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The economic effects of gender parity in education

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Abstract

This paper analyzes the effects of the gender parity index of females to males enrolled in primary, secondary and higher education on economic growth of real GDP per capita. Gender parity in primary and secondary education combined is also used as a variable. This is a novel variable used in such estimations. While high levels of development have high levels of gender parity in education, low levels of development can have equality or inequality in education between the genders. Low levels of gender parity indicate providing boys with more education than girls. Alternatively, female and male enrollment rates in each of these three levels of education are evaluated. Global panel-data regressions over a 50-year time span are used. These measures are all highly statistically significant throughout the regressions, generally at the 1-percent level. Impacts of gender parity in education on other economic variables are also found, such as reducing fertility rates, infant mortality rates, poverty, income inequality and inflation. Additionally, gender parity in education augments e.g. openness to trade, domestic investment, foreign direct investment inflows, R&D expenditures, savings, political rights, and government expenditures.

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1. Introduction

Female education has often historically fallen behind male education in many countries for various reasons. However, neglecting female education may have adverse impacts in many ways, including measurable economic effects. The countries with less education for girls are also less developed countries. A lack of human capital would be expected to impede economic development. This is likely to take place through various mechanisms. Thus, this paper will analyze the economic impacts of gender equality in education. Gender parity in enrollment rates between females and males are often achieved at high levels of education and development, however, equality in education between the genders can happen at any level of education. It would show that girls are not discriminated against when it comes to being able to attend school. Cultural and religious beliefs are important factors when it comes to parents' decisions as to whether to invest in their children's education. In the 1960s, in Bhutan, only 2 percent of girls were enrolled in primary school while 40 percent of boys were enrolled, thus the gender parity was only 0.05. In the last decade, The Gambia enrolls about 80 percent of children in primary education and about 50 percent in secondary education. As they enroll about the same percentages of girls and boys, their gender parity ratios are about 1. If more girls than boys are educated, the gender parity exceeds 1.

The main contribution of this paper is to analyze the impact of gender parity in primary, secondary (or combined) and higher education on economic growth globally over 50 years. Gender parity is a novel variable analyzed in this context. As it is related to female and male education, this paper will also estimate the separate effect of female and male enrollment rates in each level of education. Female education explains 66 percent of gender parity in primary school, 49 percent of gender parity in secondary education, and 41 percent of gender parity in tertiary education. Additionally tested for is gender parity in each level of education and its influence on other variables, some of which affect economic growth in turn. The effects of gender equality in primary and secondary schooling (or combined) as well as in tertiary education are regressed on various economic variables such as fertility rates, infant mortality rates, poverty rates, political rights, income inequality, savings, Research and Development (R&D), Foreign Direct Investment (FDI), investment, international trade, government spending and inflation. This paper will continue with a literature review, then a methodology section, followed by the panel regression results and ending with a conclusion.

2. Literature Review

There is no literature about gender parity as used here, especially in the ways it would impact economic growth and other economic variables. However, as the lack of gender parity is the level of female education falling behind that of male education, this literature review will focus on the economic effects of female education. The economic influences of female education have been been found to increase economic growth (Klasen 2002; Pegkas and Tsamadias 2017). Further education for women increases their labor force participation and employment (Bbaale and Mpuga 2011), as well as their productivity (Lincove 2008; Khandker 1990; Hassan and Cooray 2015). However, girls often drop out in primary to secondary education, especially in the countryside, e.g., to work on the farm or elsewhere or to do household chores such as care for younger siblings (Amutha 2011; Lingrove 2009).

Girls' education has also been found to increase investment (Klasen 2002). These effects, in turn, have beneficial impacts on economic growth. Parents' education - particularly a mother's education - raises the education of their children, especially increasing the educational investment of girls (Ahmed 2007). Bias in households and communities are the root cause of girls receiving less educational investment than boys, e.g. sons are often sent to private schools, while daughters attend public schools (Khandker 1990; Azam and Kingdon 2013).

Girls' education has been found to decrease fertility rates (Appleton 1996; Barro 1997). According to economic theory, women's opportunity cost of having children increases with higher earnings in the labor market. Early schooling for girls is an important factor in decreasing infant mortality (Mellington and Cameron 1999; Bhuiya 1991).

Some studies on related topics are estimated by education level, but not by gender. Nevertheless, they demonstrate that secondary and higher education have stronger impacts on poverty than primary education (Ngepah, Makgalemele and Shaaba Saba 2023; Keller 2021). Enrollment rates in secondary education indicate the most effectiveness in reducing income inequality (Keller 2010).

3. Methodology

3.1 Model Specification

This study follows the endogenous growth research that emphasizes the rate of investment in human and physical capital (given technology) as raising economic growth rates (Lucas 1988). A global panel is used in estimating the effects of the gender parity index (the ratio of girls to boys enrolled) and female and male enrollment rates separately on per capita growth. The panel data are calculated as averages for each country available in ten-year periods. To avoid business cycle fluctuations in growth rates, the dependent variable is 10-year average real GDP per capita growth rates between 1971 and 2019.

Control variables are included similarly to Barro (1997, 2000), McMahon (2000), Keller (2006a&b, 2021), and Oketch (2021). The use of lags is comparable to McMahon's (2000) dynamic framework, while Barro's (1997, 2000) analyzes steady state growth in a neoclassical static framework. Control variables are added incrementally to investigate their effects on the gender specific education variables. World Bank data are generally used, with exceptions noted. The natural logarithm of real GDP per capita (ly) is lagged by a decade. Another variable that may take time to influence growth and that is also lagged by a decade is net inflows of FDI (FDI/Y) as a share of GDP. The fertility rate (f), the growth rate of the consumer price index (infl), political rights (PR, from the Freedom House), and as shares of GDP: investment in physical capital (I/Y), openness to trade (T/Y, T = exports + imports of goods and services), and government spending enter contemporaneously to per capita growth.[1]

The gender parity index in education (gp_i) in primary education (i=1) are averages lagged by ten years, e.g. 1960-1970 on average yearly growth rates 1970-1979, etc., and likewise for the

[1] Real GDP per capita measures are in constant $U.S. Inflation is based on the CPI when available, or the GDP deflator otherwise. The data are generally from the WDI, except Political Rights, which is from the Freedom House. Political Rights are converted to 0-1 scales, 1 being the most favorable, similar to Barro (1997). R&D as a share of GDP is attempted similar to McMahon (1998) and Keller and Poutvaara (2005), but of limited availability for LDCs.

other education levels. Female (ef_i) and male enrollment rates (em_i) are measured the same way. Enrollment rates comprise both public and private enrollment. Enrollment rates in primary education have been observed to increase per capita growth rates (e.g., Barro 1991; McMahon 1998, 2000), and investments in universal basic education (primary to secondary) has been regarded as one of the most imperative reasons for East Asia growing so rapidly (Page 1994).[2] Education investments are of higher statistical significance using even longer lags, and have important externalities through indirect effects of other development goals significant to economic growth (Appiah and McMahon 2002; McMahon 2000; 2003). Due to multicollinearity, different education levels are generally not included in the same regression, as secondary education depends on completing primary education and higher education depends on the previous two levels (e.g., Keller 2006a&b; McMahon 2000).

As the pooled least square (PLS) assumption of a common constant is often too restrictive for global samples, the presence of fixed effects is tested, which would indicate that the unrestricted (fixed effect) model would be more suitable. The hypothesis that the constant terms are equal for all countries is tested with an F-test. The test results reject the hypothesis of a common intercept for the global sample. When the null hypothesis of no individual fixed effects being present is accepted, the PLS estimates are consistent, as well as efficient estimators, and are utilized. The unrestricted model is a consistent estimator for all regressions. For this global sample, most regressions indicate the existence of fixed effects. Hence, the unrestricted model (or within-groups estimator) with country-specific individual fixed effects gives unbiased, consistent and efficient estimators for most regression results.

The unrestricted model regression equations for the measures of gender parity in each level of education are as follows. Female and male enrollment rates regressions are equivalent.

$$\mathbf{g}_{it} = \mathbf{i}\alpha_i + \boldsymbol{\beta}_1\mathbf{(ln\ y)}_{i(t-10)} + \boldsymbol{\beta}_2\mathbf{gp}_{1i(t-10)} + \mathbf{X} + \boldsymbol{\varepsilon}_i \quad (1)$$

$$\mathbf{g}_{it} = \mathbf{i}\alpha_i + \boldsymbol{\beta}_1\mathbf{(ln\ y)}_{i(t-10)} + \boldsymbol{\beta}_2\mathbf{gp}_{2i(t-10)} + \mathbf{X} + \boldsymbol{\varepsilon}_i \quad (2)$$

$$\mathbf{g}_{it} = \mathbf{i}\alpha_i + \boldsymbol{\beta}_1\mathbf{(ln\ y)}_{i(t-10)} + \boldsymbol{\beta}_2\mathbf{gp}_{3i(t-10)} + \mathbf{X} + \boldsymbol{\varepsilon}_i \quad (3)$$

$$\mathbf{g}_{it} = \mathbf{i}\alpha_i + \boldsymbol{\beta}_1\mathbf{(ln\ y)}_{i(t-10)} + \boldsymbol{\beta}_2\mathbf{gp}_{12i(t-10)} + \mathbf{X} + \boldsymbol{\varepsilon}_i \quad (4)$$

$$\mathbf{g}_{it} = \mathbf{i}\alpha_i + \boldsymbol{\beta}_1\mathbf{(ln\ y)}_{i(t-10)} + \boldsymbol{\beta}_2\mathbf{ef}_{1i(t-10)} + \boldsymbol{\beta}_2\mathbf{ef}_{2i(t-10)} + \boldsymbol{\beta}_2\mathbf{ef}_{3i(t-10)} + \mathbf{X} + \boldsymbol{\varepsilon}_{it} \quad (5)$$

$$\mathbf{g}_{it} = \mathbf{i}\alpha_i + \boldsymbol{\beta}_1\mathbf{(ln\ y)}_{i(t-10)} + \boldsymbol{\beta}_2\mathbf{em}_{1i(t-10)} + \boldsymbol{\beta}_2\mathbf{em}_{2i(t-10)} + \boldsymbol{\beta}_2\mathbf{em}_{3i(t-10)} + \mathbf{X} + \boldsymbol{\varepsilon}_{it} \quad (6)$$

where $\mathbf{X} = \boldsymbol{\beta}_3\mathbf{(I/Y)}_{it} + \boldsymbol{\beta}_4\mathbf{(Infl)}_{it} + \boldsymbol{\beta}_5\mathbf{(T/Y)}_{it} + \boldsymbol{\beta}_7\mathbf{(FDI/Y)}_{i(t-10)} + \boldsymbol{\beta}_8\mathbf{(Gov/Y)}_{it} + \boldsymbol{\beta}_9\mathbf{(PR)}_i + \boldsymbol{\beta}_{10}\mathbf{(f)}_{it}$

The notation $\mathbf{i}\alpha_i$ is a matrix of individual dummies for each model (bold indicating vectors), providing an individual constant for each country. Non-education variables generally follow Barro (1997, 2000), McMahon (2000); Keller (2006a&b), and Oketch (2021):
ln y = natural log of real GDP/capita; I/Y = investment in physical capital / GDP, Infl = inflation (growth of Consumer Price Index or else GDP deflator), T/Y = openness to trade (exports and imports of goods and services / GDP), FDI/Y = net inflows of FDI / GDP, Gov/Y = Government Spending / GDP, PR = political rights, 0-1, where 1 is the most democratic, and f = fertility rate.

The individual constant (not reported) for each country in each regression comprises lasting country-specific factors not included among the control variables, e.g., history, culture, ethnic and

[2] UNESCO education data have been criticized by, e.g., Behrman and Rosenzweig (1994). Enrollment often measures beginning-of-the-year enrollments, not attendance, and thus overstates especially LDC's enrollment rates. McMahon (2003) approximates the overstated enrollment counteracting almost fully the ability bias, which under- and overestimates respectively the effects of schooling on its returns.

linguistic features. These are nonmarket effects that are unaccounted, by including GDP per capita (here changing over time). If country-specific constants reflect differences affected by education, education's direct effects would be lessened. Fixed effects reduce the degrees of freedom, but the results are rarely less significant than with a common constant for countries globally over time.

The potential problem of omitted variables is lessened by including control variables that are standard in growth regressions and country-specific individual constants. Panel data control for omitted variables that are persistent over time (Temple 1999). Using as many countries as have data available reduces any problem with self-selection. Doing this leads to the use of an unbalanced data set with some missing observations, omitting that period's observations for the country.

On average globally, about 89 percent of students complete primary education, and about 76 percent complete lower secondary education (World Bank 2024). When considering the countries with the lowest percentages of enrollment rates in each level of education, substantially fewer girls than boys enroll. Descriptive statistics (Table 1) reveal that for the countries with the lowest female enrollment rates in each level (44, 12 and less than 1 percent in primary, secondary and higher education respectively) versus equivalent male enrollment rates (64, 17 and 2 percent), the gender parity index of female to male students worsens for each level of education (61, 47 and 34 percent respectively). The lowest completion rates for primary education 2010-2019 were in South Sudan with only 19.7 percent of girls and 35.9 percent of boys. In the Central African Republic only 7.6 percent of girls and 13.1 percent of boys complete secondary education. Global averages for the latest decade indicate a growth rate of over 2 percent, and a GDP per capita of $U.S. 5716. Yet, income per person for the poorest country is only $312 annually, thus a mere 85 cents per day. This research attempts to estimate if there are statistically significant correlations between gender equality in education and higher economic growth over time.

Table I: Descriptive Statistics

	Growth GDP/ Capita	GDP/ capita ($)	Gender Parity Index (females/males enrolled) (prim, prim/sec, sec, tertiary)				Enrollment rate, female (%gross) (prim, secondary, ter)			Enrollment rate, male (%gross) (primary, sec, tertiary)		
Mean	0.0212	5716	0.98	0.99	1	1.07	1.01	0.82	0.38	1.03	0.81	0.31
Min	0.0004	312	0.61	0.5	0.47	0.34	0.44	0.12	0.01	0.64	0.17	0.02

3.2 The Effects of Gender Parity on Other Economic Variables

Gender parity in education is also regressed on other economic variables, such as the fertility rates, infant mortality rates, poverty rates, income inequality, political rights, savings, domestic investment, FDI, international trade, R&D expenditures, government spending and inflation. The results are shown in the Tables V-VII.[3]

[3] The impact on the strength of the legal system was additionally estimated. However, the data are only available for the last decade and no statistically significant effects were present in the regression results, and therefore not reported in the tables.

4. Panel Regression Results of Gender Parity and Gender in Education on per Capita Growth Worldwide

4.1 Global Regression Results

The gender parity indices in education show high statistical significance to economic growth of GDP per capita (Table II). The gender parity index in primary education is highly significant at the 1-percent level, until the fertility rate is added, at which point the significance falls to the 10-percent level (gender parity in education is highly significant and negatively related to fertility rates in Table IV). In this regression, the coefficient falls to 1.071, and if the gender parity in primary education would increase by one standard deviation (0.058), the growth rate of GDP per capita would increase by 6.22 percent. According to the adjusted R-squared, the variation in these variables explains 42.8 percent of the variation in economic growth of GDP per capita. The regressions with gender parity in primary or secondary education (or combined) explain 40-45% of economic growth. The F-statistics show high significance at the 1-percent level for the variables overall. Gender parity in secondary education is highly significant at the 1-percent level. The regression with control variables added explains over 45 percent of the variation in the growth rate of real GDP per capita. According to the coefficient (1.446), if the variable would increase by one standard deviation (0.127), the growth rate of real GDP per capita would increase by 18 percent. Combined gender parity in primary and secondary education is also statistically highly significant as well as the regression overall. The variables included explain almost 45 percent of real GDP per capita. If gender equality in primary and secondary education combined would increase by one standard deviation (0.078), the coefficient (1.851) implies that growth of GDP per capita would increase by 14.4 percent. Gender parity in tertiary education is only statistically significant at the 10-percent level before control variables are added - after which it turns insignificant. Together with the level of GDP per capita, the two variables explain 8.5 percent of the growth rate of real GDP per capita. In the gender parity regressions (Table II) of the control variables included, investment and fertility rates show high statistical significance to economic growth. In the regression where both are included, the variation in the independent variables explains 42.8 percent of the variation in economic growth between nations worldwide. Other variables might display less statistical significance due to multicollinearity between the independent variables.

Female enrollment rates in primary and secondary education are highly significant at the 1-and 5-percent levels to growth of real GDP per capita (Table III). Female enrollment rates in college education are statistically significant at the 10-percent level. Enrollment rates in primary education may be multicollinear with the control variables as this variable loses its statistical significance once the other education and control variables are all added. However, female enrollment rates in secondary education display a high significance to economic growth even once all control variables are included. The adjusted R-squared explains substantially more in the regressions that include female primary or tertiary education rather than secondary education.

Table II: Gender Parity in Enrollment Rates on GDP Per Capita Growth Globally

Dependent Variable: GDP per capita growth								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP/capita	-0.826	-0.937	-0.199	-0.838	-1.054	-0.954	-0.891	-0.890
	[6.979]***	[7.431]***	[6.294]***	[5.735]***	[5.856]***	[5.549]***	[7.177]***	[5.325]***
Gen. Parity Prim. Edu	2.227			1.995	1.071			
	[4.287]***			[3.479]***	[1.664]*			
Gen. Parity Sec. Edu		1.490				1.446		
		[3.883]***				[3.325]***		
Gen. Parity Ter. Edu			0.197					
			[1.668]*					
Gen. Parity Prim/Sec Ed							2.112	1.851
							[3.712]***	[3.007]***
Invest / GDP				2.928	3.077	2.809		2.903
				[2.678]***	[2.786]***	[2.718]***		[2.778]***
Inflation				-0.055	-0.025	-0.037		-0.039
				[1.024]	[0.493]	[0.333]		[0.353]
Trade / GDP				0.069	0.069	0.043		0.010
				[0.228]	[0.224]	[0.148]		[0.035]
FDI / GDP				0.442	0.565	0.564		0.571
				[1.038]	[1.361]	[0.990]		[0.995]
Gov / GDP				2.256	1.812	0.975		1.565
				[1.300]	[1.042]	[0.606]		[0.945]
Political Rights				0.363	0.243	0.527		0.543
				[1.001]	[0.672]	[1.403]		[1.433]
Fertility Rates					-0.203			
					[2.469]**			
R^2 adj.	0.395	0.422	0.085	0.415	0.428	0.453	0.420	0.449
F-statistics	2.830***	2.996***	21.815***	2.916***	3.003***	3.184***	2.967***	3.139***
Obs.	520	491	449	438	438	413	488	411
Countries	184	178	176	155	155	149	178	149

Notes: Each regression is estimated with individual coefficients for each country (not reported), except equation (3) is estimated with a common constant. For each variable are stated the estimated coefficient and the absolute value of the t-statistic in brackets. White's heteroskedasticity-consistent covariance matrix is used. Statistical significance is indicated by ***, ** and * for the 1-, 5- and 10-percent levels respectively.

The regression with female primary education and control variables added has the highest adjusted R-squared. In that regression, the independent variables explain 41 percent of growth of GDP per capita. The F-statistics are highly statistically significant in all regressions showing the importance of female education at each level, real GDP per capita and for these variables overall. By increasing female education by one standard deviation for primary, secondary and higher education (0.119, 0.285 and 0.255 respectively), growth of GDP per capita would increase by at least 5, 16 and 17 percent respectively. In the regressions with female enrollment rates (Table III), of the control variables included the investment share of GDP per capita and inflation (of the consumer price index) are highly significant at the 1- and 5-percent levels respectively. Investment improves and inflation dampens economic growth. The regression with the highest adjusted R-squared indicates that the variation in the independent variables explains 41 percent of the variation in growth of GDP per capita. In other regressions, inward FDI is positively related and statistically significant to economic growth at the 10-percent level of significance.

Table III: Female Enrollment Rates on Growth of GDP Per Capita Globally

Dependent Variable: GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP/capita	-0.819	-0.294	-0.385	-0.813	-0.264	-0.219	-0.291	-0.279
	[6.458]***	[6.438]***	[2.610]***	[5.210]***	[4.940]***	[4.771]***	[6.135]***	[4.933]***
Fem. Prim.	0.962			1.005			0.453	0.167
Enrol. Rate	[3.062]***			[2.867]***			[2.067]**	[0.692]
Fem. Sec.		0.806			0.898		0.645	0.576
Enrol. Rate		[3.946]***			[3.866]***		[2.622]***	[2.099]**
Fem. Ter.			0.676			0.456	-0.297	0.050
Enrol. Rate			[1.804]*			[1.695]*	[1.059]	[0.158]
Invest				2.916	4.023	3.988		3.550
GDP				[2.597]***	[4.868]***	[5.954]***		[5.215]***
Inflation				-0.078	0.063	0.025		0.050
				[2.213]**	[1.129]	[0.773]		[1.024]
Trade				0.029	0.027	0.144		0.101
GDP				[0.094]	[0.200]	[0.964]		[0.646]
FDI				0.512	0.623	0.388		0.559
GDP				[1.204]	[1.729]*	[1.039]		[1.788]*
Gov				1.401	-1.604	-0.697		-0.762
GDP				[1.756]	[2.487]	[0.968]		[1.040]
Political				0.436	-0.286	0.006		0.158
Rights				[1.225]	[1.541]	[0.036]		[1.943]
R^2 adj.	0.379	0.077	0.404	0.410	0.182	0.179	0.116	0.196
F-statistics	2.718***	21.698***	2.719***	2.871***	12.484***	11.350***	14.951***	9.816***
Obs.	527	497	450	440	415	382	426	362
Countries	186	182	176	156	151	150	169	143

Notes: Regressions 1, 3-4 are estimated with individual coefficients for each country (not reported) and equations 2, 5-8 are estimated with a common constant. For each variable are stated the estimated coefficient and the absolute value of the t-statistic in brackets. White's heteroskedasticity-consistent covariance matrix is used. Statistical significance is indicated by ***, ** and * for the 1-, 5- and 10-percent levels respectively.

Male enrollment rates in all three levels of education are statistically significant. Enrollment rates in secondary education remain highly significant even when regressed with the other levels of education and other control variables, while the statistical significance of primary education then falls to the 10-percent level, and college enrollment rates turn insignificant. If male enrollment rates in each level of education—primary, secondary and higher—would increase by one standard deviation (0.097, 0.177 and 0.182 respectively), growth rates of real GDP per capita would increase with 4, 18 and 18 percent respectively. The F-statistics show the variables overall as highly significant. The adjusted R-squared is the highest in the regression with male primary enrollment rates and indicates that these variables explain 38 percent of the growth rates of real GDP per capita globally. The regressions with male enrollment rates indicate a statistical significance at the 10-percent level that trade and inward FDI (both as shares of GDP) would improve economic growth, while government spending and inflation have adverse effects. The regression with male primary enrollment rates and control variables has the highest adjusted R-squared, indicating that these variables explain 38 percent of real GDP per capita growth.

The political rights variable is statistically insignificant in these regressions. However, this may be due to multicollinearity with the other independent variables, especially gender parity, as the variables are statistically significant in Table V. Political rights have indicated statistically

significant effects to economic growth of real GDP per capita elsewhere, e.g. Barro (1997) and in Keller (2006a&b).

Table IV: Male Enrollment Rates on GDP Per Capita Growth Rates Globally

Dependent Variable: GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP/capita	-0.165	-0.281	-0.205	-0.763	-0.318	-0.280	-0.284	-0.347
	[6.014]***	[6.325]***	[5.313]***	[4.662]***	[5.692]***	[5.465]***	[5.989]***	[5.803]***
Male Prim. Enrol. Rate	0.587			0.941			0.409	0.515
	[2.449]**			[0.941]**			[1.657]*	[1.915]*
Male Sec. Enrol. Rate		0.835			1.199		0.689	0.709
		[3.801]***			[4.595]***		[2.599]***	[2.231]**
Male Ter. Enrol. Rate			0.396			0.985	-0.158	0.330
			[1.347]			[2.888]***	[0.440]	[3.805]
Inflation				-0.075	0.052	0.012		0.025
				[2.169]**	[0.862]	[0.338]		[0.500]
Trade / GDP				0.154	0.181	0.302		0.237
				[0.495]	[1.288]	[1.963]*		[1.492]
FDI / GDP				0.315	0.232	0.071		0.202
				[0.752]	[1.597]	[0.172]		[0.583]*
Gov / GDP				0.204	-1.120	-0.382		-0.358
				[0.110]	[1.751]*	[0.536]		[0.498]
Political Rights				0.579	-0.274	0.007		-0.123
				[1.591]	[1.525]	[0.041]		[0.713]
R^2 adj.	0.056	0.075	0.085	0.380	0.113	0.110	0.108	0.143
F-statistics	16.556***	21.068***	21.987***	2.653***	8.590***	7.811***	13.809***	7.742***
Obs.	527	497	450	443	418	385	426	365
Countries	186	182	176	158	153	152	169	145

Notes: Regressions are generally estimated with a common constant (not reported), except regression 4 is estimated with individual coefficients for each country (not reported). For each variable are stated the estimated coefficient and the absolute value of the t-statistic in brackets. White's heteroskedasticity-consistent covariance matrix is used. Statistical significance is indicated by ***, ** and * for the 1-, 5- and 10-percent levels respectively.

4.2 Gender Parity in Education's Effects on Other Economic Variables

The effects of the gender parity variables in primary and secondary education combined and in higher education separately were also regressed on the following variables: fertility rates, infant mortality rates, poverty rates, political rights, income inequality, savings (share of GNI), inflation (consumer prices) and as a share of GDP: R&D, FDI (net inflows), domestic investment, trade (exports and imports) and government expenditures.

The variables of gender parity in primary and secondary education combined and higher education are both statistically highly significant in decreasing fertility rates, infant mortality rates, and poverty rates, as well as in increasing political rights (Table V). Each of the variables is regressed with the level of real GDP per capita. The regression explains a substantial part of about 64.5 - 71 percent of the first three first variables (fertility rates, infant mortality rates, and poverty rates) and over 31 percent of political rights.

As there were some differences in the statistical significance of gender parity in primary and secondary education for income inequality and savings, these two gender parity variables are displayed separately for primary and secondary education in Table VI. Gender parity in education

Table V: Other Economic Effects of Gender Parity Globally

Dep. Var.	Fertility Rate		Infant Mortality Rate		Poverty Rate	Poverty	Political Rights	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP/capita	-0.579	-0.503	-11.873	-11.302	-0.092	-0.084	0.088	0.101
	[15.433]***	[14.355]***	[13.583]***	[17.264]***	[20.502]***	[20.156]***	[11.935]***	[13.460]***
Gen. Parity	-5.129		-94.401		-0.198		0.434	
Prim/Sec Ed	[12.586]***		[9.926]***		[4.139]***		[6.617]***	
Gen. Parity		-1.978		-36.923		-0.123		0.091
Ter. Edu		[14.473]***		[14.497]***		[7.687]***		[3.112]***
R^2 adj.	0.645	0.645	0.686	0.667	0.687	0.708	0.313	0.314
F-statistics	708.360***	661.346***	643.660***	541.383***	451.683***	471.051***	172.719***	162.292***
Obs.	779	728	589	540	412	389	756	707
Countries	195	193	181	178	156	150	187	184

Notes: Each regression is estimated with a common constant (not reported). Absolute value of the t-statistic in brackets. White's heteroskedasticity-consistent covariance matrix used. Statistical significance denoted ***, ** and * for the 1-, 5-, and 10-percent levels.

is negatively related to income inequality for each level of education. However, the statistical significance increases with each level of education. Gender parity in primary education decreases income inequality, a relationship which is statistically significant at the 10-percent level. Gender parity in secondary education decreases income inequality with a high significance at the 5-percent level, and gender parity in higher education decreases income inequality with a statistical significance at the 1-percent level. However, the size of the coefficient decreases somewhat by

Table VI: Other Economic Effects of Gender Parity Globally

Dep. Var.	Income Inequality		Inequality	Savings	Savings	Savings	R&D	FDI
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP/capita	-0.001	0.004	0.017	0.002	-0.004	-0.022	-0.002	0.028
	[0.076]	[0.401]	[1.616]	[0.215]	[0.330]	[1.409]	[2.844]***	[4.240]***
Gen. Parity	-0.076			0.170				
Prim. Edu	[1.803]*			[3.580]***				
Gen. Parity		-0.062			0.088			
Sec. Edu		[2.294]**			[2.398]**			
Gen. Parity			-0.042			0.060	0.005	0.041
Ter. Edu.			[2.777]***			[2.856]***	[2.608]***	[2.190]**
R^2 adj.	0.852	0.847	0.856	0.712	0.732	0.728	0.932	0.916
F-statistics	16.573***	15.501***	16.118***	8.781***	9.223***	8.378***	32.422***	40.879***
Obs.	432	414	389	520	488	451	321	699
Countries	158	157	151	164	161	162	139	189

Notes: Each regression is estimated with individual coefficients for each country (not reported). Absolute value of the t-statistic in brackets. White's heteroskedasticity-consistent covariance matrix used. Statistical significance denoted ***, ** and * for the 1-, 5- and 10-percent levels.

each level. Gender parity in all three levels of education increases savings and the results are all statistically highly significant. The coefficients are larger for the lower levels, showing

diminishing effects for each level of education on savings. Only gender parity in higher education has a statistical significance on R&D, at the 1-percent level. Lower education levels are statistically insignificant to R&D, as R&D takes place at the university level. Gender parity in lower education levels is insignificant to FDI, while gender equality in higher education is highly significant.

Gender equality at all levels of education is highly statistically significant in augmenting investment and trade (Table VII). If women are as educated as men, more people are involved in the labor markets, active in investing for the future and participating in current international trade. Gender equality in education is positively correlated with government spending and the relationship is statistically significant. This is likely partially due to the reverse causality of higher government expenditures being needed to achieve gender balance in education, as limited private resources often favor boys in less developed countries (Azam and Kingdon 2013). It would also allow women a greater voice in advocating for other areas where government expenditures are needed. Moreover, developed countries have higher gender parity and larger government expenditures as a share of GDP per capita. The gender parity variables for all levels of education are negatively correlated with inflation, statistically significant at the 10-percent level. This is likely due to the fact that developed countries have both higher gender parity and lower inflation. Moreover, if both genders are equally highly educated, people may more effectively impact the government and federal reserve in terms of voicing their opinions about inflation eroding their purchasing power and thus high inflation may be prevented.

Table VII: Other Economic Effects of Gender Parity Globally

Dep. Var.	Investment / GDP		Trade / GDP		Gov. / GDP		Inflation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP/capita	-0.018	-0.018	0.100	0.101	0.007	0.010	0.473	0.712
	[2.621]***	[2.178]**	[5.721]***	[4.579]***	[2.393]***	[3.525]***	[1.222]	[1.500]
Gen. Parity	0.138		0.425		0.069		-1.732	
Prim/Sec Ed	[4.521***		[4.610]***		[2.520]**		[1.688]*	
Gen. Parity		0.027		0.138		0.023		-1.414
Ter. Edu		[2.155]**		[2.462]**		[2.186]**		[1.786]*
R^2 adj.	0.559	0.555	0.142	0.126	0.059	0.099	-0.050	0.011
F-statistics	5.991***	5.704***	58.170***	48.124***	17.528***	28.423***	0.847***	1.034
Obs.	674	641	691	653	533	498	604	554
Countries	170	169	178	175	168	168	188	185

Notes: Regressions for Investment and Inflation are estimated with individual coefficients for each country, while the regressions for trade and government spending are estimated with a common constant (neither reported). Absolute value of the t-statistic in brackets. White's heteroskedasticity-consistent covariance matrix used. Statistical significance denoted ***, ** and * for the 1-, 5- and 10-percent levels.

Variables can indirectly benefit growth if they are essential determinants of one or more significant regressors (Bleaney and Nishiyama 2002). Correlated variables can channel effects of one another (Barro 1991, 1997; Frankel and Romer 1999; McMahon 2000; Sylwester 2000). To test for this, gender parity in education and real GDP per capita (all lagged by a decade) are regressed on the control variables as well as on some other economic variables that are affected by gender parity in education (Tables V-VII). Income per capita is included to control for market effects, in order to estimate the nonmarket effects of education on these variables (e.g., Michael

1982; McMahon 2003). The total effect of gender equality in education is even larger as it includes past market effects of income per capita as well (not reported).

5. Conclusion

This paper demonstrates that increasing enrollment rates for female students in primary, secondary and higher education to equal those of male students improves growth of GDP per capita globally over a 50-year time span. When regressed separately, female and male enrollment rates in each level of education show statistical significance to growth of GDP per capita in most regressions.

In addition, gender parity in education is found to have other statistically significant correlations with variables in the following decade, such as lower rates of fertility, infant mortality, poverty, and income inequality. Gender equality is positively associated with openness to trade, domestic investment, FDI inflows, R&D expenditures, and savings. Gender equality is also correlated with countries having higher levels of political rights and government spending, while associated with lower rates of inflation. Some of these variables impact growth in turn. This paper does not prove causality, only indicating a statistically significant correlation between gender parity in a prior decade and these other variables in the following decade.

Many decisions regarding children's education rest with the parents, and outdated cultural notions of women needing less investment in education prevail. Policies should promote education for all, so everybody can fulfill their aspirations. Laws are needed to enforce compulsory education at the lower levels so that the children do not lose the opportunity to an education. Providing school lunches can be beneficial, as parents can see the immediate value in their children also obtaining a meal when attending school. Removing fees and uniform requirements have also facilitated children's ability to attend. As shown in this paper, improving gender equality in education can enhance various economic variables. Further research on the impact of the quality of female education is vital, as it is impactful to learning beyond mere attendance.

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