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The Impact of Fertility Rate, Gross Domestic Product, and Education Spending on Secondary School Female Enrollment

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ABSTRACT

Lack of secondary school education has adverse economic impacts, and this problem is severe for female students who have lower enrollment rates than male students, especially in low-income countries. To better understand the causes for lower female enrollment in secondary schools across the globe, we analyzed socio-economic factors that were likely to influence secondary school female enrollment. Specifically, we evaluated adolescent fertility rate (births per 1,000 women ages 15-19), per capita GDP, government spending on education (% of per capita GDP), and government spending on education (US$ per capita). Inferences on the relationship between secondary school female enrollment and the 4 variables were made from scatter plots, boxplots, regression, and correlation analyses. Pearson's product moment correlation coefficient (r) was used to measure the strength of linear relationships while non-linear monotonic trends were characterized using Spearman's rank correlation coefficient (r_s). A negative linear correlation (r = -0.798) was observed between female enrollment and fertility rates while a strong positive non-linear correlation was observed between government spending on education and female enrollment rates as indicated by a Spearman's coefficient of 0.799. Overall, our analysis indicated that reducing teenage pregnancies and increasing government spending on education, even to relatively modest levels of $100 – $200 per capita can bring female enrollment rates in the 50 – 75% range which can lead to significant gains both at the personal and national level.

Introduction

It is widely recognized that high-school education has a substantial positive impact across several economic dimensions (Glewwe et al., 2014; Peter Wobst, 2005). Furthermore, given the disparity between male and female student enrollment in high school (Anyanwu, 2016; Grant & Behrman, 2010; Lee, 2014), lower female enrollment rates can have a higher adverse impact on economic development (Baliamoune–Lutz & McGillivray, 2015; Chaaban & Cunningham, 2011; Heath & Jayachandran, 2016; Subbarao & Raney, 1995).

Female enrollment in secondary school remains a challenge (Adetunde & Akampae Akensin, 2008; de Carvalho Filho, 2012; Kazeem et al., 2010). UNESCO estimates that 97 million girls are out of secondary schooling and this problem is especially acute in low-income countries where only 36% of girls complete lower secondary school compared to 44% for boys (World Bank, 2022a). In countries affected by conflict, girls are more likely to be out of school and the economic loss is estimated to be in the tens of trillions (World Bank, 2022a). Improving enrollment rates in the female demographic will result in broad social gains by raising economic growth rates (Peter Wobst, 2005) and increasing quality of life through increased access to basic necessities (Latif, 2009).

Teenage pregnancy, low income, and wide-spread negative attitudes about women's capabilities are among the many factors that continue to keep females out of secondary schooling (Adetunde & Akampae Akensin, 2008). Studies conducted on gender equality in secondary school enrollment in Africa have found that a high domestic investment rate (Lee, 2014) and being an oil-exporting country (Anyanwu, 2016) increased gender equality in secondary

education. Additionally, studies have found that lower fertility rates and increased female education are correlated, especially in countries with low enrollment rates (Shahidul & Karim, 2015). Gross domestic product (GDP) improvements as high as 68% have been predicted if all girls are able to complete the next level of schooling (Chaaban & Cunningham, 2011). Furthermore, unequal gender norms and the stigma associated with teenage pregnancy lead many females to drop out of school, thus reducing female enrollment in secondary schools (World Bank, 2022a).

In this paper, we explore socio-economic factors that influence secondary school female enrollment. Specifically, fertility rates, per capita GDP, and government spending on education (as % of per capita GDP and in absolute US$) were identified as independent variables that could impact female enrollment rates and were analyzed. Using a combination of scatter plots, boxplots, regression and correlation analyses, we quantified the relationships between secondary school female enrollment rates and the 4 independent variables. Pearson's product moment correlation coefficient (r) was used to measure the strength of linear relationships while non-linear monotonic trends were characterized using Spearman's rank correlation coefficient (r_s).

Our analyses indicated a strong negative correlation between secondary school female enrollment and fertility rates and a strong positive correlation between secondary school female enrollment and government spending on education. Reducing teenage pregnancy and increasing per capita spend on education are the biggest opportunities to substantially increase adolescent female enrollment in secondary schools.

Analytical Approach

The impact of 4 independent variables (adolescent fertility rate as births per 1,000 women ages 15-19, per capita GDP in US$, government spending on education as % of per capita GDP, and government spending on education as US$ per capita) on global female enrollment rates was analyzed in this study. The year 2017 was used for analysis because it was the most recent year for which data were available across the 4 variables analyzed (World Bank, 2022b). While 261 countries were listed in the database, only 81 of them had data across the 4 variables and hence this set of 81 counties was used in the analysis. These 81 countries represented low-, middle-, and high-income countries and reflect global diversity in the analysis performed in this study.

Results

Secondary School Female Enrollment

Secondary school female enrollment data from 81 countries from the year 2017 were used in the analysis and they include representation from low-, middle-, and high-income countries. A histogram and boxplot for female enrollment data are shown in Figure 1 where the histogram indicates a lack of normal distribution with most data representing >70% enrollment. The high standard deviation of 22.8% (mean = 76.3%; IQR = 28.3%) is reflective of the highly varying socioeconomic conditions across the countries evaluated in this study. Niger was the only outlier (Figure 1B) as its 17.1% enrollment rate was below the lower boundary of 22.2%. The boxplot is skewed to the top (median = 86%) indicating a greater proportion of countries with high female enrollment.

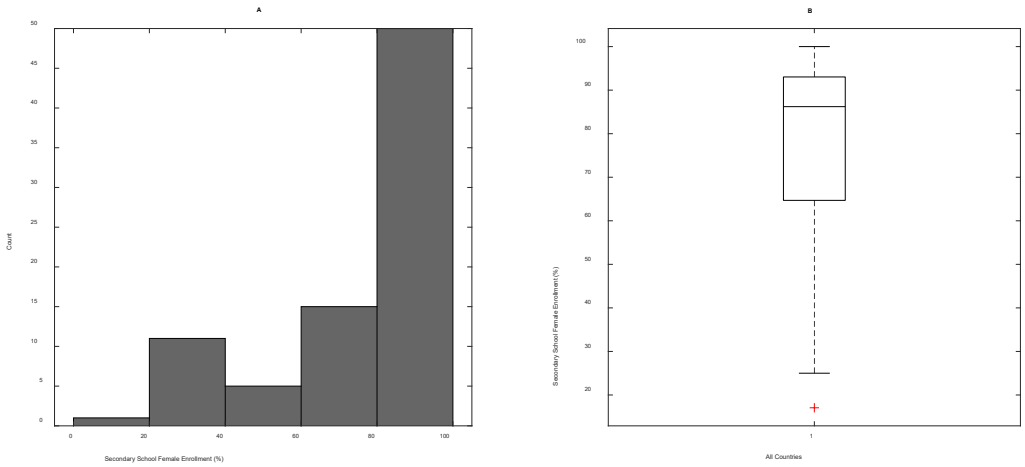

Figure 1. Histogram of secondary school female enrollment (A) and box plot for enrollment data across 81 countries (B).

Impact of Fertility on Enrollment

Figure 2 shows a scatterplot of secondary school female enrollment versus adolescent fertility rates for the 81 countries analyzed in this study. A negative correlation is seen between fertility rates and female enrollment and the trend is linear. Results from linear regression analysis suggested a clear negative linear correlation (r = -0.798) indicating that reducing births in the 15-19 demographic is an important lever to increase female school enrollment.

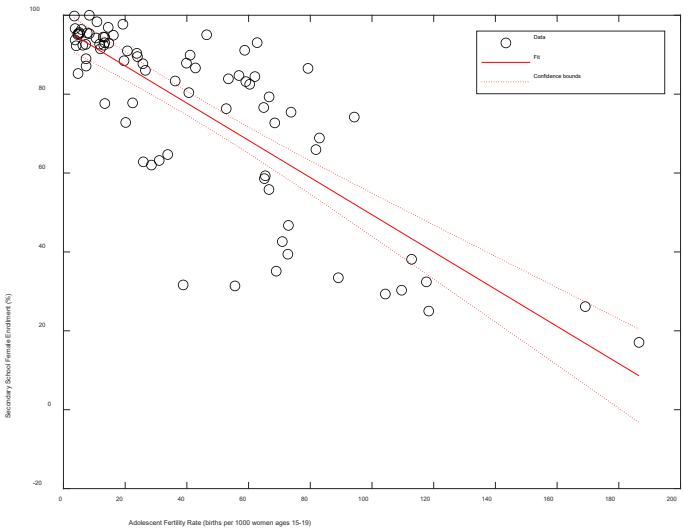

Figure 2. Relationship between secondary school female enrollment and adolescent fertility rate for 81 countries (o) and the linear regression trendline with 95% confidence intervals.

Impact of Per Capita GDP on Enrollment

Secondary school female enrollment data as a function of per capita GDP for the 81 countries analyzed in this study are shown in Figure 3. The data clearly indicates a nonlinear relationship between these two variables. A sharp

increase in enrollment rates is seen in the early part of the graph for per capita GDP up to $10,000 (Figure 3A). For per capita GDP values >$10,000, the increase in enrollment rates is relatively small, and beyond $20,000, enrollment rates are relatively flat and >90%. Following logarithmic transformation of the GDP data (Figure 3B), a linear regression was associated with a r value of 0.815 and the Spearman's coefficient of the GDP versus enrollment data (Figure 3A) was 0.811.

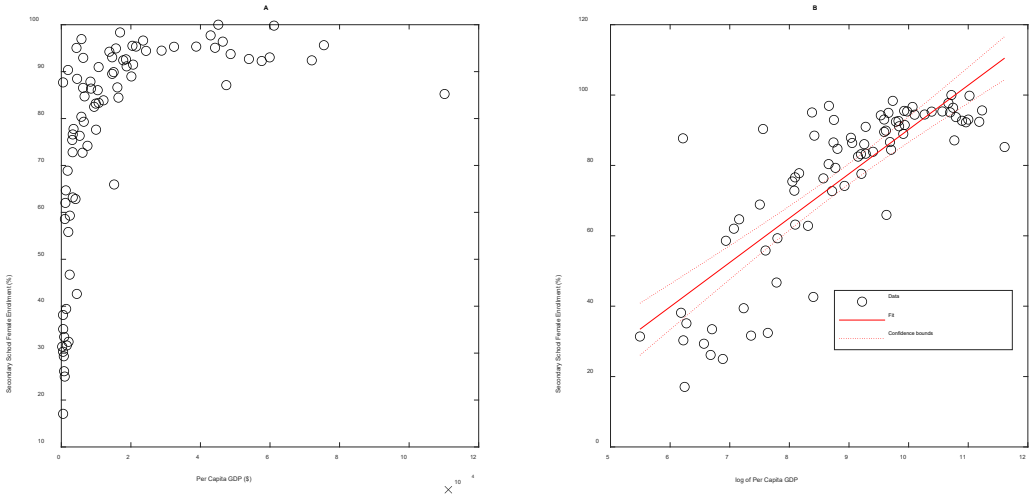

Figure 3. Relationship between secondary school female enrollment and per capita GDP. The linear regression trendline and 95% confidence intervals for the log transformed GDP data are shown in Figure 3B.

Impact of Government Education Expenditure (% of per capita GDP) on Enrollment

The next variable analyzed was government expenditure on education as a percentage of per capita GDP for the 81 countries. A graph of female enrollment versus spending on education along with the linear regression trendline and 95% confidence intervals is shown in Figure 4 where no trend was observed (r = 0.251). Government expenditures were in a relatively narrow range (2 – 9% of per capita GDP) and because the actual GDP values varied significantly across the 81 countries, education expenditure as a percentage of per capita GDP is not a reliable method of correlating government expenditure with female enrollment.

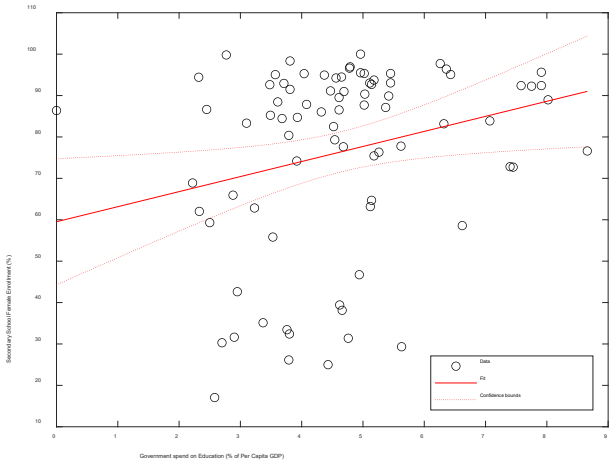

Figure 4. Relationship between secondary school female enrollment and government spend on education (% of per capita GDP) for 81 countries (o) and the linear regression trendline with 95% confidence intervals.

Impact of Government Education Expenditure (as $ per capita) on Enrollment

Recognizing the limitations of the analysis performed in Figure 4, an alternate variable was developed to track government expenditure and its potential impact on female enrollment. Specifically, the per capita GDP and percentage per capita spent on education data sets were used to determine the actual amount in US dollars per capita spent on education across the 81 countries. This variable eliminated potential bias originating from the large differences in GDP across the 81 countries and was likely to provide a more direct comparison of the impact of government spending on female enrollment.

Figure 5 shows the relationship between secondary school female enrollment and government expenditure on education measured by the dollars per capita allocated to education. A strong logarithmic dependence is seen in Figure 5a where a steep increase in enrollment is seen in the early part of the curve. Increasing dollar spend per capita to ~$100 can increase enrollment rates to ~50% and an additional increase to ~$200 can increase enrollment rates to ~75%. This presents a significant opportunity to improve female enrollment that should be considered seriously. The data also suggest that improving spending beyond $1000 results in small improvements to enrollment rates.

Following logarithmic transformation of the government spending on education data (Figure 5B), a linear regression was associated with a r value of 0.816 while the Spearman's coefficient of the spend versus enrollment data in Figure 5A was 0.799. This similarity between the r value for the log transformed data (0.816) and the r_s value (0.799) for the non-transformed data is to be expected.

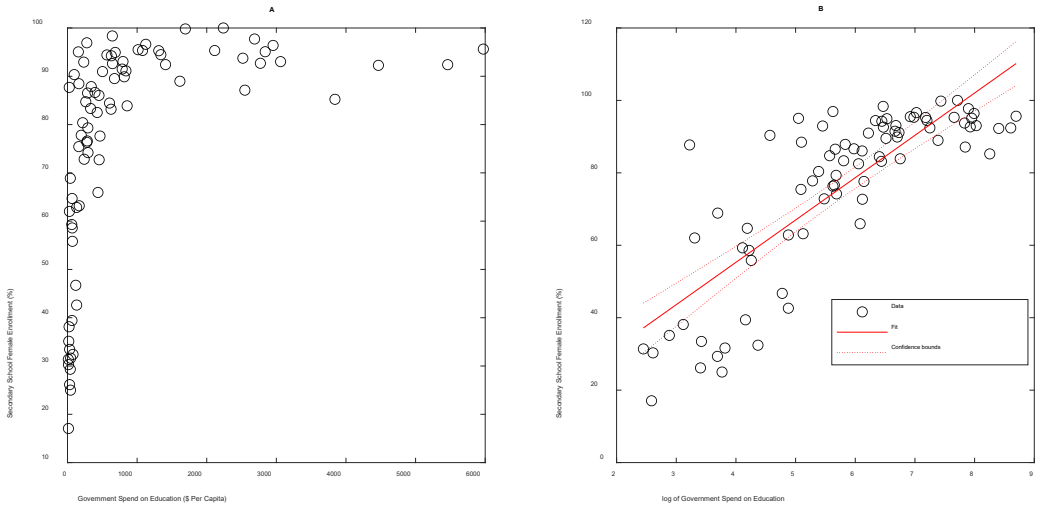

Figure 5. Relationship between secondary school female enrollment and government spending on education ($ per capita). The linear regression trendline and 95% confidence intervals for the log transformed government spending data are shown in Figure 5B.

Conclusion

To understand factors that impact adolescent female enrollment in secondary schools across the globe, 4 variables including fertility, per capita GDP, and government spending on education measured both as a percentage of GDP and in actual dollars per capita were analyzed across 81 countries for the year 2017. Linear regression analyses were performed (data were log transformed when the correlation was logarithmic) and correlation coefficients were estimated to quantify the extent of variable correlation. Results from these statistical analyses indicated the following:

- **Fertility rates:** Adolescent female enrollment was linearly and negatively correlated with adolescent fertility rates (r = -0.798). Reducing teenage pregnancies and hence fertility rates, especially in low-income countries, is a substantial opportunity to improve adolescent female enrollment in secondary schools.
- **Per-Capita GDP:** High GDP countries had higher rates of enrollment and the relationship between GDP and enrollment was non-linear (r_s = 0.811). Enrollment rates increased rapidly with GDP and approached ~80% at per-capita GDP of $10,000. This was followed by a levelling off at ~90% when the per-capita GDP values approached $20,000.
- **Government Spending on Education:** The relationship between the per capita spent on education and enrollment rates was nonlinear (r_s = 0.799) and increasing the spend on education to ~$100 per capita can raise the enrollment levels to ~50%. A further increase to ~$200 per capita can raise enrollment levels to ~75%. Modest investment increases are perhaps the biggest opportunity for low- and some middle-income countries to increase adolescent female enrollment.

References

Adetunde, I. A., & Akampae Akensin, P. (2008). *Factors affecting the standard of female education: A case study of senior secondary schools in the Kassena-Nankana district*. http://ir.ucc.edu.gh/jspui/handle/123456789/5411

Anyanwu, J. C. (2016). Accounting for Gender Equality in Secondary School Enrollment in Africa. *African Development Review*, *28*(2), 170–191. https://doi.org/10.1111/1467-8268.12188

Baliamoune–Lutz, M., & McGillivray, M. (2015). The impact of gender inequality in education on income in Africa and the Middle East. *Economic Modelling*, *47*, 1–11. https://doi.org/10.1016/j.econmod.2014.11.031

Chaaban, J., & Cunningham, W. (2011). *Measuring the Economic Gain of Investing in Girls: The Girl Effect Dividend* (SSRN Scholarly Paper No. 1907071). https://papers.ssrn.com/abstract=1907071

de Carvalho Filho, I. E. (2012). Household Income as a Determinant of Child Labor and School Enrollment in Brazil: Evidence from a Social Security Reform. *Economic Development and Cultural Change*, *60*(2), 399–435. https://doi.org/10.1086/662576

Glewwe, P., Maïga, E., & Zheng, H. (2014). The Contribution of Education to Economic Growth: A Review of the Evidence, with Special Attention and an Application to Sub-Saharan Africa. *World Development*, *59*, 379–393. https://doi.org/10.1016/j.worlddev.2014.01.021

Grant, M. J., & Behrman, J. R. (2010). Gender Gaps in Educational Attainment in Less Developed Countries. *Population and Development Review*, *36*(1), 71–89. https://doi.org/10.1111/j.1728-4457.2010.00318.x

Heath, R., & Jayachandran, S. (2016). *The Causes and Consequences of Increased Female Education and Labor Force Participation in Developing Countries* (Working Paper No. 22766). National Bureau of Economic Research. https://doi.org/10.3386/w22766

Kazeem, A., Jensen, L., & Stokes, C. S. (2010). School Attendance in Nigeria: Understanding the Impact and Intersection of Gender, Urban-Rural Residence, and Socioeconomic Status. *Comparative Education Review*, *54*(2), 295–319. https://doi.org/10.1086/652139

Latif, A. (2009). A Critical Analysis of School Enrollment and Literacy Rates of Girls and Women in Pakistan. *Educational Studies*, *45*(5), 424–439. https://doi.org/10.1080/00131940903190477

Lee, M.-H. (2014). Schooling and Industrialization in China: Gender Differences in School Enrollment. *Comparative Education Review*, *58*(2), 241–268. https://doi.org/10.1086/675380

Peter Wobst, H. S. and. (2005). The Impact of Increased School Enrollment on Economic Growth in Tanzania. *African Development Review*, *17*(2), 274–301. https://doi.org/10.1111/j.1017-6772.2005.00116.x

Shahidul, S. M., & Karim, A. Z. (2015). Factors Contributing to School Dropout among the Girls: A Review of Literature. *European Journal of Research and Reflection in Educational Sciences Vol*, *3*(2).

Subbarao, K., & Raney, L. (1995). Social Gains from Female Education: A Cross-National Study. *Economic Development and Cultural Change*, *44*(1), 105–128. https://doi.org/10.1086/452202

World Bank. (2022a). *Girls' Education* [Text/HTML]. World Bank. https://www.worldbank.org/en/topic/girlseducation

World Bank. (2022b). *World Bank Open Data*. World Bank Open Data. https://data.worldbank.org