.xhtml?persistentId=hdl:1902.1/21266

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Appendix

A 1: Education (highest class passed) of the male members

	2011/12			2015			2019		
Education	Freq.	Percent	Cum.	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Reads in class 1	17	0.77	0.77	16	0.63	0.63	7	0.34	0.34
Completed class 1	29	1.32	2.09	48	1.9	2.54	27	1.29	1.63
Completed class 2	94	4.27	6.36	114	4.52	7.05	95	4.55	6.18
Completed class 3	82	3.73	10.1	132	5.23	12.28	92	4.41	10.6
Completed class 4	168	7.64	17.7	211	8.36	20.64	160	7.67	18.3
Completed class 5	341	15.5	33.2	371	14.7	35.34	327	15.68	33.9
Completed class 6	92	4.18	37.4	108	4.28	39.62	106	5.08	39
Completed class 7	95	4.32	41.7	128	5.07	44.69	112	5.37	44.4
Completed class 8	121	5.5	47.2	146	5.78	50.48	112	5.37	49.8
Completed class 9	138	6.27	53.5	158	6.26	56.74	129	6.18	55.9
Completed ssc/dakhil	84	3.82	57.3	108	4.28	61.01	118	5.66	61.6
Completed hsc/alim	42	1.91	59.2	41	1.62	62.64	54	2.59	64.2
Ba/bsc pass/fazil	27	1.23	60.5	30	1.19	63.83	32	1.53	65.7
Ba/bsc honors/fazil	6	0.27	60.7	9	0.36	64.18	8	0.38	66.1
Ma/msc and above/kamil	24	1.09	61.8	29	1.15	65.33	46	2.21	68.3
Preschool class (general)	1	0.05	61.9	3	0.12	65.45	3	0.14	68.5
Preschool (mosque based)	1	0.05	61.9				1	0.05	68.5
Diploma engineer	3	0.14	62.1	2	0.08	65.53	6	0.29	68.8
Never attended school	835	37.95	100	870	34.47	100	651	31.21	100
Total	2,200	100		2,524	100		2,086	100	

Source: author's calculation based on BIHS 2011-12, 2015, and 2019

A 2: Descriptive statistics of levels of education for male

Levels of education	2011/12			2015			2019		
	Freq.	Per.	Cum.	Freq.	Per.	Cum.	Freq.	Per.	Cum.
No education	835	38	38	870	34.47	34.47	651	31.21	31.2
Primary	733	33.3	71.3	895	35.46	69.93	712	34.13	65.3
Secondary	530	24.1	95.4	648	25.67	95.6	577	27.66	93
Hsc	42	1.91	97.3	41	1.62	97.23	54	2.59	95.6
Tertiary	60	2.73	100	70	2.77	100	92	4.41	100
Total	2,200	100		2524	100		2086	100	

Source: author's calculation based on BIHS 2011-12, 2015, and 2019

A 3: OLS regression based on female samples

	2011/12		2015		2019	
Variables	ln of annual income (level)	ln of annual income (overall)	ln of annual income (level)	ln of annual income (overall)	ln of annual income (level)	ln of annual income (overall)
Primary	-0.11		-0.013		-0.24**	
	(0.155)		(0.139)		(0.112)	
Secondary	0.00027		-0.201		-0.158	
	(0.198)		(0.178)		(0.146)	
HSC	0.487		0.909***		0.603**	
	(0.499)		(0.345)		(0.283)	
Tertiary	1.185***		1.273***		1.169***	
	(0.355)		(0.297)		(0.264)	
Schooling year		0.0460**		0.0313*		0.039***
		(0.0197)		(0.0174)		(0.0151)
Experience	0.0145	0.0248	0.0002	-0.008	0.0261*	0.0238
	(0.0198)	(0.0199)	(0.0181)	(0.0188)	(0.0151)	(0.0156)
Experience^2	-0.00021	-0.00029	0.0001	0.00027	-0.00038*	-0.0003
	(0.00029)	(0.00029)	(0.00025)	(0.0003)	(0.00021)	(0.0002)
Married	0.296	0.309	0.705**	0.670**	-0.236	-0.130
	(0.267)	(0.267)	(0.298)	(0.307)	(0.307)	(0.312)
40hrs plus	1.22***	1.27***	1.10***	1.18***	1.34***	1.41***
	(0.138)	(0.137)	(0.120)	(0.122)	(0.106)	(0.107)
Non-agri	1.454***	1.529***	1.569***	1.67***	1.801***	1.92***

sector						
	(0.128)	(0.127)	(0.121)	(0.121)	(0.108)	(0.108)
Urban	0.432*	0.440*	0.194	0.146	0.350	0.423*
	(0.247)	(0.247)	(0.216)	(0.219)	(0.235)	(0.238)
Chittagong	-0.264	-0.172	-0.0152	-0.009	-0.0491	-0.125
	(0.289)	(0.289)	(0.215)	(0.219)	(0.240)	(0.244)
Dhaka	-0.481*	-0.428*	0.160	0.186	-0.394*	-0.44**
	(0.248)	(0.248)	(0.182)	(0.186)	(0.202)	(0.205)
Khulna	-0.251	-0.125	0.225	0.288	-0.394*	-0.414*
	(0.261)	(0.260)	(0.189)	(0.193)	(0.220)	(0.223)
Rajshahi	-0.749***	-0.677***	0.0850	0.145	-0.480**	-0.51**
	(0.253)	(0.254)	(0.219)	(0.224)	(0.221)	(0.224)
Rangpur	-0.423	-0.363	0.161	0.155	0.0856	0.0577
	(0.259)	(0.261)	(0.218)	(0.223)	(0.214)	(0.218)
Sylhet	-0.174	-0.113	-0.229	-0.264	-0.447**	-0.55**
	(0.270)	(0.270)	(0.220)	(0.224)	(0.217)	(0.220)
Hindu	0.113	0.118	0.562***	0.56***	0.470***	0.48***
	(0.137)	(0.137)	(0.131)	(0.133)	(0.109)	(0.111)
Christian	-0.920	-0.763	-1.376**	-1.49**	-0.635	-0.647
	(1.122)	(1.130)	(0.687)	(0.704)	(0.672)	(0.684)
Constant	7.834***	7.382***	7.547***	7.48***	7.716***	7.460***
	(0.447)	(0.437)	(0.382)	(0.387)	(0.354)	(0.363)
Obser.	448	448	603	603	847	847
R-squared	0.573	0.563	0.559	0.535	0.594	0.577

Note: Robust standard error clustered at the village level appears in parentheses. (*** p<0.01, ** p<0.05, * p<0.1)

A 4: OLS regression based on levels of education

When analyzing specific levels of education, the Mincerian wage equation is:

$$\ln y_i = \alpha + \sum_{j=1}^{k_1} \beta_{1,j}\, edulevel_{ij} + \beta_2 wyear_i + \beta_3 wyear_i{}^2 + \sum_{j=1}^{n} \beta_{4,j}\, x_{ij} + u_i \ldots\ldots (4)$$

where, $edulevel_i$ denotes the dummies for different levels of education: primary, secondary, HSC (Higher Secondary Certificate), and tertiary. The reference category is 'no education'.

Table: OLS regression based on levels of education

	(2011/12)		(2015)		(2019)	
	(1)	(2)	(3)	(2)	(5)	(6)
Variables	ln of annual income (Both)	ln of annual income (Male)	ln of annual income (Both)	ln of annual income (Male)	ln of annual income (Both)	ln of annual income (Male)
Primary	-0.108**	0.00878	-0.0861*	0.0394	-0.290***	-0.0322
	(0.0476)	(0.0383)	(0.0444)	(0.0345)	(0.0531)	(0.0420)
Secondary	-0.0376	0.153***	-0.123**	0.0636	-0.209***	0.141***
	(0.0566)	(0.0455)	(0.0537)	(0.0411)	(0.0637)	(0.0492)
HSC	0.435***	0.550***	0.412***	0.231**	0.571***	0.624***
	(0.140)	(0.111)	(0.136)	(0.113)	(0.137)	(0.111)
Tertiary	0.940***	0.912***	0.853***	0.642***	0.819***	0.779***
	(0.115)	(0.0933)	(0.105)	(0.0840)	(0.108)	(0.0805)
Experience	0.0217***	0.0328***	0.0126**	0.0259***	0.0153**	0.0362***
	(0.00599)	(0.00490)	(0.00554)	(0.00426)	(0.00604)	(0.00447)
Experience^2	-0.0003***	-0.0005***	-0.0002**	-0.0004***	-0.0002***	-0.0005***
	(8.34e-05)	(6.72e-05)	(7.65e-05)	(5.84e-05)	(8.51e-05)	(6.33e-05)
Female	-1.801***		-1.817***		-2.165***	
	(0.0490)		(0.0434)		(0.0469)	
Married	-0.106	-0.0951*	-0.175***	-0.214***	-0.212***	-0.0658
	(0.0645)	(0.0516)	(0.0626)	(0.0468)	(0.0730)	(0.0511)
40hrs plus	0.545***	0.249***	0.659***	0.393***	0.779***	0.383***
	(0.0395)	(0.0320)	(0.0368)	(0.0284)	(0.0441)	(0.0331)
Non-agri sector	0.443***	0.141***	0.456***	0.0996***	0.713***	0.117***
	(0.0412)	(0.0337)	(0.0380)	(0.0297)	(0.0467)	(0.0357)
Chittagong	0.0903	0.182***	-0.00296	8.89e-06	-0.0398	-0.00996
	(0.0788)	(0.0616)	(0.0723)	(0.0561)	(0.0940)	(0.0684)
Dhaka	-0.0216	0.0688	0.0450	-0.0192	-0.121	0.0892
	(0.0693)	(0.0546)	(0.0634)	(0.0497)	(0.0850)	(0.0633)
Khulna	-0.0524	-0.0589	0.0223	-0.0651	-0.132	0.0257
	(0.0753)	(0.0596)	(0.0676)	(0.0534)	(0.0967)	(0.0739)
Rajshahi	-0.360***	-0.0150	-0.112	-0.0753	-0.194**	0.0812
	(0.0783)	(0.0642)	(0.0775)	(0.0609)	(0.0959)	(0.0726)
Rangpur	-0.144*	0.0802	-0.0731	-0.102*	0.0460	-0.0231

	(0.0794)	(0.0646)	(0.0776)	(0.0611)	(0.0941)	(0.0718)
Sylhet	-0.0408	-0.0243	0.0583	0.00792	-5.71e-05	0.0577
	(0.0760)	(0.0598)	(0.0706)	(0.0545)	(0.0897)	(0.0661)
Urban	-0.0579	-0.00289	0.0748	0.111***	0.0509	0.139***
	(0.0561)	(0.0434)	(0.0553)	(0.0409)	(0.0626)	(0.0425)
Hindu	-0.0620	-0.0998**	0.0238	-0.135***	0.229***	-0.0473
	(0.0523)	(0.0446)	(0.0490)	(0.0398)	(0.0550)	(0.0449)
Christian	-1.132***	-0.755**	-0.318	-0.149	-0.198	0.0105
	(0.426)	(0.360)	(0.279)	(0.230)	(0.297)	(0.224)
Constant	9.968***	10.00***	10.23***	10.45***	10.39***	10.47***
	(0.127)	(0.102)	(0.122)	(0.0941)	(0.143)	(0.105)
Observations	2,244	1,796	2,722	2,119	2,619	1,772
R-squared	0.551	0.188	0.554	0.210	0.675	0.231

Note: Robust standard error clustered at the village level appears in parentheses. (*** p<0.01, ** p<0.05, * p<0.1)

A5: The list of variables used in the paper.

Variable in as denoted	Meaning	Measurement
Dependent variable		
Lny_i	Natural logarithm of observed annual wages	Continuous dependent variable that measures the percentage change.
Independent variable		
$syears_i$	Schooling years for *i* individuals	Years of schooling completed at the time of the survey
$wyear_i$	Work experience of *i* individuals	$\text{Working years} = \text{age} - 6 - \text{schooling years}$
${wyear_i}^2$	Squared value of the work experience of *i* individuals	Working years^2
Control variables		
x_{ij}		
1. married	Marital status	Married= 0 Never married =1
2. 40hrs plus	Overtime dummy	Less than 40hours a week=0 More than 40 hours a week=1
3. Non-agriculture	Occupational sector dummy	Agricultural sector = 0 Non-agricultural sector =1
4. Urban	Location dummy	Rural = 0

		Urban = 1
5. Chittagong 6. Dhaka 7. Khulna 8. Rajshahi 9. Rangpur 10. Sylhet 11. Barishal	Regional impact dummy	Barishal = 0 Other divisions = 1
12. Muslim 13. Hindu 14. Christian	Religion dummy	Muslim= 0 Other religion = 1
Instrumental Variable		
LME_{li}	Levels of Mothers' Education for i individual and l levels: Mother's edu: primary Mother's edu.: secondary Mother's edu : HSC Mother's edu: tertiary Mother's edu: missing Mother's edu: no education	Mother's edu: no education = 0 Mother with other educational level = 1

Source: Author's formulation based on Equations (1), (2), and (3).