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What explains cross-country growth in South Asia?
Female education and the growth effect of international openness

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Abstract

Using cross-country regional data over the 1970-2008 period, this study provides further evidence to the growth literature by exploring human capital formation from a gender dimension in India, Bangladesh, Nepal, Pakistan, Sri Lanka, Bhutan and the Maldives. We use an extended version of the Solow growth model with per capita GDP being a function of the key variables, viz, physical capital accumulation, human capital accumulation, openness to trade and capital flows, fiscal policy and financial development. We also construct two alternative measures for physical capital stock. The key contribution of this study is to show that the impact of human capital disaggregated by gender has a differential impact on economic growth, similar to the result in Barro (2001). While male human capital has a positive significant effect on growth, female human capital has insignificant explanatory power when the openness variables are considered. An implication stemming from this study is that if South Asia were to increase its growth momentum, high priority should be given to encouraging educational opportunities for females in order to maximise the effect of FDI on economic growth.

Keywords: economic growth, human capital, female human capital, openness, foreign direct investment, South Asia

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1. Introduction

Debate in the growth literature with regard to the determinants of growth has focused on either factor accumulation or productivity growth. More recent endogenous growth models have considered the impact of different types of factor accumulation, including human capital, and cross-country macroeconomic policy differences on economic growth. However the relative importance of human capital accumulation disaggregated by gender has been given limited attention. This paper therefore sheds light on this issue, together with considering policy determinants of growth differences across South Asia over the time period 1970-2008. We choose South Asia as these are a very diverse group of economies, with different initial conditions. Empirical evidence for various growth theories have been mixed, with no single model accurately explaining aggregate growth across countries (Durlauf et al., 2008). However, Durlauf et al. (2008) find strong evidence for macroeconomic policy effects and a role for unexplained regional heterogeneity, as well as some evidence of parameter heterogeneity in the aggregate production function. Consequently, there is scope for undertaking a regional exercise to explain growth differences across countries within a particular region. South Asia, which comprises a highly heterogeneous group of countries, is our preferred choice.

The standard closed-economy growth models measuring convergence across countries give limited attention to external trade and capital flows as explicit determinants of growth. Even though there are some open-economy growth models (see, for example, Mallick and Moore, 2008, and the references therein), there is little evidence on the gender dimensions of trade and foreign capital in a growth model. Therefore we specifically examine the potential impact of external trade and capital flows via their connections with the human capital stock disaggregated by gender.

The importance of human capital in a country's economic growth has been well documented in the literature: Barro (1991), Mankiw, Romer and Weil (1992), Levine and Renelt (1992), Barro and Lee (1993), Benhabib and Spiegel (1994), Hanushek (1995), Gemmel (1996), Temple (2001), Krueger and Lindahl (2001), and Hanushek and Woessmann (2008). Rosenzweig (2010) summarises this literature, emphasising the contribution of years of schooling to productivity in low-income countries, with (log) wages as the dependent variable. As many workers in low-income countries are non-wage workers, this approach can lead to a bias by restricting the schooling return estimates to only earnings and completely ignoring the non-market sector (see Rosenzweig, 2010). Moreover, in many low-income countries, women do not participate in a significant manner in the paid labour market. Therefore the effect of schooling must be investigated by considering a measure of aggregate economic activity. Nevertheless, the effect of female and male human capital stock on economic growth may exhibit differences when other factors are taken into account, for example, technology transfer, as schooling and technology adoption can be complementary (Nelson and Phelps, 1966). Klasen (2002) shows that differences in gender gaps in education explain growth differences across countries. Given the increase in female human capital stock exhibited by the South Asian region in the recent past, we disaggregate the human capital stock by gender and investigate, specifically, the relationship between the female human capital stock and economic growth in South Asia. Enrolment ratios are used to measure the human capital stock due to the United Nations Millennium Development Goal (MDG) of eliminating gender inequality in primary and secondary education, preferably by 2015.

Human capital accumulation appears to have been an important contributor to the growth trajectory of South Asia in the past two decades, compared to the initial years of the sample period. Evidence, however, suggests that women's share of the labour force is subject to greater variation, due to macroeconomic fluctuations and changes in macroeconomic policies (see Cagatay and Ozler, 1995; Serguino, 2000). Given the incentive schemes provided by the South Asian economies in the years following deregulation to encourage foreign direct investment (FDI), and the large proportion of females employed in export oriented industries, we investigate the empirical links between FDI, the female human capital stock and economic growth. In addition to FDI contributing to a country's productive capacity, it could flow into areas where women are as or more likely to be employed than men. To the extent that FDI is related to manufactured exports or export processing zones in developing countries, in a number of semi-industrial countries more women are employed compared to men in export processing zones (Singh and Zammit, 2000). Although there is a large volume of cross-country and country-specific empirical work undertaken on openness and its impact on the female labour force in developing economies (Cagatay and Ozler 1995; Fontana and Wood 2000; Ozler 2000; Serguino 2000), empirical work with a region-specific focus is limited. This paper is the first detailed exercise on South Asia investigating the role played by FDI in determining the effect of the female human capital stock on economic growth. We also examine the likelihood that the effect of the female human capital stock on economic growth due to greater openness is transferred through the uncertainty of investment generated by FDI. The uncertainty of investment is proxied by generating the variance series of a GARCH (1,1) model. In addition, we control for financial development and fiscal policy in our empirical analysis.

This paper introduces two alternative methods of calculating physical capital stock figures in South Asia. The evidence presented in this study suggests that, although the female human capital stock contributes positively to economic growth, the interactive growth effect of the female human capital stock with openness as measured by FDI turns out to be negative, suggesting a non-linear effect, in the sense that a minimum threshold level of female human capital is required in order to benefit from FDI. Further investigation shows that the absence of a minimum level of female human capital probably makes FDI inflows to South Asia more volatile, causing macroeconomic fluctuations and thereby a negative effect on growth. There is some evidence of a very weak convergence between the countries. This is reasonable, considering that the rest of South Asia has not yet reached the growth momentum of India.

We have, in addition to using OLS, estimated all the specifications within a panel regression framework controlling for country fixed effects and endogeneity using system GMM. Results are tested for robustness in a number of ways: with the inclusion and exclusion of certain countries, different time periods, additional control variables to capture a range of possible determinants of growth, including the uncertainty of investment, and several interaction terms.

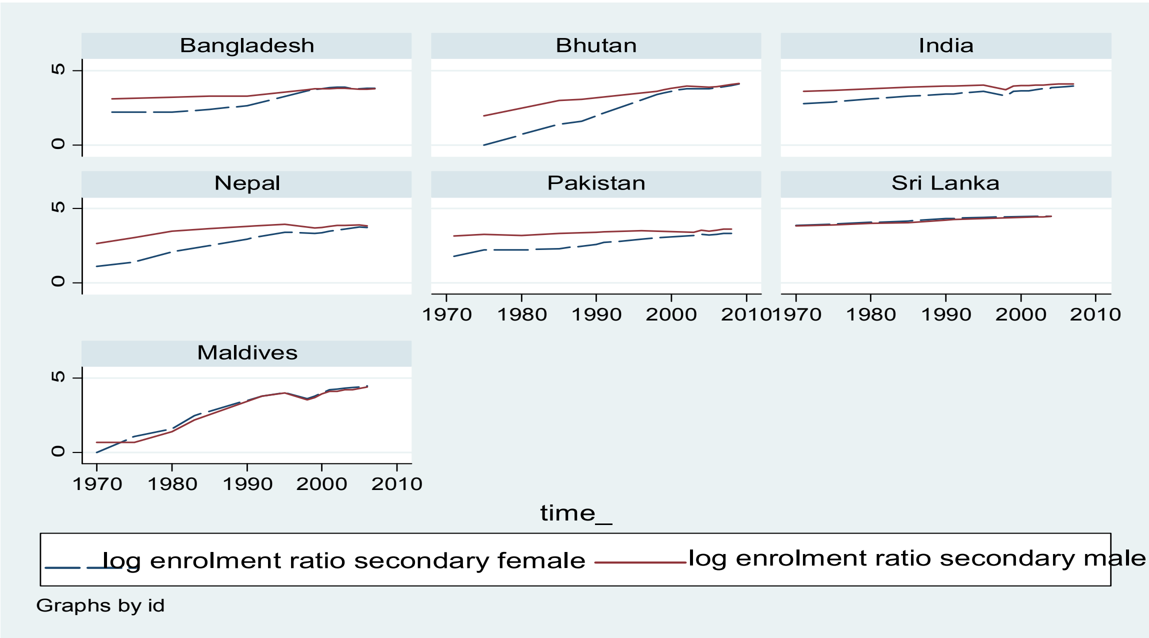
The paper is organised as follows. Section 2 briefly discusses South Asia's growth experience. Section 3 is devoted to describing the empirical model. Section 4 details the data, including the construction of the capital stock series and methodology. Section 5 discusses the empirical results. Section 6 provides a summary and policy implications.

2. Some region-specific characteristics

South Asia is one of the poorest regions in the world, faced with a number of obstacles such as conflict and high fiscal deficits. An early phase of growth was initiated from 1950 to1970 by planned industrialisation, based on a strategy of import substitution and widespread protection. This led to inefficiency and stagnation in the 1970s. A growth revival took place in 1980s and 1990s following a shift towards an export-led industrialisation strategy. A series of economic reforms were undertaken under the auspices of the IMF and the World Bank in Sri Lanka in the 1970s, Bangladesh and Pakistan in the 1980s, India, Nepal and Bhutan in the 1990s.

In the years following liberalisation, the growth rates of these countries have accelerated, in particular that of India. The key contributory factors to India's rapid growth can be attributed to the increase in physical capital per head, human capital stock and financial development. The World Bank suggests that the initial phase of structural adjustment may have a negative impact on the enrolment ratios of countries implementing these policies. A preliminary examination of the secondary enrolment data for South Asia (see Figure 1), suggests that this indeed is the case, with enrolment ratios for the countries that deregulated in the 1990s exhibiting a slight dip in this period. The gap between male and female enrolment rates, however, has narrowed significantly in the period following adjustment, with all countries exhibiting gender parity in secondary enrolment, with the exclusion of Pakistan (a similar trend is observed for the primary enrolment ratio, not shown here, but available from the authors upon request).

Figure 1: Female and male secondary enrolment ratio over time

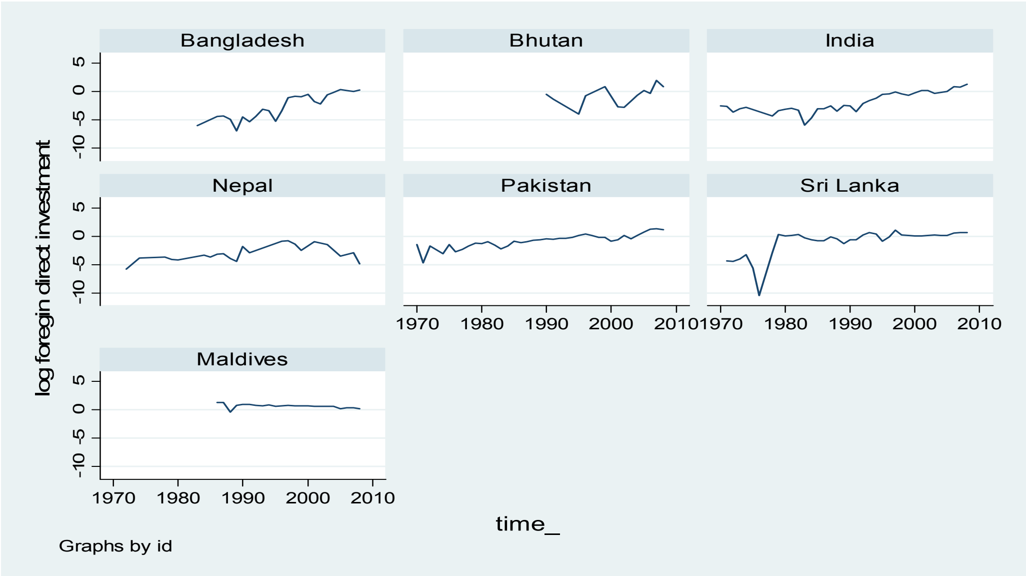


In the period following liberalisation, a number of direct export incentive schemes were introduced and foreign direct investment was encouraged through the establishment of export processing zones. FDI in South Asia is highly concentrated in the manufacturing sector, accounting for approximately more than 45 percent of approved FDI projects. In Sri Lanka, within the manufacturing sector, the textile and garment industry accounts for 28 percent of total foreign investment, followed by the chemical and plastic industries at 25.3 percent (Jayaweera, 2004). In Bangladesh there has been a significant expansion of the export-oriented manufacturing sector, from around 50 factories employing a few thousand workers in the early 1980s, to over 3,000 factories employing around 1.8 million workers by 2000 (Kabeer and Mahmud, 2004). The textile and garment industry accounts for over 50 percent of FDI-approved projects in Bangladesh. FDI in Nepal is also concentrated in the manufacturing sector, with food, beverages and tobacco accounting for 24 percent of FDI-approved projects, and the textile and garment industry accounting for 24 percent of total investment in all approved manufacturing FDI projects (UNCTAD, 2003). In Pakistan, manufacturing industries, mining and quarrying, and commerce are seen to have traditionally dominated the preferences of foreign investors during 1980-1994, accounting for over 83 percent of total inflows of FDI (Khan and Kim, 1999), while in India power and telecommunications account for about 43 percent of FDI-approved projects (Singh, 2005). Bhutan has pursued a restrictive foreign investment policy, largely due to concerns over the potentially undesirable impact that FDI may have on Bhutanese tradition and culture. In 2002, however, the National Assembly of Bhutan approved FDI legislature to keep abreast with global trends (Jigme, 2006). FDI inflows into Bhutan have been limited and FDI-approved projects have been mainly into electronic and metal products, the hotel and banking industries. Compared to its South Asian counterparts, the Maldives has been successful in attracting a relatively large proportion of FDI in marine-based industries, telecommunications and hotels. The largest recipient of FDI inflows into South Asia has been India. FDI inflows into South Asia, however, have not reached the proportions of inflows into East Asia.

With the introduction of economic reforms and establishment of export processing industries, there has been a shift in female labour from the agricultural to the industrial sector in South Asia. The studies of Cagatay and Ozler (1995), Fontana and Wood (2000), Ozler (2000), and Serguino (2000), show that increased openness to trade has led to feminisation of the labour force (increase in female share of the labour force). This is primarily due to the feminised nature of export-oriented industries, which are labour-intensive, requiring mainly unskilled labour. Seventy to 80 percent of the work force in the textile and garment industry, which is highly labour-intensive in nature, are women. The evidence shows that although increased openness has led to employment gains for women, they continue to be restricted to lower skilled, lower paid jobs (Ozler, 2000).

Figure 2 illustrates the inflow of FDI into South Asia over time. Observe that FDI inflows into the region exhibit significant volatility. This can have adverse consequences on the growth trajectory of these economies through its influence on the female human capital stock, due to the large proportion of females employed in the export-oriented sector. Although the majority of these women are employed in what is officially classified as 'the formal economy', the nature of their contracts and their terms and conditions are characteristic of work in the informal economy (Kabeer and Mahmud, 2004). A study by Jayaweera (2004) on Sri Lanka showed that the majority of workers had not received official contracts, contrary to regulations. With the exception of a few men, all the women and most men believed that they could be dismissed without much formal notice. These jobs therefore do not provide a long-term solution to increasing economic growth.

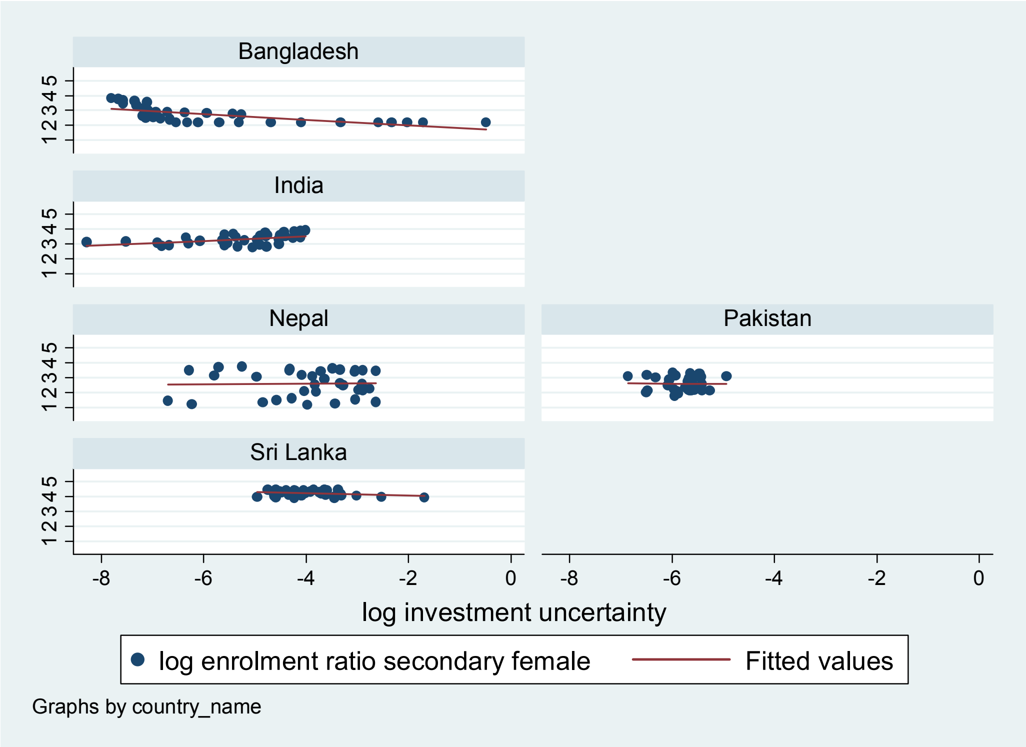
Figure 2: Foreign direct investment over time



Our study departs from the literature in several ways.

1) We disaggregate the human capital stock and investigate its impact on GDP per capita growth in South Asia. As opposed to Cagaty and Ozler (1995), Fontana and Wood (2000), Ozler (2000) and Serguino (2000), who use wages to investigate gendered outcomes, we use *enrolment ratios*.
2) The differential impact of human capital on economic growth due to FDI is one that has been overlooked in the literature. Borensztein et al. (1998), investigating the effect of FDI on economic growth in a group of developing economies, show that the contribution of FDI to economic growth is increased through its interaction with the level of human capital in the host country only when the host country has a minimum threshold stock of human capital. Our study departs from the Borensztein et al. study, in that we show that the contribution of the *female* human capital stock to economic growth is reduced through its interaction with FDI.
3) Furthermore, FDI volatility translates into increased investment volatility. Accordingly, we also examine the effect of investment uncertainty on economic growth. Figure 3 illustrates the relation between investment uncertainty and the female enrolment ratio.

Figure 3: Investment uncertainty and secondary enrolment ratio female



3. Analytical framework

The augmented Solow model is used to incorporate the gender dimension. Assume the aggregate production function takes the Cobb-Douglas form:

$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta} H_{it}^{\gamma} \varepsilon_{it}$, with $\alpha + \gamma \leq 1 \leq \alpha + \beta + \gamma$.

where y is the real GDP per capita, L is the labour force, K is real capital stock. Here A stands for everything other than the physical capital stock that influences potential output (land inputs, technical and managerial efficiency, and the like). α is the elasticity of output with respect to the capital stock.

When $\alpha + \beta + \gamma = 1$, we have a Solow model, while if $\alpha + \gamma = 1$ we have an AK model.

Dividing by L, we have:

$$y_{it} = A_{it} k_{it}^{\alpha} h_{it}^{\gamma} \varepsilon_{it} \qquad (1)$$

The next step is to express *h* as a function of male and female human capital. We carry out the conventional exercise by regressing per capita GDP on per capita capital stock and human capital by taking log of the output equation (1):

$$\ln y_{it} = \ln A_{it} + \alpha \ln k_{it} + \gamma \ln h_{it} + \varepsilon_{it} \qquad (2)$$

Estimating this equation will help us derive an estimate for total factor productivity for all economies in the region. We intend to examine the degree to which the level of human capital (decomposed on the basis of gender) influences GDP per capita:

$$\ln y_{it} = \ln A_{it} + \alpha \ln k_{it} + \gamma \ln hm_{it} + (1-\gamma)\ln hf_{it} + \varepsilon_{it} \qquad (3)$$

where *hm* and *hf* are male and female human capital, respectively.

Total factor productivity (*A*) can be influenced by financial development, trade openness, FDI and other factors. This is assumed to grow at a constant rate over time for each country, as in Mankiw-Romer-Weil approach (see Edwards, 2007).

$$A_{it} = C_i(1+\delta t) \qquad (4)$$

where *Ci* refers to country-specific time invariant effects, δ_t represents time effects influencing all countries, and z represents other control variables, which include the openness variables, FDI percentage of GDP and exports percentage of GDP and policy variables, M2 percentage of GDP and government expenditure percentage of GDP, not included in (3) above that vary over time.

Substituting (4) into (3), and taking natural logs, we get the following estimable reduced-form specification:

$$\ln y_{i,t} = \beta_0 + \beta_2 \ln k_{i,t} + \beta_3 \ln HM_{i,t} + \beta_4 \ln HF_{i,t} + \beta_5 \ln OPEN_{i,t} + \beta_6 \ln POLICY_{i,t} + \mu_i + \varepsilon_{i,t} \qquad (5)$$

where y_{it} is GDP per capita, k_{it} is the stock of physical capital per head, HM_{it} is the stock of male human capital as measured by the secondary enrolment ratio male, and HF_{it} is the stock of female human capital measured by the secondary enrolment ratio female, $OPEN_{it}$ measures the openness variables, FDI percentage of GDP and exports percentage of GDP, $POLCY_{it}$ represents M2 percentage of GDP as proxy for monetary policy and a broad indicator of financial development and government expenditure percentage of GDP as proxy for fiscal policy, μ_i represents country-specific effects and ε_{it} is a random error term that captures all other effects.
Subtracting y_{it-1} from both sides of (5) to express in terms of per capita GDP growth, we get:

$$\Delta \ln y_{i,t} = \beta_0 - \beta_1 \ln y_{i,t-1} + \beta_2 \ln k_{i,t} + \beta_3 \ln HM_{i,t} + \beta_4 \ln HF_{i,t} + \beta_5 \ln OPEN_{i,t} + \beta_6 \ln POLICY_{i,t} + \mu_i + \varepsilon_{i,t} \qquad (6)$$

Where $\Delta ln y_{it}$ is the growth rate of GDP per capita, y_{it-1} is the level of GDP per capita in the initial period, and all other variables are defined as in equation (5). Although the effect of FDI on the growth rate of the economy could be positively associated with the level of human capital, that is, the higher the level of human capital in the host country, the higher the effect of FDI on the growth rate of the economy (Borensztein et al., 1998), differential effects could exist if there is gender inequality in human capital accumulation that can be captured via introducing interaction terms in the above specification.

4. Data and methodology

4.1 Data

The data are annual and cover the 1970-2008 period for India, Sri Lanka, Pakistan, Bangladesh, Nepal, Bhutan and the Maldives. Table 1 presents summary statistics and data sources for the variables. Not many data points were available for Bhutan and the Maldives; however, we also include these two countries in our analysis.

The capital stock is estimated using the perpetual inventory method using investment data. For this, we estimate the initial capital stock K_0 for each country by following the method in Krüger (2003):

$$K_0 = I_0\left(\frac{1+g}{g+\rho}\right)$$

Where I_0 is the amount of investment in the first period for which data are available, g is the average rate of growth of investment over the subsequent five years and ρ=0.1 (the depreciation rate of 10percent). The capital stocks of the subsequent years are calculated according to the equation:

$$K_t = (1-\rho)K_{t-1} + I_t$$

Rao (2010) assumes a depreciation rate of four percent and an initial capital stock of 1.5 times the real GDP in 1969. We compare this alternative method to Krüger's method to check the sensitivity of our results.

Investment data includes total investment on fixed capital from the national accounts. We have derived a continuous series for secondary enrolment ratios (female, male and total) via the method of exponential smoothing. We use the secondary enrolment ratio as proxy for human capital rather than the primary enrolment ratio, as it is the secondary enrolment ratio that is affected by FDI inflows.

We include two variables for economic policy: money and quasi money (M2) as percentage of GDP is used as a proxy for monetary policy and the level of financial development; while government expenditure as percentage of GDP is used to capture fiscal policy. The degree of openness of the economies is measured by exports as percentage of GDP and FDI as percentage of GDP (see Mallick and Moore, 2008). As human capital has become increasingly important and a statistically significant determinant of FDI inflows (Noorbakhsh et al., 2001), we include interaction terms for human capital and FDI to overcome any potential endogeneity.

The uncertainty of investment is proxied by the variance series of a GARCH (1,1) model of real investment. This is expected to capture any macroeconomic fluctuations caused by FDI. We also control for female employment in the industrial sector as increased openness has led to a shift in the female labour force from agriculture to industry. We check the cross-correlation between all the explanatory variables to see if any two variables are highly correlated (see Table 2). For those correlated variables, we introduce interaction terms to improve the precision of the estimates. All variables are converted into natural logarithmic form for the empirical estimation.

Table 1: Descriptive statistics

Variable	Obs	Mean	Standard deviation	Min	Max	Source
Per capita income (constant 2000 US$)	237	530.42	554.90	138	3418	World Development Indicators 2010
Kruger capital per head	206	1.22e+11	2.45e+11	2.90e+07	1.56e+12	Authors' own calculation
Rao capital per head	196	1.97e+11	3.81e+11	9.08e+08	2.29e+12	Authors' own calculation
Enrolment ratio secondary (% gross)	184	35.78	18.38	8.74	88.48	World Development Indicators 2010
Enrolment ratio secondary female (% gross)	184	36.01	22.53	3	87.98	World Development Indicators 2010
Enrolment ratio secondary male (% gross)	184	40.94	15.32	14	85.66	World Development Indicators 2010
M2 (% of GDP)	242	34.30	12.88	8	73	World Development Indicators 2010
Government expenditure (% of GDP)	227	11.17	4.92	3	28	World Development Indicators 2010
Exports (% of GDP)	252	25.77	27.35	3	166	World Development Indicators 2010
FDI (% of GDP)	211	0.74	0.96	-0.20	6.71	World Development Indicators 2010
Industrial employment female (% of female employment)	98	17.91	10.73	0.8	55.9	World Development Indicators 2010
Investment uncertainty	190	0.02	0.05	0.0003	0.62	Authors' own calculation

Table 2: Pair-wise correlations between variables

Variables	GDP per capita	Kruger kph	Rao kph	Enrolment secondary	Enrolment secondary female	Enrolment secondary male	Money supply	Govt. exp	Exports	FDI	Employ-ment female	Investment uncertainty
GDP per capita	1.00	-	-	-	-	-	-	-	-	-	-	
Kruger Kph	0.981	1.00	-	-	-	-	-	-	-	-	-	
Rao kph	0.981	0.984	1.00	-	-	-	-	-	-	-	-	
Enrolment secondary	0.547	0.560	0.716	1.00	-	-	-	-	-	-	-	
Enrolment secondary female	0.584	0.597	0.713	0.982	1.00	-	-	-	-	-	-	
Enrolment secondary male	0.467	0.465	0.675	0.975	0.917	1.00	-	-	-	-	-	
Money supply	0.427	0.315	0.302	0.400	0.349	0.348	1.00	-	-	-	-	
Govt. exp.	0.608	0.754	0.421	0.210	0.250	0.234	0.283	1.00	-	-	-	
Exports	0.901	0.880	0.649	0.256	0.342	0.113	0.158	0.595	1.00	-	-	
FDI	0.502	0.703	0.685	0.225	0.271	0.147	0.243	0.363	0.584	1.00	-	
Ind. Employment female	0.449	0.476	0.372	0.601	0.619	0.562	-0.273	0.054	0.567	0.231	1.00	
Investment Uncertainty	-0.107	-0.155	-0.100	-0.128	-0.102	-0.036	-0.250	-0.144	-0.044	-0.065	0.292	1.00

4.2 Methodology

We use several alternative methodologies to test the model. Estimation is initially carried out on equation (5) and (6) by using OLS. We also test the model using fixed effects, and system GMM to check the robustness of the estimates to the estimation method. The advantage of using panel data is that it contains more degrees of freedom and greater sample variability than cross-sectional data improving the efficiency of estimates.

The panel data model takes the following form:

$$y_{it} = \gamma y_{it-1} + x_{it}\beta + \mu_i + \eta_i + u_{it\ t} \qquad (7)$$

where y_{it} is GDP per capita for country i in period t. All control variables are captured by the vector X_{it}. μ_i is a country-specific effect and $\eta_{i,}$ a fixed time effect. u_i is a random error term that captures all other variables.

The fixed effects estimator permits controlling for any unobserved country-specific time-invariant effects. Both fixed and random effects models were estimated. A Hausman test showed greater support for the fixed effects model, therefore results are reported for the fixed effects estimator. Although the fixed effects estimator is designed to control for unobserved country-specific time-invariant effects in the data, it does so, by conditioning them out and taking deviations from time-averaged sample means. The result of this is the removal of any long run variation in the dependent variable.

In our model, the explanatory variables are not strictly exogenous. An approach that allows controlling for the joint endogeneity of explanatory variables through the use of internal instruments is the Arellano-Bover (1995)-Blundell-Bond (1998) system GMM estimator. This approach uses both lagged level observations as instruments for differenced variables and lagged differenced observations as instruments for level variables, making them exogenous to fixed effects. Moreover, causality could run in both directions, from FDI and enrolment to economic growth, and economic growth to FDI inflows and enrolment ratios. In order to exploit the time series dimension of the data and individual country-specific effects controlling for any endogeneity in the model, we apply the Arellano-Bover (1995)-Blundell-Bond (1998) system GMM method. Here the levels equation (8) is combined with a first difference equation (9). The equation in levels, (8), is instrumented with lagged first differences of the variables, while the equation in first differences, (9), is instrumented with lagged levels of the variables.

$$y_{it} = \gamma y_{it-1} + x_{it}\beta + \mu_i + \eta_i + u_{it} \qquad (8)$$

$$y_{it} - y_{it-1} = \gamma(y_{it-1} - y_{it-2}) + \beta(x_{it} - x_{it-1}) + \mu_i + \eta_i + (u_{it} - u_{it-1}) \qquad (9)$$

The variable definitions are the same as above for equation (7), with lagged values of the variables now entering the equation. The GMM estimator is based on the assumption that the error terms are not serially correlated and that the explanatory variables are weakly exogenous or not correlated with future realisations of the error terms under which the following moment condition holds for the first difference estimator:

$E[y_{it-s}\,(u_{it} - u_{it-1})] = 0$; $E[\boldsymbol{x}_{it-s}\,(u_{it} - u_{it-1})] = 0$; where i = 1…..n, t = 3….T and s≥ 2.

And, as mentioned above, the levels equation is instrumented with lagged first differences of the variables which leads to the additional moments condition:

$E[\Delta y_{it-s}\,(\mu_i + u_{it})] = 0$; $E[\Delta \boldsymbol{x}_{it-s}\,(\mu_i + u_{it})] = 0$ for s =1.

Two diagnostic tests are carried out on the system GMM estimates. The null hypothesis for the Sargan test for over-identifying restrictions is that the instruments are not correlated with the residuals. The second is the Arellano-Bond test for second order correlation in the first differenced residuals.

5. Empirical findings

5.1 Preliminary results

We start off by using OLS estimation with the level of GDP per capita as the dependent variable, see Table 3. Column (1) estimates the model using capital per head estimated by the Kruger method as the independent variable, column (2) reports results for capital per head estimated by the Rao method. As there is consistency between the two capital per head variables, we continue estimating the model using the stock of capital per head calculated under the Kruger method. Column (3) adds the enrolment ratio to the model; column (4) disaggregates the human capital stock by gender. Column (5) augments the model with the policy variables and column (6) augments the model with the openness variables.

The results suggest that capital per head is important and significant for economic growth. Column (1) for example suggests that a one percent increase in capital per head leads to a 2.68percent increase in the level of GDP per capita. Our variable of interest, the secondary female human capital stock, as proxied by the enrolment ratio, has a positive impact on economic growth in equations (4) and (5). A one percent increase in the female human capital stock leads to a 0.14percent increase in the level of GDP per capital in column (4). Note, however, that when the model is augmented with the openness variables, the coefficient on the female human capital stock changes sign, but is not significant in column (6).

It is possible that the partial effect of enrolment on growth varies over different levels of openness. For example, the marginal effect of openness on growth could be quite different in India than in Bangladesh. A greater degree of openness via higher FDI in terms of technology transfer could be correlated with the level of human capita by gender in the host country. One means of capturing such nonlinearities is to include an interaction term between the secondary school enrolment ratio and the country's level of openness in the regression specification (see Minier, 2007). Therefore, in column (7), we interact the human capital variables with the openness variables. An interesting finding emerges here. FDI reduces the influence of the female human capital stock on the level of GDP per capita. Note that FDI does not have the same effect on the male human capital stock. Similarly, openness as measured by exports does not act to reduce the effect of the female human capital stock on GDP per capita. Money supply is statistically significant in columns (6) and (7) and government expenditure in column (5). We also introduce interaction terms for FDI*capital per head, exports*capital per head, and government expenditure * capital per head, to improve the precision of the estimates. Exports contributes to an increase in GDP per capita through its interaction with capital per head.

Table 3: OLS estimation: dependent variable GDP per capita

Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Capital per head Kruger	0.268 (0.017)***	-	0.252 (0.014)***	0.240 (0.018)***	0.249 (0.013)***	0.203 (0.062)***	0.138 (0.104)***
Capital per head Rao	-	0.384 (0.028)***	-	-	-	-	-
Enrolment ratio	-	-	0.530 (0.099)***	-	-	-	-
Enrolment ratio female	-	-	-	0.014 (0.004)***	0.161 (0.058)***	-0.114 (0.157)	-0.214 (0.244)
Enrolment ratio male	-	-	-	0.019 (0.010)**	0.110 (0.010)***	0.177 (0.101)*	0.210 (0.071)***
Money supply	-	-	-	-	0.076 (0.057)	0.171 (0.049)***	0.093 (0.030)***
Government expenditure	-	-	-	-	0.401 (0.058)***	0.039 (0.046)	-0.352 (0.371)
Exports	-	-	-	-	-	0.234 (0.037)***	0.434 (0.067)***
FDI	-	-	-	-	-	0.157 (0.046)***	0.483 (0.150)**
FDI*enrolment ratio female	-	-	-	-	-	-	-0.495 (0.184)***
FDI*enrolment ratio male							0.231 (0.182)
FDI*capital per head Kruger	-	-	-	-	-	-	0.048 (0.132)
Exports*enrol-ment ratio female	-	-	-	-	-	-	0.113 (0.121)

Exports*enrol-ment ratio male	-	-	-	-	-	-	0.120 (0.111)
Exports*capital per head Kruger	-	-	-	-	-	-	0.124 (0.047)***
Government expenditure* capital per head Kruger	-	-	-	-	-	-	0.068 (0.073)
Constant	1.55 (0.209)***	0.733 (0.382)**	0.413 (0.564)	1.13 (0.340)***	-1.84 (0.528)***	-1.17 (0.050)***	-0.398 (0.145)***
R^2	0.62	0.71	0.70	0.75	0.81	0.98	0.99
Observations	201	191	183	183	176	144	56

Note: Robust standard errors reported in parenthesis. *, **, *** Significant at the 10%, 5% and 1% levels.

In Table 4, the model is re-estimated using the growth rate of GDP per capita as the dependent variable. The initial level of GDP per capita, is negative and statistically significant in all columns, except for column (5). Note however, that the coefficient estimates are very small suggesting a very weak convergence between these countries. The coefficients on capital per head are positive and statistically significant. The enrolment ratio in column (3) and the male enrolment ratio in columns (4) - (7) are positive and statistically significant. Observe that the female human capital stock which is statistically significant in columns (4) and (5), lose statistical significance when the openness variables are incorporated into the model in column (6). The coefficients on money supply are significant in columns (5) and (7), and government expenditure in column (7). Exports are significant in column (6) and FDI in columns (6) and (7). The preliminary results suggest that the sign of the male human capital stock is robust to the inclusion of the openness variables, the sign of the female human capital stock however, is not. Therefore in column (7) the openness variables are interacted with the human capital variables. The coefficient on the FDI* female enrolment ratio, is once again, negative and statistically significant suggesting that FDI acts to reduce the effect of the female human capital stock on GDP per capita growth.

In a similar vein, the effect of FDI on growth has been examined in the recent literature by focusing on the complementarities between FDI inflows and financial markets (see Alfaro et al., 2009). They find that countries with well-developed financial markets gain significantly from FDI through improvements in total factor productivity (TFP), rather than factor accumulation in explaining cross-country income differences – a key finding in the growth literature. Adding an interaction term between financial development and FDI (M2*FDI), we find an insignificant coefficient (not reported), which suggests that financial markets are heterogeneous in our sample and that these countries have a long way to go in terms of achieving a threshold level of financial development for FDI to have a significant effect on growth. The OLS estimator is unbiased and consistent when all explanatory variables are exogenous and are uncorrelated with the individual country-specific effects, which is not the case in our model. Therefore the next section goes on to carry out several robustness tests.

Table 4: OLS estimation: dependent variable change in GDP per capita

Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Initial GDP per capita	-0.0001 (0.00005)**	-0.0001 (0.00005)**	-0.0001 (0.00004)**	-0.0001 (0.00005)**	-0.00007 (0.00006)	-0.0004 (0.0001)***	-0.00007 (0.00004) *
Capital per head Kruger	0.005 (0.001)***	-	0.013 (0.002)***	0.013 (0.002)***	0.008 (0.002)***	0.030 (0.013)*	0.059 (0.089)
Capital per head Rao	-	0.013 (0.003)***	-	-	-	-	-
Enrolment ratio	-	-	0.031 (0.007)***	-	-	-	-
Enrolment ratio female	-	-	-	0.021 (0.006)***	0.008 (0.002)***	0.025 (0.021)	0.034 (0.024)
Enrolment ratio male	-	-	-	0.015 (0.009)*	0.002 (0.001)**	0.024 (0.014)*	0.050 (0.014)***
Money supply	-	-	-	-	0.012 (0.007)*	0.011 (0.019)	0.041 (0.012)***
Government expenditure	-	-	-	-	-0.0006 (0.005)	-0.004 (0.014)	0.845 (0.512)*
Exports	-	-	-	-	-	0.045 (0.012)***	0.068 (0.054)
FDI	-	-	-	-	-	0.021 (0.005)***	0.087 (0.037)**
FDI*enrol ratio female	-	-	-	-	-	-	-0.074 (0.047)*
FDI*enrol ratio male	-	-	-	-	-	-	0.053 (0.045)
FDI*capital ph Kruger	-	-	-	-	-	-	0.088 (0.045)**
Exports*enrol ratio female	-	-	-	-	-	-	0.021 (0.016)
Exports*enrol ratio male	-	-	-	-	-	-	0.019 (0.011)
Export*capital ph Kruger	-	-	-	-	-	-	0.051 (0.039)
Government expenditure* capital ph	-	-	-	-	-	-	0.061 (0.038)
Constant	0.041 (0.016)***	0.127 (0.030)***	0.269 (0.050)***	0.157 (0.051)***	-0.159 (0.049)***	0.091 (0.110)	-0.521 (0.445)
R^2	0.14	0.10	0.19	0.20	0.24	0.51	0.51
Observations	195	189	181	181	175	142	54

Note: Robust standard errors reported in parenthesis. *, **, *** Significant at the 10%, 5% and 1% levels

5.2 Robustness checks

First, we use two different estimation techniques, fixed effects estimation and system GMM. The results for fixed effects estimation are reported in Table 5.

Table 5: Panel data fixed effects estimation: dependent variable GDP per capita

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Capital per head Kruger	0.386 (0.039)***	-	0.315 (0.042)***	0.297 (0.041)***	0.326 (0.047)***	0.349 (0.076)***	0.268 (0.143)**
Capital per head Rao	-	0.380 (0.049)***	-	-	-	-	-
Enrolment ratio	-	-	0.276 (0.101)***	-	-	-	-
Enrolment ratio female	-	-	-	0.154 (0.050)***	0.255 (0.083)***	0.063 (0.085)	-0.097 (0.080)
Enrolment ratio male	-	-	-	0.130 (0.125)	0.465 (0.088)***	0.136 (0.066)**	0.158 (0.081)**
Money supply	-	-	-	-	0.096 (0.080)	0.161 (0.087)*	0.034 (0.070)
Government expenditure	-	-	-	-	0.108 (0.190)	0.063 (0.052)	0.576 (0.098)
Exports	-	-	-	-	-	0.046 (0.051)	0.332 (0.146)***
FDI	-	-	-	-	-	0.057 (0.024)**	0.650 (0.326)**
FDI*enrolment ratio female	-	-	-	-	-	-	-0.367 (0.193)*
FDI*enrolment ratio male	-	-	-	-	-	-	0.024 (0.021)
FDI*capital per head Kruger	-	-	-	-	-	-	0.077 (0.152)
Exports*enrolment ratio female	-	-	-	-	-	-	0.142 (0.121)
Exports*enrolment ratio male							0.121 (0.110)
Exports*capital per head Kruger	-	-	-	-	-	-	0.037 (0.086)
Government expenditure* capital ph Kruger	-	-	-	-	-	-	0.117 (0.072)
Constant	1.09 (0.487)**	0.789 (0.650)	0.753 (0.564)	0.955 (0.659)	-1.96 (0.499)***	-2.85 (0.536)***	-1.19 (0.476)**
R^2	0.63	0.71	0.68	0.68	0.76	0.94	0.97
Hausman p-value	0.03	0.01	0.07	0.59	0.02	0.00	0.00
Observations	201	191	183	183	175	144	56

Note: Robust standard errors reported in parenthesis adjusted for clustering on country. *, **, *** Significant at the 10%, 5% and 1% levels.

The coefficients on capital per head are positive and significant. The coefficient on the overall enrolment ratio is positive and significant. The enrolment ratio for males is positive and significant in columns (5)-(7). Observe that the coefficient on the female enrolment ratio, which is significant and positive in columns (4) and (5), loses statistical significance when the openness variables are incorporated into the model in column (7). The interaction term on FDI*female enrolment ratio is negative and statistically significant at the 10 percent level, confirming the results obtained above.

To correct for the potential problem of endogeneity, system GMM is used. Table 6 reports results for system GMM. The results are consistent with those in the Tables 3-5 above. The coefficients on capital per head are positive and statistically significant. The overall enrolment ratio and male enrolment ratio are positive and significant. The coefficients on the female enrolment ratio are positive and significant in columns (4) and (5). However, when the openness variables are incorporated, once again, the coefficients on the female enrolment ratio lose statistical significance. The coefficients on money supply, which is used as a proxy for monetary policy, are statistically significant. Government expenditure used as a proxy for fiscal policy is statistically significant in column (6). The openness variables, as measured by exports and FDI, are significant and positive. Note that the interaction term on FDI*female enrolment ratio is negative and significant at the five percent level. The lagged dependent variable is statistically significant reflecting a high degree of persistence in the variables. The p values for the Sargan test for over-identifying restrictions, where the null hypothesis is that the instruments are uncorrelated with the residuals, confirm that the instruments are not correlated with the residuals. The Arellano-Bond test for second order serial correlation in the first-differenced residuals, confirms that the moment conditions cannot be rejected.

In addition to using different estimation procedures, several other robustness checks are carried out. In our baseline specification, we use data from 1970-2008. Given that FDI inflows have shown a marked increase into South Asia only from around the early 1990s (India after deregulation in 1991), we re-estimate the model for the time span covering 1992-2008. The results controlling for both female human capital stock and FDI are reported in Column (1) of Table 7. Note, only results controlling for the impact of both FDI and female human capital stock on GDP per capita are reported, due to space constraints. The conclusion that the female human capital stock, when interacted with FDI, contributes negatively to GDP per capita does not change.

As India is the region's largest recipient of FDI, the results could be driven by FDI inflows into India. Accordingly, we re-estimate the model by excluding India from the estimation. The basic conclusion that the female human capital stock reduces the influence of FDI on GDP per capita does not change (results reported in Column 2 of Table 7).

It is possible that the negative coefficient on the female human capital ratio is due to the low female human capital ratios in Nepal and Bhutan. Moreover, Nepal and Bhutan have not been very successful in attracting FDI, due to the fact that both are landlocked countries. The model therefore is

Table 6: System GMM estimation

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Capital per head Kruger	0.015 (0.010)*	-	0.017 (0.010)**	0.019 (0.012)*	0.006 (0.003)**	0.066 (0..022)***	0.835 (0.063)***
Capital per head Rao	-	0.013 (0.009)*	-	-	-	-	-
Enrolment ratio	-	-	0.065 (0.035)**	-	-	-	-
Enrolment ratio female	-	-	-	0.012 (0.002)***	0.003 (0.001)***	-0.042 (0.037)	-0.012 (0.013)
Enrolment ratio male	-	-	-	0.014 (0.005)**	0.002 (0.001)**	0.066 (0.036)*	0.013 (0.004)**
Money supply	-	-	-	-	0.018 (0.009)**	0.099 (0.021)***	0.088 (0.020)***
Government expenditure	-	-	-	-	-0.007 (0.012)	0.020 (0.006)***	0.551 (0.771)
Exports	-	-	-	-	-	0.103 (0.014)***	0.232 (0.090)*
FDI	-	-	-	-	-	0.021 (0.004)***	0.632 (0.320)**
Lag dependent variable	0.984 (0.032)***	0.989 (0.030)***	0.974 (0.031)***	0.976 (0.032)***	0.880 (0.020)***	0.803 (0.028)***	0.835 (0.063)***
FDI*enrolment ratio female	-	-	-	-	-	-	-0.148 (0.072)**
FDI*capital per head Kruger	-	-	-	-	-	-	0.095 (0.051)*
Exports*enrolment ratio female	-	-	-	-	-	-	0.025 (0.018)
Exports*enrolment ratio male							0.017 (0.101)
Exports*capital per head Kruger	-	-	-	-	-	-	0.014 (0.028)
Government expenditure* capital ph Kruger	-	-	-	-	-	-	0.040 (0.057)
Constant	-0.183 (0.085)**	-0.199 (0.087)**	-0.329 (0.150)**	-0.250 (0.125)**	-0.180 (0.088)**	-0.486 (0.146)***	-0.106 (0.103)
Sargan test for over-identifying restriction: p value	0.12	0.13	0.11	0.13	0.21	0.23	0.12
Arellano-Bond Test for 2nd order Autocorr: p value	0.48	0.49	0.54	0.51	0.95	0.88	0.76
Observations	195	191	183	183	175	144	56

Note: Robust standard errors reported in parenthesis. ***, **, *, significant at the 1%, 5% and 10% levels respectively. The difference equation is instrumented with the lagged levels, two periods, of the dependent variable and the levels equation with the difference lagged one period.

Table 7: System GMM estimation

Variable	(1)	(2)	(3)	(4)	(5)
	1992-2008	Excluding India	Excluding Nepal and Bhutan	Additional Control Variables	Additional Control Variables
Capital per head Kruger	0.019 (0.006)***	0.037 (0.020)	0.041 (0.020)**	0.029 (0.007)***	0.035 (0.019)**
Enrolment ratio female	-0.007 (0.005)	-0.009 (0.008)	0.121 (0.155)	-0.231 (0.260)	-0.021 (0.024)
Enrolment ratio male	0.022 (0.015)*	0.004 (0.002)*	0.035 (0.019)**	0.009 (0.003)***	0.024 (0.014)*
Money supply	0.004 (0.013)	0.009 (0.006)	-0.009 (0.033)	0.007 (0.003)**	0.006 (0.004)*
Government expenditure	-0.034 (0.014)**	-0.009 (0.005)**	-0.009 (0.009)	-0.010 (0.002)***	-0.006 (0.005)
Exports	0.025 (0.015)	0.008 (0.004)*	0.046 (0.026)**	0.011 (0.003)***	0.090 (0.060)*
FDI	0.004 (0.002)**	0.004 (0.001)***	0.014 (0.008)***	0.203 (0.063)***	0.024 (0.011)**
FDI*enrolment ratio female	-0.049 (0.009)***	-0.036 (0.010)***	-0.026 (0.008)***	-0.041 (0.011)***	-0.046 (0.024)**
Investment uncertainty	-	-	-	-0.0008 (0.0005)*	-0.0005 (0.0003)*
Female employment in industry	-	-	-	0.025 (0.014)*	-
FDI*female employment in industry	-	-	-	0.032 (0.010)***	-
FDI*investment uncertainty	-	-	-	-0.002 (0.001)*	-0.002 (0.001)*
Female employment industry* enrolment ratio female	-	-	-	-	-0.011 (0.005)*
Enrolment ratio female squared	-	-	-	-	-0.025 (0.035)
Lag dependent variable	0.881 (0.071)***	0.831 (0.093)***	0.831 (0.093)***	0.015 (0.010)*	0.020 (0.010)**
Constant	-0.043 (0.096)	-0.068 (0.087)	0.024 (0.027)	0.625 (0.606)	0.021 (0.031)
Sargan test: p value	0.11	0.12	0.14	0.17	0.15
Arellano-bond Test : p value	0.14	0.15	0.21	0.22	0.14
Observations	76	68	61	61	40

Note: Robust standard errors reported in parenthesis. ***, **, *, significant at the 1%, 5% and 10% levels respectively. The difference equation is instrumented with the lagged levels, two periods, of the dependent variable and the levels equation with the difference lagged one period.

re-estimated by excluding Nepal and Bhutan from the estimation. The results indicate that the findings do not change: see column 3, Table 7.

The findings could be the result of an omitted variable bias. Consequently we control for female employment in industry, as the inflow of FDI has led to an increase in female participation in the industrial sector. The coefficient on this variable is positive and significant. The result could also be attributed to the uncertainty generated by FDI. Accordingly, we generate a FDI volatility series by using a GARCH(1,1) model, which we use as an additional control variable in the estimation: see Column (4) of Table 7. Finally, we use several interaction terms to improve the robustness of the results. While the results improve with the inclusion of these additional variables, the main conclusions do not change. The investment uncertainty variable is negative and statistically significant at the 10 percent level, suggesting that investment uncertainty contributes to reducing growth. The coefficient on the FDI*investment uncertainty is negative and statistically significant, suggesting that the investment uncertainty generated by FDI contributes to reducing economic growth. The interaction term on FDI*female employment in industry is positive, implying that FDI contributes to increasing the impact of female employment in the industrial sector on economic growth. The interaction term on the FDI*female enrolment ratio continues to be negative, confirming the conclusion that FDI, when interacted with the female human capital stock, acts to reduce the effect of female enrolment ratio on GDP per capita.

We also carry out another test (see Column 5, Table 7) to detect any non-linear pattern between female school attainment at the secondary level of education and growth by adding a squared enrolment term as a regressor to the model. The lack of significant explanatory power of this coefficient suggests no non-linear effect emanating from the variable female schooling itself. However, the interaction between female secondary schooling and FDI does show possible non-linear pattern, suggesting that female human capital at secondary level does not increase the growth effect of FDI. When female schooling is insignificant and FDI is positively significant in influencing growth, the interaction between them turning out to be negatively significant does suggest that the level of female human capital has limited variability over time in South Asia to benefit from higher level of net FDI flows, thus corroborating the aggregate result in Borensztein et al. (1998). Clearly, female schooling is an insignificant source of growth in South Asia, given the low level of female enrolment in these countries. The interaction of female schooling with FDI becoming negatively significant could also be due to FDI volatility generated by investment uncertainty, as shown in Table 7.

6. Conclusion

This paper extends the existing literature by identifying the contribution of the human capital stock disaggregated by gender on economic growth in South Asia. We also explore the interactions between female human capital stock and FDI, and their effect on economic growth. The impact of investment uncertainty on economic growth is also considered. We find that the impact of the human capital stock disaggregated by gender has differential impacts on economic growth, with the female human capital stock influencing economic growth negatively when FDI is considered.

Much of the FDI inflows into South Asia have gone into the manufacturing sector, in particular, the textiles and garments industry. This industry employs a large proportion of females. In Bangladesh, the textile and garment industry is the largest employer of women. The concentration of females in South Asia's manufacturing export sector, which is mainly labour-intensive in nature, is perhaps the reason for the female human capital stock to negatively impact on growth when FDI is considered. The Borensztein et al. (1998) study sheds some light on the findings of the present study. According to Borensztein et al., if the human capital stock does not possess the minimum threshold that is required for the transfer of technology, it will not have a positive effect on economic growth. Thus, the lack of a minimum female human capital threshold in South Asia is another possible explanation for this conclusion. In South Asia some of the incentives introduced to encourage FDI inflows could therefore be hampered by the lack of proper human resources. An important policy implication stemming from this study is that it is imperative for South Asia to encourage the skill levels and education opportunities for females, in order to maximise the effects of FDI on the female human capital stock and therefore economic growth. This in turn will enable South Asia to attract FDI, which requires skilled human resources rather than unskilled human resources, so that FDI impacts positively on growth through its interaction with the female human capital stock. The current employment provided by FDI inflows does not provide a long-term solution to economic growth or the improvement in welfare of low income groups.

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The Brooks World Poverty Institute (BWPI) creates and shares knowledge to help end global poverty.

BWPI is multidisciplinary, researching poverty in both the rich and poor worlds.

Our aim is to better understand why people are poor, what keeps them trapped in poverty and how they can be helped - drawing upon the very best international practice in research and policy making.

The Brooks World Poverty Institute is chaired by Nobel Laureate, Professor Joseph E. Stiglitz.

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