The Effects Of Female Tertiary Education On Fertility And Development

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Abstract

The objective of this study is to investigate whether an increase in development is observed as the female education increases with respect to the male. The study estimates combined cross-section times-series regressions using the adolescent fertility rate as the dependent variable to measure development. Education is measured by the ratios of female to male primary, secondary, and tertiary enrollment. The panel data analysis covers the 1997-2011 period for 53 countries. The analysis and estimation results of the dynamic balanced panel data model reveal that the *n-step* GMM estimation technique is the one that explains the model and the exogeneity of the instrumental variables in the best manner, while also producing statistically significant and consistent coefficients. The results of the dynamic panel data estimation roughly show that as the level of female education increases; the rate of adolescent fertility decreases, and therefore development increases.

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Kadın Yüksek Öğretiminin Doğurganlık ve Kalkınmaya Etkileri

Öz

Bu çalışmanın amacı, kadın eğitimindeki artışın erkeğe kıyasla kalkınmada bir artışa neden olup olmadığını araştırmaktır. Araştırma, ergen doğurganlık hızını, kalkınmayı ölçmek için bağımlı değişken olarak kullanan çapraz kesit zaman serisi regresyonlarını tahmin etmektedir. Eğitim; kadın, erkek birincil, ikincil ve üçüncül kayıt oranları ile ölçülmektedir. Panel veri analizi, 53 ülke için 1997-2011 dönemini kapsamaktadır. Dinamik dengeli panel veri modelinin analiz ve tahmin sonuçları, n-adım GMM tahmin tekniğinin, enstrümantal değişkenlerin modelini ve dışsallığını en iyi şekilde açıklarken aynı zamanda istatistiksel olarak anlamlı ve tutarlı katsayılar üreten yöntem olduğunu ortaya koymaktadır. Dinamik panel veri tahmininin sonuçları kabaca; kadın eğitim düzeyindeki artışın ergen doğurganlık oranını azalttığını ve bu nedenle kalkınmayı arttırdığını göstermektedir.

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Anahtar Kelimeler: Eğitim ve Ekonomik Kalkınma; Doğurganlık, Aile Planlaması, Çocuk Bakımı, Çocuklar, Gençlik; Panle Veri Modelleri, Mekansal-zamansal Modeller; Enstrümental Değişkenleri (IV) Tahmini.

1. Introduction

Research on development has shed some light on the relationship between adolescent fertility and education in the last decades. Adolescent childbearing is an important concept that affects the level of poverty and income inequality in the developing and less developed countries especially. Eloundou-Enyegue (2004) states the need for the integration of teen fertility and gender-equity programs to meet the Millennium Development Goal of achieving gender parity in education by 2015. The adverse socioeconomic effects of adolescent fertility and childbearing are low levels of living, lower incomes, and gender inequality in the developing countries. Ribar (1994) indicates that teenage fertility and schooling may have a causal relationship. Hence, as the fertility rate of the adolescent girls increases the level of their educational attainment decreases (McCarthy and Radish, 1982; Klepinger et al., 1995). Teen mothers and their children face severe disadvantages, and such negative effects may not be overcome in the long-run (Geronimus, and Korenman, 1992).

Adolescent fertility also has adverse and severe effects on the health outcomes of the nations in the sense that young mothers' health is endangered. Therefore, adolescent mothers are more prone to such risk and the mortality rate of children between 0 and 5 years is much higher in the less developed countries. Adolescent fertility decreases with higher levels of education which in turn leads to higher levels of development (United Nations, Economic and Social Council, 2011).

The human capital approach asserts that the progress and development of human capital stems from education. Investment in human capital creates economic growth, development, and innovation. A young mother who is obliged to take care of her child may not be attending school regularly or at all. Adolescent childbearing and maternity may prevent the attainment of further education, and lead specifically to an increase in the number of high school dropouts (Rafalimanana, 2006; Klepinger et al., 1999). Years of schooling and level of education are positively related to each other. Hence, adolescent motherhood may get in the way of higher education due to the time constraint. Lower levels of education lead to lower incomes, job skills and qualifications. Higher education and research lead to higher levels of development which may not be triggered with ascending adolescent fertility rates in the developing nations.

This article postulates the hypothesis that the rate of adolescent fertility decreases with higher education. In other words, as the education level increases, the fertility rate of the females between 15 to 19 years decreases. As the female level of education increases it adds to the human capital of a country, thereby helping to speed up the development process of that country. Female education affects the number of births a woman may choose to give throughout her life. Women who achieve a certain level of educational attainment are generally included in the labor force indicating that their time and energy are expensive and precious so that the opportunity cost of staying at home should outweigh the benefit received from income, salary or wage (Chen and Morgan, 1991; Rindfuss et al., 1984; Hofferth et al., 2001). An employed woman may prefer to form a smaller and intact family rather than a crowded one (Manski et al., 1992). The causality of the estimated model in this study runs from the ratios of female to male enrollment - primary, secondary, and tertiary - to the adolescent fertility rate.

The second part of this article explains the theoretical background which includes the relationship between adolescent female education and fertility rates as well as other determinants of adolescent fertility specifically, and total fertility rate in general. Possible explanations and adverse negative effects of early childbearing are also analyzed in this section. The third part defines the methodology of the model estimated with multivariate regressions. Data sources and definitions of the variables are explained in the fourth part, followed by part five that depicts the results of different estimation techniques employed in this article. Final part is reserved for conclusion and further discussion.

2. Theoretical Background

Differences in the patterns of education, individual expectations about the future, childbearing and rearing, the employment rates and labor force participation of women stem from different development levels and cultures of the countries. Hence, the years of schooling and literacy rates also differ from one country to another. Higher human development may be achieved through higher education, and thus investments to human capital.

The developed countries have high literacy rates, and their compulsory years of schooling and education are higher between twelve to sixteen years for both the female and male population. The governments of such countries put forward new educational policies and regulations, and spare a substantial amount from their budgets for education. Adolescent fertility may decrease through the application of correct policies to accelerate development in the developing and less developed countries. These policies should narrate family planning and sexual education to adolescents, and educate women about their rights and make them take the control and autonomy of their actions. Mothers of the adolescents need to share relevant information on family planning techniques with them. Otherwise, the number of miscarriages performed under unsafe conditions will continuously increase, and endanger the health of both the adolescent mother to be and her child. Son preference and thus sex selective abortion also put the young mother at risk in terms of health (Dreze and Murthi, 2001). Adolescent maternity is a burden on the shoulders of a woman who is not able to calculate these risks and additional costs of childbearing and birth.

Better education and knowledge on fertility rules out severe consequences and outcomes of being a mother between the ages 15 and 19 (Berquo and Cavenaghi, 2005). The reproductive behavior of an adolescent is therefore important in the analysis of fertility gap between the educational strata and also the gender gap.

Developing countries on the other hand are not able to provide such generous funds for education. These countries rather make investments in the health sector which reflects the results of such investments quicker than education where one may not be able to collect the fruits before a decade or more.

The family structure of the parents from the higher income and educational attainment levels are more intact than the family structure of the poorer and less educated parents (Upchurch et al., 2002). Hence, the labor market outcomes, human capital, skills, educational attainment, poverty status which reflects financial well-being and self- sufficiency are the most crucial factors of adolescent childbearing which may generate street children (Rafalimanana, 2006). Fertility subject covers the between and within family analysis which make use of samples that include the sisters in a family (Hofferth et al., 2001).

Potential consequences and costs of adolescent fertility should be calculated correctly. Maternity and school enrollment are negatively correlated to each other. Timing of the first birth is important for an adolescent woman since it creates socioeconomic consequences for her and her family (Singh, 1998). This brings the selection bias problem to light in which case the young mother to be may have to choose between the child and higher education (Hotz, 1999). Yet, some of these young women may not even be able to make such a choice given the financial, religious and other circumstances of their families. These families are disadvantaged families where the connection, interaction, and affection between the young or teenage mother and her mother are either lacking or very small. The level of education affects the decision of adolescent fertility since the parents are aware of the emotional behaviors of their children. These families are from the higher social status. They have a less fatalistic viewpoint (Martin and Juarez, 1995). Parents educate their children to take necessary precautions to avoid adolescent pregnancy. The under-class families are more subject to problems of poverty and income inequality.

The number of adolescent mothers who are financially self-sufficient may choose to interrupt their education for a short period of time and continue later on due to the availability of paid childcare which became an important factor for educated women who want to continue their presence in the labor market.

Fecundity which refers to the reproductive capacity of an individual is another subject matter in fertility analysis (Chen and Morgan, 1991). The empowerment of women gains emphasis for the gender gap to be eliminated (Agüero et al., 2011). The decisions of the adolescent women differ from each other. While some women prefer or are prone to accept their fate, others the autonomy on their reproductive behavior and choose to continue their education (Bongaarts, 2003). Yet, the remaining adolescent women prefer voluntary childlessness (Rindfuss et al., 1996 and Akın, 2005).

Urban and rural areas also differ in terms of adolescent fertility rate where this rate is higher in rural areas more where the adolescent girls and women are not lucky enough to continue their education compared to adolescent boys and men. Same fact holds true for the urban areas which shelter the poor and illiterate when compared to the areas where the rich, educated, and literate people reside.

Lack of motivation, success, and achievement in school increase the number of school dropouts and therefore, open the path to early childbearing and adolescent fertility (Berquo and Cavenaghi, 2005; Mott and Marsiglio, 1985). Child mortality and labor may be stated as two of the most serious outcomes of adolescent or teenage fertility. According to the earlier analyses in the literature; children who are born to a young mother generally follow the same footsteps, thereby also bearing and giving birth to a child at a young age just like her own mother (Chagas de Almeida and Aquino, 2009).

Adolescent childbearing contributes to school dropout, lower educational attainment, poorer job opportunities, and lower income levels (Lee, 2006 and Marini, 1984). Young mothers compensate work for baby care, and house chores which are put on the mother who needs to stay home because of the baby, sometimes leading to severe postpartum cases. They quit their jobs to be able to raise their children. Being emotionally and financially prepared to take on the responsibility of being a parent is another milestone in adolescent fertility and childbearing. Most of the teen mothers are welfare dependent when they become pregnant. This dependence however puts them in the middle of the so called poverty trap where they may have no other choice than quitting school, and thus abandoning her expectations of higher education at least for the next several years to come.

Childbearing and rearing impose socioeconomic and psychological responsibilities on the adolescent females who are in the middle of their developmental stage of life. Such decisions also depend on family background, occupation, age, religiousness, race, ethnicity, culture, beliefs, attitudes and preferences of the young mother (Olsen and Farkas, 1988; Gupta and Leite, 1999). Adolescent childbearing interrupts education and leads to irregular attendance. It requires and demands strong commitment and patience, and leads to lifetime consequences such as morbidity and mortality. The adverse social consequences are to some extent decreased through a social mechanism for dealing with such an outcome (Upchurch and McCarthy, 1989).

The expectations and demands of the teenage mother, immaturity of young women makes it even harder for her to accept the family role of motherhood and the work role of being a student (Chen and Morgan, 1991 and Rindfuss, 1991). Competition between peers is another burden for the adolescent in the sense that it gets even harder for the adolescent woman to catch up with her former classmates after birth, abortion or miscarriage (Moore and Waite, 1977). The United States is one of the developed country examples where the fertility rate of the adolescents among total population seems to be high or equal to the fertility rate of most of the developing countries such as Turkey.

Motivation and encouragement or help from the other people influence years of schooling positively in most cases. The intergenerational patterns of fertility indicate that the decision of early first birth is followed by the daughter of that mother who gave birth during her adolescent years (Khan and Anderson, 1992). Education has an influence on fertility decisions of all females. Gender inequality and the society also affect the employment, and educational attainment of women in general. Developing and less developed countries face severe outcomes.

The need for proper infrastructure and establishment and management of educational systems and institutions should be emphasized in all countries whether they are developed or not. As the level of education gets better, so does the level of development in a country thereby creating higher returns to the society, and higher earnings for the adolescents when they become a mature person. Higher education is therefore very important for the developing and less developed countries especially since science and technology as well as human capital investments are the factors that are necessary for scientific research and development and innovations which lead to the changes in technologies (Lee, 2006).

3. Methodology

This study aims to analyze the relationship between adolescent fertility and tertiary education. The datasets of this study contain observations on multiple countries, where country information is observed from 1997 to 2011 for dynamic panel data estimation of 53 countries in order to capture the variations and changes both within and between countries. World Bank (2013) World Development Indicators data is used in the regression estimations.

Panel data regression has a double subscript on its variables, with *i* denoting countries or cross-sections, and *t* denoting the time. Y_{it} is the endogenous or dependent variable, β_1 is the intercept, β_2 is the slope coefficient, Y_{it-1} is the lag of the endogenous or independent variable, and X_{2it} is the exogenous or independent variable. X_{3it} represents the control variables or instrumental variables (IVs) of the model. The traditional panel model which includes a lagged dependent or endogenous variable is written as:

$$Y_{it} = \beta_1 + \beta_2 Y_{it-1} + \beta_3 X_{2it} + \beta_4 X_{3it} + u_{it} \quad (2.1)$$

The slopes remain constant for all individuals. Errors, u_{it} are assumed to be homoscedastic and serially independent both within and between individuals for pooled and panel data models.

The Fixed Effects Model (henceforth, FEM) measures differences in intercepts, by using a separate dummy variable for each group. This model is also called the Least Squares Dummy Variable (LSDV) Regression Model (Gujarati, 2003). In LSDV the slope coefficients are constant, but the intercept varies across individuals. LSDV is also known as the Covariance Model or estimator (CV). The model allows for each cross-sectional unit to reflect its own special characteristics. The FEM with a lagged dependent variable is also stated as:

$$Y_{it} = \beta_{1i} + \beta_2 Y_{it-1} + \beta_3 X_{2it} + \beta_4 X_{3it} + u_{it} \quad (2.2)$$

However, the *i* subscript on β_1 shows that the intercepts of all the cross-sections may be different. Each cross-section's intercept is time invariant, since the *t* subscript is excluded from $\beta_{1i.}$ FEM is applicable in cases where one or more exogenous variables are correlated with the cross-section specific intercept (Gujarati, 2003).

A standard FEM assumes that: (1) all the cross-sections have the same coefficients on X_{2it} and $X_{3it,}$ (2) each cross-section or country has a different intercept, (3) the error variances are the same for all the cross-sections, (4) there is no contemporaneous correlation between errors of different countries. FEM depends on different intercept terms of the cross-sections (Hill *et al*., 2008). The differential intercept dummies allow for the fixed effect intercept to vary between countries. This study uses the E-Views 5.1 (2007) econometrics computer package in the estimation of multiple regression analysis. Hence, dummy variables are not included manually. *n* referring to the number of cross-sections, the model simply becomes:

$$Y_{it} = \alpha_1 + \alpha_2 \text{Dummy}_{2i} + \ldots\ldots + \alpha_n \text{Dummy}_{ni} + \beta_2 Y_{it-1} + \beta_3 X_{2it} + \beta_4 X_{3it} + u_{it} \quad (2.3)$$

The Random Effects Model (REM) is not utilized in this study due to some missing data for the period between 1997 and 2011, which form an unbalanced panel.

Multiple regression analysis in the traditional panel data estimation which consists of both static and dynamic linear models is made in this study. The inclusion of the lag of the endogenous variable as a regressor into the estimation reflects the dynamic nature of the model. Fixed effects are employed in the analysis of the dynamic panel data with the Panel Least Squares (PLS), Generalized Least Squares (GLS), Two Stage Least Squares (2SLS), and Generalized Method of Moments

(GMM) estimation techniques. The estimation is also carried out without the cross-section and period effects for the panel data.

This study first employs the PLS estimation technique. Then, the GLS weighting is used since the PLS estimation technique does not produce consistent results. The 2SLS method with a linear model and IVs are used to correct the autoregressive (AR) errors in cross-section and period dimensions through fixed effects (FE). Finally, following the literature various system-weighting matrices are used in the balanced panel data estimation by GMM in order to achieve significant and consistent results. Dynamic panel data specifications are estimated with *one-step* and *n-step* estimators that use IVs when GMM is applied. The IVs of the GMM method are tested for exogeneity with the Sargan test which uses the J-Statistic in the calculation of the p-values of the estimation.

Arellano and Bond (1991) state that the orthogonality between lagged values of the dependent variable Y_{it} and the errors u_{it} determine the validity of additional instruments that are used. Including additional instruments gives a more efficient estimator. Baltagi (2008, p. 154) indicates that, the variability of the GMM estimator is underestimated in dynamic panel data models with small samples that use *two-step* GMM estimator which has asymptotic standard errors. He states that, individual specific effects and any time-invariant exogenous variables are eliminated by basic differences applied to the model. Any endogeneity caused by the correlation between individual effects, and exogenous variables is also eliminated with the GMM.

4. Data

The unbalanced panel data set of 53 countries is used for the period between 1997 and 2011 in this article. The study employs the adolescent fertility rate (births per 1,000 women ages 15-19) as the dependent variable to measure development. Ratio of female to male tertiary enrollment (%), ratio of female to male secondary enrollment (%), ratio of female to male primary enrollment (%) are used as indices to measure different levels of education.

Instrumental variables (IVs) are also used in this study to analyze further effects of education on development. Hence, measures related to development, gender, health and science and technology are also employed in the estimation. The usage of improved water source (% of urban population with access) as an instrumental variable represents the level of development. Female life expectancy at birth (years) is employed as the variable representing health. The control variable high-technology exports (current US dollars) are utilized to measure science and technology.

Table 1. Estimated Variables, Definitions, and Sample Means, 1997 and 2011.

Variable	Definition	1997	2011
Adolescent fertility rate *	Number of births per 1,000 women ages 15-19	37,92374 (30,52213)	26,22125 (23,35328)
Ratio of female to male tertiary enrollment (%) §	Percentage of men to women enrolled at tertiary level in public and private schools	116,27675 (31,83326615)	121,8395 (31,39849621)
Ratio of female to male secondary enrollment (%) ɸ	Percentage of girls to boys enrolled at secondary level in public and private schools	102,9549688 (10,2852807)	100,6724118 (7,682389155)
Ratio of female to male primary enrollment (%) ψ	Percentage of girls to boys enrolled at primary level in public and private schools	98,13321622 (3,388919183)	98,43683333 (2,233118796)
Improved water source, urban (% of urban population with access) ɸ	Percentage of the population with reasonable access (the availability of at least 20 liters a person a day from a source within one kilometer of the dwelling) to an adequate amount of water from an improved source	97,23529412 (5,612800496)	- (-)

Population ϴ	Total population	24056645,7 (43524622,7)	26714416,6 (49087963,1)
Urban population ɣ	People living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects	16853830,4 (33491643)	19934753,2 (40405496,6)
Life expectancy at birth (female, years) ❧	Number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life	75,8984 (5,322881)	79,49215 (4,454472)
High-technology exports (current USD) ϖ	Products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery	12,292,446,965 (30078627630)	23,214,462,922 (38953092785)
Poverty headcount ratio at 1.25 US dollars a day ((PPP) (% of population)) θ	Population below 1.25 US dollars a day is the percentage of the population living on less than 1.25 US dollars a day at 2005 international prices.	21,03625 (26,10897)	- (-)

Source: World Bank, 2013, World Development Indicators, http://data.worldbank.org/data-catalog/world-development-indicators

* United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. Catalog Sources World Development Indicators

§ United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. Catalog Sources World Development Indicators

ф United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. Catalog Sources World Development Indicators

ψ United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for

Statistics. Catalog Sources World Development Indicators

ɸ World Health Organization and United Nations Children's Fund, Joint Measurement Program (JMP) (http://www.wssinfo.org/). Catalog Sources World Development Indicators

ϴ(1) United Nations Population Division. World Population Prospects, (2) United Nations Statistical Division. Population and Vital Statistics Report (various years), (3) Census reports and other statistical publications from national statistical offices, (4) Eurostat: Demographic Statistics, (5) Secretariat of the Pacific Community: Statistics and Demography Program, and (6) U.S. Census Bureau: International Database. Catalog Sources World Development Indicators

ɣ World Bank Staff estimates based on United Nations, World Urbanization Prospects. Catalog Sources World Development Indicators.

ɚ(1) United Nations Population Division. World Population Prospects, (2) United Nations Statistical Division. Population and Vital Statistics Report (various years), (3) Census reports and other statistical publications from national statistical offices, (4) Eurostat: Demographic Statistics, (5) Secretariat of the Pacific Community: Statistics and Demography Program, and (6) U.S. Census Bureau: International Database. Catalog Sources World Development Indicators

ϖ United Nations, Comtrade database. Catalog Sources World Development Indicators

ϑ World Bank, Development Research Group. Data are based on primary household survey data obtained from government statistical agencies and World Bank country departments. Data for high-income economies are from the Luxembourg Income Study database. For more information and methodology, please see PovcalNet (http://iresearch.worldbank.org/PovcalNet/index.htm). Catalog Sources World Development Indicators

Note. Means are unweighted. Standard deviations are in parentheses.

Other IVs are: population and urban population in analyzing further effects of female tertiary education on adolescent fertility and development. The level of urbanization is estimated through the urban population. The last instrumental variable used in the panel data estimation is the poverty headcount ratio at 1.25 US dollars a day ((PPP) (% of population)). The variables, their definitions and sample means are given in Table 1.

All data are extracted from World Bank's World Development Indicators (2013) database. The countries that constitute the data set are: Armenia, Australia, Austria, Belarus, Brunei Darussalam, Bulgaria, Colombia, Cuba, Czech Republic, El Salvador, Estonia, Finland, France, Georgia, Hungary, Iceland, Ireland, Italy, Japan, Kazakhstan, Korea Republic, Kyrgyz Republic, Lao PDR, Latvia, Lebanon, Lithuania, Macao SAR China, Macedonia FYR, Madagascar, Mexico, Moldova, Mongolia, Netherlands, New Zealand, Norway, Panama, Poland, Portugal, Romania, Saudi Arabia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Tajikistan, Thailand, Turkey, Ukraine, United Kingdom, United States of America, Uruguay, and West Bank and Gaza.

5. Results

The first part of this section reflects the results estimated with panel data analyses. The explanations for ratios of female to male enrollment and adolescent fertility rate are also indicated and graphed separately for different countries in the second part of section five.

5.1. Panel Data Estimation Results

The dynamic or AR panel data estimation techniques such as the PLS, GLS, 2SLS, GMM *one* and *n-step* estimators are estimated in this section.

5.1.1. Estimating with OLS and GLS

The dynamic panel data OLS estimation, known as the panel least squares (PLS) results are presented in this section. The results are given for the sample period between 1997-2011, with 53 cross-sections, and unbalanced observations. The natural logarithm of the adolescent fertility rate is the dependent variable. The PLS estimation results do not yield information about the exogeneity of the IVs of the dynamic and balanced panel data model. Hence, this study uses other panel data model estimation techniques to improve the results.

The study used the models with no effects or fixed effects to account for both the cross-section effects and period effects. The analysis was carried out with different selections. Including the lagged variable produces results that are significant at one percent level when no cross-section and period effects are employed for the estimation of ratio of female to male tertiary enrollment both with PLS and GLS estimations. First, the coefficients for the ratio of tertiary enrollment was estimated and later the same exogenous variable and the IVs were estimated.

The results in Table 2 reflect 1 percent, 5 percent, and 10 percent levels of statistical significance for tertiary enrollment. Although, the population coefficients are statistically significant at one percent level for the PLS and GLS estimated with the IVs, their values are close to zero for both of the estimations. R^2s are reasonably high, indicating the goodness of fit of the sample to the regression line and showing a high level of explanatory power of the independent variables. Durbin Watson (DW) Statistics are not high enough to rule out the problem of autocorrelation. As the DW statistic approaches to two (2), it is more likely that the residuals are independent of each other, at least successively, indicating no autocorrelation between variables. However, the results of the DW statistic in Table 2 indicate autocorrelation.

Table 2 gives the test results of panel regression with no cross-section and period effects. The estimated results for the separate ratios of female to male primary and secondary enrollment do not produce significant results. Although, the coefficients for the ratio of female to male tertiary employment were statistically significant, they are nearly equal to zero showing no relationship whatsoever between the adolescent fertility rate and the ratios of female to male enrollment. Majority of the PLS tests gave good results but, showed no relationship. Finally, the model is tested by using GLS weights in estimating the data. The cross-section or period weights are indicated in the tables. The feasible GLS specification corrects cross-section heteroskedasticity, and contemporaneous correlation. Both, cross-section and period weights are employed in the GLS estimation in order to correct heteroskedasticity.

Despite the high significance levels (at one percent) of the coefficients and high R^2 showing a high level of explanatory power of the independent variables, coefficients are close to zero. Therefore, there is almost no relationship between the enrollment ratios and the adolescent fertility rate. Inclusion of the lagged dependent variable to the model does not enhance the results seriously. Hence, it shows no significant relationship between the enrollment ratios and the adolescent fertility rate for the countries of this sample.

Table 2. Adolescent Fertility Rate (Afr) and Ratio of Female to Male Enrollment, 1997-2011, Panel Least Squares (PLS) and Panel Extended Generalized Least Squares (PEGLS)

Regressor	Adolescent Fertility Rate PLS (No Cross-Section and Period Effects)	Adolescent Fertility Rate PLS (No Cross-Section and Period Effects)	Adolescent Fertility Rate PEGLS Cross-Section Weights (No Cross-Section and Period Effects)
Ratio of Female to Male Primary Enrollment (Rfmpe)	-	-	-
Ratio of Female to Male Secondary Enrollment (Rfmse)	-	-	-
Ratio of Female to Male Tertiary Enrollment (Rfmte)	**-8.70E-05 (4.77E-05*)**	**0.000282 (0.000114**)**	**0.000327 (3.83E-05***)**
Improved water source, urban (% of urban population with access) (Wat)	-	-0.000186 (0.001146)	-0.000221 (0.000519)
Population (Pop)	-	5.00E-10 (1.82E-10***)	4.24E-10 (1.14E-10***)
Urban Population (Urp)	-	-3.35E-10 (1.84E-10*)	-1.48E-10 (9.77E-11)
Life Expectancy at Birth Female (years) (Leabf)	-	-0.001437 (0.001652)	-0.001350 (0.000730*)
High-Technology Exports (current USD) (Hte)	-	-1.97E-13 (3.21E-13)	-2.42E-13 (1.85E-13)
Poverty headcount ratio at 1.25 USD a day (PPP) (% of population) (Phr)	-	-0.000361 (0.000291)	-0.000188 (7.76E-05**)
Log of Lagged Endogenous Variable	0.994404 (0.001720***)	1.016156 (0.004601***)	1.013666 (0.002976***)
Constant	0.002336 (0.007889)	-	-
Number of Countries	53	25	25
Number of Observations	697	206	206
R^2	0.997936	0.998108	0.999993
Adjusted R^2	0.997930	0.998041	0.999993
Sum of Squared Residuals	1.088134	0.135983	0.127900
Durbin-Watson Statistic	0.456815	0.775227	0.793427

Notes. Standard errors in parentheses. *, **, and *** denote the level of significance at 10 percent, 5 percent, and 1 percent level respectively.

Table 2 also reflects the dynamic panel data estimation with Generalized Least Squares (GLS weights). The adolescent fertility rate in Table 2 with no effects and GLS period effects show no relationship between the ratios of female to male enrollment and adolescent fertility. The coefficients are very small, and R^2s for the lagged- variable model are low, when the lagged endogenous variable is excluded from the regression. However, when the lagged endogenous variable is included, the adolescent fertility rate coefficient becomes significant at a five percent level with a high R^2. But, the coefficient is almost zero, showing no relationship between the ratios of female to male enrollment and adolescent fertility. The results for the dimensions of the ratio of female to male primary, secondary, and tertiary enrollment reflect that the inclusion of the lagged variable does not produce a relationship either.

Table 3. Adolescent Fertility Rate (Afr) and Ratio of Female to Male Enrollment, 1997-2011, Panel Least Squares (PLS)

Regressor	**Adolescent Fertility Rate (Cross-Section and Period Fixed Effects)**			
Ratio of Female to Male Primary Enrollment (Rfmpe)	**-0.002722 (0.001338**)**	-	-	-
Ratio of Female to Male Secondary Enrollment (Rfmse)	-	**-0.001197 (0.000429***)**	-	-
Ratio of Female to Male Tertiary Enrollment (Rfmte)	-	-	**0.000293 (0.000163*)**	-0.000745 (0.000421*)
Log of Lagged Endogenous Variable	0.915365 (0.015234***)	0.916232 (0.015126***)	0.900450 (0.014303***)	-
Constant	0.507202 (0.140619***)	0.354137 (0.061407***)	0.248074 (0.050509***)	3.194065 (0.052445***)

Number of Countries	53	53	53	53
Number of Observations	680	657	697	737
R^2	0.998643	0.998638	0.998567	0.988037
Adjusted R^2	0.998495	0.998483	0.998415	0.986839
Sum of Squared Residuals	0.706694	0.655169	0.755290	6.679303
Durbin-Watson Statistic	0.658044	0.513384	0.571809	0.184980

Notes. Standard errors in parentheses. *, **, and *** denote the level of significance at 10 percent, 5 percent, and 1 percent level respectively.

The inclusion of the six independent variables as stated in Table 4 also does not produce statistically significant variables for the ratio of female to male primary enrollment for neither the cross-section and period fixed effects and nor for the no cross-section and period effects.

Table 4. Adolescent Fertility Rate (Afr) and Ratio of Female to Male Enrollment, 1997-2011, Panel Least Squares (PLS) and Panel Extended Generalized Least Squares (PEGLS)

Regressor	Adolescent Fertility Rate PLS (Cross-Section and Period Fixed Effects)	Adolescent Fertility Rate PLS (No Cross-Section and Period Effects)	Adolescent Fertility Rate PEGLS Cross-Section Weights (No Cross-Section and Period Effects)
Ratio of Female to Male Primary Enrollment (Rfmpe)	**0.000285 (0.002001)**	**0.001130 (0.001162)**	**0.000695 (0.000913)**
Ratio of Female to Male Secondary Enrollment (Rfmse)	**-0.000847 (0.000386*)**	**-0.000505 (0.000458)**	**-0.000382 (0.000256)**

Ratio of Female to Male Tertiary Enrollment (Rfmte)	**0.000315 (0.000274)**	**0.000354 (0.000173**)**	**0.000391 (7.72E-05***)**
Improved water source, urban (% of urban population with access) (Wat)	-0.001087 (0.003612)	-0.000764 (0.001762)	-0.000856 (0.000844)
Population (Pop)	-1.26E-08 (7.92E-09)	4.39E-10 (2.09E-10**)	5.61E-10 (1.85E-10***)
Urban Population (Urp)	1.09E-08 (7.56E-09)	-2.99E-10 (1.90E-10)	-3.39E-10 (2.16E-10)
Life Expectancy at Birth Female (years) (Leabf)	-0.008585 (0.006332)	-0.001745 (0.001591)	-0.001178 (0.000881)
High-Technology Exports (current USD) (Hte)	1.06E-12 (1.08E-12)	-2.01E-14 (3.61E-13)	-2.18E-13 (1.40E-13)
Poverty headcount ratio at 1.25 USD a day (PPP) (% of population) (Phr)	-0.000712 (0.000280**)	-0.000762 (0.000605)	-0.000564 (0.000282**)
Log of Lagged Endogenous Variable	0.876179 (0.038670***)	1.019695 (0.005794***)	1.016969 (0.004528***)
Constant	1.304667 (0.355237***)	-	-
Number of Countries	25	25	25
Number of Observations	191	191	191
R^2	0.999378	0.997910	0.999995
Adjusted R^2	0.999179	0.997806	0.999995
Sum of Squared Residuals	0.038698	0.130054	0.121704
Durbin-Watson Statistic	0.994935	0.785749	0.837390

Notes. Standard errors in parentheses. *, **, and *** denote the level of significance at 10 percent, 5 percent, and 1 percent level respectively.

Application of the GLS cross-section weights do not produce statistically significant results for the ratios of female to male primary and secondary enrollment. Although, the ratio of female to male tertiary enrollment is statistically significant at 5 percent and 1 percent levels for no cross-section and period fixed effects, and GLS cross-section weights estimation respectively. Hence, they do not reflect any relationship between adolescent fertility rate and ratio of female to male tertiary education since they are nearly zero. The same forecast is made for the population. The R^2 values are high, and the DW statistics seem to have improved with this estimation. The estimation results do not support a relationship between the ratios of female to male enrollment and adolescent fertility rate as well. The PEGLS estimation technique was not able to bring any strength to the model.

The estimation is extended further for better results. Since the models explained and tested in the previous sections did not provide satisfactory results, another method of estimation - the 2SLS - is used. The 2SLS is also known as the Generalized Instrumental Variables Estimator (GIVE). The lags of the endogenous (dependent) variable, together with the exogenous (independent) variables, and also the lags of the IVs are added to the AR model. The 2SLS means that, the same estimator may be obtained in two steps. The reduced form of the model is estimated by PLS in the first step. All right hand side endogenous variables in the regression equation are replaced by the values estimated from the previous step in the second step as done by Verbeek (2008). The original model is then once again estimated by PLS in the latter step.

5.1.2. Estimating with 2SLS and GMM

Table 5 shows the 2SLS and GMM estimations for the ratio of female to male primary enrollment especially where the 2SLS result reflects that one point increase in the ratio of female to male primary enrollment leads to 1.6 percent decline in adolescent fertility at 10 percent statistical significance level. The R^2 value for this estimation is high reflecting the explanatory power of 2SLS with cross-section and period fixed effects. The p-value of the Sargan test of over-identifying restrictions reflect that we fail to reject the null hypothesis Ho that these restrictions are valid. Hence, the model is robust.

The Sargan test is a test of over-identifying restrictions, and it shows whether the model is correctly specified or not. Exogeneity of the instruments means that they are uncorrelated with the error term, u_i. The Sargan test indicates that, the over-identifying test statistic J is exactly zero, if the coefficients are exactly identified (Stock and Watson, 2007).

Table 5. Adolescent Fertility Rate (Afr) and Ratio of Female to Male Primary Enrollment, 1997-2011 - Two Stage Least Squares (2SLS) and Generalized Method of Moments (GMM)

Regressor	Adolescent Fertility Rate 2SLS (Cross-Section and Period Fixed Effects)	Adolescent Fertility Rate GMM (No Cross-Section and Period Effects) Identity GMM weights	Adolescent Fertility Rate GMM (No Cross-Section and Period Effects) White Period GMM weights
Ratio of Female to Male Primary Enrollment (Rfmpe)	**-0.016037 (0.008709*)**	**-0.000560 (0.000184***)**	**-0.000481 (0.000126***)**
Log of Lagged Endogenous Variable	0.730099 (0.077814***)	1.007469 (0.004980***)	1.005810 (0.003218***)
Constant	2.530631 (0.889800***)	-	-
Number of Countries	25	25	25
Number of Observations	202	202	202
R^2	0.998794	0.997900	0.997873
Adjusted R^2	0.998512	0.997889	0.997862
Sum of Squared Residuals	0.083992	0.146230	0.148117
J- Statistic Sargan test (prob>χ^2)	3.405085 1	4.646334 0.4605	3.012360 0.6981

Notes. Standard errors in parentheses. *, **, and *** denote the level of significance at 10 percent, 5 percent, and 1 percent level respectively. The results produced by Adolescent Fertility Rate (Afr) 2SLS (Cross-Section and Period Fixed Effects) estimation for Ratio of Female to Male Secondary Enrollment (Rfmse), and Ratio of Female to Male Tertiary Enrollment (Rfmte) are not statistically significant. The Instrumental Variables (Ivs) of the GMM estimation were: c, Wat, Pop, Urp, Leabf, Hte, and Phr for both GMM weights.

The null hypothesis (Ho) is that, over-identifying restrictions are valid, and all the instruments are exogenous. We reject the null hypothesis, if the *computed* χ2 is higher than the *critical* χ2 value. The computed p-values of the Sargan test fail to reject the over-identifying restrictions for all estimations at one percent level in Table 5. Hence, we fail to reject Ho that the instruments are valid and exogenous. This means that the IV estimates based on the chosen instruments are valid, since none of the instruments are correlated with the error term, meaning that the model is robust (Baum *et al*., 2002, and Gujarati, 2003). All the p-values of the Sargan test stated as prob>χ2 are calculated individually by hand for this study from the J-Statistic values provided by E-Views 5.1.

The J-Statistic obtained from the test allows one to realize whether the exogenous variables of the estimated model exactly identify the model or not. Also known as, the **over-identifying restrictions test**, the **J-Statistic** tests if all the instruments or variables are exogenous. If so, then the coefficients of the model are exactly identified. Baum *et al*. (2002) indicate that, under the assumption of conditional homoskedasticity, Sargan's statistic is a special case of the J-Statistic.

According to the computed p-values of the Sargan test, the estimation results in Table 5 fail to reject Ho that the instruments are exogenous. Failing to reject the over-identifying restrictions at the one percent level of significance (for example: 0.4708 > 0.01 in column one) means that the IV estimates based on the chosen instruments are valid, and no instruments are correlated with the error term, indicating exogeneity of the variables, and robustness of the model.

The estimation results of the GMM with no cross-section and period effects for the model which employs the identity GMM weights and White period GMM weights in turn also reflect that both coefficients are statistically significant at 1 percent level for ratio of female to male primary enrollment indicating that primary education is necessary for further education and development. Although, their signs are negative suggesting a decline in adolescent fertility rate actually these values are close to zero which means that this estimation does not enhance the relationship between ratio of female to male primary enrollment and adolescent fertility rate. In other words, a relationship between these two variables are not observed with this estimation technique. The p-values of the Sargan test for over-identifying restrictions reflect that we fail to reject the null hypothesis and therefore the model is robust for both GMM estimations.

Table 6 demonstrates the GMM estimations of no-cross section and period effects with identity GMM weights and White period GMM weights for both ratios of female to male secondary and tertiary education. The coefficient of the ratio of female to male secondary enrollment for cross-section and period effects with identity GMM weights states a statistical significance level of 10 percent. One-point increase in the ratio of female to male secondary enrollment leads to a minimal decline in the coefficient of adolescent fertility rate which is close to zero. This outcome indicates that there is no relationship between secondary enrollment and adolescent fertility. Results of the same estimation with White period GMM weights reflect 5 percent level of statistical significance for ratio of female to male secondary enrollment. There is no relationship between ratio of female to male secondary enrollment and adolescent fertility rate.

The estimation coefficients of ratio of female to male tertiary enrollment show that they are statistically significant at 5 percent level and 1 percent level for identity GMM weights, and White period GMM weights respectively. Even though the coefficient values have negative signs; they reflect a weak kind of relationship or none at all between ratio of female to male tertiary enrollment and adolescent fertility rate. All the R^2 values are high. The model estimations are powerful enough. The p-values of the Sargan test show no statistical significance, backing up the hypothesis that the over-identifying restrictions are valid. The model is therefore robust. The results of the Sargan test reflect the validity of the model although the coefficients are statistically significant and close to zero, and change is negligible. The employment of the GMM estimation techniques have improved the estimation results, but were not able to produce a strongly negative relationship or higher coefficient values.

Table 6. Adolescent Fertility Rate (Afr) and Ratio of Female to Male Secondary and Tertiary Enrollment, 1997-2011 - Generalized Method of Moments (GMM)

Regressor	Adolescent Fertility Rate GMM (No Cross-Section and Period Effects) Identity GMM weights	Adolescent Fertility Rate GMM (No Cross-Section and Period Effects) White Period GMM weights	Adolescent Fertility Rate GMM (No Cross-Section and Period Effects) Identity GMM weights	Adolescent Fertility Rate GMM (No Cross-Section and Period Effects) White Period GMM weights
Ratio of Female to Male Secondary Enrollment (Rfmse)	-0.000458 (0.000233*)	-0.000391 (-0.000391**)	-	-
Ratio of Female to Male Tertiary Enrollment (Rfmte)	-	-	-0.000214 (0.000100**)	-0.000250 (6.52E-05***)
Log of Lagged Endogenous Variable	1.004898 (0.006178***)	1.003334 (0.004167***)	0.999805 (0.003075***)	1.001188 (0.001860***)
Constant	-	-	-	-
Number of Countries	25	25	25	25
Number of Observations	194	194	206	206
R^2	0.997607	0.997586	0.997734	0.997724
Adjusted R^2	0.997595	0.997573	0.997723	0.997713
Sum of Squared Residuals	0.149661	0.151013	0.162882	0.163563
J- Statistic Sargan test (prob>χ^2)	3.857575 0.5701	1.803567 0.8756	3.273692 0.6579	2.291345 0.8075

Notes. Standard errors in parentheses. *, **, and *** denote the level of significance at 10 percent, 5 percent, and 1 percent level respectively. The Instrumental Variables (Ivs) of the GMM estimation are: c, Wat, Pop, Urp, Leabf, Hte, and Phr for both GMM weights.

5.1.3. GMM estimation with AB one-step estimator

Since, the OLS, GLS, and 2SLS estimators did not yield the expected results, the GMM estimators are employed here. Arellano and Bond (AB, 1991) developed the GMM AB *one step* estimation for dynamic panel data which is used to secure the unbiasedness and consistency of the model. [13]

This study employs dynamic panel data Arellano and Bond *one-step estimator* for cross-section FE, and lagged endogenous variables. The *difference* estimation in E-Views 5.1 is made for Arellano and Bond (1991) first-differenced data. The identity matrix is used as the weighting matrix in Arellano and Bond *one-step* estimator calculation.

Arellano and Bond *one-step* estimator standard errors are reported in this section. The two-step estimator standard errors of Arellano and Bond may not always be reliable. This study employs a dynamic panel data model in which a lagged variable is included as a regressor or an endogenous variable. The lagged endogenous variable is the adolescent fertility rate. The IVs of the dynamic (dyn) model are then stated as: the logarithm of the lag of adolescent fertility rate (@dyn(log(afr),-2)), the ratios of primary, secondary, and tertiary enrollment (rfmpe, rfmse, and rfmte in turn) together with the IVs selected for this study.

The lags of the dependent variable are included as regressors. In this case, the specified lag is one (1). Period dummy variables are used to control for period FE. The transformation method of differences is applied to the specification of a dynamic panel model to remove the cross-section effects. The Arellano-Bond type dynamic panel

13 The GMM estimator uses the *one-step* estimator which takes the first-differences of the equations that are estimated. The IVs are employed in the Arellano and Bond *one-step* estimation.

$y_{it} - y_{it-1} = \alpha + \beta(y_{it-1} - y_{it-2}) + \gamma'(G_{it} - G_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1})$

for $t = 2, \ldots, T$. There exists a correlation between $(y_{it-2} - y_{it-3})$ and $(y_{it-1} - y_{it-2})$. On the contrary, $(y_{it-2} - y_{it-3})$ is not correlated with $(\varepsilon_{it} - \varepsilon_{it-1})$. Hence, we may use $(y_{it-2} - y_{it-3})$ as an IV for $(y_{it-1} - y_{it-2})$. The IVs method allows for the estimation of β and γ' (Hsiao, 2003, p. 85).

Dreher and Gaston (2008) state that, the GMM estimator also accounts for the potential *endogeneity of globalization* pursuing inward oriented policies, in which case the Sargan test may be used to find out the result.

It then, includes the lagged dependent variable from at least the previous two periods, together with the lagged exogenous variables as instruments. Appropriate weighting of the instruments is important, when an over-identification of the equations, due to the fact that, the number of instruments is higher than the number of variables at the right-hand side of the equation is experienced.

instruments with lags that vary by observation are specified as "@ dyn(log(afr),-2)" in E-Views 5.1, where the specified lag is two (2).

Table 7. Adolescent Fertility Rate (Afr) and Ratio of Female to Male Enrollment, 1997-2011, Generalized Method of Moments (GMM)

Regressor	**Adolescent Fertility Rate GMM Arellano and Bond (AB) 1-step (Cross-Section Difference and Period No Effects)**	**Adolescent Fertility Rate GMM Arellano and Bond (AB) 2-step (Cross-Section Difference and Period No Effects)**	**Adolescent Fertility Rate GMM Arellano and Bover (AB) n-step (Cross-Section Difference and Period No Effects)**
Ratio of Female to Male Primary Enrollment (Rfmpe)	-0.006582 (0.003174**)	-0.006622 (0.000512***)	-0.006491 (9.71E-06***)
Ratio of Female to Male Secondary Enrollment (Rfmse)	-0.000226 (0.001217)	-9.08E-05 (0.000180)	4.24E-05 (1.16E-06***)
Ratio of Female to Male Tertiary Enrollment (Rfmte)	-6.09E-05 (0.000272)	-9.40E-05 (3.84E-05**)	-0.000115 (7.09E-07***)
Log of Lagged Endogenous Variable	0.868077 (0.037463***)	0.874556 (0.007261***)	0.878007 (0.000235***)
Constant	-	-	-
Number of Countries	24	24	24
Number of Observations	153	153	153
R^2	0.649261	0.649115	0.649916
Adjusted R^2	0.642199	0.642050	0.642868
Sum of Squared Residuals	0.079770	0.079803	0.079621
J- Statistic Sargan test (prob>χ^2)	120.5262 0.0002	19.07680 0.5802	30.72914 0.1296

Notes. Standard errors in parentheses. *, **, and *** denote the level of significance at 10 percent, 5 percent, and 1 percent level respectively. The GMM weights of Adolescent Fertility Rate GMM Arellano and Bond (AB) 1-step (Cross-Section Difference and Period No Effects) are difference AB 1-step, and coefficient covariance method utilizes White period 1-step GMM iterations. AB

1-step GMM iterations for i.i.d. innovations are used in the estimation. Standard errors are robust, and White period weights from final iteration are employed. The innovations have time series correlation structure that varies by cross-section. Fixed GMM weights for first difference of i.i.d. innovations are used in the estimation. The GMM weights of Adolescent Fertility Rate GMM Arellano and Bond (AB) 2-step (Cross-Section Difference and Period No Effects) are White period AB n-step, and coefficient covariance method utilizes White period 2-step GMM iterations. The GMM weights of Adolescent Fertility Rate GMM Arellano and Bond (AB) n-step (Cross-Section Difference and Period No Effects) are White period AB n-step, and coefficient covariance method utilizes White period n-step GMM iterations. The Ivs of the estimations are: first column are @DYN(LOG(AFR),-2) RFMPE(-1) RFMSE(-1) RFMTE(-1) WAT(-1) POP(-1) URP(-1) LEABF(-1) HTE(-1) PHR(-1).

The analysis of the GMM estimation technique is carried further with the employment of Arellano and Bond (1991) 1-step and 2-step and Arellano and Bover (1995) n-step estimation techniques which take the cross-section differences and period no effects into account for all ratios of enrollment (Table 7). The results show that while, AB AB 1-step estimation coefficient is statistically significant at 5 percent level, AB 2-step and AB n-step estimation coefficients are statistically significant at 1 percent level for the ratio of female to male primary enrollment. The signs of the coefficients are negative but reflect no relationship between the ratio of female to male primary enrollment and adolescent fertility rate. The coefficients of ratio of female to male secondary enrollment for AB 1-step and 2-step estimations are very low and not statistically significant whereas the level of significance is 1 percent for the ratio of female to male secondary enrollment ratio of female to male secondary enrollment which reflects a coefficient value of zero for AB n-step showing no relationship between ratio of female to male secondary enrollment and adolescent fertility rate. The value of the coefficient is statistically insignificant for the ratio of female to male tertiary enrollment in AB 1-step estimation. AB 2-step and AB n- step estimation coefficients suggest that these values are statistically significant at 5 percent and 1 percent levels. Hence, the relationship between the ratio of female to male tertiary enrollment and adolescent fertility rate is not reflected in the results. The p-value of AB 1-step is statistically significant at 1 percent level indicating that the null hypothesis Ho is rejected.

The over-identifying restrictions are not valid in this case, the robustness and validity of the model are questioned, and at least one of the instruments are correlated with the error term. The IV estimates indicate that, there may be an endogenous instrument in this estimation, indicating a weakness in fitting the model to the data. In this case, the results imperil the estimation, and its reliability. Yet, the p-values of the Sargan tests for AB 2-step and n-step estimation techniques reflect that the over-identifying restrictions are valid, and the model is therefore robust.

The GMM weights (*Difference AB 1-step*), and Sargan test computed p-values for this test shows that this estimated technique improves the robustness of the model. The GMM technique has a qualitative impact on the results. The GMM is valid, since it checks for the lags of the endogenous variable, and other instruments.

5.1.4. GMM estimation with AB n-step estimator

An alternative method was introduced to the literature by Arellano and Bover (1995) where the individual effects are removed or eliminated by orthogonal deviations. Arellano and Bover *n-step estimator* implies that, Y_{it-1} is an endogenous variable (Baltagi, 2008, p. 157).

Table 8 shows the GMM estimation results for cross-section difference and period fixed effects with cross-section GMM weights, where the coefficient for ratio of female to male primary enrollment produces a statistically significant result at 10 percent level indicating a decline in adolescent fertility rate by 0.29 percent. This is in line with the literature that education generates a decline in the adolescent fertility rate and therefore helps the developing countries to catch up with the others. The coefficient of GMM cross-section orthogonal deviation and period fixed effects with identity GMM weights for the ratio of female to male primary enrollment is statistically significant at 10 percent level as well; showing a 0.38 percent decline in the adolescent fertility rate with an increase in adolescent female literacy.

The same estimation with cross-section GMM weights for ratio of female to male primary enrollment produces a statistically significant coefficient at 5 percent level reflecting a decline in adolescent fertility rate by 0.36 percent. The coefficient for the ratio of female to male secondary enrollment with cross-section difference and period fixed effects and cross-section GMM weights is statistically significant at 1 percent level for adolescent fertility rate where it decreases this rate by 0.27 percent, but the same estimation is not statistically significant for the ratio of female to male tertiary enrollment.

The coefficients of identity GMM weights and cross-section GMM weights for the ratio of female to male secondary enrollment and ratio of female to male tertiary enrollment are statistically insignificant. Although, the R^2 values are high for cross-section orthogonal deviation, the R^2 value of cross-section difference reflects a lower R^2 than the other two R^2 values.

The p-values of the Sargan tests for cross-section difference reflect that we fail to reject Ho that the over-identifying restrictions are invalid, and hence, the model is robust. The employment of cross-section orthogonal deviation identity GMM weights also fails to reject the Ho of this estimation. Therefore, the model is valid and robust indicating that education leads to a decline in adolescent fertility rate at the primary and secondary education levels as can be seen from Table 8 as an outcome of all the estimation techniques. 2SLS and GMM estimation techniques have enhanced the models and their explanatory powers for both the primary and secondary education levels. But, these estimations did not support the existence of a strong relationship between the ratio of female to male tertiary enrollment and adolescent fertility rate.

Table 8. Adolescent Fertility Rate (Afr) and Ratio of Female to Male Enrollment, 1997-2011, Generalized Method of Moments (GMM)

Regressor	Adolescent Fertility Rate GMM (Cross-Section Difference and Period Fixed Effects) Cross-Section GMM Weights	Adolescent Fertility Rate GMM (Cross-Section Orthogonal Deviation and Period Fixed Effects) Identity GMM Weights	Adolescent Fertility Rate GMM (Cross-Section Orthogonal Deviation and Period Fixed Effects) Cross-Section GMM Weights
Ratio of Female to Male Primary Enrollment (Rfmpe)	-0.002935 (0.001680*)	-0.003783 (0.002217*)	-0.003624 (0.001675**)
Ratio of Female to Male Secondary Enrollment (Rfmse)	-0.002680 (0.001017***)	-0.000169 (0.000961)	-0.000582 (0.000616)
Ratio of Female to Male Tertiary Enrollment (Rfmte)	-4.14E-05 (7.80E-05)	-6.45E-05 (0.000306)	-6.10E-05 (0.000225)
Log of Lagged Endogenous Variable	0.936374 (0.036993***)	0.937384 (0.067172***)	0.867752 (0.034639***)
Constant	-	-	-
Number of Countries	24	24	24
Number of Observations	153	153	153
R^2	0.826069	0.942884	0.938281
Adjusted R^2	0.805606	0.936165	0.931020
Sum of Squared Residuals	0.039558	0.036448	0.039386
J- Statistic Sargan test (prob>χ^2)	79.18051 0.2366	82.02616 0.1754	99.31557 0.0149

Notes. Standard errors in parentheses. *, **, and *** denote the level of significance at 10 percent, 5 percent, and 1 percent level respectively. The Ivs of the estimations are: first column are @DYN(LOG(AFR),-2) RFMPE(-1) RFMSE(-1) RFMTE(-1) WAT(-1) POP(-1) URP(-1) LEABF(-1) HTE(-1) PHR(-1).

PLS, 2SLS, and GMM estimation results for the ratio of female to male tertiary enrollment reflect that the values of the coefficient in all the techniques are either very small or statistically insignificant signaling that primary and secondary education are more important for development and the decline in the adolescent fertility rates of 53 countries for the period between 1997 and 2011.

5.2. Ratios of Female to Male Primary, Secondary, and Tertiary Enrollment and Adolescent Fertility

Figure 1 reflects that the adolescent fertility rate of Turkey has continuously declined from approximately 52 percent to 32.2 percent between 1997 and 2011 period. The female to male primary and tertiary enrollment ratios have all increased during the same period from approximately 92 percent and 55 percent in 1997 to nearly 99 percent and 82 percent in 2010. The female to male secondary enrollment ratio rose from 69 percent in 1999 to 92 percent in 2010. The female to male primary, secondary, and tertiary enrollment ratios rose by 7 percent, 33 percent, and 49 percent respectively between 1997 and 2011, indicating that the highest increase was observed in the tertiary enrollment ratio. The increase in years of schooling and enrollment for higher education led to an ongoing decline in adolescent fertility rate in Turkey. This result is in line with the literature, and therefore supports the hypothesis that the fertility rate of the females between 15 to 19 years of age declines with tertiary education.

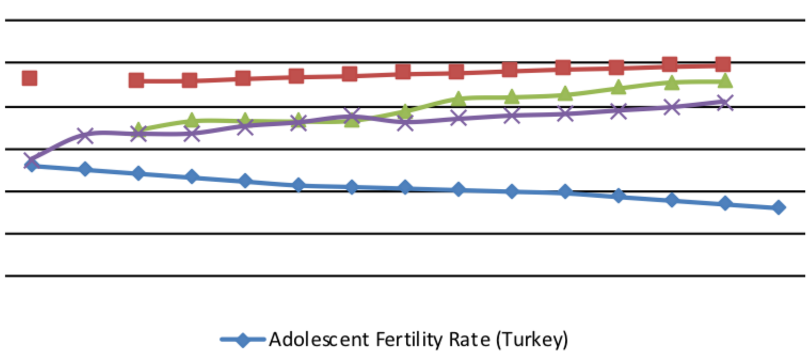
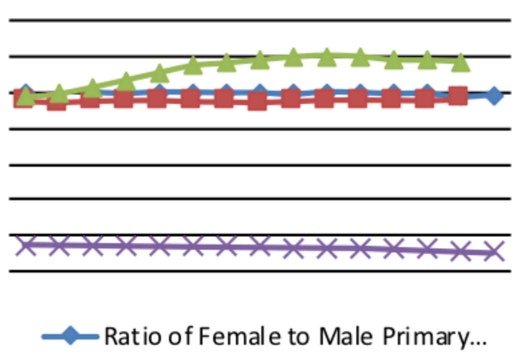
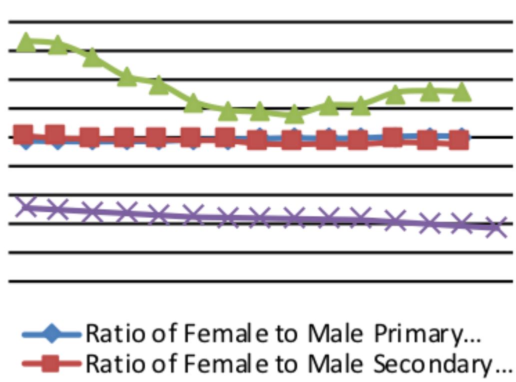
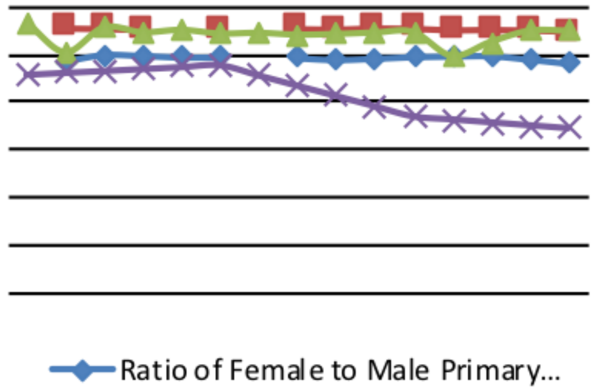


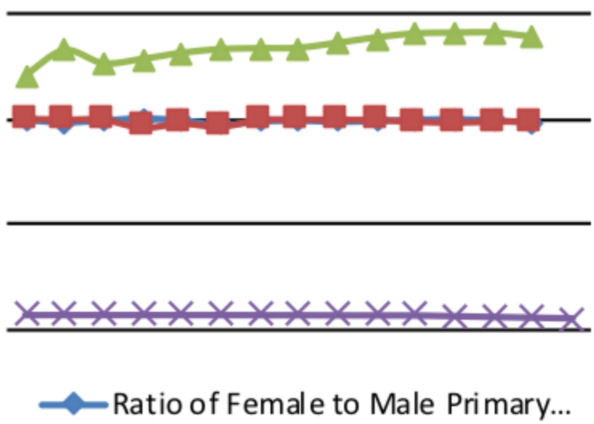
Figure 1: *Adolescent Fertility Rate and Ratio of Female to Male Enrollment (Primary, Secondary, and Tertiary) of Turkey (World Bank, 2013, World Development Indicators.)*

Figure 2 illustrates the adolescent fertility rates, primary, secondary, and tertiary enrollment ratios of several countries selected out of the 53 country sample. The adolescent fertility rate in Austria declined on average by 4 percent. Although, female to male primary and secondary enrollment ratios remained much less the same, the most significant outcome was the increase in tertiary enrollment by nearly 20 percent indicating that Austria would experience even further development. The rate of adolescent fertility decreased by roughly 13 percent in Bulgaria between 1997-2011, together with the ratio of female to male tertiary enrollment declining by approximately 35 percent for 1997-2010 period.






Ratio of Female to Male Primary...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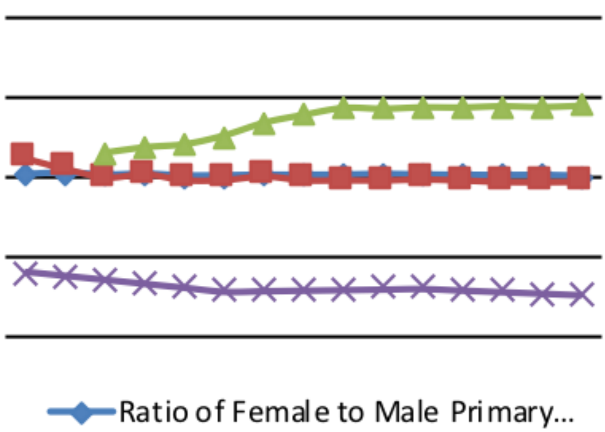
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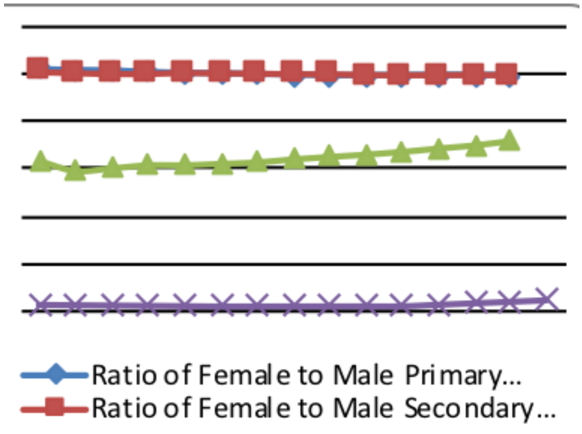


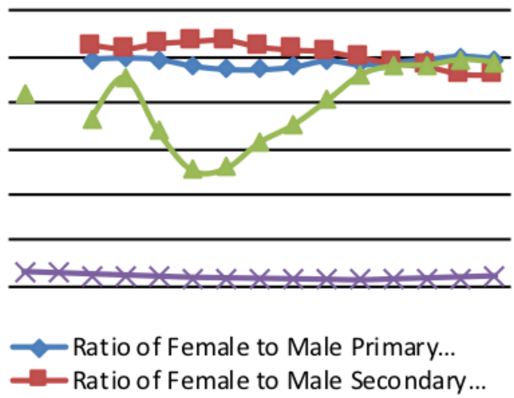
Figure 2: *Adolescent Fertility Rates and Primary, Secondary, and Tertiary Enrollment Ratios of Sample Countries (World Bank, 2013, World Development Indicators.)*

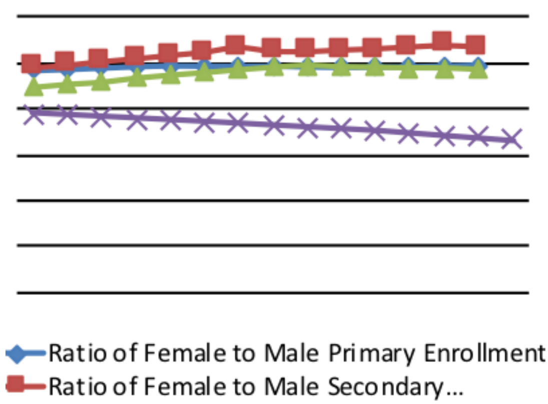
Contrary to the hypothesis, the adolescent fertility seems to decrease even though the enrollment to higher education has declined by nearly triple as much reflecting a sharp decline in the human capital and level of development of Bulgaria. Colombia is another example of such a country where the adolescent fertility rate as well as the ratio of female to male tertiary enrollment decreased by 22 percent and 3 percent respectively. The ratios of female to male primary and secondary enrollment remained somewhat stable.

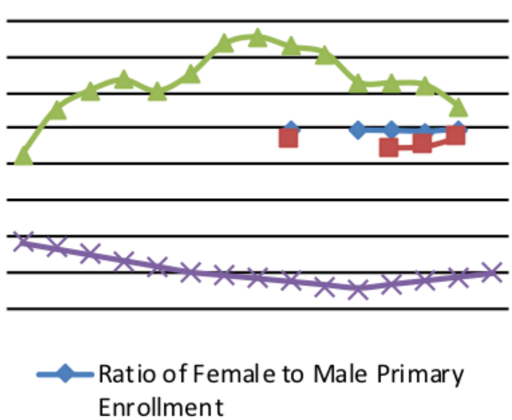
The adolescent fertility rate data for Italy reflects a 2.5 percent decrease, while the tertiary enrollment ratio increases by 18 percent between 1997 and 2011. Kazakhstan data for adolescent fertility rate shows a decrease by roughly 13.5 percent. Another outstanding result is that although the ratio of female to male secondary enrollment declined by 14 percent, the tertiary enrollment rose by 30 percent. Such a result shows the acceleration of the development process in Kazakhstan which helps the country to catch-up with the developed and other developing ones, thereby leading the path for Kazakhstan to converge with other developed countries between the period 1997 and 2011. The adolescent fertility rate of Korea Republic increased by 2.1 percent together with the ratio of female to male tertiary enrollment which rose by approximately 10 percent for the period between 1997 and 2011.

The female to male tertiary enrollment ratios of the developed countries have increased throughout the 1997-2011 period leading to an even higher level of development thereby creating a bigger gap between them and the developing and less developed countries. Data of some of the developing and less developed countries reflect that the tertiary enrollment ratios of for some are declining, thus generating divergence between the so called and the developed countries. Although, other developing and less developed countries experienced higher levels of tertiary enrollment these levels were still much below the levels of the ones experienced by the developed countries. The convergence between the rich and poor or the developed and not so developed countries may not be achieved under such conditions.

Figure 3 illustrates the adolescent fertility rates, ratios of female to male primary, secondary, and tertiary enrollment for Macao SAR, China, Mexico, Saudi Arabia, Thailand, United States, and West Bank and Gaza. Relevant data for Macao SAR, China reflects a 1.5 percent slight decrease in the adolescent fertility rate between the 1997-2011 period. 12.5 percent decline in the ratio of female to male secondary enrollment, and 13.5 percent increase in the ratio of tertiary enrollment are also observed for this country. The adolescent fertility rate of Mexico decreased by 11.3 percent while the ratio of female to male secondary enrollment increased by nearly 9 percent. The tertiary enrollment ratio rose by 7 percent for Mexico between the 1997-2011 period. Saudi Arabia's adolescent fertility rate decreased by 17 percent between the period 1997 and 2011. The ratio of female to male tertiary enrollment increased by 26 percent for the same period. Hence, Saudi Arabia invested in human capital and higher level of development throughout those years.


Ratio of Female to Male Primary...
Ratio of Female to Male Secondary...


Ratio of Female to Male Primary Enrollment
Ratio of Female to Male Secondary...


Ratio of Female to Male Primary Enrollment

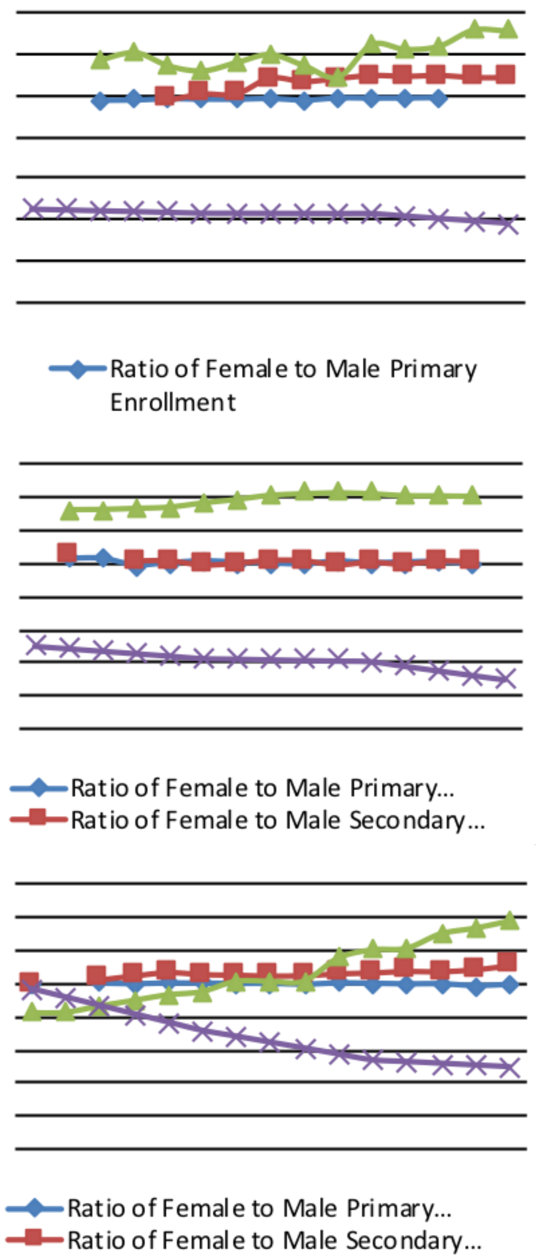


Figure 3: *Adolescent Fertility Rates and Ratios of Female to Male Primary, Secondary, and Tertiary Enrollment (World Bank, 2013, World Development Indicators)*

7.5 percent of decline in the adolescent fertility rate is reflected in Thailand's data. The ratios of female to male secondary and tertiary enrollment increased by 10 percent and 14 percent respectively for the period between 1997 and 2011. United States data for the adolescent fertility rate reflects 20.4 percent decline for the mentioned period. The tertiary enrollment ratio increased by 9 percent indicating a further increase in the already very high level of development for the United States. Adolescent fertility rate of the final sample West Bank and Gaza decreased by 47.10 percent, while the ratios of secondary and tertiary enrollment increased by 11.1 and 55.6 percent respectively for the period between 1997 and 2011.

6. Conclusion

The results of this study indicate that education and the level of development are negatively correlated with the rate of adolescent fertility and hence, primary education decreases the adolescent fertility rate. The estimation results indicate that primary education is necessary for further education and development.

Adolescent fertility rate decreases with an increase in adolescent female literacy. Estimation results for both of the ratios of female to male primary enrollment and female to male secondary enrollment produce statistically significant results.

All the estimation results for the ratio of female to male tertiary enrollment reflect that primary and secondary education are more important for development and the decline in the adolescent fertility rates of 53 countries for the period between 1997-2011.

The analysis of the adolescent fertility rate for Turkey reflects a continuous decline from approximately 52 percent to 32.2 percent between 1997 and 2011 period. The increase in years of schooling and enrollment for higher education in Turkey supports the hypothesis that the fertility rate of the females between 15 to 19 years of age declines with tertiary education.

References

Akın, M. Ş., (2005), "Education and Fertility: A Panel Data Analysis for Middle Eastern Countries", *The Journal of Developing Areas*, Vol. 39, No. 1, pp. 55-69.

Almeida, M. C. C. and Aquino, E. M. L., (2009), "The Role of Education Level in the Intergenerational Pattern of Adolescent Pregnancy in Brazil", *International Perspectives on Sexual and Reprodcutive Health*, Vol. 35, No. 3, pp. 139-146.

Bongaarts, J., (2003), "Completing the Fertility Transition in the Developing World: The Role of Educational Differences and Fertility Preferences", *Population Studies*, Vol. 57, No. 3, pp. 321-335.

Chen, R. and Morgan, S. P., (1991), "Recent Trends in the Timing of First Births in the United States", *Demography*, Vol. 28, No. 4, pp. 513-533.

Dreze, J. and Murthi, M., (2001), "Fertility, Education, and Development: Evidence from India", *Population and Development Review*, Vol. 27, No. 1, pp. 33-63.

Geronimus, A. T. and Korenman, S., (1992), "The Socioeconomic Consequences of Teen Childbearing Reconsidered", *The Quarterly Journal of Economics*, Vol. 107, No. 4, pp. 1187-1214.

Gupta, N. and Leite, I., (1999), "Adolescent Fertility Behavior: Trends and Determinants in Northeastern Brazil", *International Family Planning Perspectives*, Vol. 25, No. 3, pp. 125-130.

Hofferth, S. L., Reid, L., and Mott, F. L., (2001), "The Effects of Early Childbearing on Schooling over Time", *Family Planning Perspectives*, Vol. 33, No. 6, pp. 259-267.

Kahn, J. R. and Anderson, K. E., (1992), "Intergenerational Patterns of Teenage Fertility", *Demography*, Vol. 29, No. 1, pp. 39-57.

Klepinger, D. H., Lundberg, S., and Plotnick, R. D., (1995), "Adolescent Fertility and the Educational Attainment of Young Women", *Family Planning Perspectives*, Vol. 27, No. 1, pp. 23-28.

Manski, C. F., Sandefur, G. D., McLanahan, S., and Powers, D., (1992), "Alternative Estimates of the Effect of Family Structure During Adolescence on High School Graduation", *Journal of the American Statistical Association*, Vol. 87, No. 417, pp. 25-37.

Marini, M. M., (1984), "Women's Educational Attainment and the Timing of Entry into Parenthood", *American Sociological Review*, Vol. 49, No. 4, pp. 491-511.

McCarthy, J. and Radish, E., (1982), "Education and Childbearing Among Teenagers", *Family Planning Perspectives*, Vol. 14, No. 3, pp. 154-155.

Moore, K. A. and Waite, L. J., (1977), "Early Childbearing and Educational Attainment", *Family Planning Perspectives*, Vol. 9, No. 5, pp. 220-225.

Mott, F. L. and Marsiglio, W., (1985), "Early Childbearing and Completion of High School", *Family Planning Perspectives*, Vol. 17, No. 5, pp. 234-237.

Olsen, R. J. and Farkas, G., (1988), "Endogenous Covariates in Duration Models and the Effect of Adolescent Childbirth on Schooling", *The Journal of Human Resources"*, XXIV, 1, pp. 39-53.

Ribar, D. C., (1994), "Teenage Fertility and High School Completion", *The Review of Economics and Statistics*, Vol. 76, No. 3, pp. 413-424.

Rindfuss, R. R., John, C. S., and Bumpass, L. L., (1984), "Education and the Timing of Motherhood: Distentangling Causation", *Journal of Marriage and Family*, Vol. 46, No. 4, pp. 981-984.

Rindfuss, R. R., (1991), "The Young Adult Years: Diversity, Structural Change, and Fertility", *Demography*, Vol. 28, No. 4, pp. 493-512.

Rindfuss, R. R., Morgan, S. P., and Offutt, K., (1996), "Education and the Changing Age Pattern of American Fertility: 1963-1989", *De-*

mography, Vol. 33, No. 3, pp. 277-290.

Singh, S., (1998), "Adolescent Childbearing in Developing Countries: A Global Review", *Studies in Family Planning*, Vol. 29, No. 2, Adolescent Reproductive Behavior in the Developing World, pp. 117-136.

Upchurch, D. M. and McCarthy, J., (1989), "Adolescent Childbearing and High School Completion in the 1980s: Have Things Changed?", *Family Planning Perspectives*, Vol. 21, No. 5, pp. 199-202.

Upchurch, D. M., Lillard, L. A., and Panis, C. W. A., (2002), "Nonmarital Childbearing: Influences of Education, Marriage, and Fertility", *Demography*, Vol. 39, No. 2, pp. 311-329.

World Bank, (2013), World Development Indicators.

Internet Links

Agüero, J. M., Marks, M., and Raykar, N., (2011), "Do Children Reduce their Mother's Earnings? Evidence from Developing Countries", accessed on December 14th, 2015 at http://www.isid.ac.in/~pu/conference/dec_11_conf/Papers/MindyMarks.pdf

Berquo, E. and Cavenaghi, S., (2005), "Increasing Adolescent and Youth Fertility in Brazil: A New Trend or a One-Time Event?", accessed on December 14th, 2015 at http://paa2005.princeton.edu/papers/51746

Eloundou-Enyegue, P. M., (2004), "Population and Millennium Development: Integrating Teen Fertility and Gender-Equity Programs", *United Nations Millennium Project Background Paper to the Report "Public Choices, Private Decisions: Sexual and Reproductive Health and the Millennium Development Goals"*, accessed on December 16th, 2015 at http://www.unmillenniumproject.org/documents/Parfait-final.pdf

Hotz, V. J., McElroy, S. W., and Sanders, S. G., (1999), "Teenage Childbearing and its Life Cycle Consequences: Exploiting a Natural Experiment", *NBER Working Paper Series*, No. 7397, accessed on December 14th, 2015 at http://www.nber.org/papers/w7397

Klepinger, D., Lundberg, S, and Plotnick, R., (1999), "Teen Childbearing and Human Capital: Does Timing Matter?", accessed on December 14th, 2015 at http://citeseerx.ist.psu.edu/viewdoc/citations;jsessionid=40DFE836E13E7C9AA9E2842C0D4B62D6?doi=10.1.1.199.22

Lee, D., (2006), "Reevaluating the Socioeconomic Effects of Teenage Childbearing: A Counterfactual Approach", accessed on December 14th, 2015 at http://paa2007.princeton.edu/papers/71702

Martin, T. C. and Juarez, F., (1995), "The Impact of Women's Education on Fertility in Latin America: Searching for Explanations", *International Family Planning Perspectices*, Vol. 21, No. 2, accessed on December 14th, 2015 at https://www.guttmacher.org/pubs/journals/2105295.html

Rafalimanana, H., (2006), "Adolescent Fertility in the Developing World: Levels and Trends in the 1990s and early 2000s", paper to be presented at the Annual Metting of the Population Association of America, Los Angeles, California, March 30-April 1, 2006, accessed on December 14th, 2015 at http://paa2006.princeton.edu/papers/60711

United Nations Economic and Social Council, (2011), accessed on December 16th, 2015 at http://www.un.org/press/en/2011/pop994.doc.html