GENDER EQUALITY AND ECONOMIC GROWTH: SOLVING THE ASIAN PUZZLE

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Abstract

This paper uses gender gaps in educational attainment to estimate the effect of gender inequality on economic growth in Asia's developing nations. Using panel data covering 33 countries from 1970-2010 from the Barro-Lee data set, the results reveal a positive and statistically significant effect of gender equality on economic growth: a 1% increase in the ratio of female-to-male educational attainment is expected to increase GDP per capita by 0.848%. The estimates are robust to the inclusion of various controls, the distinction between time periods, and the exclusion of outliers. The use of female seat share in national parliament as an instrumental variable also reveals a positive correlation between gender equality and economic growth in Developing Asia, further affirming the results of this paper.

1. INTRODUCTION

Despite the international trend of countries moving toward gender equality in the past several decades, gender gaps remain pervasive in Asia's developing nations. The high levels of poverty in developing nations, coupled with the persistence of discriminatory cultural and social values in Asia, are partially responsible for this phenomenon. Indeed, South Asia has the highest level of gender disparities in health and education outcomes, compared to any other region (Filmer, King, and Pritchett, 1998). This, coupled with the fact that South Asia and East Asia and the Pacific accommodated around 33% and 9%, respectively, of those living below the poverty line of US$1.9 in 2018, leads one to question whether there is a correlation between the region's economic conditions and its high prevalence of gender inequalities (World Vision 2019).

Given that the prevalence of gender gaps is indicative of poorer outcomes and fewer opportunities for women, there is a strong equity case for addressing this issue. One of the most notable attempts at policy action focused on gender equity is the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), which has been signed and ratified by nearly all countries across the world (Klasen 2018, 281). Apart from the inherent problems of gender discrimination, the potential for gender equality to promote economic development and decrease poverty has inspired economists to study this relationship. Since the 1990s, a growing body of literature has emerged studying the relationship between gender equality and the performance of the economy (Klasen 2018, 282).

In particular, there is a wealth of literature investigating the effect of gender inequality in education on economic performance. While most studies identify a positive relationship, there remains a lack of agreement on the effects of gender equality on growth and development. Additionally, there is much less literature focusing specifically on Asia, as most analyses examine the relationship in developing countries at large. The conflicting claims made in prior research studies, as well as the lack of literature solely looking at Asia, leave the question of how gender equality affects economic growth in Developing Asia, unanswered.

This paper investigates the effect of gender inequality, as measured by educational attainment, on economic growth in Asian developing nations from 1970-2010. Reasons for the focus on Developing Asia are twofold: firstly, several researchers have studied this relationship either in all Asian countries, or in developing countries across the globe, but there is an absence of literature on this topic that focuses on Asia's developing nations in particular. Such an analysis is necessary due to Asia's unique social and cultural characteristics, which may play an important role in contributing to gender inequality and a subsequent stagnation in development. Secondly, it is noteworthy that most studies identify a positive correlation between gender equality and economic growth, but some empirical analyses document the opposite. The results from this paper shed light on the true effect of gender inequality on economic growth in Developing Asia, filling a critical gap that currently exists in the literature.

Using the ratio between female and male educational attainment as a measure of gender inequality, the aggregate-level regression analyses estimate the relationship between the log-ratio and log-GDP per capita. The results reveal a positive and statistically significant effect of the ratio of educational attainment on economic growth: a 1% increase in the female-to-male education ratio is expected to increase GDP by 0.848% in Asia's developing nations, on average. These results are robust to the inclusion of several controls and restriction to a shorter time period. The results also remain positive and statistically significant with the exclusion of the highest-income countries in the sample: Brunei Darussalam, Kuwait, Qatar, and the United Arab Emirates. Finally, the analysis uses fixed effects in a panel setting to control for bias resulting from unobserved heterogeneity or omitted variables, as well as an instrumental variable approach using female seat share in national parliaments to address potential endogeneity.

The paper proceeds as follows. Section 2 examines the theoretical links between gender inequality and economic growth. Section 3 discusses the existing literature and empirical frameworks previously used to study the effect of gender inequality in education on economic growth. Section 4 describes the data and estimation method employed. Section 5 presents the results of the basic regressions and a range of robustness checks. Section 6 concludes.

2. GENDER INEQUALITY AND ECONOMIC GROWTH: THEORETICAL LINKS

There have been a number of theoretical studies documenting the causal linkages between gender inequality and economic growth. This section briefly summarizes some of the most important mechanisms that have been identified.

Firstly, assuming that an economy has a similar distribution of innate abilities between males and females, higher gender inequality implies giving educational opportunities to boys who are less capable. Removing girls who are relatively more qualified from the pool of talent available for education lowers the average innate ability of educated children. Assuming that human capital is a combination of innate abilities and education, larger gender gaps in education would therefore harm economic performance by reducing the average level of human capital in a country (Knowles et al. 2002).

Secondly, gender inequality hinders economic growth by reducing the well-known externalities of female education, including lower fertility levels, lower child mortality, and higher education of the next generation (Klasen and Lamanna 2008). Increasing female educational attainment is known to reduce fertility levels in developing countries, which has a positive impact on economic growth through both human capital effects and demographic effects (Klasen 2018, 283). Mothers with more schooling are also known to have better-educated children, especially daughters. This effect has often been found to be greater than that of a father's schooling on children's educational attainment (King and Hill, 1993). Each of these positive spillovers subsequently promotes economic growth if the gender gap is reduced in developing countries.

Thirdly, the argument of international competitiveness has been used to support opposing claims, that gender inequality stimulates economic growth and that gender inequality reduces it. Advocating for the former, Seguino (2000) posits that high gender pay gaps grant female-intensive, export-oriented countries a comparative advantage and thus support their economic growth. Contrastingly, Klasen and Lamanna (2008) suggest that such a strategy would require women to be educated, in order for countries to become competitive in world markets. Gender gaps in employment and education would reduce the ability of these countries to capitalize on these growth-enhancing opportunities.

3. LITERATURE REVIEW

There is a growing body of literature studying the link between gender equality and the performance of the economy. Several researchers have studied this relationship across the globe, while others have focused on specific regions such as Latin America or East Asia. However, there is an absence of literature investigating the effect of gender inequality on economic growth in Developing Asia. It is worth noting that most analyses identify a positive correlation between gender equality and economic growth, but frequently cited studies (Barro and Lee 1994; Seguino

2000) have provided empirical evidence with contradictory findings. As such, this topic merits further analysis and this paper aims to fill the gap in the literature focusing on Developing Asia in particular. This section first discusses research that estimates a positive impact of gender equality on growth, then explores evidence for the more unconventional theory that the disadvantaged status of women acts as a stimulus to economic growth, and concludes with a discussion of the gap in the current literature that this paper aims to fill.

3.1. Positive Correlations Between Gender Equality and Economic Growth

Many authors have identified a positive and significant impact of gender equality on GDP. Mitra et al. (2015) analyze five measures of gender equality to find that equality of economic opportunities and equality in economic and political outcomes (labeled participatory equality) both increase the rates of economic growth. They use a standard neoclassical model – with economic growth as the dependent variable, and investment, government expenditure, inflation, and GDP_{t-1} as independent variables – augmented with measures of gender equality. They discover that the effects of the dimensions vary based on a country's stage of development. In particular, they find that participatory equality only has a significant impact on economic growth for developed countries, while gender equality in economic opportunities is a stimulator of growth exclusively for developing economies (Mitra et al. 2015). Their findings highlight the importance of separately studying developing and developed countries, as the effects of policies promoting gender equality may change when a country reaches a certain threshold of economic and social development.

Ferrant (2015) similarly explores multiple aspects of gender inequality by utilizing a Multidimensional Gender Inequality Index (MGII) – a weighted measure of eight dimensions of gender inequality – to develop an empirical framework describing the feedback between gender inequality and income per capita, as well as the impact of gender inequality on the Human Development Index (HDI). The United Nations Development Programme's HDI combines the following dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. Regressing the HDI on the MGII, and regressing GDP on the MGII, the investment rate, the level of human capital, and the population growth rate, Ferrant (2015) finds that an increase in the MGII causes both long-run per capita income and the HDI to rise. The results confirm a notion common in the theoretical literature, that gender inequality hinders economic growth by reducing the average level of human capital.

This article differs from Mitra et al. (2015) and Ferrant (2015) in two important ways. Firstly, this paper aims to specifically identify the effect of gender disparities in education on economic growth, rather than the impact of multiple dimensions of inequality. Such an approach reduces the possibilities for measurement error and multicollinearity. Nevertheless, the various dimensions examined in these articles are an interesting area for future research. Secondly, Ferrant (2015) only includes observations for one or two years for each of the variables in their analysis. Contrastingly, this paper utilizes data spanning four decades in order to account for the variability of gender inequality both across time and across countries. Thus, the panel data shown below includes more variability and information than would be available in a simple cross-sectional data set.

Of the literature studying the relationship between gender inequality and growth, the largest and arguably most mature has been on the effects of gender inequality in education (Klasen 2018). Thévenon and Salvi Del Pero (2015) and Knowles et al. (2002) use a human-capital-augmented Solow model and find that gender gaps in education have a negative impact on a country's GDP. Both studies define the gender gap as the female-male ratio in the average total years of schooling, which is identical to the explanatory variable used in this paper. This approach avoids the potential for collinearity that exists in specifications which include male and female education levels as separate variables. Given that the correlation coefficient between male and female years of education is estimated to be greater than 0.9, directly including the gender gap in the growth equation is an effective strategy to avoid the problem of collinearity (Klasen 2002). As such, the empirical specification in this paper follows the approach of Thévenon and Salvi Del Pero (2015), using lagged values of the gender gap to address the potential collinearity and reverse causality issues that may exist.

An interesting study which finds a positive correlation between gender equality and economic growth is that by Caselli et al. (1996), as it estimates a positive statistically significant coefficient on female schooling, but a negative and insignificant coefficient on male schooling when both are included in growth regressions. This result is obtained by re-estimating Barro and Lee's equations (discussed below) using a generalized method of moments framework. Such a result is unusual as there is no theory that predicts different signs for male and female human capital. Caselli et al. (1996, 379) posit that “the female education variable captures both (positive) fertility effects, and (negative) human capital effects, and the former outweighs the latter. Male education, on the other hand, only represents a human capital effect. Hence, its negative coefficient.” Despite the fact that the positive coefficient on female schooling seems to align with existing theory and literature, the negative correlation between education and human capital remains puzzling.

The mainstream theory that gender equality is beneficial to economic growth aligns with the positive and significant effects of gender equality on GDP found in the empirical research presented above. Several channels have been identified to explain this relationship, some of which include health, the quality of human capital, and governance. Several such mechanisms are reviewed in Section 2 above, and discussed in further detail in Klasen (2018).

3.2. Negative Correlations Between Gender Equality and Economic Growth

A number of empirical studies have suggested that gender inequality may actually increase economic growth, in counter with majority of the theoretical literature to date. Arguably the most commonly cited is a study in which Barro and Lee (1994) obtain a significantly negative coefficient on female secondary education and a significantly positive one on male secondary education. This is the opposite of the estimates obtained by Caselli et al. (1996), but both results are puzzling for the same reason: different signs on male and female secondary attainment are inconsistent with any existing theory. Barro and Lee acknowledge the unusual nature of their results, and present the following as a possible explanation: “a high spread between male and female secondary attainment is a good measure of backwardness; hence, less female attainment signifies more backwardness and accordingly higher growth potential through the convergence mechanism” (1994, 18). Assuming this were true, a country would grow faster because it initially started with a lower real per-capita GDP. However, the results presented by Barro and Lee (1994) have been frequently challenged as several empirical studies have documented that the relationship between male education and economic growth has the same sign as that of female education.

Other studies, such as Seguino (2000), have found that gender inequality stimulates growth. Using gender wage gaps (WGAP) as a measure of inequality, Seguino (2000) finds a positive and significant relationship between WGAP and output, suggesting that Asian economies with the highest gender inequality grew the fastest from 1975 to 1990. Seguino argues that high gender pay gaps complement state-level policies that direct investment to export industries, which would have facilitated the shift of many East Asian nations to export orientation, and subsequently provided the foreign direct investment needed to develop these countries. An argument that runs contrary to this claim, is that female-intensive, export-oriented manufacturing industries require women to be educated in order for countries to grow and remain competitive (Klasen 2018, 286). Additionally, it is possible that several other factors other than female education contributed favorably to rapid Asian growth. Seguino's study is particularly relevant to this paper as it includes a unique analysis that is restricted to Asia and presents evidence that is contrary to my hypothesis that gender equality increases economic growth.

Other authors go far enough to report that gender disparities in health and education outcomes have almost no correlation to per-capita income in South Asian countries. A paper by Filmer, King, and Pritchett (1998) focuses on the descriptive level of differences in outcomes and is unique in that it disaggregates data to the subnational level, including data from individual states of India and provinces of Pakistan. The study tests the relationship between gender disparity (measured by female-male enrolment ratios) and the general standard of living (proxied by per-capita GDP) to find that only the absolute *levels* of health and education outcomes for girls affect economic conditions, while *disparities* in these outcomes do not. While this could certainly be the case, this claim is contrary to literature studying the effects of gender inequality on economic growth across the globe and goes against the theoretical framework identifying a positive correlation between gender equality and growth. Since the analysis by Filmer, King, and Pritchett (1998) takes a theoretical approach when examining this issue, an empirical investigation focusing on Asia's developing nations is yet to be completed.

3.3. Gap in the Existing Literature

The question of how gender inequality affects economic growth remains unanswered, despite the heightened attention this topic has received over the last two decades. This is especially true of the link between gender gaps in education and the level of GDP, about which several conflicting claims have been made in prior empirical research. While some consensus has been established in recent years, that gender equality and economic growth are positively correlated, such an analysis has yet to be completed in Asia's developing nations on their own. Furthermore, the fact that one of the most recent studies reporting a negative effect of gender equality on output focused only on Asia's semi-industrialized economies leads to a critical need for further analysis of the region. Due to the absence of studies specifically investigating the relationship between gender inequality and economic growth in Developing Asia, this paper will fill a clear gap that exists in the literature. Such an analysis can be useful for creating domestic policies within Asian countries, as well as designing development initiatives that aim to tackle poverty and poor education systems in the region.

4. DATA, MEASUREMENT, AND METHODOLOGY

4.1. Estimation Method

This paper aims to test the following hypothesis: gender equality stimulates economic growth, which will cause disparities between male and female outcomes to hinder development. It follows that the ratio of female-to-male educational attainment will be positively associated with GDP per capita in Asia's developing economies.

To determine the effects of gender inequality in education on growth, I estimate the following equation, with *H*, *K*, and *P* as control variables:

$$\ln(GDP_{it}) = \beta_0 + \beta_1 \ln\,(R^{f/m}_{it-1}) + \beta_2 H_{it} + \beta_3 P_{it} + \beta_4 K_{it} + \varepsilon_{it};$$

where i is an index for the country, t is an index for the year, *GDP* is the GDP per capita adjusted for purchasing power parity, $R^{f/m}_{it-1}$ is the lagged female-male ratio in educational attainment, *H* is the average human capital, *P* is population, *K* is the investment rate in physical capital, and ε is the error term. The measurement of these variables is described in further detail in the following section. We would anticipate that $\beta_1 > 0$ if gender inequality is negatively associated with GDP per capita.

The main specification is first estimated with only the primary explanatory variable, before each of the controls is added individually. This strategy allows for the separation of the effects of gender bias in education on economic growth, without the influence of other factors that impact growth. Therefore, each of the controls included in the primary specification are expected to have an influence on GDP per capita. Given the well-documented importance of human and physical capital as determinants of economic growth, these variables are included to account for possible endogeneity.

To deal with reverse causality, which can be a serious issue when analyzing the effect of gender inequality on education, I use lagged values of the female-male educational attainment ratio. The inclusion of country-level fixed effects in the robustness checks is an additional method of addressing the possibility of reverse causality. To avoid bias from endogenous explanatory variables and verify the results from the main analysis, I conduct several robustness checks which include a number of regressors that may be correlated with both economic growth and gender gaps in education. Finally, I use an instrumental variable approach, using the proportion of women in national parliament (%) as an instrumental variable, in order to control for possible endogeneity.

4.2. Data

To estimate the effect of gender differences in education on economic growth, I use a revised data set on educational attainment published by Barro and Lee. The data for school attainment are given by sex for each country at five-year intervals. Thus, to calculate the independent variable of interest, a ratio of the average years of total schooling for females and males, I use each five-year average to represent the annual values for the respective years it applies to: the 1970 average is used for years 1970-1974, the 1975 average is used for the years 1975-1979, and so on.

Thévenon and Salvi Del Pero (2015, 360) emphasize the sensitivity of the relationship between human capital accumulation and growth to the choice of indicators used to measure educational attainment. As previously mentioned, using the gender gap instead of individual values for female and male education avoids the possibility of multicollinearity. Additionally, the revised version of the Barro and Lee data set provides longer time series data than others presenting similar information. The data set has also been updated repeatedly – from its 1993, 1996, and 2001 versions – to address criticisms by other researchers. These revisions have included an improvement in data disaggregated by sex and age, an increase in the coverage of countries, and the incorporation of recent census/survey observations to improve the accuracy of estimation (Barro and Lee, 2010, 1).

To select developing countries, the World Economic Situation and Prospects (WESP) 2020 report, a publication jointly produced by several UN departments and commissions, was used. The report classifies countries as “developed economies, economies in transition and developing economies," and identifies a total of 46 Asian nations as developing. The sample used in this paper includes the 33 developing countries in Asia for which data were available for each of the variables included in the main specification.

For the outcome variable, data are extracted from the Penn World Tables (Version 9.1). The GDP per capita is derived by dividing values for output-side real GDP at chained PPPs (in mil. 2011US$) by the country's population in that given year. Data for the population (measured in millions) and investment rate controls are also from the Penn World Tables (Version 9.1). A country's share of gross capital formation at current PPPs is used to proxy for the investment rate in physical capital. The third control variable in the main specification, human capital, is measured by the percentage of the population attaining at least secondary school education. This data are extracted from the Barro and Lee data set.

Finally, the following country data were used for the robustness checks in this article:

- Data on poverty are based on PovcalNet, a source developed by the World Bank to report the Bank's official economy level poverty estimates. Poverty is measured using the poverty gap, defined as the average shortfall of income from the poverty line, expressed as a proportion of the poverty line.
- Data on trade openness are derived from Our World in Data and refer to the aggregate value of imports and exports as a share of a country's GDP.
- Data on corruption are found in The Worldwide Governance Indicators (WGI) and refer to a country's control of corruption, which "reflects perceptions of the extent to which public power is exercised for private gain, as well as 'capture' of the state by elites and private interests." This variable is measured in standard normal units, ranging from -2.5 (weak governance) to 2.5 (strong governance).

- Data on birth control are found in the World Contraceptive Use 2020 data set compiled by the United Nations Department of Economic and Social Affairs, Population Division. The selected indicator is contraceptive prevalence for any modern method, as a percentage of married or in-union women of reproductive age.
- Data on a country's educational requirements are from The UNESCO Institute for Statistics (UIS). The variable used is compulsory education, defined as the "number of years of compulsory primary and secondary education guaranteed in legal frameworks."
- Data on labor force participation (LFP) are from the World Development Indicators (2021) and refer to the ratio of female to male LFP.

Table I shows summary statistics for each of the variables, separated by country. Despite the regional similarity, there is evidently great variation within Asia's developing nations themselves. GDP per capita ranges from $685 in Lao People's Democratic Republic in 1970 to

Table I - Descriptive Statistics

Statistic	***MEA***	***FEA***	***FMR***	***GDPpc***	***POP***	***HC***	***INV***
Max	12.76	12.32	1.19	0.26	1359.76	48.10	71.04
Min	0.87	0.12	0.14	0.001	0.11	0.29	0.70
Median	5.88	4.60	0.81	0.005	15.25	13.80	22.32
Mean	6.18	4.99	0.76	0.02	89.28	16.15	23.72

Note: Sample includes 33 countries for which data for dependent and all explanatory variables from the main specification are available for the period 1970-2010. Variables are defined as follows: *MEA*: average years of schooling among men age 15 and older. *FEA*: average years of schooling among women age 15 and older. *FMR*: female-male ratio of average years of schooling. *GDPpc*: output-side real GDP per capita at chained PPPs (in mil. 2011US$). *POP*: population in millions. *HC*: human capital, measured by the percentage of the population attaining at least secondary school education. *INV*: investment, measured by a country's share of gross capital formation at current PPPs.

$257,394 in the United Arab Emirates in 1970. The female-male educational attainment ratio also varies greatly within the sample, with Qatar's ratio at 1.19 and Nepal's at 0.14. The statistics reveal that there are some developing countries in Asia where female educational attainment is indeed higher than that of males. It is noteworthy that the countries with the highest mean GDP per capita – the United Arab Emirates and Qatar – are also the two countries with the highest values for the female-male education ratio.

5. EMPIRICAL RESULTS

5.1. Main Specification:

Relationship Between Educational Attainment and Growth

A number of different models are used to estimate the relationship between educational attainment and growth, with the inclusion of several controls. Table II reports the basic set of cross country-regressions, estimating the effect of the ratio of educational attainment on GDP per capita.

The results confirm the importance of the controls in the baseline regression as each control is statistically significantly correlated with log GDP per capita. Adding these variables ensures that the effect of education is not overstated. The R-squared also provides further insight, as its value increases from 0.236 for model (1) to 0.437 for model (4). This indicates that model (4) explains 43.7% of the variation in GDP per capita, whereas model (1) explains only 23.6% of the variation. Therefore, model (4) is the most appropriate specification to use when estimating the effect of gender inequality in education on economic growth.

The estimated coefficient, 0.848 (s.e. = 0.095), means that a 1% increase in the female-male education ratio raises GDP per capita by 0.848% in developing Asian countries, on average. For countries like Nepal and Pakistan, whose ratios of educational attainment are on average 0.32 and 0.40 respectively, a 1% increase in gender equality is certainly achievable and is predicted to lead to beneficial outcomes in these developing economies.

Finally, while human capital, investment share, and population size clearly influence the estimate on the variable of interest, majority of the variation in growth in this sample seems to be explained by the ratio of educational attainment. Additionally, adding controls does not drastically change the result: the estimated effect of the female-to-male ratio on GDP is positive and statistically significant at the 1% level, regardless of which controls are added. This highlights the importance of prioritizing gender equality in education as a policy objective.

Table II: Educational Attainment and Growth: Main Estimates

	(1)	(2)	(3)	(4)
Log(FMR)$_{(t-1)}$	1.758***	1.114***	1.087***	0.848***
	(0.086)	(0.106)	(0.103)	(0.095)
HC		0.035***	0.034***	0.025***
		(0.004)	(0.004)	(0.003)
POP			-0.001***	-0.001***
			(0.0001)	(0.0001)
INV				0.042***
				(0.002
Observations	1,353	1,353	1,353	1,353
R^2	0.236	0.288	0.320	0.437

Note: Dependent variable is log of GDP per capita. Lagged values of the explanatory variable are used. Standard errors in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

5.2. Robustness Checks

It is important to confirm the robustness of the results from the baseline regressions. A comprehensive set of robustness checks confirms that these results are robust to different specifications and controls for possible endogeneities. They are also robust to the inclusion of country-fixed effects, which are introduced in order to control for unobserved heterogeneity.

Table III presents results from the robustness checks. Each of the fourteen models presented includes country-fixed effects. Column (1) shows the baseline specification re-estimated for the 1990-2010 period in order to account for effects of the Cold War. Column (2) re-estimates the baseline regression with the omission of outliers, specifically without the four countries with the highest mean GDP per capita in the sample: the United Arab Emirates, Qatar, Brunei Darussalam, and Kuwait. In both cases, the coefficient on the ratio of educational attainment remains positive and significant at the 1% level. However, the effect of gender inequality is markedly smaller when eliminating high-income countries from the sample, indicating that their inclusion may be biasing the results.

Column (3) displays the results when the poverty gap is added as a control, while column (4) re-estimates the main specification only for the years for which data on poverty is available. Columns (5) and (6) do the same for trade openness. Interestingly, the effect of gender inequality on growth becomes insignificant, but remains positive for Columns (3), (4), and (6). This may be due to the small sample size used for the poverty estimation. However, given that the specification with trade openness returns a negative coefficient, but includes nearly as many observations as the baseline regression, it is possible that trade openness is causing the effect of gender inequality to be biased upward.

Table III: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Log(FMR)$_{(t-1)}$	1.379***	0.210***	0.204	0.287	-0.009	0.039	1.743***	1.793***	-0.060	0.034	2.599***	2.988***	1.170***	1.376***
	(0.151)	(0.060)	(0.214)	(0.199)	(0.062)	(0.066)	(0.321)	(0.321)	(0.123)	(0.125)	(0.315)	(0.342)	(0.150)	(0.153)
HC	0.019***	0.030***	0.038***	0.038***	0.017***	0.024***	0.014***	0.012**	0.044***	0.046***	-0.010**	-0.005	0.017***	0.018***
	(0.003)	(0.002)	(0.006)	(0.006)	(0.002)	(0.002)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
POP	0.001***	0.0005**	-0.0002	0.0002	0.001***	0.001***	0.002	0.002	-0.0004	-0.0003	0.007***	0.006***	0.002***	0.002***
	(0.001)	(0.0002)	(0.001)	(0.001)	(0.0002)	(0.0003)	(0.001)	(0.001)	(0.0003)	(0.0004)	(0.002)	(0.002)	(0.001)	(0.001)
INV	0.007***	0.016***	0.016***	0.017***	0.007***	0.010***	0.013***	0.013***	0.019***	0.019***	0.011***	0.015***	0.008***	0.007***
	(0.002)	(0.002)	(0.004)	(0.004)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
PG			-0.007											
			(0.006)											
TRO					0.005***									
					(0.0004)									
COR							-0.153*							
							(0.082)							
BC									0.002***					
									(0.001)					
COMPE											0.130***			
											(0.016)			
FMLFP													0.023***	
													(0.003)	
Observations	693	1,189	159	159	1,312	1,312	264	264	246	246	329	329	672	672
R^2	0.323	0.377	0.583	0.580	0.321	0.237	0.336	0.326	0.647	0.622	0.496	0.387	0.371	0.321

Note: Dependent variable is log of GDP per capita. Lagged values of the explanatory variable are used. Standard errors in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively. Variables are defined as follows: *PG*: poverty gap; *TRO*: trade openness; *COR*: corruption; *BC*: birth control; *COMPE*: compulsory education; *FMLFP*: female-to-male LFP ratio.

Since there are many factors that could directly affect educational disparity and growth, it is reasonable for one to question whether an omitted variable may be driving the results from the main analysis. To address this, I re-estimate the model with several additional controls, the results of which are shown in Columns (7), (9), (11), and (13). The following controls are added: corruption, birth control, years of compulsory education, and the female-male labor force participation ratio, respectively. For each of these, the main specification is re-estimated using observations for which data on the control variables are available – these are shown in Columns (8), (10), (12), and (14). All these controls have a statistically significant effect on economic growth, and each has a sign that is consistent with the expectations derived from existing theory. With the exception of Columns (9) and (10), the effect of gender equality remains positive and statistically significant with the addition of the controls. For Column (9) and (10), however, the sign on the female-male ratio is insignificant, and is indeed negative for Column (9). It is puzzling that accounting for the effects of birth control causes gender equality to become negatively correlated with growth. A possible explanation for this may be the small sample size used in these estimations. Alternatively, birth control use and gender inequality in education may be correlated, leading to the problem of collinearity in these specifications.

Finally, there is an obvious concern of endogeneity in the baseline growth regression, given that there could be reverse causality causing GDP to drive the reduction in the educational attainment gap. The use of lagged values of the ratio of educational attainment and the instrumental variable estimation described below, both attempt to control for this endogeneity.

5.3. Instrumental Variable Estimation

One technique of addressing the problem of endogeneity is to apply an instrumental variable approach. In this paper, a panel two-stage least squares (2SLS) regression analysis is used with seat share of women in national parliament (%) as an instrumental variable (IV). Table IV presents the estimates obtained by re-estimating the baseline regressions (Table II) using female seat share as an IV.

The representation of women in politics may indicate that a country is more open to female representation or has undertaken measures to reduce discrimination against women (e.g. through gender electoral quotas). As shown by Chattopadhyay and Duflo (2004), elected leaders invest more in public goods that are closely linked to the needs of their own genders. As such, higher female representation is likely to result in policies that promote gender equality, such as increased investment in girls' education. Therefore, the proportion of seats held by women in national parliaments can be used as an instrument for the gender gap in schooling between girls and boys.

Table IV: Instrumental Variable Estimation

	(1)	(2)	(3)	(4)
$FMR_{(t-1)}$	0.147***	0.175***	0.181***	0.154***
	(0.030)	(0.045)	(0.052)	(0.053)
HC		-0.001	-0.001	-0.001**
		(0.0004)	(0.0004)	(0.0004)
POP			0.00001	-0.00000
			(0.00001)	(0.00001)
INV				0.001***
				(0.0004)
Observations	140	140	140	140
R^2	0.325	0.274	0.259	0.417

Note: Dependent variable is GDP. Estimates of 2SLS regressions are shown, using seat share of women in national parliament (%) as an instrumental variable. Lagged values of the explanatory variable are used. Standard errors in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

The instrumental variable has to be a key determinant of the ratio of educational attainment (instrument relevance), while being uncorrelated with the error term (instrument exogeneity). Conditional on these two conditions being satisfied, the coefficient of interest can be estimated using a 2SLS estimator (Güvercin 2020). When running the model in Column (4) of Table IV, I used diagnostic tests to examine the validity of the IV. An F-test on the instruments in the first stage, with a null hypothesis that the instrument is weak, is rejected at the 0.1% level. However, the Wu-Hausman test returns a p-value of 0.14, suggesting that the OLS specification does not contain endogenous regressors. Ultimately, the results from these tests indicate that the instrumental variable is appropriate, but returns estimates similar to those from the OLS specification.

Table IV shows that the results from the main specification are robust to the use of an instrumental variable. In each of the IV models, the coefficient of interest is smaller in magnitude than those in the OLS specifications, but remains positive and statistically significant at the 1% level. Therefore, even when controlling for possible endogeneities, greater gender equality results in higher economic growth.

6. CONCLUSION

Since the 1990s, more and more researchers have investigated the value – both inherent and instrumental – of gender equality. This paper highlights the extent to which gender inequality can impact economic outcomes, which is of particular relevance given the heterogeneity in gender equality across the globe. Of particular importance is the fact that Developing Asia is primarily composed of poor nations with high levels of gender discrimination, for whom such an analysis is particularly relevant. This study of 33 developing Asian countries from 1970-2010 reveals the large and positive impact that gender equality can have in the region. As hypothesized, the positive effect of the ratio of educational attainment between females and males is robust to various specifications and the inclusion of several controls.

There are numerous mechanisms that can explain this link. One commonly explored channel is that of health, as higher levels of female education can decrease fertility rates and improve children's health. A second explanation is the human capital argument, which points out that higher gender inequality implies giving educational opportunities to boys who are less capable, thereby reducing the level and quality of human capital in the country (Ferrant, 2015, 316). Moreover, a lower gender gap in educational attainment can change the composition of politicians in a country, thus leading to different infrastructure and investment opportunities being prioritized at the regional or national level. Evidently, each of these channels could explain the positive link between a lower gender gap in educational attainment and GDP per capita. In contrast, one way in which gender equality could hinder growth is by increasing political and labor conflict, subsequently reducing investment (Seguino 2000). The results from this paper were not sufficient to reject this gender-investment nexus, and this remains an area for future research.

In limiting its focus to a particular subset of countries, this paper provides the first estimates of the impact of gender inequality in education in Asia's developing nations. While the importance of education to economic growth is commonly accepted, the finding that it is not just *levels* but also *disparities* in educational attainment that influence the success of developing Asian countries, has important policy implications. It suggests that these countries will benefit from policy intervention aimed at improving outcomes for girls in particular. It may also indicate that increased participation of women in the workforce and in the political sphere should be encouraged through policy intervention. Importantly, it provides incentives for developing nations – who generally dedicate little money to female empowerment initiatives – to invest in gender equality.

The specific focus of this paper allows it to fill an important gap in the literature and provide relevant evidence for policymaking, but also leaves room for future research. A study of the effect of cultural norms and patriarchal values on growth remains an interesting area for further exploration. Additionally, the gender-investment nexus discussed in this paper and investigated by Seguino (2000) is critical in understanding the effect of gender equality and investment, particularly in a region like Developing Asia that is largely still going through the modernization process. Finally, future studies may consider the impacts of reforms in this area and their cost-effectiveness for developing nations. Ultimately, there is ample room for improvement in the area of gender discrimination in Developing Asia, and this study is an important step toward understanding how to work toward this essential goal.

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