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Abstract
The paper examines the impact of adolescent fertility rate on tertiary educational attainment of populations aged 25 and above in 116 nations, divided into high income, upper-middle income and lower-middle income economies under the World Bank's classification. It looks at this relationship while also studying the impact of urbanization on educational attainment. The reason why the relationship between adolescent fertility rate, urbanization and population with tertiary schooling is of interest is because most research associated with fertility rate and education focuses on the relationship between primary education and fertility, not on the level of impediments for higher education that relates to adolescent fertility rate and urbanization. It would be reasonable to think that higher education postpones parenthood and decreases the number of children a woman would have in their adolescent years. However, this research examines this relationship in the opposite direction to provide some observations on adolescent fertility and urbanization's impact on educational attainment in a global perspective.

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I. INTRODUCTION

High adolescent fertility rate had been a common concern for many of the least developed countries in the world. Among the nations with relatively high adolescent fertility, they also share a common trait of low educational attainment in terms of tertiary schooling. According to the World Bank, in 2010, Niger had an adolescent fertility rate of 20.5%, the highest among all reported nations (World Bank, World Development Indicators, 2018). Similarly, Mozambique, Zimbabwe and Republic of Congo all had the highest adolescent fertility rate in the world ranging from 10% and above, and they all had a below 3% population with tertiary schooling. All of these nations were classified as either lower-middle income or low-income economies by the World Bank. Young women in developing countries tend to have children earlier in their adolescent life, between the ages of 15 and 19, and women who were pregnant during their adolescent age would be less likely to attain a higher education level to become a contributing family worker. Ultimately, their children would also be less likely to receive a higher education level in the future. This would impede the family's chances of getting out of poverty or engaging in the formal economy. Research consistently showed that higher education level tends to lower fertility rates due to higher opportunity cost for women with higher education level to be pregnant. Even at the primary education level, countries such as Japan with a 100% primary school enrollment had a total fertility rate of 1.3 children per woman, while on the other end of the spectrum, Eritrea only had a 35.7% primary school enrollment rate and a total fertility rate of 4.6 children per woman (Fitzgerald, 2011). With technological advancements and automation coming at a faster pace than ever, it is no longer sufficient for transitioning economies to specialize in low skilled and labor-intensive industries to drive economic growth. Countries must improve their population's skill levels through proper education.

This paper examines the impact of adolescent fertility rate on tertiary educational attainment of populations aged 25 and above in 116 nations, divided into high income, upper-middle income and lower-middle income economies under the World Bank's classification. It looks at this relationship while also studying the impact of urbanization on educational attainment. The reason why the relationship between adolescent fertility rate, urbanization and population with tertiary schooling is of interest is because most research associated with fertility rate and education focuses on the relationship between primary education and fertility, not on the level of impediments for higher education that relates to adolescent fertility rate and urbanization. It would be reasonable to think that higher education postpones parenthood and decreases the number of children a woman would have in their adolescent years. However, this research examines this relationship in the opposite direction to provide some observations on adolescent fertility and urbanization's impact on educational attainment in a global perspective.

II. LITERATURE REVIEW

The relationship between adolescent fertility and educational attainment has been studied by economists numerous times. It was Gary Becker who pioneered the concept of human capital in Economics during the mid-1900's. It was the seminal work of Gary Becker, An Economic Analysis of Fertility, where he theorized children as "consumer durable goods" that produce "psychic income to parent" (Becker, 1960). Becker claimed fertility to be a function of income, child costs, knowledge, uncertainty and taste (Becker,1960). He later refined his theory on human capital, proposing that the quality of the children is directly related to the amount of investment - such as education - spent on them. Thus, the more children one chooses to have, the lower quality each child would become (Becker; Lewis, 1973). Becker's contributions served as a foundational work for many economists in development studies.

In addition, the causal relationship between adolescent fertility and educational attainment of women has been argued by economists in both directions. Some economists argued fertility as a function of education, and some in the other direction. Galindev suggested the theory that states: "the rise in income, the decline in the relative price of leisure goods and increase in educational attainment in the process of development speed up the demographic transition from high to low fertility and contributed to the transition from stagnation to growth" (Galindev, 2011). Galindev argued that children were a substitution good to leisure, so growing education levels among mothers were one of the factors for low fertility. The focus of this research, however, examines education as a function of fertility and urbanization, where the latter of which serves as an indicator of income level and development. On top of that, this research will expand to less developed countries where high fertility still remains a pressing issue.

Becker's theory was tested by many economists through empirical studies. An example of earlier empirical studies after Becker's publication, "The Impact of an Early First Birth on Young Women's Educational Attainment," concluded that 1) the lower the age at first birth, the fewer years of schooling; 2) the effect of most educational attainment depends on the age at first birth; 3) the effect of educational decrement caused by an early birth is about half as large for young black women as for their white counterparts (Waite and Moore, 1978). Waite and Moore used survey data from the National Longitudinal Study of the Labor Market Experience of Young Women to create a regression examining educational attainment of women based on their first childbearing age, race, occupation of head of household, high school curriculum, and parent's educational goal etc. Waite and Moore's model also considered the social and economic background of women in addition to their childbearing age.

A later study by Seeborg and Kumazawa concluded that the impact on women's educational attainment from teenage motherhood "depend on the socio-economic background of the mother" (Seeborg; Kumazawa, 1996). Seeborg and Kumazawa used an OLS regression model based on data from the National longitudinal Survey of Youth. They argued that while early pregnancy does impede a woman's chance of achieving higher educational attainment, improving under-privileged young women's educational readiness would have more impact on educational attainment, and subsequently, their socio-economic status, than simply decreasing adolescent pregnancy. Similar to Seeborg and Kumazawa's study, this research uses income levels as a proxy for women's socio-economic status in a

broader international scale. Furthermore, a more recent case study in Cameroon was conducted by Tabetando and Ahidjo in 2015 with survey data from the Demographic and Health Survey Program (DHS) of Cameroon. Their OLS regression found that adolescent motherhood led to a 0.5 to 3.5 years of reduction in schooling of teenage mothers (Tabetando; Ahidjo, 2015).

Based on previous publications, it had been found that a relationship does indeed exist between fertility and educational attainment. This research will expand on the previous studies by examining adolescent fertility rate and urbanization's impact on educational attainment levels in various country groups. The relationship between tertiary schooling, adolescent fertility and urbanization will be compared across different income levels. Furthermore, unlike the previous studies that focused on fertility and other factors' impacts on education in specific countries, this research will provide a global analysis of adolescent fertility and educational attainment. Last but not least, the previous researchers did not look at urbanization's impact on raising educational attainment levels. Since many developing economies have a relatively larger rural population than developed countries, it would be beneficial to evaluate the impacts of urbanization on population with tertiary schooling.

III. DATA AND METHODS

To explore the impacts of adolescent fertility rate and urbanization on population with tertiary schooling, data was retrieved from the World Development Indicators (World Bank, 2018). The dataset containing the percentages of population aged 25 and above with some tertiary education was sourced from the Barro-Lee Educational Attainment Dataset and was compiled by the Geographical Economic Data website of the Federal Reserves of St. Louis (GEOFRED, 2018). This dataset contained the percentages regardless of completion for both male and female by nation in 2010 and was collected every 5 years with 2010 being the latest set available. The adolescent fertility rate (births per 1,000 women ages 15-19) and urban population (percent) in 2010 datasets were sourced from the World Bank where they are collected annually. Adolescent fertility rate is defined as the number of births per 1,000 women ages 15-19. Urban population is the percentage of population living in urban areas as defined by national statistical offices. Due to limited availability for the tertiary schooling data as mentioned above, 2010 was selected as the sample year for this research.

Moreover, some data transformations were conducted to prepare for the analysis. To ensure all variables had the same unit, the adolescent fertility rate data series was divided by 10 to convert its unit to percentage, because the original unit was births per 1,000 women. To prevent the data set from skewing too much, some outliers were removed. For example, Guatemala only had 0.02% of their population with some tertiary schooling education while the mean for population with tertiary schooling for upper-middle income countries were approximately 13%. For the same reason, Swaziland, Paraguay and Senegal were also removed as outliers of the dataset. In addition, there are various incomplete data for many countries. For instance, some low-income countries do not have data on urban population or tertiary schooling. Thus, countries without complete data from all three datasets were removed. In order to have a better picture on the relationship between adolescent fertility rate, urban population and tertiary schooling, the sampled countries were divided into three categories by income levels according to the World Bank's classification: high-income econo-

mies (with gross national income (GNI) per capita of $12,056 or more), upper-middle-income economies (GNI per capita between $3,896 and $12,055), and lower-middle-income economies (GNI per capita between $996 and $3,895) (World Bank Country). Table 1 contains the complete list of countries sampled. As expected, high-income countries, on average, have the highest tertiary schooling and urban population while maintaining the lowest average adolescent fertility rate. High-income countries had the highest mean in tertiary schooling population at 24.38%, but Russia, an upper-middle income country, had the highest tertiary schooling population at 62.02% among all nations. As expected, upper-middle and lower-middle income countries had the highest adolescent fertility rate average at 4.86% and 6.38% respectively. Singapore, a high-income country, had a 100% urban population. Refer to Table 2 for all the maximums, minimums and means for all income groups and all three variables. As a snapshot, graphs 1 to 4 show that tertiary schooling and adolescent fertility had a negative correlation, and the strength of this relationship varied across income groups.

Furthermore, the datasets contain several strengths and weaknesses that should be considered when examining the results. Fertility rates and education have been two frequently used variables in the studies of development economics. However, since urban population was rarely used in the analysis of educational attainment, this study would provide a valuable insight into how urbanization might affect a country's educational attainment levels. Unfortunately, the datasets could not account for any cultural differences among nations, such as women's social status or expectations from society that could impact the typical marriage age in each nation. In addition, it might be easier for a woman to still have a college education in a high-income country even if she had a child during her adolescent years, simply because there are more public and private support systems in place, such as government grants and family assistance. On the other hand, low-income economies would not have the adequate support systems in place that can support the woman as well to continue higher education while raising a child. Also, this study would not be able to control for equal education opportunities between male and female, which might vary across countries.

Ultimately, multiple linear regressions are run through RStudio to examine the relationship between adolescent fertility rate, urban population and population with tertiary schooling. The independent variables include adolescent fertility rate and urban population. Population with tertiary schooling is the dependent variable. All variables have percentage as their units. The basic regression equation is as follows:

$$Tertiary\ (Tert) = \alpha + \beta_1 Adolescent\ Fertility\ (Fert) + \beta_2\ Urban\ Population\ (Urban) + \varepsilon$$

Out of the 4 regressions run for high-income, upper-middle-income, lower-middle-income, and all countries as a group, the logarithmic values of all three variables were used in the regressions for lower-middle-income and all countries as a group to induce linearity.

IV. RESULTS

A total of 4 linear regressions were ran using RStudio with the general estimation equation:

$$Tert = \alpha + \beta_1 Fert + \beta_2\ Urban + \varepsilon$$

Each of the linear regression ran represented the estimation model based on data for high-income (N=51), upper-middle-income (N=35), lower-mid-

dle income (N=30), and all countries (N=116), respectively. The outputs of the final regressions were consolidated in Table 4 of the appendix.

Furthermore, according to Table 4, only the intercept of high-income and all countries were statistically significant with the coefficients of 18.1656 and -2.1664, respectively. The intercept measures the population percentage that would receive some college education if adolescent fertility and urban population were 0. The magnitudes of the intercepts for high-income countries were relatively larger than the intercepts for upper-middle and lower-middle countries.

In addition, adolescent fertility rate was statistically significant in all country groups except for upper-middle income. Notably, lower-middle income countries had a higher degree of statistical significance for the coefficient of adolescent fertility than high-income countries. However, regardless of significance levels, all coefficients for adolescent fertility were negative, which supports the hypothesis that adolescent fertility and educational attainment have a negative relationship regardless of income group. The coefficients for adolescent fertility were -1.5735, -0.7611 and -0.2744 for high-income, upper-middle income and lower-middle income countries, respectively. For every 1% increase in adolescent fertility rate in high-income countries, population with tertiary schooling would suffer a 1.6% decrease. Likewise, for every 1% increase in adolescent fertility, lower-middle income countries would suffer a 0.76% decrease in population with tertiary schooling. The coefficient magnitudes of adolescent fertility rate were similar for upper-middle and lower-middle income countries at approximately 0.80, but the coefficient for adolescent fertility rate was not statistically significant for upper-middle income countries.

On the other hand, the results supported the hypothesis that urbanization had a positive relationship with educational attainment, since all coefficients were positive for urban population. The coefficients for high-income, upper-middle, lower-middle and all countries were 0.1141, 0.3379, 0.7993 and 1.2075, respectively. The urban population coefficient was the largest for lower-middle income countries. Therefore, an increase in urban population would be most beneficial to lower-middle countries in order to achieve higher educational attainments. As stated before, the coefficient for urban population was not statistically significant for high-income countries, given these countries are very urbanized for a long time already, such as Singapore which has a 100% urban population. Therefore, increasing their urban population would not significantly improve their educational attainment. However, urban population coefficients were statistically significant in upper-middle and lower-middle income countries. For upper-middle income countries, as the urban population increases by 10%, the population with tertiary schooling would increase by 3.4%, and for lower-middle income countries, a 10% increase in urban population would increase the population with tertiary schooling by 8%.

Lastly, the goodness of fit of the linear model differed significantly between different income groups. The adjusted R-Squared for high-income, upper-middle, lower-middle and all countries were 0.0539, 0.2109, 0.4223 and 0.4738, respectively. This implied that, for high-income countries, the linear regression model employed in this study could only account for 5% of variations in population with tertiary schooling. Whereas, for upper-middle and lower-middle income countries, this model could account for 21% and 42% of the variations, respectively. There was also an issue of high standard errors.

The standard errors for high-income, upper-middle, lower-middle and all countries were 11.04, 9.406, 0.6772 and 0.6777, respectively. This meant that the actual population with tertiary schooling could deviate 11.04% from the predicted percentage for the high-income countries, which was large given that 11% of the population means millions of people. Likewise, the standard error for upper-middle income was relatively large. The high standard errors could be due to the sample size being too small for this model. Thus, this model was not very robust for high-income and upper-middle-income countries.

When examining the robustness of the model for homoscedasticity, the Breusch-Pagan test found that the lower-middle-income and all countries' regressions in levels had a p-value of 0.0144 and 0.0666, respectively. Thus, the Breusch-Pagan statistical test rejected the null hypothesis of homoscedasticity at the 10% significance level for both of these country groups and confirmed the existence of heteroscedasticity. Ultimately, as reported in the results table, the regressions for these 2 country groups were run in logarithms to fix the problem of heteroscedasticity.

V. CONCLUSION

Even though the linear regression model was not very robust for high-income countries, the results for lower-middle countries were more indicative in terms of the impact of adolescent and urban population on population with tertiary schooling. The findings were unclear regarding adolescent fertility's impact on tertiary schooling for upper-middle income countries because only the coefficient for urban population was statistically significant with a value of 0.3379 for this country group. Fortunately, both adolescent fertility and urban population's coefficients were statistically significant for lower-middle income countries. As expected, tertiary schooling had a negative relationship with adolescent fertility, while with urban population, it had a positive relationship. The coefficient magnitudes for both adolescent fertility and urban population in lower-middle income countries were similar at approximately 0.80 for both variables.

Generally, the findings were consistent with previous literature regarding adolescent fertility. Waite & Moore (1978) found that the younger the age at first birth for women, the fewer years of schooling would be completed by them. Then, Tabetando & Ahidjo (2015) found that teenage motherhood led to 0.5 to 3.5 years less in the schooling of these teenage mothers. Both of these empirical studies were consistent with the finding in this research such that adolescent fertility has a negative relationship with educational attainment. Though not a direct comparison, urban population's positive relationship with educational attainment could be a supportive finding to Galindev's (2011) theory, suggesting the rise in income would increase educational attainment, given the assumption that higher urbanization infer more high skilled jobs compared to rural areas that have more labor-intensive jobs in developing countries.

In addition, this research could be expanded in various ways. It would be helpful to acquire more complete cross-country data regarding human capital and development, such as primary and secondary schooling completion rates, cost of education, gross national income, and government investments on education. The statistical model would also be more robust if the sample size could be expanded, but the data were limited under the current circumstances. In addition, other than a linear regression model, future researchers could also consider doing a time series analysis of educational attainment to examine the trends in the global education develop-

ment scene.

Ultimately, this research concluded that no universal policy recommendations would suit all the countries analyzed to increase their educational attainment. Countries, depending on their income and development levels, have different drivers for higher educational attainment. While adolescent fertility decreases tertiary schooling and urbanization increases tertiary schooling across the board, the levels of importance for both of these variables vary greatly. It might be a good idea for upper-middle and lower-middle income countries to invest in more urban infrastructures such as universities, so more people from the rural area could move into cities to have a better education. However, it might not be worthwhile for higher-income countries to increase their urbanization as an effort to promote higher educational attainment, because urban population was not a statistically significant driver for tertiary schooling in these richer countries. It would still be beneficial for countries to decrease adolescent fertility regardless of income levels, because of adolescent fertility's negative impact on educational attainment. This could be done by increasing the opportunity costs of having a child for young women through policies such as providing more job opportunities for women or making education more affordable and accessible. To understand what can be done to promote tertiary schooling, research must be done with a smaller and more local scope to understand the situation in each country or even down to the local community level.

APPENDIX

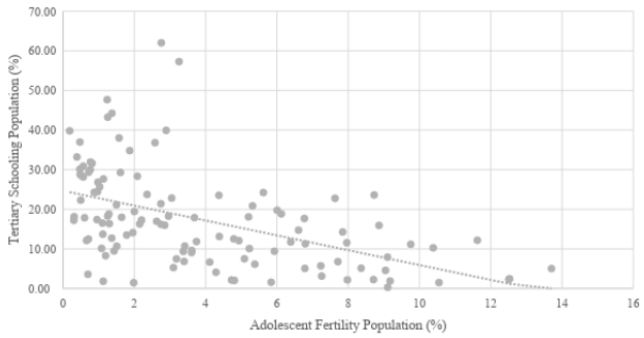
Table 1: List of Countries in Sample

	High Income Economies	Upper-Middle Income Economies	Lower-Middle Income Economies
1	Argentina	Albania	Bangladesh
2	Australia	Algeria	Bolivia
3	Austria	Armenia	Cambodia
4	Bahrain	Belize	Cameroon
5	Barbados	Botswana	Côte d'Ivoire
6	Belgium	Brazil	Egypt
7	Brunei Darussalam	Bulgaria	El Salvador
8	Canada	China	Ghana
9	Chile	Colombia	Honduras
10	Croatia	Costa Rica	India
11	Cyprus	Cuba	Indonesia
12	Czech Republic	Dominican Republic	Kenya
13	Denmark	Ecuador	Kyrgyzstan
14	Estonia	Fiji	Lao PDR
15	Finland	Gabon	Lesotho
16	France	Guyana	Mauritania
17	Germany	Iran	Moldova
18	Greece	Iraq	Mongolia
19	Hong Kong	Jamaica	Morocco
20	Hungary	Jordan	Myanmar
21	Iceland	Kazakhstan	Nicaragua
22	Ireland	Libya	Pakistan
23	Israel	Malaysia	Papua New Guinea
24	Italy	Maldives	Philippines
25	Japan	Mauritius	Republic of Congo
26	Kuwait	Mexico	Sri Lanka
27	Latvia	Namibia	Tunisia
28	Lithuania	Peru	Ukraine
29	Luxembourg	Romania	Vietnam
30	Macao	Russian Federation	Zambia
31	Malta	Serbia	
32	Netherlands	South Africa	
33	New Zealand	Thailand	
34	Norway	Turkey	
35	Panama	Venezuela	
36	Poland		
37	Portugal		
38	Qatar		
39	Republic of Korea		
40	Saudi Arabia		
41	Singapore		
42	Slovakia		
43	Slovenia		
44	Spain		
45	Sweden		
46	Switzerland		
47	Trinidad and Tobago		
48	United Arab Emirates		
49	United Kingdom		
50	United States		
51	Uruguay		

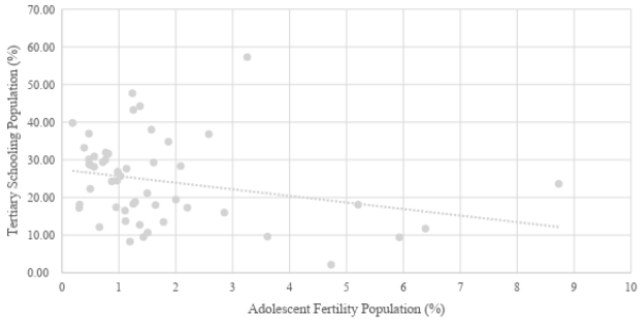
Table 2: Summary Statistics

	Max	Mean	Min
	Tertiary Schooling Population (%)		
High-Income	57.28	24.38	2.14
Upper-Middle Income	62.02	13.80	0.30
Lower-Middle Income	39.92	9.73	1.50
	Adolescent Fertility Rate (%)		
High-Income	8.73	1.73	0.19
Upper-Middle Income	11.62	4.86	0.6
Lower-Middle Income	13.70	6.38	0.71
	Urban Population (%)		
High-Income	100	78.31	31.87
Upper-Middle Income	88.08	63.73	26.63
Lower-Middle Income	68.6	43.41	13.02

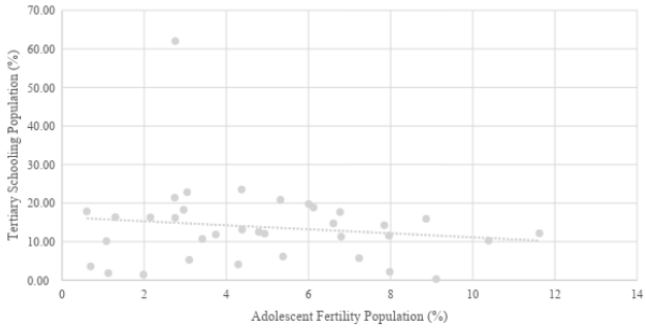
Graph 1: Tertiary Schooling and Adolescent Fertility - All Countries



Graph 2: Tertiary Schooling and Adolescent Fertility - High-Income



Graph 3: Tertiary Schooling and Adolescent Fertility - Upper-Middle-Income



Graph 4: Tertiary Schooling and Adolescent Fertility - Lower-Middle-Income

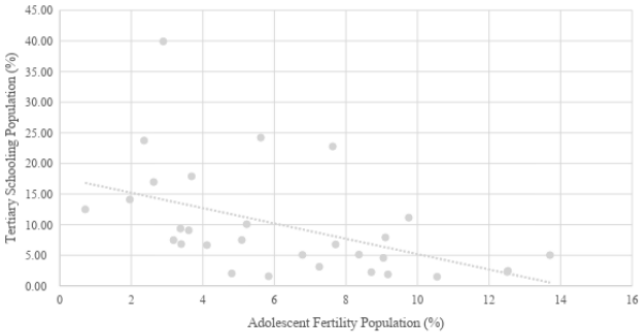


Table 3: Estimation Results of Linear Regression (2010)

Dependent Variable: Population with Tertiary Schooling

	Higher-Income (N=51)	Upper-Middle Income (N=35)	Lower-Middle Income (N=30), Log-Values	All Countries (N=116), Log-Values
Intercept	18.1656**	-3.8967	0.2393	-2.1664***
	(2.064)	(-0.55)	(0.212)	(-2.888)
Population with Adolescent Fertility	-1.5735*	-0.7878	-0.7611***	-0.2744***
	(-1.702)	(-1.38)	(-3.982)	(-3.951)
Urban Population	0.1141	0.3379***	0.7993**	1.2075***
	(1.084)	(3.199)	(2.742)	(6.907)
Adjusted R-Square	0.0539	0.2109	0.4223	0.4738
s.e. equation	11.04	9.406	0.6772	0.6777
Residual diagnostic				
Heteroskedasticity	0.5325[a]	0.4399	0.0144	0.0666

Significance at the 1% (***), 5% (**), and 10% (*) levels (t-values in parenthesis)

[a] p-values of Breusch-Pagan test for heteroskedasticity

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