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Female Schooling and Economic Development

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Abstract

The interpretation of a weak link between female schooling and economic development evidenced in cross-country studies has posed difficulties for development economists. Attempts have been made to explain these findings, however it remains unclear whether such statistical findings for female schooling are gender-specific or representative of comprehensive schooling. This panel data study provides evidence that the weak female schooling effect is not gender-specific, but is more likely to represent a weak link between general schooling and development. It also suggests that raising women's social status, which seems to be reinforced by enhancing female schooling, is beneficial in terms of reducing infant mortality.

JEL classification: O11, I21, I10

Key words: women's education, women's social status, infant mortality, human capital, panel data, developing countries

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1. Introduction

Cross-country studies have often found female schooling to have a weak, sometimes even negative, effect on development. This is puzzling since both theoretical and empirical economics suggest the positive economic value of human capital. Economic theory tells us that accumulation of human capital is beneficial to economic development because it increases productivity (Becker 1975, Shultz 1961, Thurow 1970). Human capital also stimulates technological innovation (Romer 1990a, 1990b) and helps adoption of foreign technology (Nelson and Phelps 1966). Statistical evidence strongly supports the human capital theory (Barro 1991, Gemmell 1996, Mankiw *et al.* 1992). Turning from general education to women's education, the substantial role of women's education is also well-documented. In most developing countries, mothers are more likely to be the primary carers of their children. Since better-educated mothers use a different mix of health inputs more efficiently than less-educated mothers, women's education enhances child health and nutrition (Schultz 1993). School education provides future mothers with health knowledge, literacy and numeracy skills for future child carers, and receptiveness to modern medical treatments (Glewwe 1999). Considering the significant role of women in family as well as in society, past statistical findings demonstrating a weak link between female schooling and development are contradictory. At present there are few theories in the literature that adequately explain this problem, and this represents a challenge for researchers.

This study reexamines the link between female schooling and economic development. It provides empirical evidence to indicate that past statistical findings of the weak female schooling effect are likely to reflect a weak link between general schooling and development in developing countries.

Section 2 reviews the literature on female and male schooling in development.

Section 3 overviews the methods and data used in this study. Section 4 provides empirical results. Section 5 presents conclusions.

2. Literature Review

An increasing body of empirical literature has investigated the relationship between gender-specific education and economic development, however some papers have presented statistical findings suggesting that women's education has little impact on economic development. Few researchers, however, have attempted to account for the unexpected statistical findings of the negative effect of female schooling on development. Barro and Lee (1994) found that female secondary and higher education has a significantly negative effect on subsequent economic growth. Barro (1997) reported that female schooling at various levels is not significantly related to economic growth, and accordingly, his growth regressions include a variable for male schooling, but not female schooling. Forbes (2000) concluded that neither female nor male schooling is significantly correlated to economic growth, and those estimated coefficients often have the opposite signs. Caselli *et al*. (1996) stated that female schooling has a positive and significant effect on economic growth whilst male schooling has a negative coefficient. These unexpected results, namely the weak effect of female schooling on development are often left unexplained.

While some other cross-country studies show statistical findings that women's education has a positive impact on development, they are subject to an interpretational problem. The effect of female schooling on economic development is typically estimated by regressing a dependent variable of interest on a variable of female schooling without controlling male schooling. Focusing on the role of female schooling in development, Smith and Haddad (2002) and Haddad *et al.* (2003) revealed that female schooling is a vital factor in

reducing child malnutrition. However, in the absence of a control variable of male schooling in their regressions, the estimated coefficient of female schooling may capture the effect of male schooling which is an omitted variable in the model.

A possible explanation for these puzzling statistical findings is that the coefficient of female schooling captures the effect of general schooling, rather than female schooling *per se*, on development. The weak relationship between general schooling and economic development has been repeatedly found in growth regressions (Islam 1995, Hoeffler 2002). An influential paper by Pritchett (2001) argues that the weak link between educational capital and development may be caused by the low quality of schooling, excess supply of educational capital, and the employment of educational capital in socially unproductive activities. Cross-country differences in education quality may prevent precise estimation (Jamison *et al.* 2006). These factors are inherent in cross-country analysis of the schooling-development link. Therefore, the puzzling statistical findings of the weak female schooling effect on economic development in the literature may mirror the similarly weak link between general schooling, rather than female schooling, and economic development.

3. Methodology and Data

The question addressed here is whether the statistical findings of the impact on economic development of female schooling are gender-specific or representative of comprehensive schooling. In order to reexamine the relationship between female schooling and economic development, the present study investigates the different effects of female and male schooling on infant mortality. This study employs panel data from developing countries for the period 1962 to 2002, where infant mortality as a proxy for poverty is regressed on

female and male schooling and control variables including per capita GDP.[1] The statistical methods in the study control country- and period-specific effects, which compensate for cross-country differences in quality of schooling.

The two-way fixed and random effects models are employed. The two-way fixed effects model is given by

$$H_{it} = \alpha_0 + \alpha_i + \delta_t + \beta_1 fs_{it} + \beta_2 ms_{it} + \gamma' X_{it} + \varepsilon_{it}. \quad (1)$$

where H_{it} is the natural logarithm of infant mortality in country *i* in period *t*. The separate impacts of female schooling (fs_{it}) and male schooling (ms_{it}) on infant mortality are estimated. X_{it} is a vector of determinants of infant mortality. The $\alpha_i s$ are individual specific constants capturing country-specific effects, and the $\delta_t s$ are time specific constants.

The two-way random effects model is written as

$$H_{it} = \alpha + \beta_1 fs_{it} + \beta_2 ms_{it} + \gamma' X_{it} + \varepsilon_{it} + u_i + w_t. \quad (2)$$

These statistical procedures reduce the risk of omitted variables.

The dataset consists of 76 developing countries for the concerned period 1962 to 2002 in five-year intervals. As control variables, per capita GDP, food availability, women's social status and urbanization are used. The first two variables are standard controls in development economics, and the last two variables are potentially substantial determinants of the health of the poor. Description of data is provided in the Data Appendix. Due to missing values, the panel dataset is unbalanced.

A dependent variable for infant mortality is employed as a proxy for the living standard of the poor. Infant mortality is defined as the number of infants dying before

[1] For the purpose of this research, the countries which joined the OECD after the year 1991 are categorized as developing countries. Thus, the Czech Republic, Hungary, South Korea, Mexico, Poland, and the Slovak Republic are included in the sample of developing countries.

reaching one year of age per 1,000 live births in a given year. A variable for infant mortality is available from Easterly's (2001) *Global Development Network Growth Database*, released by the World Bank. The country observations of infant mortality and life expectancy for the majority of countries are available beginning from the year 1962 with five-year intervals up to the year 1997. Missing values in the 40-year period from 1962 to 2002 under consideration have been filled by data from *World Development Indicators* published by the World Bank.

As a variable for GDP per capita, this study employs PPP-adjusted GDP per capita in 2000 constant prices in chain series (RGDPCH) from the *Penn World Table* Version 6.2 by Heston *et al*. (2006). This variable is "the recommended intertemporal GDP time series" (Summers and Heston, 1991, p.344) since it mitigates the Laspeyres fixed-base problem in which, as the year-point of the observation is remote from the base year, "relative prices change and the base year weights become less and less appropriate" (Summers and Heston, 1991, p.344).

The present study employs as a proxy for the level of education the total number of years of schooling in the population over 25 years old in Barro and Lee's (2001) dataset. The data availability is from 1960 to 2000 with 5-year intervals. Since our dependent variable — infant mortality — spans the years 1962 to 2002 with five-year intervals, there is a two-year gap between health and schooling variables.

A number of studies have indicated three potentially important determinants of poor people's health: women's social status, urbanization and food availability. Women's social status is a plausible factor in improving infant mortality if enhancing the power of women leads resource allocation to be more favorable to family health. Its important role is emphasized in Smith and Haddad (2002), where the female-male life expectancy ratio is treated as a key determinant of the poor's health. The present study incorporates a measure of

women's social status calculated by female life expectancy divided by male life expectancy.

Urbanization is also likely to be an important factor influencing poverty alleviation and hence is a potential determinant of infant mortality. Particularly in developing countries, child malnutrition is usually lower in urban areas than in rural areas arguably because of better socioeconomic conditions such as piped water (Smith *et al*. 2005). Nevertheless, it is reasonable to suppose that urbanization is a proxy for positive as well as negative determinants of health, since on the positive side it provides access to medical care and health information, while on the negative side it introduces the issues of overpopulation and congestion (Thornton 2002). Many urban areas in developing countries include slum areas having appalling environmental and sanitary conditions, which exacerbate the health problems of the overall population. In the year 2003, the ratio of slum population to urban population was 72 percent in Cambodia, 66 percent in Lao PDR, and 47 percent in Vietnam (Asian Development Bank *et al*. 2005). As the overall impact of urbanization upon infant mortality is ambiguous, the expected sign of the coefficient on urbanization is *a priori* unknown. A variable for urbanization is proxied for by the proportion of the population who live in urban areas, the data being taken from *World Development Indicators*.

The other potentially important determinant of health is food availability. It is clear that a high level of food availability promotes health in poor households. Mothers' consumption of plentiful food helps to raise the quality of breast milk, which leads to improved infant health. The importance of food availability for the state of health among the poor is clear, and a lengthy explanation is thus omitted.

4. Empirical Results

Table 1 presents the estimated results, using two-way fixed and random effects

models where all of the country dummies and period dummies are included, and with per capita GDP, women's social status, urbanization, and food availability being controlled. The Lagrange Multiplier tests always suggest that the fixed/random effects models are preferable to the restricted OLS estimation in all model specifications. Estimates of both fixed effects and random effects models are shown whilst the Hausman (1978) test consistently suggests that fixed effects models are preferable to random effects models. In none of the three models (Regressions 1, 2, and 3) where both variables of female and male schooling are included is the coefficient of female schooling statistically significant at any conventional level. Meanwhile, the coefficient of male schooling is not robust to different estimation methods: It has a negative sign and is statistically significant in the OLS and the two-way random effects models, but not in the two-way fixed effects model.

Table 1. The effects of female and male schooling on infant mortality, 1962-2002

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Method:	**OLS**	**Two-way fixed effects**	**Two-way random effects**	**Two-way fixed effects**	**Two-way random effects**	**Two-way fixed effects**	**Two-way random effects**
(Ln) Female schooling	0.025	0.072	-0.039	0.058**	-0.093***		
	(0.456)	(1.642)	(-0.973)	(2.032)	(-3.950)		
(Ln) Male schooling	-0.526***	-0.027	-0.104*			0.043	-0.132***
	(-6.582)	(-0.438)	(-1.799)			(1.162)	(-4.057)
(Ln) GDP per capita, PPP	-0.397***	-0.203***	-0.392***	-0.201***	-0.383***	-0.203***	-0.397***
	(-10.959)	(-6.129)	(-14.174)	(-6.122)	(-13.812)	(-6.135)	(-14.473)
Women's social status	0.212	-0.745	-1.082**	-0.763	-1.126**	-0.800*	-1.036**
	(0.335)	(-1.533)	(-2.427)	(-1.580)	(-2.514)	(-1.649)	(-2.318)
(Ln) Urbanization	0.018	0.403***	0.111**	0.400***	0.104**	0.416***	0.102**
	(0.417)	(6.666)	(2.455)	(6.675)	(2.280)	(6.924)	(2.285)
(Ln) Food availability	0.020	-0.050**	-0.045***	-0.050**	-0.046***	-0.047**	-0.046***
	(1.504)	(-2.337)	(-3.010)	(-2.336)	(-3.051)	(-2.212)	(-3.098)
Constant	7.654***	4.992***	8.059***	4.992***	7.969***	4.980***	8.085***
	(10.691)	(8.410)	(16.047)	(8.416)	(15.756)	(8.392)	(16.265)
R^2	0.688	0.958		0.958		0.958	
Adjusted R^2	0.684	0.950		0.950		0.950	
Akaike Info. Criterion	-1.683	-3.386		-3.389		-3.385	
F-statistic (prob.)	191.16	113.49		114.99		114.84	
	(0.000)	(0.000)		(0.000)		(0.000)	
Lagrange Multiplier Test		675.69		764.91		688.08	
(p-value)		(0.000)		(0.000)		(0.000)	
Hausman Test		199.69		194.68		196.43	
(p-value)		(0.000)		(0.000)		(0.000)	
No. of Countries	76	76		76		76	
No. of Observations	528	528		528		529	

Note: The dependent variable is natural logarithm of infant mortality. The data consists of observations of developing countries only. *t*-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% significance level, respectively. Lagrange multiplier tests are for a fixed/random effects model against a restricted OLS model. The Hausman tests a fixed effects model *vs.* a random effects model.

Some unexpected estimates may be due to multicollinearity, since variables of female and male schooling are likely to be influenced by the general effects of comprehensive schooling. To avoid multicollinearity, either female or male schooling is excluded from the specification in Regressions 4, 5, 6, and 7. Female schooling turns out to be statistically significant at the 5% level with a negative coefficient in the two-way random effects model, but has an unexpected positive sign in the two-way fixed effects model. The estimated coefficient of male schooling is negative and statistically significant in the two-way random effects model, but is not significant in the two-way fixed effects model. These results denote that the effect of female schooling on infant mortality depends largely on estimation methods and control of the male schooling variable. They also indicate that the unexpected estimates of female schooling in Regressions 1, 2, and 3 are not necessarily due to multicollinearity.

The variable of women's social status has a statistically significant, negative coefficient in more than half of the regressions, indicating that raising women's social status leads to lower infant mortality. This evidence agrees well with the findings of Behrman and Wolfe (1987) who report that women's endowments such as abilities and habits are more significantly correlated than women's education with health and nutrition. This set of evidence, together with the unexpected coefficients of female schooling, suggests that women's social status relative to men can be a more substantial factor in reducing infant mortality than female schooling, however this by no means signifies that the effect of female schooling is inconsiderable. Enhancing women's social status is a key to decreasing infant mortality, and women's social status is likely to be strengthened by increasing female schooling. In this sense, female schooling solidifies the foundation of child health.

GDP per capita and food availability constantly have statistically significant, negative coefficients, suggesting that macroeconomic and social circumstances play

substantial roles in development. The estimated coefficient of urbanization is positive and statistically significant in most specifications.

5. Conclusions

The interpretation of a weak link between female schooling and economic development evidenced in cross-country studies has posed difficulties for development economists. The question addressed in this study is whether such statistical findings of female schooling are gender-specific or representative of comprehensive schooling. This panel data study provides evidence that the effect of female schooling on infant mortality depends largely on estimation methods and control of the male schooling variable. The statistical evidence also suggests that the weak female schooling effect is not gender-specific. It is more likely to represent a weak link between general schooling and development. It should be emphasized that the statistical evidence in this study, by no means, indicates that female schooling is unimportant. The evidence suggests the opposite. The study found that raising women's social status, which is reinforced by enhancing female schooling, is beneficial in reducing infant mortality. These findings suggest that the beneficial influence of female schooling is indirect, but vital in reducing infant mortality.

It is also noteworthy that empirics on female schooling in development without sufficient consideration of male schooling may misinterpret the role of female schooling in development, and *vice versa*. Therefore, statistical findings in past literature focusing on the role of only one gender need to be generalized with caution.

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Data Appendix

Variable name	*Description and Source*
Infant mortality rate	Mortality rate, under one year (per 1,000 live births). Source: Mainly from World Development Indicators 2005; For missing values, data are added from Global Development Network Growth Database, World Bank.
Real GDP per capita PPP	PPP-adjusted Real GDP per capita (Chain). Source: Penn World Table 6.2 (RGDPCH).
Male years of schooling	Average years of schooling in the male population (25+). Source: Barro&Lee 2001 (TYRM).
Female years of schooling	Average years of schooling in the female population (25+). Note: The figure of average years of schooling in the female population (25+) (*i.e.*, TYRF) in Nepal in the year 1970 scores zero in the data source. Treating this observation as the outcome of serious measurement error, it is excluded from the dataset of this study. Source: Barro&Lee 2001 (TYRF).
Male life expectancy	Life expectancy at birth, male (years). Source: World Development Indicators 2005.
Female life expectancy	Life expectancy at birth, female (years). Source: World Development Indicators 2005.
Women's social status	Calculated by the author: Female life expectancy divided by male life expectancy.
Urbanization	Urban population (% of total population). Source: World Development Indicators 2005.
Cereal production	Cereal production (metric tons). Source: World Development Indicators 2005.
Population	Population, total. Source: World Development Indicators 2005.
Food availability	Calculated by the author: Cereal production (metric tons) divided by population.

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