Bridging the Gender Gap: Exploring the Nexus between Education, Public Expenditure, and Economic Growth in Bangladesh

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Declaration of AI

During the writing process, I used ChatGPT and Grammarly to refine grammar and improve the readability of some segments. However, I have thoroughly reviewed and modified the writings to my liking. I take full responsibility for the contents of this thesis.

Abstract

Achieving gender equality in education is widely recognized as essential for driving sustainable economic development, with public expenditure playing a pivotal role in fostering such equality. Understanding the interplay between these factors can inform policies to promote inclusive growth. This study aims to explore the relationship between gender equality in education, public expenditure on education and economic growth in Bangladesh from 1995 to 2022, using the ARDL model in two parts: first, it investigates the impact of gender equality, as reflected by female secondary school enrollment, on economic growth in Bangladesh in both short and long run; second, it evaluates the short and long-run dynamics of public expenditure on education in promoting gender equality in education. Results reveal that in the long run, a 1% increase in female secondary enrollment is associated with a 10.72% decrease in GDP per capita. This might be attributed to low workforce participation among educated women, societal norms, and job market mismatches. Conversely, public education expenditure significantly affects gender equality in education, with a 1% increase in expenditure leading to a 0.1048% increase in female enrollment. Short-term results indicate that changes in female enrollment do not significantly influence GDP per capita. At the same time, public education spending continues to positively impact female enrollment by 0.067% per 1% increase in spending. The findings of this study have important implications for shaping education and economic policymaking within the country. It suggests that the government should prioritize policies that enhance workforce participation among women, challenge restrictive societal norms, and better align education with labor market demands to achieve meaningful economic growth. Furthermore, the study emphasizes the need for gender-responsive budgeting, infrastructure development, and

curriculum reforms as essential measures to maximize the impact of education on sustainable economic growth and social progress.

Keywords: Gender Equality, Female Secondary School Enrollment Rate, Economic Growth, Public Expenditure, ARDL Model.

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Background

Gender inequality remains a pervasive issue affecting women worldwide, influencing their access to education, economic opportunities, health care, and political representation. Despite global efforts to promote gender equality in every sphere, significant disparities persist. According to the World Economic Forum's Global Gender Gap Report (2023), at the current pace of progress, achieving global gender parity may take approximately 131 years (World Economic Forum, 2023). This disparity is evident in labor force participation, wage gaps, and leadership roles, where women are consistently underrepresented.

Bangladesh is no exception to this scenario, as gender inequality is deeply rooted in our socio-cultural norms and practices. Women face barriers that limit their access to education, economic resources, and decision-making processes. These barriers are particularly pronounced in rural areas, where traditional gender roles and early marriage significantly impede women's educational and economic prospects (Chowdhury et al., 2020).

However, despite progress, women continue to face significant barriers to access to education, which is a crucial tool to promote gender parity. Notably, considerable advancements have been made in increasing female enrollment worldwide, with over two-thirds of countries reaching gender parity at the primary education level. However, in regions such as Africa and South Asia, girls still experience considerable disadvantages in comparison to their male counterparts (UNICEF, 2022). Furthermore, global disparities persist at the secondary and

tertiary education levels, as socio-economic factors and cultural expectations often impede girls' educational achievements beyond primary education (UNICEF, 2022). Various international frameworks, including the UN Sustainable Development Goals (SDGs), emphasize the necessity of providing equal access to quality education for all genders (United Nations, 2023), citing education as an effective mechanism for empowering women, breaking the poverty cycle, and allowing them to contribute more robustly to their communities and economies. In recent decades, Bangladesh has also witnessed significant strides toward gender equality in education, with increases in female enrollment at both the primary and secondary levels. Government initiatives and non-governmental organizations (NGOs) have contributed to promoting girls' education through scholarships, awareness campaigns, and improvements in educational infrastructure (BANBEIS, 2022). Nevertheless, challenges persist, particularly in rural and marginalized communities, where girls continue to encounter obstacles such as poverty, early marriage, and social stigma. The gender gap in higher education and labor-force participation further illustrates the urgency for targeted interventions to address these disparities (Hossain & Tisdell, 2005).

Achieving gender equality in education is crucial for developing human capital and fostering economic resilience. Education improves women's skills, knowledge, and abilities, resulting in better health outcomes, lower fertility rates, and greater involvement in the workforce (M. K. Islam, 2016). Literate girls are more likely to engage in decision-making and speak up for themselves and their communities, fostering social progress and advancing gender equality (Shashank, 2023). Additionally, when women have equal access to education, it contributes to a more diverse and skilled labor force, driving innovation and productivity (Dollar & Gatti, 1999).

Again, one of the many significant efforts to close the existing gender gap in education is increasing the public expenditure on education, which provides the resources and infrastructure necessary for inclusive and quality education. Strategic investments in education can help mitigate gender disparities by addressing the unique barriers girls face in accessing education. These include expanding school infrastructure, providing scholarships and financial aid, and implementing programs that promote safe and supportive learning environments for girls (Rupa, 2023). Public spending also helps recruit and train female teachers, creating role models for young girls and fostering an inclusive educational culture. However, effective public expenditure requires increased funding and ensuring that resources are allocated efficiently and equitably. This is why public expenditure's impact on gender equality in education shows mixed results. The benefits of public expenditure are not distributed evenly, and disparities persist in rural and remote areas where socio-cultural norms and economic constraints continue to limit girls' educational opportunities. Even when educational facilities are available, factors such as poor quality of education, lack of female teachers, and inadequate sanitation facilities hinder the retention and success of female students (UNESCO, 2021). Moreover, while public expenditure often focuses on increasing access, it very often addresses the quality of education and the need for gender-sensitive curricula, both of which are crucial for empowering female students and challenging stereotypes. In some cases, the allocation of resources doesn't align with the specific needs of female students, resulting in programs that fail to address the root causes of gender inequality (Nath, 2019).

1.2 Research Purpose

The study aims to provide an in-depth analysis of the relationship between gender equality in secondary education and Bangladesh's GDP per Capita by examining data from 1995 to 2022.

Again, despite the significant role of gender equality in education, limited research specifically focuses on the factors influencing this equality within the Bangladeshi context. This research seeks to address this gap by examining how government education spending affects female secondary school enrollment rates, with a particular emphasis on the period from 1995 to 2022.

1.3 Research Problems and Research Questions

The key research questions which will be answered are:

1) What is the current state of female secondary education in Bangladesh?

2) How does gender equality in secondary education impact the GDP per capita of Bangladesh?

3) How does public expenditure on education influence gender equality in Bangladesh?

4) What additional factors contribute to gender equality in secondary education in Bangladesh?

1.4 Significance of the Study

This research has implications for policymakers, as it offers insights that could guide policy solutions to motivate them to take action. For instance, examining the relationship between gender equality in education and economic growth could help policymakers recognize

the critical role education plays in fostering economic development and encourage them to prioritize gender equality in educational policy or address aspects of gender equality that could have been previously neglected. Furthermore, the research offers valuable information to governance bodies on how to effectively promote equality in education by examining the effects of public expenditure and other control variables, such as literacy rates and female enrollment rates, on gender equality.

1.5 Scope and Limitations of The Study

This study investigates the relationship between gender equality in education, economic growth and public expenditure on education in Bangladesh. It focuses on female secondary school enrollment rates as a proxy for gender equality and GDP per capita as an indicator of economic growth. It utilizes time series data that spans three decades.

The choice of indicators, such as GDP per capita, which, while widely used, may not fully capture the multifaceted nature of economic growth. For example, GDP overlooks the economic contributions of unpaid household labor, predominantly performed by women, potentially skewing the analysis. Similarly, using female secondary school enrollment rates as a proxy for gender equality focuses solely on access to education, excluding factors like education quality, gender-specific experiences, and disparities in academic outcomes, which are significant determinants of human capital development. Additionally, the study does not account for broader structural dynamics, such as cultural norms, labor market gender biases, and the alignment of education with job opportunities. These factors influence the translation of education into economic growth. The reliance on secondary data introduces potential measurement errors and biases, and changes in data collection methods, policies, and external

shocks over the study period may have affected the results. Furthermore, regional disparities in public education funding and their impact on gender equality are not explored in the study.

1.6 Methodology and Approach

This study uses time series data from 1995 to 2022, sourced from the World Bank and BANBEIS. It employs the ARDL model to analyze the relationship between the variables. Log transformations are applied to the variables to improve model robustness. Key dependent variables include GDP per capita and female secondary school education enrollment, while independent variables include Gross Capital Formation, Labor Force Participation Rate, Trade, Public Expenditure on Education, Adult Literacy Rate, and Remittances. The study also conducts diagnostic tests for autocorrelation, heteroskedasticity, normality, and omitted variable bias to ensure the reliability of the results.

The study is organized into several key chapters. Chapter 2 reviews the literature on gender equality in education, its impact on economic growth, and public initiatives in Bangladesh. Chapter 3 outlines the methodology, including the ARDL model and various diagnostic tests. the results and findings, focusing on gender parity and education spending, are presented in Chapter 4. Chapter 5 discusses the findings in the context of existing literature, while Chapter 6 offers policy recommendations. Chapter 7 addresses the study's limitations and suggestions for future research, and Chapter 8 concludes the thesis.

2 Literature Review

2.1 Current Status of Gender Equality in Education in Bangladesh

Over the past years, Bangladesh has seen a significant rise in its gender parity index. For example, in 1999, the Gender Parity Index (GPI) was only 0.478, indicating a significant gender gap. However, this index improved to 0.841 in 2020, reflecting concerted efforts by the government and other stakeholders to enhance female participation in higher education (World Bank, 2023a).

Among the several education levels in Bangladesh, secondary education holds crucial significance as it serves as a bridge between primary education and higher education or vocational training. It is during this period that students solidify their academic foundations, develop critical thinking skills, and prepare for future professional and personal challenges. As in GPI, Bangladesh has also made remarkable strides in promoting gender equality in secondary education. According to BANBEIS (2022), the percentage of girls enrolled in secondary education was 46.97% in 1995. However, this figure rose significantly over the years, reaching 54.69% by 2022 (BANBEIS, 2022). This increase can be attributed to various government policies and initiatives aimed at encouraging female education, such as scholarships for girls, awareness campaigns, and the establishment of more schools in rural areas where girls' education was previously neglected (Gee, 2015). The data from BANBEIS (2022) also shows a positive trend in the number of female teachers in secondary schools. In 1995, only 13.88% of secondary school teachers were women, which, by 2022, more than doubled to 30.66%. This growth is crucial as female teachers often serve as role models and mentors for female students, fostering a more inclusive educational environment.

Table 1

Percentage of Girl Students by Level

Level of Education	2017	2018	2019	2020	2021	2022
Junior Secondary (Grade 6-8)	54.98	55.14	54.91	55.41	55.12	54.98
Secondary (Grade 9-10)	51.82	51.65	51.68	53.57	53.28	53.01
Secondary (Grade 6-10)	53.96	53.95	53.79	54.74	54.41	54.23
Higher Secondary (Grade 11-12)	47.24	46.97	46.96	48.85	48.42	48.44
Tertiary (Degree Level)	42.00	41.39	43.23	43.80	45.06	45.70
Tertiary (Master's Level)	36.35	36.07	36.70	40.78	39.18	39.00

Note. Data retrieved from BANBEIS (2022)

Table 1 depicts the percentage of girl students by level in Bangladesh from 2017 to 2022. The percentage for junior secondary levels remained stable at 55%, while secondary (Grades 9-10) saw a slight increase from 51.82% to 53.01%. Higher secondary education rose modestly from 47.24% to 48.44%. Tertiary degree-level participation increased from 42.00% to 45.70%, but master's level participation fluctuated.

Thus, Bangladesh has made significant improvements in its gender equality in education over the past few years. NGOs hold one of the most important positions in bringing about small-scale changes within schools and having wider effects on communities and national policies by involving various actors in gender equality discussions (DeJaeghere & Wiger, 2013). Women in Bangladesh have also contributed to this discourse by leading, managing, and owning educational institutions that have promoted progress toward gender equity in public and private education (Sperandio, 2007). Furthermore, Bangladesh's government is contributing to the rise in gender equality in education by promoting women's participation in high-skill and entrepreneurial jobs and increasing their access to education (Hossain & Tisdell, 2005).

However, despite these changes, significant challenges remain. Begum (2015) identified a range of sociocultural factors, such as poverty, social norms, safety concerns, and cultural and

institutional barriers that contribute to gender inequality in education in rural areas in Bangladesh. Cultural biases of this patriarchal society favor boys' education, while poverty forces many girls to drop out of secondary education. Safety issues like harassment deter school attendance, while the lack of female role models and effective policies exacerbates these challenges (Begum, 2015). Alam & Hoque (2022) demonstrated that personal, societal, and cultural factors, including child marriage, addiction to the digital world, illegal relationships, and substance abuse, all contribute equally to the dropout of female students from secondary education in Bangladesh.

2.2 Gender Equality in Education and Economic Growth: Theory and Evidence

A vast amount of literature suggests that gender equality in education can considerably impact a country's economic growth. This is particularly true for developed countries as with the industrialization of an economy, the returns on educating females increase, making gender inequality a significant distortion that affects growth. However, in agrarian economies like Bangladesh, the return on educating a second adult (often a female) is lower, making gender inequality a minor economic distortion (Dollar & Gatti, 1999). In theoretical literature, it is suggested that gender disparity in education lowers a society's average level of human capital, which, in turn, impairs economic performance. For this, it artificially narrows the talent pool from which to choose students, consequently excluding highly qualified women ladies and selecting less qualified guys in their place (Dollar & Gatti, 1999; Klasen & Lamanna, 2009). Another channel through which gender equality in education impacts economic growth is demographic trends. It affects demographic trends such as fertility rates and population growth,

impacting economic growth. Higher female education levels are associated with lower fertility rates, thus contributing to a lower dependency burden and a demographic gift, facilitating higher savings and investment (Klasen & Lamanna, 2008).

Kolovich, Malta, Newiak & Robinson (2020) employed a micro-founded general equilibrium model to measure the economic benefits of reducing the gender education gap in the Nigerian economy. This study analyzed gender-specific policies and their influence on macroeconomic outcomes and found that equalizing education increases female labor force participation and wages, reducing income inequality and boosting GDP (Kolovich et al., 2020).

Another important theory in the literature is that gender parity in education drives economic growth by boosting human capital formation. Mishra, Mishra & Sarangi (2020) concluded that the relationship between gender parity and GDP is supported by the fact that gender equality in education contributes to the formation of human capital, resulting in higher labor productivity, increased employment opportunities, poverty reduction, and overall socio-economic development. According to Zeng (2023), promoting gender equality in education enhances women's status and improves the human capital of the entire population, which, in turn, fosters family development and elevates economic development.

Several methodologies, such as panel data analysis, distributed lag analysis, cointegration methods, partial least squares modeling, causality tests, etc., were used to explore the relationship between gender equality in education and economic growth. Altuzarra, Gálvez-Gálvez & González-Flores (2021), and Klasen & Lamanna, (2008) utilized panel data analysis to explore how gender inequality in education affects economic growth in developing countries. Zahra, Yasin, Sultana, Haider & Khatoon (2021) employed a micro-founded general equilibrium model to measure the economic benefits of reducing the gender education gap. This model,

tailored to the Nigerian economy, analyzed gender-specific policies and their influence on macroeconomic outcomes. In contrast, Esen & Seren (2021) utilized cointegration techniques to assess how gender equality in education and employment affects economic performance, particularly in real GDP per capita.

In sum, while gender equality in education is universally beneficial for economic growth, its impact varies by a country's economic structure. In Bangladesh's agrarian economy, the returns on female education may appear lower. However, fostering gender equality in education can still significantly enhance human capital, reduce poverty, and support sustainable socio-economic development. The subsequent section will delve into the literature, specifically addressing the impact of gender equality in education on economic growth in Bangladesh.

2.3 Gender Equality in Education and Economic Growth in Bangladesh

In terms of Bangladesh, there is limited literature focusing on this specific area, more of which focus on the relationship indirectly. Dhar & Sarker (2023) studied the impact of female secondary education on economic growth in Bangladesh from 1995 to 2021 using the ARDL cointegration model to analyze long-term and short-term effects. The findings showed that a 1% increase in female secondary education leads to a 0.63% rise in long-term economic growth and a 1.4% increase in the short term (Dhar & Sarker, 2023). Again, Hossain & Tisdell (2005) found a positive correlation between female education and labor force participation in Bangladesh. According to the study, various measures of female education, particularly primary education enrollment, have a high correlation with female labor force participation rates. Specifically, a 1 percentage point increase in female primary education enrollment leads to a 1.06 percentage

point increase in urban female labor force participation, which, in turn, contributes to the economic growth of Bangladesh, highlighting the significant role of female education in enhancing women's economic involvement in Bangladesh (Hossain & Tisdell, 2005). Otsuka, Takahashi & Tanakam (2020) investigated the impact of gender equality in education on several key indicators of economic growth in Bangladesh through the lens of a nationwide female secondary school stipend program, which significantly increased women's educational attainment, with an eligible woman gaining about 1.2 more years of schooling. This increased education was found to have a substantial positive impact on household income and welfare, with each additional year of women's education leading to an 18-26% rise in household income, primarily through non-farm activities and the husband's higher educational attainment and foreign migration. Furthermore, increased education improved household welfare, including better sanitation and children's health outcomes, concluding that while female education does not directly drive FLFP or economic growth, it significantly enhances economic well-being through various indirect household channels (Otsuka et al., 2020).

While existing literature establishes a strong theoretical and empirical link between gender equality in education and economic growth, there is still a notable gap regarding direct studies focused on Bangladesh. Dhar & Sarker (2023) used the ARDL cointegration model to analyze the impact of female secondary education on economic growth using control variables like fertility and labor force growth rate. This leaves room for further exploration using different control variables. This thesis aims to fill this gap by employing an ARDL model to analyze the direct relationship between gender equality in education and economic growth using control variables with a more direct impact on economic growth.

2.4 Sustained Initiatives to Promote Female Education in Bangladesh

Bangladesh has undertaken significant initiatives to enhance female participation in education through various government policies and programs, which has led to notable improvements in gender equality in the education sector. One of the landmark initiatives is the Female Secondary Stipend and Assistance Initiative (FSSAP), which set a minimum participation rate of 75% along with a required score of at least 45% on annual exams and mandated remaining unmarried until taking the Secondary School Certificate (SSC) exam or reaching 18 years of age. This initiative successfully enhanced socioeconomic and educational outcomes for women, boosting enrollment and graduation rates for rural female middle school students while discouraging marriage before the age of 18 (Rupa, 2023). According to Khandker (2021), this program positively impacted school results in the short term, including improvements in the educational achievements of males through the influence of their siblings. Over an extended period, the FSSAP program achieved success in postponing marriage, enhancing the likelihood of self-employment and nonfarm employment for employed women, and increasing the likelihood of marrying men who have higher levels of education and are more engaged in nonfarm work compared to women in the control group. Also, the approach has developmental benefits, including improved contraceptive use, decreased fertility rates, and heightened inclination towards having daughters, exceeding its cost by almost 200%.

National Education Policy (NEP) was established in 2010 to support female involvement in education and address barriers preventing girls from accessing schools (Rupa, 2023). Again, with the support of the World Bank, the Transforming Secondary Education for Results (TSER)

program aims to improve the quality of secondary education for 13 million students. They focus mostly on curriculum modernization, teacher development, and accountability. This program also contributes to gender parity in the education sector by addressing access and retention, particularly for girls and children from disadvantaged backgrounds, through stipends, school grants, and infrastructure improvements (World Bank, 2017).

The Secondary Education Sector Investment Program (SESIP) in Bangladesh, which ran from 2013 to 2023, aimed to enhance secondary education's quality, efficiency, and equity. They primarily focused on curriculum development, teacher capacity building, infrastructure improvement, and ICT integration, targeting improved access and retention rates, especially for marginalized groups, and strengthening governance and management of the education system. With total funding of $185 million from ADB and $2,949 million from the Government of Bangladesh, this program supported various reforms aligned with the National Education Policy 2010 and Vision 2021 goals (Directorate of Secondary and Higher Education, n.d.).

These concerted efforts illustrate the government’s commitment to improving female education and achieving gender equality in the education sector. The government has implemented initiatives that directly impact female students, such as providing stipends, improving school infrastructure, and enhancing teacher training by allocating resources strategically. This success highlights the critical role targeted public expenditure can play in addressing gender disparities. The following section will delve into the broader impact of such expenditures, illustrating theories that describe how financial commitments in education contribute to narrowing the gender gap in the education sector.

2.5 Impact of Public Expenditure on Gender Equality in Education: Theory and Evidence

There is a lack of literature focusing on the factors contributing to gender equality in education. To address this gap, Mbodji (2023) conducted a similar study by examining the impact public education expenditures have on gender inequality in sub-Saharan Africa, analyzing data from 25 countries between 2010 and 2019 using the generalized method of moments. It found that higher public spending on education significantly enhances gender equality at primary, secondary, and tertiary levels, while remittances tend to exacerbate gender disparities. Furthermore, population growth shows varying impacts, negatively affecting gender equality at primary and tertiary levels but positively at the secondary level (Mbodji, 2023).

Transitioning to another regional study, Emara & Hegazy (2021) applied Panel Least Squares with Regional Dummies (LSDV) to examine the factors contributing to the gender disparity in primary, secondary, and tertiary education across 54 developing nations from 1990 to 2014. They found that public spending on education positively impacts the gender parity index but asserted that depending solely on this factor would not be sufficient to close the gap by 2030. The analysis also revealed that economic growth and ICT play a significant role in narrowing the gender gap at all levels of education. In contrast, the impact of trade openness was statistically insignificant (Emara & Hegazy, 2021). Senadza & Hodey (2015) reached similar conclusions in their study on the effect of public education spending on primary education outcomes in Sub-Saharan Africa (SSA), using net enrolment rate (NER) and persistence to the last grade of primary education (PLG) as key indicators. Their findings showed that a 1% rise in government education spending as a percentage of GDP was associated with an 11.4% increase in NER and a

2% rise in PLG. Other factors that influenced the narrowing of the gender gap included the primary pupil-teacher ratio, child mortality rate, and other economic indicators such as GDP per capita and foreign aid (Senadza & Hodey, 2015). Emara (2021) applied panel least squares with regional dummies (LSDV) to analyze data from 22 MENA countries from 1990 to 2007. They concluded that economic growth should be complemented by other factors, such as public spending, trade, and infrastructure, to improve the prospects of achieving gender equality in education. Asongu & Odhiambo (2020) assessed the effect of credit access on governance to promote gender-inclusive education in Sub-Saharan Africa (SSA) between 2004 and 2014, using private domestic credit and three levels of education as key indicators. They used the Generalized Method of Moments (GMM) to find that access to credit boosts political stability, government effectiveness, and the rule of law, significantly positively impacting primary, secondary, and tertiary education (Asongu & Odhiambo, 2020).

Saâd & Ella (2021) attempted to see the influence of economic complexity on gender parity in education across various income-level countries and regions from 1984 to 2014, using GMM estimations and robustness checks with instrumental variables GDP and gender gap in labor market access. They found that economic complexity positively impacts tertiary education gender parity in middle- and low-income countries, while high-income and MENA countries face a reduction in inequalities at this level. They used public spending in education, good governance, and FDI as control variables and found that these variables consistently reduce gender inequalities in education and regions.

The literature also shows that women are disproportionately affected by underfunding in public education programs, underscoring the importance of sufficient public expenditure to support gender equality initiatives (Perry, 2022). National legislation also plays a significant role

in advancing gender equality in education, as evidenced by laws in the United States that promote gender equality in higher education (Zhang, 2022). Additionally, high levels of public spending have been associated with a decrease in occupational gender segregation, further highlighting the positive impact of public expenditure on gender equality in education (Barth et al., 2024).

Research on the impact of public education expenditure on educational inequality in Bangladesh is limited. However, focusing specifically on Bangladesh, Sheikh (2021) investigated the impact of public education expenditure on educational inequality using the Gini coefficient. They found a positive relationship between increased education spending and reduced inequality, marked by higher years of schooling. The study emphasized the need for targeted policies and sustained investment to further reduce educational disparities, recommending the inclusion of need-based curricula, appropriate budget allocations, and improved infrastructure through public-private partnerships (Sheikh, 2021).

In sum, considerable studies support government expenditure's influence in reducing educational inequalities. While Sheikh (2021) investigated the relationship between public education spending and educational inequality using the Gini coefficient in Bangladesh, there remains a scarcity of focused research specifically exploring how public expenditure influences gender disparities in education within the Bangladeshi context, underscoring the need for further empirical investigations that specifically analyze how public spending policies in Bangladesh affect gender equality outcomes.

3 Methodology

This study uses time series data from 1995 to 2022 to capture time-specific effects. It is sourced from reputable and extensively utilized platforms, such as the World Bank Databank and Bangladesh Bureau of Educational Information and Statistics (BANBEIS), which are dependable sources of data and impartial towards certain nations or areas. To be specific, female secondary school education data was taken from BANBEIS (2022). The data for other variables was extracted from the World Bank.

3.1.1 Variables

The research utilizes the ARDL model, which requires the log transformation of variables for various reasons. First, log transformations are known to reduce the impact of outliers and skewness in the data by compressing large values and expanding small ones, making the data more normally distributed and satisfying key assumptions of OLS regression, on which the ARDL model is based. The log transformations also help transform the relationships of the variables into a linear form, making them easier to estimate and interpret using regression techniques (West, 2022). Moreover, log transformations can improve model fit by stabilizing variance and making the data more homoscedastic. This is essential for ensuring the robustness of the regression results, as heteroscedasticity results in inefficient estimates and biased statistical inferences (Luetkepohl & Xu, 2009).

3.1.2 Dependent Variables:

This paper uses two dependent variables. GDP per capita and female secondary school education.

GDP per Capita:

In this study, GDP per capita, a comprehensive measure of a country's economic performance and standard of living, is a proxy for economic growth. This variable captures the overall economic output relative to the population size, thereby assessing how gender equality initiatives and policies may influence economic prosperity. It is determined by dividing a nation's GDP by its overall population. The total monetary value of all final goods and services produced in a nation over a given period—typically a year—is called GDP (IMF, n.d.).

Female Secondary School Education:

Another key variable in this paper is the percentage of female students in secondary schools in Bangladesh, which measures the proportion of female students enrolled in secondary education relative to the total number of students at this level. This variable serves as a proxy for gender equality here due to the unavailability of data on other measures of gender parity and to simplify the analysis. Also, despite providing a ratio of female-to-male enrollment, GPI and similar indicators can sometimes mask nuances in absolute enrollment numbers and fail to highlight whether an adequate percentage of the total population—both girls and boys—are accessing education. This study directly examines girls' participation in secondary education and provides a clear picture of whether they are equitably represented among all students at this level.

Secondary education is chosen because it represents a crucial stage in the educational journey, typically covering the years following primary education and preceding tertiary or higher education. This period, usually between the ages of 12 and 18, is formative for personal, social, and intellectual development.

3.1.3 Independent Variables:

The first regression model is formulated as follows:

$LogGPC_t = \alpha + ß_1 LogFSE_t + ß_2 LogGCF_t + + ß_3 Log\ LPR_t + ß_4 LogTr_t + U_t$

Where,

LogGPC= Log of GDP per Capita

LogFSE = Log of Female Secondary School Education

LogGCF= Log of Gross Capital Formulation

LogLPR = Log of Labor Force Participation Rate

LogTr = Log of Trade as a Percentage of GDP

Gross Capital Formulation: Gross Capital Formulation is used as a proxy variable for the economy's investment rate. This variable includes investments in physical assets such as buildings, machinery, and infrastructure (World Bank, 2023).

Labor Force Participation Rate: The percentage of people of working age actively participating in the labor market is known as the labor force participation rate (World Bank, 2023).

Trade: Trade is the total amount of products and services exported and imported, measured as a share of GDP (World Bank, 2023). This variable captures the impact of trade openness and integration with the global economy on economic growth, indicating how exposure to international markets and trade can influence economic performance

The second regression model can be formulated as follows:

$Logfemenroll_t = \alpha + ß_1 LogEduSp_t + ß_2 Loglitrate_t + + ß_3 LogRem_t + U_t$

Where,

Logfemenroll= Log of Female Secondary School Education

LogEduSp = Log of Public Expenditure on Education

Loglitrate = Log of Adult Literacy Rate

LogRem = Log of Remittances as a Percentage of GDP

Public Expenditure on Education: It is the key independent variable for the model, which measures the government's investment in the education sector, indicating how financial resources allocated to education can influence access (World Bank, 2023).

Adult Literacy Rate: The adult literacy rate is the proportion of people aged 15 and above with the ability to read and write, who understand short and simple statements about everyday life (Macrotrends, 2024).

Remittance: Remittance is measured as a percentage of GDP to capture the economic impact of remittances on households, which can influence their ability to invest in education, particularly for girls (World Bank, 2023).

3.2 Method

All analyses are done using STATA 16.

3.2.1 ARDL Model

As mentioned earlier, the paper uses the ARDL approach by Pesaran et al. (2001), which is a popular econometric technique used to investigate the long-term and short-term dynamics of relationships between variables to find the impact of female education on economic growth and public expenditure on education on female enrollment rate. This model is especially effective for analyzing time series data with different integration orders, as it permits variables to be I(0), I(1), or a mix of both. Additionally, the method incorporates lagged values of the dependent variables along with both current and lagged values of the independent variables, allowing for capturing the dynamic relationship between the variables over time (Kripfganz & Schneider, 2023).

Again, to ensure the reliability and validity of the results, this study conducts various diagnostic tests, including tests for autocorrelation, heteroskedasticity, normality, etc., which are described in detail in the subsequent sections.

3.2.2 Autocorrelation

Autocorrelation arises when residuals are correlated with each other. When this occurs, the standard errors of the regression coefficients can get distorted. Thus, this study uses the Breusch–Godfrey LM Test for autocorrelation in the residuals. In this test, the null hypothesis posits that there is no autocorrelation up to a specified order, and rejecting the null hypothesis suggests the presence of autocorrelation (Legendre, 1993).

3.2.3 Heteroskedasticity

Heteroskedasticity, which arises when the variance of the residuals fluctuates across various levels of the independent variables and affects hypothesis testing by producing inefficient estimates and invalid standard errors, is detected in this study using the White Test. If the test statistic is significant, the null hypothesis of homoskedasticity is rejected (constant variance), indicating the presence of heteroskedasticity (Kaufman, 2013).

3.2.4 Omitted Variable Bias

This study uses the Ramsey RESET Test (Regression Equation Specification Error Test) to identify specification errors within the model, particularly omitted variables or incorrect functional form. This test involves adding polynomial terms of the fitted values of the dependent variable to the regression model. If these added terms are statistically significant, it suggests that the original model may be misspecified, indicating that important variables might be omitted or that the functional form of the model is incorrect (Clarke, 2005).

3.2.5 Normality

The normality of residuals is a crucial assumption in many econometric models, including ordinary least squares (OLS) regression. This study uses the Shapiro–Wilk W Test for Normality to assess whether the residuals of the regression model follow a normal distribution. This test calculates a W statistic by comparing the ordered sample values with their expected values under the normality assumption. If the test statistic is significant, we reject the null hypothesis of normality, indicating that the residuals do not follow a normal distribution. (Monter-Pozos & González-Estrada, 2024).

3.2.6 Stability

CUSUM Test: This test monitors the cumulative sum of residuals over time. If the cumulative sum moves outside a predefined confidence interval, it suggests instability in the model parameters (Caporale & Pittis, 2004).

CUSUM SQ Test: This test is Similar to the CUSUM test but monitors the cumulative sum of squared residuals. It is more sensitive to sudden changes or large deviations in the residuals (Caporale & Pittis, 2004).

3.3 Hypotheses

Hypothesis 1:

H_0: There is no impact of female secondary school education on GDP per capita.

H_1: There is a significant impact of female secondary school education on GDP per capita.

Hypothesis 2:

H_0: Public expenditure on education has no impact on female enrollment rate in secondary schools.

H_1: Public expenditure on education has a significant positive impact on female enrollment rate in secondary schools.

4 Results and Findings

4.1 Impact of Gender Parity in Education on Economic Growth

4.1.1 Descriptive statistics of the variables

Table 2

Descriptive Statistics

Variables	LogGPC	LogFSE	LogGCF	LogLPR	LogTr
Obs	28	28	28	28	28
Mean	-3.187331	-0.6437534	-1.33121	-0.5222933	-1.094292
Std. dev.	0.3438714	0.0410644	0.1391316	0.0152141	0.2014963
Min	-3.951966	-0.7556611	-1.654446	-0.5493759	-1.344151
Max	-2.704907	-0.6003857	-1.132777	-0.4904349	-0.731661
Skewness	-0.54191	-1.828814	-0.3916644	0.3205924	0.4496925
Kurtosis	2.104376	5.472023	2.483427	2.667056	1.807659
Jarque-Bera	3.49	14.53	1.12	0.68	5.63
Probability	0.1746	0.0007	0.5704	0.7102	0.06

Table 2 presents descriptive statistics for the five log-transformed variables used in this model. The mean values indicate average levels, with LogGPC at -3.187331, LogFSE at -0.6437534, LogGCF at -1.33121, LogLPR at -0.5222933, and LogTr at -1.094292. Skewness reveals that LogGPC and LogFSE are left-skewed, while LogLPR and LogTr are slightly right-skewed. Kurtosis values suggest that most variables follow a near-normal distribution, except for LogFSE, which exhibits higher peakedness.

The null hypothesis of the Jarque-Bera test assumes that the residuals follow a normal distribution. If the p-value is greater than 0.05, it suggests that the null hypothesis cannot be rejected, implying that the residuals follow a normal distribution. The findings in Table 2 show

that all variables, except for LogFSE, are distributed normally. Specifically, the p-value for LogFSE is 0.007, which results in rejecting the null hypothesis, indicating that the residuals for the variable aren't normally distributed.

4.1.2 Stationarity Check Report

Stationarity denotes that the statistical characteristics of the series, such as mean and variance, stay constant throughout time (LUTKEPOHL & KRATZIG, 2004). This study employs the Augmented Dicky Fuller (ADF) test to check the stationarity of the variables. The null hypothesis of this test is that the time series has a unit root, implying that the series is non-stationary. A p-value less than the chosen significance level would result in rejecting the null hypothesis, indicating a stationary series. As can be seen from Table 3, LogGPC, LogFSE, and LogGCF have p-values less than 0.05 at their levels, indicating they are stationary at the level. However, LogLPR and LogTr have p-values greater than 0.05 at their levels, indicating they are non-stationary, but become stationary after the first difference with p-values less than 0.05.

Table 3

Stationarity Check Report

Variables	Level (With Intercept)	First Difference (With Intercept)	Order of Integration
LogGPC	-2.702***	-7.502***	I (0)
(p-value)	0.0061	0.0000	
LogFSE	-2.983 ***	-4.859***	I (0)
(p-value)	0.0031	0.0000	
LogGCF	-3.078***	-4.300***	I (0)
(p-value)	0.0025	0.0001	
LogLPR	-1.219	-5.104***	I (1)
(p-value)	0.6655	0.0000	
LogTr	-1.606	-3.970***	I (1)
(p-value)	0.4808	0.0016	

***p < .01

4.1.3 Optimum Lag Selection Criteria

Before running the ARDL bounds test to check cointegration, determining the ideal number of lags is crucial to achieving the best fit and predictive accuracy. Table 4 indicates different criteria, including Log-Likelihood (LL), Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Bayesian Information Criterion (SBIC). In this analysis, the optimum lag is 4, as it provides the best fit across all criteria. Given the small sample size, I will emphasize the Schwarz-Bayesian Information Criterion (SBIC) for its robustness in such contexts (Cavanaugh & Neath, 1999).

Table 4

Optimum Lag Selection Criteria

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	-252.375		90.4056	21.5313	21.6094	21.8258
1	-154.745	195.26	.590276	16.3955	16.9424	18.457
2	-104.516	100.46	.353641	15.2097	16.2254	19.0383
3	381.349	971.73	2.6e-16*	-22.2791	-20.7945	-16.6833
4	4122.81	7482.9*	.	-331.567*	-329.692*	-324.499*

* Optimal lag

LR: Sequential modified LR test statistic (each at 5% level)

FPE: Final Prediction Error

AIC: Akaike Information Criterion

HQIC: Hannan-Quinn Information Criterion

SBIC: Schwarz Bayesian Information Criterion

4.1.4 Results of ARDL Bounds Testing

The result of the ADF test revealed that the variables are stationary either at the level or first difference. In such cases, the ARDL bounds testing (Pesaran et al., 2001) can determine if a long-run relationship exists between the model's variables. Also, ARDL bounds testing is suitable for small sample sizes (Alimi, 2014) and is particularly relevant to my study with 25 observations. The decision rule for ARDL bounds testing is to compare the F-statistic (6.043) with the critical values for the respective significance levels. If the F-statistic is higher than the upper bound critical value, it indicates a rejection of the null hypothesis, suggesting the existence of a long-run relationship. Again, if the F-statistic is lower than the lower bound critical value, it indicates a failure to reject the null hypothesis, suggesting no long-run relationship (Alimi, 2014). As can be seen from the ARDL Bounds Testing Report (Table 5), the F-statistic is greater than the upper bound critical values at all significance levels, indicating that we can reject the null hypothesis of no long-run relationship at the 1% significance level. Thus, there is strong evidence of a significant long-run relationship among the variables in the model.

Table 5

ARDL Bounds Testing Report

F-Statistic	Significance Level	Critical Values	
		Lower Bound I (0)	Upper Bound I (1)
6.043	10%	2.45	3.52
	5%	2.86	4.01
	2.5%	3.25	4.49
	1%	3.74	5.06

4.1.5 Long-run Outcomes

The ARDL bounds testing results indicate a significant long-run relationship among the variables. The long-run outcomes (Table 6) reveal that in the long run, Female Secondary Education (LogFSE) has a substantial negative impact on Gross Product per Capita (LogGPC), with a 1% increase in Female Enrollment in Secondary Education associated with approximately a 10.72% decrease in GDP per Capita. This finding is consistent with the findings by Barro & Lee (1994), who found that female education has a negative impact on economic growth. Dollar & Gatti (1999) also concluded that the return on educating a female is lower in agrarian economies. Trade (LogTR) shows a marginally significant positive effect, with a 1% increase in Trade linked to a 0.94% increase in GDP per Capita. Additionally, Gross Capital Formation significantly boosts economic growth, where a 1% rise in gross capital formulation or investment rate corresponds to a 2.60% increase in GDP per Capita. However, the Labor Participation Rate (LogLPR) does not exhibit a significant impact in the long run.

Table 6

Long-run Outcomes

Dependent Variable: LogGPC				
Explanatory Variables	Coefficients	Std. Err.	t-values	P-values
Constant	-3.116089	4.324179	-0.72	0.484
LogFSE	-10.71555**	4.083866	-2.62	0.021
LogLPR	5.432089	6.870786	0.79	0.443
LogTR	0.9371867*	0.4872496	1.92	0.077
LogGCF	2.60396***	0.7744028	3.36	0.005
R-squared: 0.8145 Adj R-squared: 0.6576				

***p < .01. ** p < .05. *p < .10

4.1.6 Short-run Outcomes

Table 7 depicts the short-run dynamics of the variables. In the short run, the dynamics differ slightly, with changes in Trade and Gross Capital Formation positively and significantly affecting economic growth. Specifically, a 1% increase in trade and gross capital formulation is associated with 1.03% and 7.46% increases in GDP per Capita in the short run, respectively. Nonetheless, changes in female secondary enrollment rates do not significantly impact economic growth in the short run.

The Error Correction Model (ECM) term is highly significant and negative, indicating a strong adjustment mechanism. Approximately 115.83% of the disequilibrium is corrected each period, underscoring a rapid return to long-run equilibrium following economic shocks.

Table 7

Short-run Outcomes

Variables	Coefficients	Std. Err.	t-values	P-values
D(LogGPC(-1))	-.1583006	.2293029	-0.69	0.502
D(LogFSE)	-7.345823	4.371476	-1.68	0.117
D(LogFSE(-1))	-5.066001	3.006973	-1.68	0.116
D(LogLPR)	11.26908	8.493814	1.33	0.207
D(LogLPR(-1))	-4.977086	5.098647	-0.98	0.347
D(LogTR)	1.029939	.4448671	2.32	0.038
D(LogTR(-1))	.0556051	.844542	0.07	0.949
D(LogGCF)	7.464405**	3.277583	2.28	0.040
D(LogGCF(-1))	-7.289481	5.466491	-1.33	0.205
D(LogGCF(-2))	-7.289481	4.953123	0.11	0.917
D(LogGCF(-3))	2.315712	2.800084	0.83	0.423
ECM (-1)	-1.15830***	.2293029	-5.05	0.000

***p < .01. ** p < .05.

4.1.7 Diagnostic Tests:

Several diagnostic tests are conducted to validate the model's underlying assumptions, which are described below.

Serial Correlation Test:

The Breusch–Godfrey LM Test is performed to identify autocorrelation in the residuals. This test assumes a Null Hypothesis of no correlation in the residuals. Since the p-value (0.8164), as can be seen in Table 8, is much greater than the typical significance level (0.05), we fail to reject the null hypothesis, indicating no evidence of serial correlation in the model's residuals.

Table 8

Breusch–Godfrey LM Test Report for Autocorrelation

lags(p)	chi2	df	Prob > chi2
1	0.054	1	0.8164

Note: H0: no serial correlation

Heteroskedasticity Test

Table 9 shows the result of White's Test to detect heteroskedasticity, which is the presence of non-constant variance in the residuals. It assumes a Null Hypothesis of constant variance of residuals. Since the p-value (0.4058) is greater than 0.05, we fail to reject the null hypothesis, suggesting no evidence of heteroskedasticity in the model.

Table 9

Heteroskedasticity Test Report

Test	chi2	Prob > chi2
White's test	25.00	0.4058
Cameron & Trivedi's decomposition of the IM-test		
Heteroskedasticity	25.00	0.4058
Skewness	10.13	0.5184
Kurtosis	0.97	0.3244
Total	36.10	0.4637

Ramsey RESET Test for Omitted Variables

Table 10 depicts the result of the Ramsey RESET Test, which is conducted to identify whether the model suffers from omitted variable bias. Since the p-value (0.7003) is much greater than 0.05, we fail to reject the null hypothesis of no omitted variables, concluding that there is omitted variable bias in the model.

Table 10

Omitted Variable Biasedness Report

Test	F	df	Prob > F
Ramsey RESET test	0.48	3, 19	0.7003

Shapiro–Wilk W Test for Normality

The Shapiro–Wilk W Test for Normality assesses whether the residuals are normally distributed. As Table 11 shows, the p-value (0.06472) is greater than 0.05, which indicates failure to reject the null hypothesis. This suggests that the residuals are normally distributed.

Table 11

Normality Test Report

Variable	Obs	W	V	z	Prob > z
resid	28	0.93084	2.089	1.516	0.06472

Stability Check

The plot of the Cumulative Sum (CUSUM) test (Figure 1) assesses the coefficients' stability in a regression model over time. The red line stays within the grey-shaded area throughout the period from around 2008 to 2022, so we do not reject the null hypothesis of parameter stability. This suggests no significant structural break in the model over the period considered. The CUSUM SQ test (Figure 2) tests the stability of a regression model, focusing on the variance of the errors. Throughout most of the period, the CUSUMSQ line remains within the critical bounds, suggesting no significant instability in the variance of the residuals.

Figure 1

Plot of Cumulative Sum of Recursive Residuals (CUSUM)Test

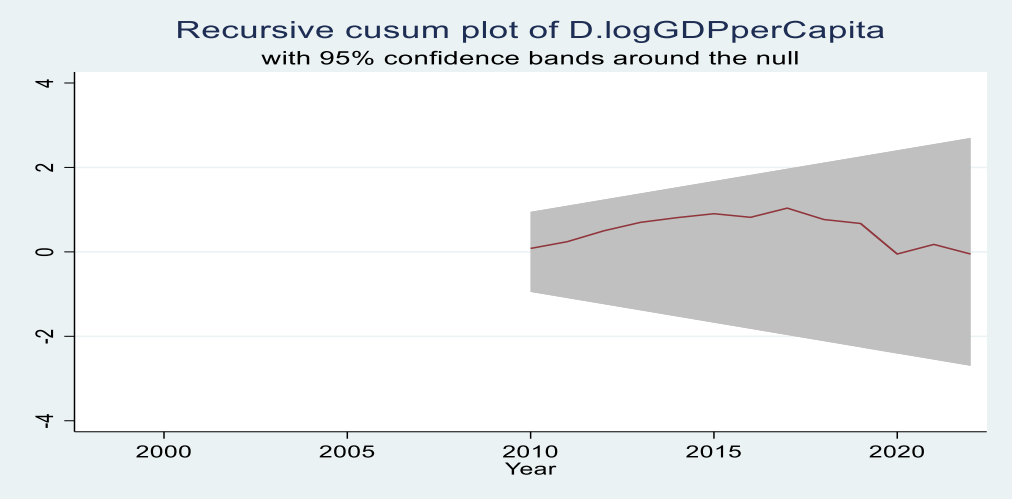
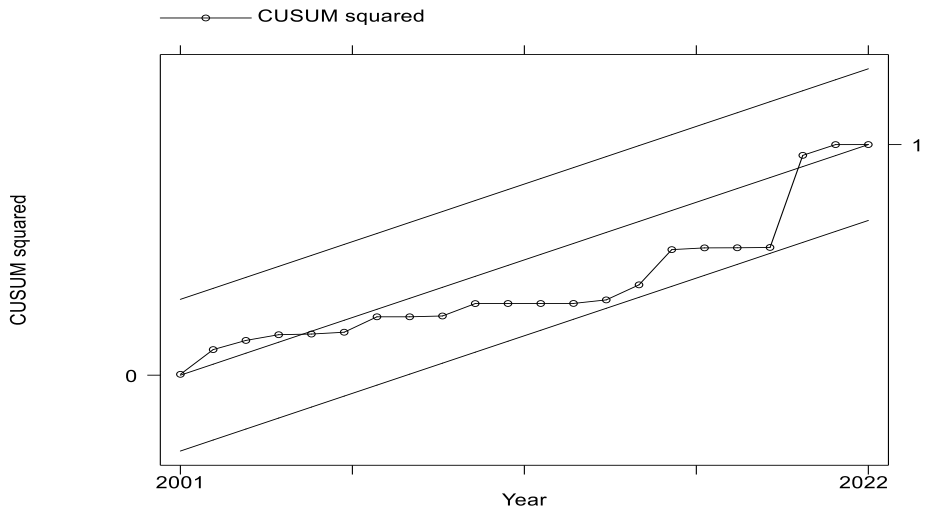


Figure 2

Plot of Cumulative Sum of Squares of Recursive Residuals (CUSUM SQ) Test



4.2 Impact of Education Spending on Gender Parity in Education

4.2.1 Descriptive Statistics of the Variables

Table 12

Descriptive Statistics

Variable	Logfemenroll	LogEduSp	Loglitrate	LogRem
Obs	28	28	28	28
Mean	-0.643753	-1.920868	-0.5444937	-2.865781
Std. dev.	0.0410644	0.2022462	0.2126044	0.405882
Min	-0.755661	-2.280696	-0.967584	-3.541986
Max	-0.600386	-1.560648	-0.241053	-2.245455
Skewness	-1.828814	-0.0521567	-0.0322321	-0.0150823
Kurtosis	5.472023	1.945225	2.046035	1.795895
Jarque-Bera	14.53	3.05	1.97	4.87
Probability	0.0007	0.2173	0.3735	0.0878

Table 12 provides descriptive statistics for the variables used in the model. The standard deviations indicate the degree of variation, with LogRem showing the highest variability (0.405882) and Logfemenroll the lowest (0.0410644). Skewness indicates that Logfemenroll is highly left-skewed, while the other variables exhibit slight skewness. Kurtosis values suggest that Logfemenroll has a distribution with higher peakedness (5.472023), while the other variables are closer to a normal distribution. The Jarque-Bera test results show that Logfemenroll significantly deviates from normality (p=0.0007). However, the other variables do not show

significant deviations from normality with p-values of 0.2173, 0.3735, and 0.0878, respectively.

4.2.2 Stationarity Check Report

The ADF test is conducted again as the first step in running an ARDL model to check the variables' stationarity. As shown in Table 13, Logfemenroll, LogEduSp, and Loglitrate have p-values less than 0.05 at their levels, indicating they are stationary at that level. However, LogRem has p-values greater than 0.05 at its level, indicating non-stationarity, but it becomes stationary after the first difference with p-values less than 0.05.

Table 13

Stationarity Check Report

Variables	Level (With Intercept)	First Difference (With Intercept)	Order of Integration
Logfemenroll	-2.917***	-5.013***	I (0)
(p-value)	0.0039	0.0000	
LogEduSp	-1.935**	-5.712***	I (0)
(p-value)	0.0322	0.0000	
Loglitrate	-1.778**	-3.468***	I (0)
(p-value)	0.0438	0.0010	
LogRem	-1.428	-3.293***	I (1)
(p-value)	0.0828	0.0015	

***p < .01. ** p < .05.

4.2.3 Optimum Lag Selection Criteria

Table 14 shows that lag 1 is the optimal lag length, according to most criteria (FPE, HQIC, and SBIC). This lag provides the best balance between model fit, predictive accuracy, and

complexity. The AIC suggests lag 4 as the optimal length, but considering the balance of all criteria, lag 1 is the preferred choice for this model.

Table 14

Optimum Lag Selection Criteria

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	96.4731		5.30E-09	-7.70609	-7.654	-7.50975
1	183.994	175.04	1.4e-11*	-13.6662	-13.4058*	-12.6845*
2	197.287	26.586	2.00E-11	-13.4406	-12.9718	-11.6735
3	207.212	19.851	4.80E-11	-12.9344	-12.2572	-10.3819
4	234.766	55.106*	4.40E-11	-13.8971*	-13.0116	-10.5593

* Optimal lag

LR: Sequential modified LR test statistic (each at 5% level)

FPE: Final Prediction Error

AIC: Akaike Information Criterion

HQIC: Hannan-Quinn Information Criterion

SBIC: Schwarz Bayesian Information Criterion

4.2.4 Results of ARDL Bounds Testing

ARDL bounds testing assesses whether a long-run relationship exists between the model's variables, as the ADF test confirmed that the variables are stationary at either level or first difference. The report depicted in Table 15 shows that the F-statistic surpasses the upper bound critical values at the 10% and 5% significance levels. This means we can reject the null hypothesis of no long-run relationship at the 5% significance level, indicating a significant long-run relationship among the variables in the model.

Table 15

Short-run Outcomes

F-Statistic	Significance Level	Critical Values	
		Lower Bound I (0)	Upper Bound I (1)
4.808	10%	2.72	3.77
	5%	3.23	4.35
	2.5%	3.69	4.89
	1%	4.29	5.61

4.2.5 Long-term Outcomes

The ARDL bounds testing results (Table 16) indicate a significant long-run relationship among the variables. In the long run, a 1% increase in education spending is associated with a 0.1048% increase in female enrollment. This relationship is statistically significant ($p = 0.002$), demonstrating that higher education spending has a positive and significant effect on female enrollment in secondary schools. The literacy rate of a country also has a substantial positive impact on female enrollment, with a 1% increase in the literacy rate resulting in an increase of female enrollment by 0.205936%. The coefficient for the log of remittances implies that a 1% increase in remittances is associated with a 0.00247% decrease in female enrollment. However, this effect is not statistically significant ($p = 0.804$), suggesting that remittances do not have a meaningful impact on female enrollment in the context of this model.

Table 16

Long-run Outcomes

Dependent Variable: Logfemenroll				
Explanatory variables	Coefficient	Standard error	t-values	P-values
Constant	-0.26629***	0.076352	-3.49	0.003
LogEduSp	0.1048***	0.027852	3.76	0.002
Loglitrate	0.205936***	0.032041	6.43	0.000
LogRem	-0.00247	0.009785	-0.25	0.804
R-squared = 0.7177 Adj R-squared = 0.5590				

***p < .01. ** p < .05. *p < .10

4.2.6 Short-term Outcomes

Short-term dynamics (Table 17) reveal different patterns. Female enrollment in secondary school does not significantly affect enrollment in the subsequent period. However, education spending has a positive and significant impact on female enrollment in the short run, with a 1% increase in education spending leading to a 0.067% increase in female enrollment. Other variables do not significantly impact female secondary school enrollment rates in the short term. The error correction term (ECM(-1)) is highly significant, with a negative coefficient of -0.8063197 (p = 0.001), indicating a strong adjustment back to equilibrium, with approximately 80.63% of the disequilibrium corrected each period.

Table 17

Short-run Outcomes

Variables	Coefficient	Std. err.	t-values	P-Values
D(Logfemenroll(-1))	0.1936803	0.1935367	1	0.332
D(LogEduSp)	0.0670882	0.0235947	2.84	0.012
D(LogEduSp(-1))	0.0174139	0.0304065	0.57	0.575
D(Loglitrate)	0.0570062	0.1077895	0.53	0.604
D(Loglitrate(-1))	0.0488218	0.16582	0.29	0.772
D(Loglitrate(-2))	0.0602222	0.1045686	0.58	0.573
D(LogRem)	0.0065978	0.0333791	0.2	0.846
D(LogRem(-1))	0.0310104	0.046359	0.67	0.513
D(LogRem(-2))	-0.0395962	0.0269758	-1.47	0.162
ECM(-1)	-0.8063197	0.1935367	-4.17	0.001

***p < .01. ** p < .05. *p < .10

4.2.7 Diagnostic Tests

Shapiro–Wilk W Test for Normality

The Shapiro–Wilk W Test for Normality assesses the normality of the residuals of a model. The null hypothesis is that the residuals are normally distributed. The p-value (0.9372), as can be seen in Table 18, is much higher than the lowest level of significance 0.01, indicating the failure to reject the null hypothesis. This suggests that the residuals are normally distributed.

Table 18

Normality Test Report

Variable	W	V	z	Prob > z
resid	0.98344	0.474	-1.532	0.93724

Breusch–Godfrey LM test for autocorrelation

The null hypothesis of the Breusch–Godfrey LM Test is that there is no correlation in the residuals. Since the p-value (0.2450) from the Autocorrelation test report (Table 19) is much greater than the typical significance level (0.05), we fail to reject the null hypothesis. Thus, it can be concluded that there is a serial correlation in the model's residuals.

Table 19

Autocorrelation Test Report

lags(p)	chi2	df	Prob > chi2
1	1.352	1	0.2450

Note: H0: no serial correlation

White's Test for Heteroskedasticity

White's Test checks for heteroskedasticity, which is the presence of non-constant variance in the residuals. White's Test assumes a Null Hypothesis of constant variance residuals. Since the p-value (0.4076) (Table 20) is greater than 0.05, we fail to reject the null hypothesis, suggesting no evidence of heteroskedasticity in the model.

Table 20

Heteroskedasticity Test Report

Test	chi2	Prob > chi2
White's test	26.00	0.4076
Cameron & Trivedi's decomposition of the IM-test		
Heteroskedasticity	26.00	0.4076
Skewness	1	0.1059
Kurtosis	0.97	0.9713
Total	36.10	0.2408

Ramsey Reset Test for Omitted Variables

The Ramsey RESET test evaluates the model for omitted variable bias. The F-statistic is 16.63 has a p-value of 0.0007. Since the p-value is higher than 0.05, we fail to reject the null hypothesis, indicating that there is no omitted variable bias in the model.

Table 21

Omitted Variable Biasedness Report

Test	F	Prob > F
Ramsey RESET test	16.63	0.07

Stability Check

The Cumulative Sum (CUSUM) test assesses the coefficients' stability in a regression model over time. Figure 3 shows that the red line fluctuates within the grey confidence bands,

indicating that there are no significant structural breaks in the model over the given period and suggesting that the model's parameters remain stable throughout the time period analyzed. The second plot shows the CUSUM squared test for stability over the period. The red line represents the cumulative sum of squared residuals, and the blue line indicates the expected value under stability. The green lines mark the 95% confidence bounds. As long as the red line remains within these bounds, the model is considered stable. The plot shows that the CUSUM squared values (Figure 4) remain within the confidence bounds, suggesting that the model is stable over the period.

Figure 3

Plot of Cumulative Sum of Recursive Residuals (CUSUM)Test

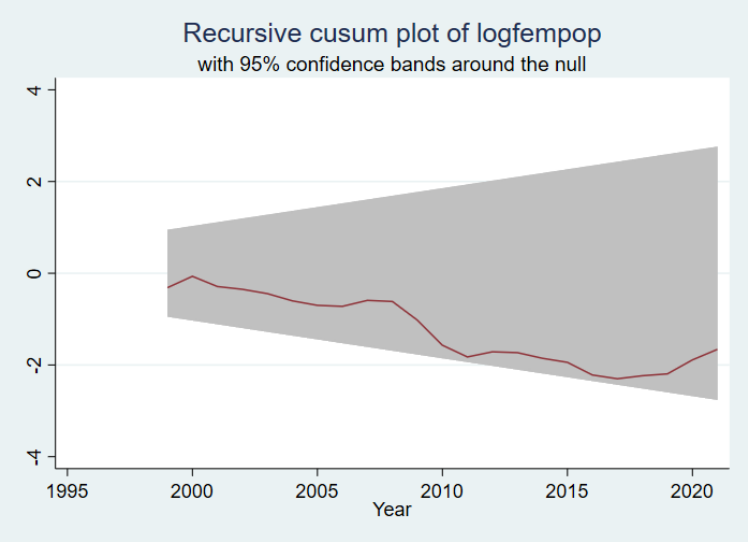
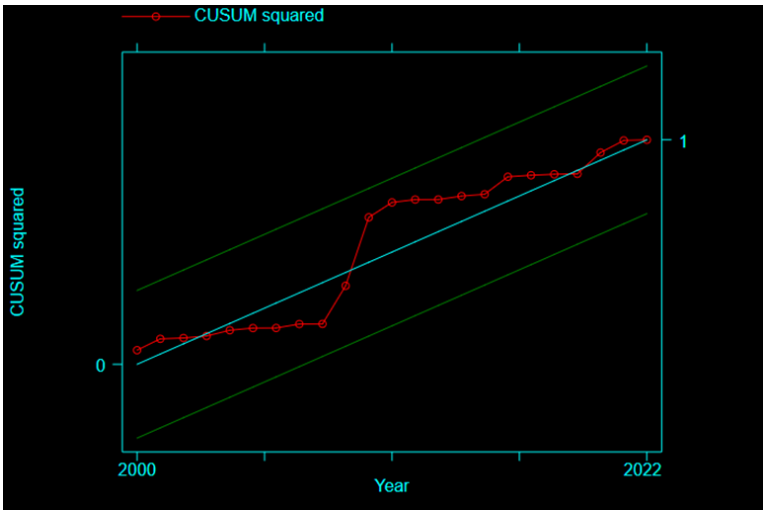


Figure 4

Plot of Cumulative Sum of Squares of Recursive Residuals (CUSUM SQ) Test



5 Discussion

One of our key findings is that female secondary school education, which is used as a proxy for gender equality in education, significantly negatively impacts Bangladesh's long-term economic growth. This unexpected result can be attributed to various socio-economic factors prevalent in the country.

Firstly, in a patriarchal society like Bangladesh, a substantial number of women do not enter the workforce after completing their secondary education or even after graduation. Cultural norms and family expectations often lead to women being married off at a young age, prioritizing their roles as wives and mothers over career pursuits. Consequently, many educated women voluntarily leave the workforce to focus on family responsibilities, including raising children (Rahman & Islam, 2013). This withdrawal from the labor force represents a significant economic opportunity cost, as these educated women are not contributing to economic production. In contrast, their male counterparts are more likely to enter the workforce and drive economic growth, suggesting that higher enrollment of males in secondary education could have a more direct positive impact on economic growth (Das & Desai, 2003).

Furthermore, female education is often associated with reduced fertility rates, as educated women tend to delay childbirth and have fewer children due to increased access to family planning and a desire for career development (K. Islam, 2014). While lower fertility rates can contribute positively to economic growth by reducing the dependency ratio and enabling women to participate more actively in the workforce, they can also present challenges for the country's economy. A declining fertility rate may lead to an aging population, resulting in a shrinking labor force and increased pressure on social services to support an older population. This demographic

shift also lessens economic growth as fewer workers are available to support economic production, and the government faces increased financial burdens related to healthcare and pensions (Jaiyeoba, 2015). Moreover, with fewer children, there might be less motivation for significant investment in education and child services, potentially slowing human capital development (Singh & Kumar, 2021).

Additionally, uneducated women in Bangladesh often engage in self-employment activities in rural areas or work in the ready-made garment industry in urban areas, which are vital sectors of the country (Hossain & Tisdell, 2005). However, as women attain higher levels of education, they seek high-skilled jobs or positions in decision-making bodies. The job market in Bangladesh is not well-equipped to absorb such a large number of educated women, partly due to a lack of available positions that match their qualifications and partly due to gender biases favoring male employees. This mismatch between the supply of educated female workers and the demand for their skills leads to increased unemployment or underemployment among educated women, reducing their potential economic contribution(Rahman & Islam, 2013). Moreover, Bangladesh's economy is heavily reliant on agriculture and labor-intensive industries, where physical labor is a significant component (Byron, 2023). Many jobs in these sectors are traditionally deemed more suitable for men due to their physical demands, further limiting the participation of educated women in the country's workforce.

Despite the observed negative impact of female education on GDP per capita, the importance of female education should not be underestimated, as educated women contribute significantly to societal well-being and economic resilience through multiple channels. Firstly, educated mothers are better equipped to ensure the health and education of their children, which positively influences the cognitive and emotional development of the next generation, leading to

a more skilled and productive workforce in the long term and contributing to sustainable development (Ali et al., 2022; Brown, 2004). Moreover, as more women become educated, the overall literacy rate increases, fostering a culture of learning and innovation that benefits society as a whole (Noureen & Awan, 2011). Also, educated women are more likely to advocate for their rights as well as the rights of others, thereby promoting gender equality, social advancement, and justice (Mukherjee & Agarwal, 2023; Zahra et al., 2021). Including females in different sectors, even in those with the majority of male participants, contributes to economic diversification. This inclusion results in increased resilience in the nation's economy (Akhtar et al., 2020). Additionally, educated women exhibit a comparatively lower fertility rate (Bora et al., 2023). This has the potential to mitigate excessive pressure on available resources by balancing population growth and economic instability(Guan, 2019). Finally, educated women can carry out pivotal roles in reducing gender-specific violence and discrimination by utilizing their capability to identify and fight against such events(World Bank, 2015).

Another key finding of this study is that public education expenditure bolsters the journey toward gender inequality in education in the country. This type of financial support is essential for providing everyone equitable access to relevant learning resources, infrastructures, and opportunities regardless of gender. Still, some underserved areas in Bangladesh lack local educational facilities. Consequently, girls face risks and safety concerns associated with covering long distances to reach schools or colleges (Tareque & Ahmed, 2024). The government of Bangladesh often addresses these types of challenges by allocating resources to construct more schools in these regions and implementing initiatives such as the "Secondary Education Development Program" (Ministry of Education Bangladesh, n.d.).

The government is channeling public funds into scholarships and financial aid programs to promote female enrollment and retention in schools. At the same time, stringent laws are implemented to discourage early marriages (Rupa, 2023). These initiatives have relieved some economic barriers disproportionately faced by girls. For instance, financial incentives offset direct costs related to education, such as tuition and supplies, and indirect costs, such as girls' time spent in school instead of working.

In Bangladesh, public expenditure is also frequently allocated to enhance educational quality through initiatives such as recruiting and training teachers, with a focus on hiring female educators (Layton et al., 2021). Apart from serving as a role model and fostering a more inclusive learning environment, female teachers motivate young girls to pursue education. Seeing them work helps these young girls dream of a similar future where they can participate actively in the workforce (Xu et al., 2019). Authorities are heavily investing public funds to provide safe, accessible school infrastructures with essential amenities, such as separate toilets for girls. These marginal enhancements establish a secure environment and make them feel valued. Hence the chances of joining and remaining at school significantly increase (Ahsan et al., 2020).

6 Policy Recommendation

According to the findings of the study, female secondary school education currently exerts a significant negative effect on economic growth in Bangladesh. This research proposes several evidence-based policies to address socio-economic challenges and optimize the benefits of female education. Primarily, enhancing women's participation in the workforce through targeted initiatives could unlock the economic potential of educated women. For instance, implementing paid parental leave would facilitate a balance between work and family responsibilities, which would subsequently reduce the rate at which women leave the labor market post-childbirth. Furthermore, establishing mentorship programs complemented by grants or low-interest loans for female entrepreneurs could encourage women to initiate and expand their businesses. Implementing gender diversity quotas within leadership roles and corporate boards is essential for fostering equitable representation and empowering women in decision-making capacities. Additionally, tackling cultural and societal norms through awareness campaigns and community engagement is necessary to alter perceptions regarding women's roles, thereby motivating more women to enter the workforce. Skill development programs should be established, and collaborations between educational institutions and industries should be nurtured to enhance alignment with labor market demands, ensuring women acquire the requisite skills for high-demand occupations. Supporting income diversification by promoting non-traditional sectors and investing in infrastructure projects that create job opportunities for women, especially in rural areas, is crucial. Moreover, leveraging female education to drive social development through health and wellness initiatives, as well as leadership and civic engagement programs, can significantly enhance the overall societal impact of educated women. Finally, expanding access to family planning services and implementing economic policies for

retirees can effectively address concerns related to fertility rates, ensuring lower fertility contributes positively to economic stability.

Again, several strategic policy recommendations can be introduced to optimize public expenditure in education, thereby enhancing gender equality and contributing to economic development. Bangladesh should adopt a gender-responsive budgeting strategy, ensuring funds are specifically allocated to confront the distinct barriers female students face. This approach may include increasing scholarships and financial incentives for girls, particularly in rural and economically disadvantaged areas, encouraging them to pursue education despite prevailing challenges.

In addition, enhancing infrastructure by constructing additional schools and providing safe transportation options can alleviate logistical difficulties disproportionately affecting girls. The curriculum should be updated to include gender-sensitive materials that challenge stereotypes and promote female participation in non-traditional fields such as STEM. Moreover, the establishment of monitoring and accountability systems is vital to guarantee that funds are utilized effectively and reach the intended beneficiaries, thereby improving the efficacy of public expenditures.

7 Limitations and Future Research

Like many other studies, this research has its limitations. GDP per capita was selected as the primary indicator of economic growth due to its widespread availability and use. However, it might not be the most comprehensive measure of economic growth. Economic growth is a multifaceted concept encompassing more than the production and consumption captured by GDP. For instance, GDP calculations often overlook the economic value of unpaid household labor disproportionately performed by women. If the monetary value of such labor, particularly the caregiving roles of mothers, were accounted for, it might reflect a more nuanced economic reality and potentially alter the conclusions regarding the impact of gender equality in education on economic growth. Additionally, this study uses female secondary school enrollment rates as a proxy for gender equality in education. While this measure captures access to education, it does not address other aspects, such as the quality of education, gender-specific experiences within schools, or disparities in academic outcomes. The quality of education, in particular, is an abstract and multidimensional concept influenced by factors such as teacher qualifications, curriculum content, learning environments, and the availability of resources, being one of the major factors in determining how education translates into the development of human capital. However, it is excluded from the model due to the complexities of measuring education quality and the lack of reliable data.

Additionally, it is important to recognize that education alone cannot drive economic growth. Socioeconomic factors, cultural norms, and structural barriers—such as the availability of job opportunities, gender biases in the labor market, and societal expectations—play significant roles in determining the extent to which education translates into economic

contributions. Unfortunately, my model, which uses time series data, does not account for these broader structural dynamics.

Again, the data used in this study, which were not collected directly by the author, may be subject to measurement errors or inconsistencies. Reliance on secondary data sources means the study inherits any inaccuracies or biases present in the original datasets, potentially affecting the robustness of the results and the reliability of the conclusions drawn. The study's temporal scope, though spanning nearly three decades, is also subjected to biases from the changes in data collection methods, policy shifts, and external shocks, such as natural disasters or global economic crises, which might have impacted the results.

The study, however, opens up the space for a wide range of topics to be investigated in future research. One of the most surprising findings—the negative impact of gender equality in education on economic growth—requires further investigation to address the pressing "why" question it raises. I hypothesize that this counterintuitive result could stem from several structural factors, such as cultural norms and family expectations regarding their caregiving roles that limit women's participation in the labor force despite their educational achievements, the mismatch between the skills acquired through education and the job opportunities available in the market, or the pervasive gender biases that hinder women's access to high-paying and leadership roles. Future research should explore these dynamics to identify the most significant barriers and pave the way for policy interventions that maximize the economic benefits of education. Additionally, future studies could examine potential biases and gender segregation within the education system itself, which may fail to address the unique needs of women effectively. Investigating these systemic issues could inform more inclusive and impactful education policies across different geographical contexts. Researchers might also consider alternative measures of economic

growth, such as inclusive wealth or human development indices, to test whether the observed relationships persist. Furthermore, the results could vary significantly across urban, rural or other geographical contexts due to disparities in infrastructure, teacher quality, and societal norms. Exploring these variations could help determine whether region-specific policies are necessary to address the challenges.

Similarly, the impact of public expenditure on gender equality in education might differ across regions. For instance, Dhaka, as the capital, likely receives more public education funding than other areas, leading to uneven impacts. Understanding how these disparities play out could enhance the design of equitable education funding policies that ensure gender equality contributes positively to economic growth across all contexts. Also, to inform more targeted investment strategies, future studies could investigate the specific components of public education expenditure—such as spending on infrastructure, teacher salaries, scholarships, or extracurricular activities—to determine which elements are most effective in improving female secondary enrollment rates. While this study focuses on access to education for women, future research could examine whether public expenditure has a similar impact on improving the quality of education, which remains a critical determinant of gender parity and overall educational outcomes. Quality-related factors, such as teacher training, curriculum relevance, and classroom resources, could provide valuable insights into maximizing the benefits of public spending. Finally, exploring how public expenditure on female education influences broader economic indicators—such as female labor force participation, entrepreneurship, and poverty alleviation—could help policymakers better understand the comprehensive and long-term value of investing in gender-equitable education.

8 Conclusion

The purpose of this empirical study was to examine the impact of gender equality in education on economic growth and to assess how public funding in education influences gender parity in a developing nation like Bangladesh, using data from 1995 to 2022. The findings reveal a complex relationship between these factors. Contrary to expectations, the study concludes that gender equality in education negatively impacts the economic growth of Bangladesh. Specifically, increasing the gender ratio by 1% results in a 10.72% reduction in GDP per capita. This result aligns with previous research indicating that in agricultural economies, gender equality in education may have little to no positive effect on economic growth and can sometimes even have negative consequences. This can be attributed to the country's socio-cultural factors, such as educated women not participating in the labor force at levels comparable to men due to societal norms and employment barriers.

The study also finds that public expenditures in education significantly enhance gender equality, with a 1% increase in education spending associated with a 0.1048% rise in female enrollment in secondary schools. This also aligns with existing literature emphasizing that public funding is a crucial driver of gender parity in education, as it can improve access and reduce barriers for female students.

While the findings reveal some of the challenges and nuances involved in leveraging gender equality for economic growth in Bangladesh, they also highlight the vital role of public expenditure in promoting educational opportunities, presenting an opportunity for policymakers to tailor their strategies to ensure that educational investments not only increase enrollment but also translate into economic benefits. Efforts to integrate women more effectively into the labor

force, particularly by creating opportunities in sectors that match their skills and aspirations, could help mitigate the negative impact on economic growth.

I believe addressing the cultural and structural barriers hindering women's economic participation should be a priority for the Bangladeshi government and society. Creating a more inclusive labor market and supporting women in balancing professional and personal responsibilities could unleash the full potential of female education as a driver of economic growth. This study underscores the importance of continued research into the complex interplay between gender equality and economic development. Future studies should explore the qualitative aspects of these relationships and assess the impact of targeted policy interventions.

Ultimately, fostering a more equitable educational environment and a dynamic economy that values the contributions of all its members will be essential for Bangladesh's long-term prosperity.

References

Ahsan, K. Z., Streatfield, P. K., Jamil, K., & Arifeen, S. E. (2020). *Progress towards the Ending Preventable Maternal Mortality (EPMM) target for Bangladesh: The role of female education* (p. 2020.06.01.20119479). medRxiv. https://doi.org/10.1101/2020.06.01.20119479

Akhtar, R., Masud, M. M., & Rana, M. S. (2020). Labour Force Participation and Nature of Employment Among Women in Selangor, Malaysia. *Environment and Urbanization ASIA*, *11*(1), 123–139. https://doi.org/10.1177/0975425320906285

Alam, M. M., & Hoque, M. N. (2022). The Personal, Social, and Cultural Perspectives on Female Secondary School Dropouts in Bangladesh: An Investigation into Pabna District. *South Asian Journal of Social Sciences and Humanities*, *3*(3), Article 3. https://doi.org/10.48165/sajssh.2022.3304

Ali, H., Farooq, F., Sheikh, M. R., & Perveeen, A. (2022). Education, Human Capital, and Endogenous Growth Nexus: Time Series Evidence from Pakistan. *Review of Education, Administration & Law*, *5*(2), Article 2. https://doi.org/10.47067/real.v5i2.223

Alimi, R. S. (2014). ARDL Bounds Testing Approach to Cointegration: A Re-Examination of Augmented Fisher Hypothesis in an Open Economy. *Asian Journal of Economic Modelling*, *2*(2), 103–114. https://doi.org/10.18488/journal.8.2014.22.103.114

Altuzarra, A. A., Gálvez-Gálvez, C., & González-Flores, A. (2021). *Is Gender Inequality a Barrier to Economic Growth? A Panel Data Analysis of Developing Countries*. https://doi.org/10.3390/su13010367

Asongu, S. A., & Odhiambo, N. M. (2020). Finance, governance and inclusive education in Sub-Saharan Africa. *Social Responsibility Journal*, *17*(8), 1044–1061. https://doi.org/10.1108/SRJ-02-2020-0039

BANBEIS. (2022). *Bangladesh Education Statistics 2022* [Dataset]. https://banbeis.gov.bd/

Barro, R. J., & Lee, J.-W. (1994). *Sources of economic growth*. *40*, 1–46. https://doi.org/10.1016/0167-2231(94)90002-7

Barth, E., Reisel, L., & Misje Østbakken, K. (2024). The Equality Hurdle: Resolving the Welfare State Paradox. *Work, Employment and Society*, *38*(3), 766–786. https://doi.org/10.1177/09500170231155293

Begum, A. (2015). Gender in education: Policy discourse and challenges. *Development in Practice*, *25*(5), 754–768. https://doi.org/10.1080/09614524.2015.1049514

Bora, J. K., Saikia, N., Kebede, E. B., & Lutz, W. (2023). *Revisiting the causes of fertility decline in Bangladesh: The relative importance of female education and family planning programs*.

Brown, D. S. (2004). Democracy and Gender Inequality in Education: A Cross-National Examination. *British Journal of Political Science*, *34*(1), 137–152. https://doi.org/10.1017/S0007123403210395

Byron, R. K. (2023, March 30). Labour Force Survey 2022: Agriculture still main job generator. *The Daily Star*. https://www.thedailystar.net/news/bangladesh/news/labour-force-survey-2022-agriculture-still-main-job-generator-3283936

Caporale, G. M., & Pittis, N. (2004). *Robustness of the CUSUM and CUSUM-of-squares tests to serial correlation, endogeneity and lack of Structural invariance: Some Monte Carlo*

evidence (Working Paper No. 157). Reihe Ökonomie / Economics Series. https://www.econstor.eu/handle/10419/72284

Cavanaugh, J. E., & Neath, A. A. (1999). Generalizing the derivation of the schwarz information criterion. *Communications in Statistics - Theory and Methods*, *28*(1), 49–66. https://doi.org/10.1080/03610929908832282

Chowdhury, S., Rahman, M., & Zayed, N. (2020). Factors Affecting Early Marriage in Bangladesh: An Analysis on BDHS, 2014 Data. *Journal of Humanities, Arts and Social Science*, *4*, 40–47. https://doi.org/10.26855/jhass.2020.01.006

Clarke, K. A. (2005). The Phantom Menace: Omitted Variable Bias in Econometric Research. *Conflict Management and Peace Science*, *22*(4), 341–352. https://doi.org/10.1080/07388940500339183

DeJaeghere, J., & Wiger, N. P. (2013). Gender discourses in an NGO education project: Openings for transformation toward gender equality in Bangladesh. *International Journal of Educational Development*, *33*(6), 557–565. https://doi.org/10.1016/j.ijedudev.2013.02.002

Dhar, S., & Sarker, T. (2023). *The Impact of Female Secondary Education on Economic Growth in Bangladesh: An ARDL Approach*. https://doi.org/10.21203/rs.3.rs-3031511/v1

Directorate of Secondary and Higher Education. (n.d.). *SESIP | Secondary Education Sector Investment Program*. Retrieved June 17, 2024, from https://sesip.gov.bd/about-sesip/

Dollar, D., & Gatti, R. (1999). *Gender Inequality, Income, and Growth: Are Good Times Good for Women?*

Emara, N. (2021). *Income Elasticity and the Gender Gap: A Challenging MDG for the MENA Countries by Noha Emara :: SSRN* (SSRN Scholarly Paper No. 3814395). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3814395

Emara, N., & Hegazy, A. (2021). *Government Spending on Education and Closing the Gender Gap: The Case of Developing Economies by Noha Emara, Azza Hegazy :: SSRN*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3814368

Esen, Ö., & Seren, G. Y. (2021). The impact of gender inequality in education and employment on economic performance in Turkey: Evidence from a cointegration approach. *Equality, Diversity and Inclusion: An International Journal*, *41*(4), 592–607. https://doi.org/10.1108/EDI-04-2021-0099

Gee, K. A. (2015). Achieving gender equality in learning outcomes: Evidence from a non-formal education program in Bangladesh. *International Journal of Educational Development*, *40*, 207–216. https://doi.org/10.1016/j.ijedudev.2014.09.001

Guan, L. (2019). Research on the Contribution of Female Human Capital in Economic Growth in Guangdong Province. *Modern Economy*, *10*(4), Article 4. https://doi.org/10.4236/me.2019.104087

Hossain, M. A., & Tisdell, C. A. (2005). Closing the gender gap in Bangladesh: Inequality in education, employment and earnings. *International Journal of Social Economics*, *32*(5), 439–453. https://doi.org/10.1108/03068290510591281

IMF. (n.d.). *Gross Domestic Product: An Economy's All*. Retrieved December 4, 2024, from https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/gross-domestic-product-GDP

Islam, K. (2014). *Impact of Female Education on Fertility in Bangladesh*. 15–33.

Islam, M. K. (2016). *Impact of Female Education on Fertility in Bangladesh*. https://www.semanticscholar.org/paper/Impact-of-Female-Education-on-Fertility-in-Islam/8a2aab231f2028322e0ece088ac96794108bad05

Jaiyeoba, S. V. (2015). Human Capital Investment and Economic Growth in Nigeria. *African Research Review*, *9*(1), Article 1. https://doi.org/10.4314/afrrev.v9i1.4

Kaufman, R. L. (2013). *Heteroskedasticity in Regression: Detection and Correction*. SAGE Publications.

Khandker, S. R. (2021). *The Female Secondary Stipend and Assistance Program in Bangladesh: What Did It Accomplish?* (Bangladesh). https://www.adb.org/publications/female-secondary-stipend-assistance-program-bangladesh

Klasen, S., & Lamanna, F. (2008). The Impact of Gender Inequality in Education and Employment on Economic Growth in Developing Countries: Updates and Extensions. *Ibero-America Institute for Economic Research, Ibero America Institute for Econ. Research (IAI) Discussion Papers*.

Klasen, S., & Lamanna, F. (2009). The Impact of Gender Inequality in Education and Employment on Economic Growth: New Evidence for a Panel of Countries. *Feminist Economics*, *15*, 91–132. https://doi.org/10.1080/13545700902893106

Kolovich, L., Malta, V., Newiak, M., & Robinson, D. (2020). Gender equality and macroeconomic outcomes: Evidence and policy implications. *Oxford Review of Economic Policy*, *36*(4), 743–759. https://doi.org/10.1093/oxrep/graa049

Kripfganz, S., & Schneider, D. C. (2023). *ardl: Estimating autoregressive distributed lag and equilibrium correction models | Request PDF*. http://dx.doi.org/10.1177/1536867X231212434

Layton, L. A., Lusk-Stover, O., Inoue, K., & Sosale, S. (2021, July 8). *How to provide opportunities for all? From girls' education to women's labor force participation in Bangladesh*. https://blogs.worldbank.org/en/education/how-provide-opportunities-all-girls-education-womens-labor-force-participation-bangladesh

Legendre, P. (1993). *Spatial Autocorrelation: Trouble or New Paradigm? - Legendre—1993—Ecology—Wiley Online Library*. https://esajournals.onlinelibrary.wiley.com/doi/abs/10.2307/1939924

Luetkepohl, H., & Xu, F. (2009). *The role of the log transformation in forecasting economic variables*. http://dx.doi.org/10.2139/ssrn.1505506

LUTKEPOHL, H., & KRATZIG, M. (2004). *APPLIED TIMESERIES ECONOMETRICS*. http://www.cambridge.org/9780521839198

Macrotrends. (2024, November 25). *Bangladesh Literacy Rate 1981-2024*. https://www.macrotrends.net/global-metrics/countries/BGD/bangladesh/literacy-rate

Mbodji, Y. C. (2023). Effects of public expenditure on education on gender inequality in education in sub-Saharan Africa (SSA). *Review of Education*, *11*(2), e3398. https://doi.org/10.1002/rev3.3398

Mishra, P. K., Mishra, S. K., & Sarangi, M. K. (2020). Do Women's Advancement and Gender Parity Promote Economic Growth? Evidence from 30 Asian Countries. *Millennial Asia*, *11*(1), 5–26. https://doi.org/10.1177/0976399619900603

Monter-Pozos, A., & González-Estrada, E. (2024). On testing the skew normal distribution by using Shapiro–Wilk test. *Journal of Computational and Applied Mathematics*, *440*, 115649. https://doi.org/10.1016/j.cam.2023.115649

Mukherjee, P., & Agarwal, M. (2023). FACTORS INFLUENCING FEMALE WORKFORCE PARTICIPATION IN URBAN INDIA-A CASE STUDY. *International Journal of Indian Economic Light(JIEL)*, *11*(2), Article 2.

Nath, S. R. (2019). *Education Watch 2018-19: Quality and Governance of Secondary Education in Bangladesh. Campaign for Popular Education (CAMPE).*

Noureen, G., & Awan, R. (2011). Women's Education in Pakistan: Hidden Fences on Open Frontiers. *Asian Social Science*, *7*(2), Article 2. https://doi.org/10.5539/ass.v7n2p79

Otsuka, K., Takahashi, K., & Tanakam, T. (2020). *Increasing female education, stagnating female labor force participation, and gains from marriage: The case of rural Bangladesh*. 19–34. https://doi.org/10.24545/00001729

Perry, K. (2022). Better for whom? Sanction type and the gendered consequences for women. *International Relations*, *36*(2), 151–175. https://doi.org/10.1177/00471178211018843

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics*, *16*(3), 289–326.

Rahman, R. I. ., & Islam, R. (2013, October 15). *Female labour force participation in Bangladesh: Trends, drivers and barriers | International Labour Organization*. https://www.ilo.org/publications/female-labour-force-participation-bangladesh-trends-drivers-and-barriers

Rupa, U. F. (2023, July 31). Behind the Success of Female Education in Bangladesh. *The Confluence*. https://theconfluence.blog/behind-the-success-of-female-education-in-bangladesh/

Saâd, M. B., & Ella, G. A. (2021). *Economic Complexity and Gender Inequality in Education: An Empirical Study by Myriam Ben Saâd, Giscard Assoumou-Ella :: SSRN* (SSRN

Scholarly Paper No. 3340913). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3340913

Senadza, B., & Hodey, L. (2015). Effect of public education expenditure on selected primary education outcomes in Sub-Saharan Africa. *International Journal of Education Economics and Development*, *6*, 314. https://doi.org/10.1504/IJEED.2015.075794

Shashank. (2023, March). *Why Education is Key to Break the Poverty Cycle in Developing Countries*. https://gobookmart.com/why-education-is-key-to-break-the-poverty-cycle-in-developing-countries/?amp=

Sheikh, Md. R. I. (2021). *Distributional Effects of Public Educational Expenditures: Empirical Results from Cohort Analysis | Advances in Social Sciences Research Journal*. https://doi.org/10.14738/assrj.83.9928

Singh, A. K., & Kumar, S. (2021). Assessing the Performance and Factors Affecting Industrial Development in Indian States: An Empirical Analysis. *Journal of Social Economics Research*, *8*(2), Article 2. https://doi.org/10.18488/journal.35.2021.82.135.154

Sperandio, J. (2007). Women Leading and Owning Schools in Bangladesh: Opportunities in Public, Informal, and Private Education. *Journal of Women in Educational Leadership*. https://digitalcommons.unl.edu/jwel/64

Tareque, M., & Ahmed, T. T. (2024, April 3). Growing rural-urban education divide is hurting Bangladesh's future. *The Daily Star*. https://www.thedailystar.net/opinion/views/news/growing-rural-urban-education-divide-hurting-bangladeshs-future-3580771

UNESCO. (2021). *Global education monitoring report, 2021/2: Non-state actors in education: who chooses? who loses?* UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000379875

UNICEF. (2022). *Education*. https://data.unicef.org/topic/gender/gender-disparities-in-education/

United Nation. (2023). *Transforming our world: The 2030 Agenda for Sustainable Development | Department of Economic and Social Affairs*. https://sdgs.un.org/2030agenda

West, R. M. (2022). Best practice in statistics: The use of log transformation. *Annals of Clinical Biochemistry*, *59*(3), 162–165. https://doi.org/10.1177/00045632211050531

World Bank. (2015, December 2). Education as a vehicle to end violence against women. *World Bank Blogs*. https://blogs.worldbank.org/en/voices/education-vehicle-end-violence-against-women

World Bank. (2017). *World Bank Helps Bangladesh Improve Secondary Education, Benefiting 13 Million Students* [Text/HTML]. World Bank. https://www.worldbank.org/en/news/press-release/2017/12/18/world-bank-helps-bangladesh-improve-secondary-education-benefiting-13-million-students

World Bank. (2023a). *World Bank Open Data* [Dataset]. https://data.worldbank.org

World Bank. (2023b). *World Bank Open Data*. https://data.worldbank.org

World Economic Forum. (2023). *Global Gender Gap Report 2023*. https://www.weforum.org/publications/global-gender-gap-report-2023/

Xu, S., Shonchoy, A., & Fujii, T. (2019). *Illusion of Gender Parity in Education: Intrahousehold Resource Allocation in Bangladesh* (SSRN Scholarly Paper No. 3386159). Social Science Research Network. https://doi.org/10.2139/ssrn.3386159

Zahra, K., Yasin, M., Sultana, B., Haider, Z., & Khatoon, R. (2021). *Impact of Women Education on Economic Growth: An Evidence from Pakistan | Journal of Economic Impact*. https://doi.org/10.52223/jei30221037

Zeng, Y. (2023, February 15). *The Positive Effect of Promoting Gender Equality in Education on Economic Growth: From the Perspective of Gender Dividend*. Proceedings of the 4th International Conference on Economic Management and Model Engineering, ICEMME 2022, November 18-20, 2022, Nanjing, China. https://eudl.eu/doi/10.4108/eai.18-11-2022.2326768

Zhang, C. (2022). *Features and Insights of Gender Equity Legislation in Higher Education in the United States:* 2021 International Conference on Social Development and Media Communication (SDMC 2021), Sanya, China. https://doi.org/10.2991/assehr.k.220105.159