Review of Development Economics, 12(1), 90–105, 2008

School Attainment, Completion, and Economic Development: A Cross-Country Analysis

*Kausik Chaudhuri and Pushkar Maitra**

Abstract

The primary aim of this paper is to examine the relationship between school attainment, school completion, and economic development. In doing so it also examines the effect of other macroeconomic variables on school attainment and completion. Estimation is conducted using a panel dataset of 138 countries. Our results show that income levels, government expenditure on education, and political instability all have significant effects on school completion and attainment. In addition these variables have different effects on male and female schooling. Our results have important policy implications and in particular allow policymakers to identify different instruments to target the problem of non-completion of schooling.

1. Introduction

Education and investment in human capital are universally recognized as essential components of economic development in any country. Education endows individuals with the means to enhance their skills, knowledge, health, and productivity and also enhances the economy's ability to develop and adopt new technology for the purpose of economic and social development. Given these benefits from education, increasing education levels is an important concern for policymakers everywhere.

In recent years one issue that has been of increasing concern to policymakers both in developed and developing countries is that of school dropouts. While there might be "valid" economic reasons for dropping out of school early, the consequences of such action are quite severe. In the context of developing countries, children typically drop out of school because the current income requirements of the household exceed the expected returns from continuing to remain in school. Obviously this has significant long-term impacts—low educational attainment and consequently low levels of human capital accumulation imply that future income earning opportunities are limited and lifetime incomes are low. Additionally there is an inter-generational effect: children born to parents with low levels of education are themselves more likely to end up with low levels of educational attainment. But the problem is not limited to developing countries. Even in developed countries, early school dropouts and non-completion of schooling is fast becoming a serious problem. For example, in Australia (an OECD

* Chaudhuri: Indira Gandhi Institute for Development Research, Gen A. K. Vaidya Marg, Goregaon (E), Mumbai 40065, India and Economics Division, Leeds University Business School, The University of Leeds, Leeds LS2 9JT, UK. Email: kausik@igidr.ac.in. Maitra: Department of Economics, Monash University, Clayton Campus, VIC 3800, Australia. Email: Pushkar.Maitra@Buseco.monash.edu.au. The authors would like to thank Heather Anderson, John Landon-Lane, Farshid Vahid, participants at the 5th Australasian Workshop held at the University of Queensland, participants at the Econometric Society Australasian Standing Committee (ESASC) Inaugural Intensive Workshop for Young Scholars on Economic Growth: Theory and Econometrics (Re)united, Waikato Management School, Hamilton, New Zealand, seminar participants at Monash University, and two anonymous referees for their comments and suggestions. The earlier version of this paper was titled "School Dropouts and Economic Growth: A Cross-Country Analysis." The usual disclaimer applies.

country), studies have shown that almost one third of students drop out from high school each year and most of them never gain a year 12 or equivalent qualification. High school dropouts are much more likely to be unemployed, or to have given up looking for work, or to have low lifetime incomes. They are more likely to have poor numeracy and literacy skills, which affect their productivity, social participation, and decision making. While half of the male 15–19-year-olds who leave school early end up with full-time work, as do 65% of 20–24-year-olds who dropped out of school, the story is much more depressing for women. Less than 35% of women in both age groups who left school early have a full-time job and more than a third of the 20–24-year-olds are unemployed (see Spierings, 1999).

While there now exists a fairly large literature, which examines educational attainment of school-aged children in a number of countries, almost all of these papers look at specific countries in isolation, using unit record datasets. To the best of our knowledge there does not exist any previous paper that examines this issue using cross-country datasets. While use of cross-country datasets has its problems (primarily relating to missing data and data incompatibility), it does have the advantage of allowing one to examine the relationship between macroeconomic variables and educational attainment, which is of especial interest to policymakers everywhere. In this context, of particular importance is the relationship between educational attainment and economic growth.

The theoretical literature on endogenous growth theory argues that growth is enhanced by education. Empirical studies have, however, failed to arrive at a consensus regarding how important education is for growth. On the one hand, Barro (1991), Levine and Renelt (1992), Barro and Lee (1993), and Barro and Sala-i-Martin (1995) document a positive and significant impact of schooling on the growth of per capita real GDP across countries. On the other hand, Lau et al. (1991), Islam (1995), and Pritchett (1996) find that education either does not have a statistically significant effect on economic growth or the effect is actually negative. There might be two plausible explanations behind this. First, it might be the case that it is the quality of education rather than the quantity of schooling which matters for economic growth. Indicators such as enrolment ratios and literacy rates just capture the quantum of schooling but not the quality of schooling. There have therefore been attempts to use alternative measures of schooling that might better capture quality achievement within the existing schooling system. For example, Hanushek and Kimko (2000) and Lee and Barro (1997) have used test scores in Mathematics, Science and Reading as measures of school quality. Second, following Bils and Klenow (2000), one might argue the existence of a reverse causality running from economic growth to education.

The empirical relationship between education and economic growth therefore continues to be one that is highly debated. In this context it is important to clarify how we define education. Generally, education is measured as a stock variable (for example the average years of education attained by individuals in a country aged 25 or higher). The use of stock variables of this kind does not capture the full story because educational attainment is a flow variable. To investigate this flow aspect, in this paper we instead examine school progression (in terms of school attainment and completion rates).

How do we measure school progression? Ideally we would have liked to look at school dropouts at different stages of schooling.[1] However there are a number of problems associated with defining school dropouts (see note 1), and therefore we restrict ourselves to the proportion of the total population above the age of 15 that have attained and completed different levels of schooling and compute separate estimates for attainment and completion at the different levels.

To the best of our knowledge there is very little work that examines the relationship between school progression and economic growth. The only exception, to the best of our knowledge, is Lee and Barro (1997) who, using aggregate (cross-country) data, document that the dropout at the primary school level is significantly negatively related to the level of GDP and the primary education of adults. In addition, they also find that a lower pupil-to-teacher ratio reduces school dropouts but average teacher salary and educational spending per pupil do not have a significant impact on primary school dropout rates. Examining dropouts at primary school (as in Lee and Barro, 1997) is, however, only part of the story. In fact, school dropouts can happen at different stages and there is no unique way in which macroeconomic aggregates (like the level of income in the country or the existing stock of human capital in the country) affect school dropouts at the different levels.

2. Model Specification and Estimation Methodology

We consider four levels of school attainment: percentage of no schooling in the total population aged 15 and higher ($s = 1$), percentage of primary school attained in the total population aged 15 and higher ($s = 2$), percentage of secondary school attained in the total population aged 15 and higher ($s = 3$), and percentage of high school attained in the total population aged 15 and higher ($s = 4$). We also consider three levels of school completion: percentage of primary school completed in the total population aged 15 and higher ($j = 1$), percentage of secondary school completed in the total population aged 15 and higher ($j = 2$), and percentage of high school completed in the total population aged 15 and higher ($j = 3$). Note that since all of these variables are in percentages, they are by definition bounded in the interval [0,100]. To account for this "bounded" nature of the dependent variable, we have two alternatives. First, we can use an estimation methodology like the "double-sided Tobit". Second, we can use a logit transformation of the dependent variable in the regression. We could not compute the double-sided Tobit estimates because of convergence problems and therefore in this paper we use only the second approach. Suppose p_1 denotes the percentage of no schooling in the total population aged 15 and higher, then the logit transformation can be expressed as: $x_1 = \log\left(\frac{p_1}{100 - p_1}\right)$. We follow the same procedure for the other variables.[2]

Both the school attainment at level s, $s = 1, 2, 3, 4$ and school completion at level j, $j = 1, 2, 3$ are assumed to be functions of the log of GDP per capita (*LNGDP*), the square of the log of GDP per capita (*LNGDPSQ*), the ratio of real government current educational expenditure per pupil at primary school to real per capita GDP (in percentage) denoted by *SHPUPP* (capturing supply side variables)[3] and political factors (*PINSTAB*), which is a weighted average of the number of assassinations per million per year and number of revolutions per year.[4] In addition, we include a set of country-specific fixed effects (α_i) that control for unobserved country-specific time invariant variables that affect school attainment and completion rates after conditioning for the other explanatory variables and a set of time dummies (δ_t), which allows us to capture the impact of aggregate shocks, which can influence school attainment and completion rates.

Government expenditure on education is measured in our model by the ratio of total public spending (at the primary school level or the secondary school level) per capita relative to per capita GDP to capture some of the supply side effects on school attainment and completion rates. Defined in this way, per capita public spending on

education can also serve as a proxy for teacher–student ratio at various levels of education, average salary of teachers, and improvements in the existing stock of infrastructure such as instructional materials. Total educational expenditure per pupil is likely to have a positive effect on child schooling and should significantly decrease school non-completion rates. For example, Fuller (1986) finds that there is a positive relationship between student achievement and the availability of textbooks and other instructional materials. However, the expenditure variable can be (potentially) endogenous: increased government expenditure on primary/secondary schooling could be the result of historically high school non-attainment and non-completion rates in a particular country. See Rosenzweig and Wolpin (1986, 1988) for more discussion on this issue.[5] In order to tackle the endogeneity of the expenditure variable, we have used one-period lagged government expenditure on primary and secondary schooling (*LSHPUPP*/*LSHPUPS*) in the actual regression. One would expect an increase in the (lagged) government educational expenditure on schooling to increase school attainment and completion rates.

A priori, it is difficult to say what the sign of the political instability variables will be. On the one hand, one could argue that an increase in political instability should decrease school attainment and completion rates; while on the other hand, one could argue that political instability will increase the probability of staying in school as this would be the safer option.

The estimating equation for school attainment at level s is written as:

$$ATTAIN(s)_{it} = \alpha_i + \delta_t + \beta_1 LNGDP_{it} + \beta_2 LNGDPSQ_{it} + \beta_3 LSHPUPP_{it} + \beta_4 PINSTAB + \varepsilon(s)_{it}; \quad s = 1, 2, 3, 4, \tag{1}$$

and the estimating equation for school completion at level j is written as:

$$COMPLETION(j)_{it} = \alpha_i + \delta_t + \beta_1 LNGDP_{it} + \beta_2 LNGDPSQ_{it} + \beta_3 LSHPUPP_{it} + \beta_4 PINSTAB + \varepsilon(j)_{it}; \quad j = 1, 2, 3. \tag{2}$$

Equations (1) and (2) are estimated as Fixed Effects regression but we allow for country-specific heteroskedasticity and the reported standard errors are robust to the presence of unknown form of heteroskedasticity both between and within countries. This is the Fixed Effects GLS estimation.

3. Data and Descriptive Statistics

The data used in this paper come mainly from Barro and Lee (1997) and Lee and Barro (1997). This paper uses data on attainment and completion rates at different stages from 1960 to 1985 using a panel of 138 countries, although the unbalanced nature of the panel data implies that the actual number of countries in each regression is actually less than 138.[6]

Table 1 presents selected descriptive statistics on school attainment and school completion rates separately for the full sample and the sample of developing countries, and also by gender. Two broad issues are clear. First, there are significant differences in school attainment and completion rates of the OECD and the developing countries. This is confirmed by conducting *t*-tests for the difference in means between OECD and developing countries. The proportion of the population with no schooling is significantly higher in developing countries, while the school attainment and completion rates at every level are significantly higher in OECD countries. Second, for both the OECD and the developing countries there are significant gender differences in school

Table 1. Descriptive Statistics on School Attainment and School Completion

	All countries			*Developing countries*			
Variable	*Mean*	*Median*	*CV*	*Mean*	*Median*	*CV*	*t-test*[a]
No Schooling	37.608	34.150	0.795	46.487	44.800	0.592	16.524***
Primary School Attainment	38.767	38.750	0.519	36.438	36.300	0.554	–5.487***
Secondary School Attainment	19.246	14.500	0.852	14.187	10.500	0.842	–18.060***
High School Attainment	3.847	1.900	1.363	2.428	1.200	1.272	–15.346***
Primary School Completed	15.271	11.950	0.775	11.985	9.650	0.791	–15.049***
Secondary School Completed	6.253	3.700	1.125	4.222	2.600	1.087	–16.379***
High School Completed	1.642	0.800	1.312	1.093	0.500	1.282	–14.145***
No Schooling (Female)	42.977	39.900	0.772	53.041	53.800	0.564	17.055***
No Schooling (Male)	32.254	26.700	0.851	39.967	37.650	0.653	15.281***
Primary School Attainment (Female)	36.241	37.100	0.608	32.764	31.950	0.669	–7.655***
Primary School Attainment (Male)	41.234	41.650	0.474	40.095	40.400	0.486	–2.717***
Secondary School Attainment (Female)	17.375	11.150	0.958	12.028	8.050	0.967	–19.234***
Secondary School Attainment (Male)	21.150	17.350	0.797	16.347	12.200	0.783	–16.079***
High School Attainment (Female)	2.940	1.000	1.619	1.786	0.600	1.586	–13.256***
High School Attainment (Male)	4.769	2.700	1.245	3.061	1.700	1.143	–16.706***
Primary School Completed (Female)	14.394	10.650	0.877	10.629	7.700	0.936	–16.633***
Primary School Completed (Male)	16.129	13.600	0.729	13.352	11.200	0.722	–12.199***
Secondary School Completed (Female)	5.808	3.000	1.219	3.691	2.000	1.203	–17.238***
Secondary School Completed (Male)	6.687	3.900	1.104	4.722	2.800	1.091	–14.641***
High School Completed (Female)	1.117	0.400	1.538	0.771	0.300	1.616	–10.560***
High School Completed (Male)	2.177	1.100	1.269	1.411	0.800	1.185	–15.849***

[a] Test for difference in means between developing countries and OECD countries.
*** significant at 1% level.

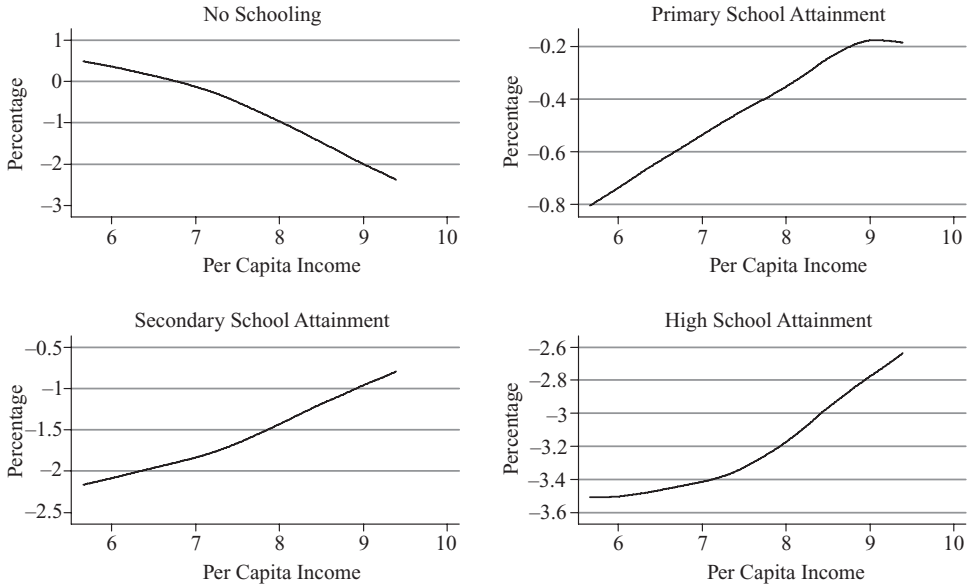

Figure 1. Relationship between School Attainment and Log of Per Capita Real Income

attainment and completion rates and in all cases the bias is against women: the proportion of no schooling is higher for females and the proportion completing and attaining different levels of schooling are higher for males.

To better understand the relationship between school attainment and completion rates and economic growth, we computed the non-parametric regression of school attainment and completion rates on log per capita GDP, i.e., regressions of the form:

$$\begin{aligned} ATTAIN(s)_{it} &= f_s(LNGDP_{it}) + \varepsilon(s)_{it}; \quad s = 1, 2, 3, 4 \\ COMPLETION(j)_{it} &= f_j(LNGDP_{it}) + \varepsilon(j)_{it}; \quad j = 1, 2, 3. \end{aligned} \tag{3}$$

The estimated relationships, which are presented in Figure 1 (school attainment) and Figure 2 (school completion) show that an increase in per capita GDP is associated with an increase in the level of school attainment and with an increase in primary and secondary school completion rates. The relationship between per capita GDP and high school completion rates is, however, highly non-monotonic.[7]

4. Estimation Results

4.1 Baseline Results

We start with the baseline regression results (for the sample of all countries). The results are presented in Table 2. An increase in per capita GDP is associated with a decrease in the percentage of the population with no schooling and, surprisingly, the percentage of the population with high school attained and completed. An increase in per capita GDP is, on the other hand, associated with an increase in primary and secondary school attainment and completion. It is, however, important to note

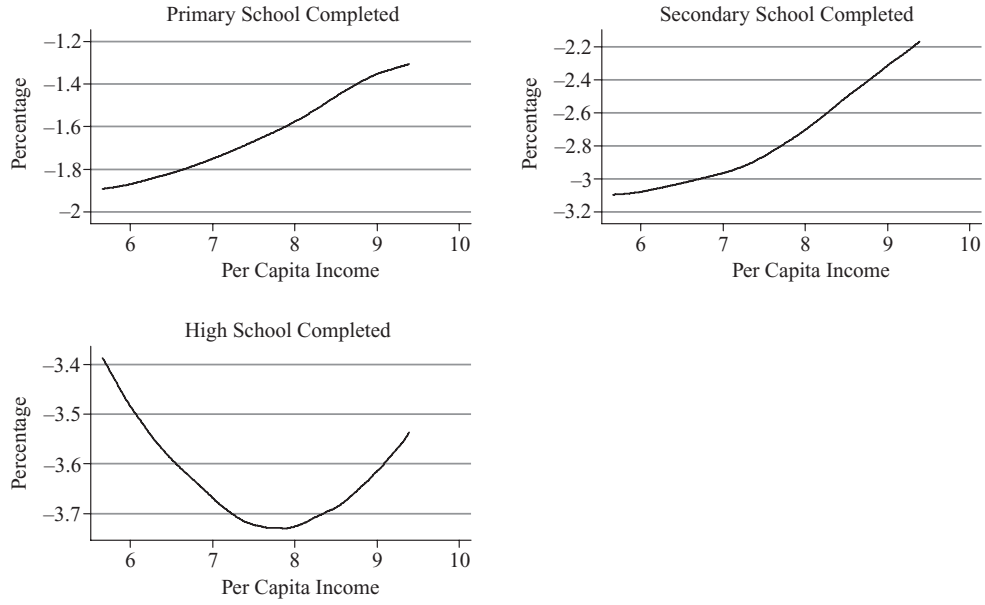

Figure 2. Relationship between School Completed and Log of Per Capita Real Income

that there is significant nonlinearity in the effect of income on school attainment and completion—the estimated coefficient of *LNGDPSQ* is always statistically significant.

An increase in political instability (*PINSTAB*) reduces the percentage of the population with no schooling, the percentage of population with secondary school attainment and completion, and the percentage of the population with high school attainment (though it is worth noting that the effect in this case is quite weak, being statistically significant only at the 10% level). An increase in political instability, on the other hand, increases the percentage of the population with primary school attainment and completion and high school completion.

There are statistically significant supply side effects on school attainment and completion, though the effects are not "correctly" signed. We find that an increase in *LSHPUPP* (ratio of total public spending on primary schooling to per capita GDP, lagged by one period) actually increases the percentage of the population with no schooling and reduces the percentage of the population with primary school attainment and completion. On the other hand, an increase in *LSHPUPS* (ratio of total public spending on secondary schooling to per capita GDP, lagged by one period) increases the percentage of the population with secondary and high school attainment and completion. One way of interpreting these results is that government expenditure on education has a strong effect on school attainment and completion only beyond the primary school level. Second, and possibly more importantly, the incorrect sign at the primary school level possibly reflects the potential endogeneity of government expenditure on education, an issue we have discussed earlier. While we did try to correct for this potential endogeneity by taking the one period lagged value of *SHPUPP* as the

Table 2. Regression Results for All Countries

	No Schooling	*Primary School Attainment*	*Primary School Completed*	*Secondary School Attainment*	*Secondary School Completed*	*High School Attainment*	*High School Completed*
LNGDP	–3.622***	4.954***	2.257***	2.478***	2.691***	–2.420***	–2.704***
	(0.403)	(0.342)	(0.415)	(0.290)	(0.549)	(0.369)	(0.588)
LNGDPSQ	0.235***	–0.339***	–0.158***	–0.146***	–0.158***	0.163***	0.169***
	(0.025)	(0.021)	(0.026)	(0.018)	(0.033)	(0.025)	(0.037)
LSHPUPP/LSHPUPS	0.005**	–0.013***	–0.020***	0.001***	0.002***	0.003***	0.003***
	(0.002)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
PINSTAB	–0.274***	0.403***	0.120**	–0.135**	–0.454***	–0.145*	0.453***
	(0.042)	(0.060)	(0.057)	(0.053)	(0.076)	(0.085)	(0.072)
CONSTANT	0.000	0.000	0.000	0.000	0.000	5.203**	6.566*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(2.463)	(3.376)
Observations	300	300	300	287	287	293	293
Number of countries	95	95	95	94	94	95	95

Heteroskedasticity corrected standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

relevant instrument, one could argue that simply looking at a one period lagged effect is not sufficient to capture the true effect of government expenditure on primary schooling. Sustained government input is necessary before we can actually see any positive impact. Sample size considerations unfortunately prevented us from running the regressions with more than one period lag.

In Table 3 we present the corresponding results for the sample of developing countries. The results are qualitatively similar to the all country case (presented in Table 2) and we therefore do not discuss them in detail.

4.2 Gender Differences

The descriptive statistics presented in Table 1 highlighted significant gender differences in school attainment/completion. The effect was particularly strong (and biased in favor of males). The results presented in Table 4 (school attainment) and Table 5 (school completion) explore the issue of gender differences further. Note that the results presented are only for the sample of developing countries, and the full set of results are available from the authors on request.

School attainment Income levels have statistically significant effects on the school attainment rates of both males and females and the effect is quite nonlinear—both *LNGDP* and *LNGDPSQ* are statistically significant and in all cases of opposite sign. An increase in *LNGDP* increases the percentage of no schooling for both males and females and somewhat surprisingly has a stronger effect on the percentage of no schooling for males. An increase in *LNGDP* increases the primary school attainment levels for both males and females and the effect is stronger on the primary school attainment rates for males. Finally, an increase in *LNGDP* reduces the high school attainment levels of both males and females and the effect is stronger on the high school attainment levels for females.

An increase in political instability reduces the percentage of no schooling for both males and females, increases the percentage of males and females with primary school attainment, decreases the percentage of males and females with secondary school attainment and increases the percentage of females with high school attainment but reduces the corresponding percentage of males. A possible explanation for the latter phenomenon can be that females continue to remain in school because it is viewed as the safer option.

Turning to the supply side variables, we see that an increase in government expenditure on education has a statistically significant effect on the school attainment rates of both males and females but interestingly the effect is generally stronger for females. For example, an increase in total government spending on secondary schooling does not have a statistically significant effect on the high school attainment rates of males but has a positive and statistically significant effect on the high school attainment rates of females. This again is an important result, particularly from the policy point of view. Remember that school attainment rates are generally lower for girls. What this result implies is that, by investing in infrastructure, the government can significantly increase the school attainment rates of females.

School completion Turning to the school completion regressions, we find that there are some interesting gender differences. First, in general the income effects are stronger for female school completion rates. Second, we find that there is very little gender difference in the effect of government expenditure on education on the school

Table 3. Regression Results for Developing Countries

	No Schooling	*Primary School Attainment*	*Primary School Completed*	*Secondary School Attainment*	*Secondary School Completed*	*High School Attainment*	*High School Completed*
LNGDP	0.107	2.504***	–0.025	1.979***	3.177***	–4.671***	–4.478***
	(0.174)	(0.522)	(0.399)	(0.394)	(0.614)	(0.636)	(0.825)
LNGDPSQ	–0.007	–0.188***	–0.011	–0.118***	–0.186***	0.320***	0.300***
	(0.011)	(0.035)	(0.026)	(0.025)	(0.037)	(0.043)	(0.051)
LSHPUPP/LSHPUPS	0.011***	–0.018***	–0.024***	0.001***	0.001***	0.000	0.003***
	(0.001)	(0.002)	(0.002)	(0.000)	(0.000)	(0.001)	(0.001)
PINSTAB	–0.230***	0.411***	0.172***	–0.226***	–0.478***	–0.204**	0.455***
	(0.058)	(0.050)	(0.052)	(0.037)	(0.095)	(0.089)	(0.071)
CONSTANT	3.661***	–12.562***	–4.218**	0.000	–16.563***	13.505***	0.000
	(0.809)	(2.092)	(1.681)	(0.000)	(2.580)	(3.194)	(0.000)
Observations	225	225	225	216	216	222	222
Number of countries	72	72	72	71	71	72	72

Heteroskedasticity corrected standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4. Gender Differences in School Attainment: Regression Results for Developing Countries

	No Schooling		*Primary School Attainment*		*Secondary School Attainment*		*High School Attainment*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
LNGDP	1.012***	0.626***	3.377***	2.855***	2.244***	2.278***	–4.412***	–12.375***
	(0.330)	(0.230)	(0.482)	(0.518)	(0.451)	(0.606)	(0.694)	(1.016)
LNGDPSQ	–0.072***	–0.036***	–0.240***	–0.210***	–0.139***	–0.130***	0.299***	0.854***
	(0.022)	(0.013)	(0.032)	(0.033)	(0.029)	(0.037)	(0.045)	(0.062)
LSHPUPP/LSHPUPS	0.009***	0.014***	–0.012***	–0.008**	0.001***	0.003***	–0.000	0.001**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.000)	(0.001)	(0.000)	(0.001)
PINSTAB	–0.148**	–0.207***	0.466***	0.371***	–0.261***	–0.322***	–0.205**	0.764***
	(0.073)	(0.053)	(0.049)	(0.064)	(0.050)	(0.063)	(0.081)	(0.081)
CONSTANT	–5.851***	0.000	–15.377***	0.000	0.000	0.000	0.000	40.861***
	(1.544)	(0.000)	(1.988)	(0.000)	(0.000)	(0.000)	(0.000)	(4.835)
Observations	225	225	225	225	216	216	222	222
Number of countries	72	72	72	72	71	71	72	72

Heteroskedasticity corrected standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5. Gender Differences in School Completion:Regression Results for Developing Countries

	Primary School Completed		*Secondary School Completed*		*High School Completed*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
LNGDP	0.325	1.980***	4.088***	3.734***	–1.128*	–3.075***
	(0.738)	(0.460)	(0.710)	(1.090)	(0.684)	(0.962)
LNGDPSQ	–0.035	–0.140***	–0.233***	–0.186***	0.087*	0.210***
	(0.047)	(0.029)	(0.044)	(0.068)	(0.045)	(0.067)
LSHPUPP/LSHPUPS	–0.016***	–0.019***	0.002***	0.006***	0.003***	0.003***
	(0.003)	(0.003)	(0.000)	(0.001)	(0.001)	(0.001)
PINSTAB	0.201***	0.102*	–0.670***	0.287**	0.281**	0.459***
	(0.045)	(0.061)	(0.112)	(0.114)	(0.134)	(0.138)
CONSTANT	0.000	0.000	0.000	–21.889***	–0.093	8.169**
	(0.000)	(0.000)	(0.000)	(4.885)	(3.601)	(4.046)
Observations	225	225	216	216	222	222
Number of countries	72	72	71	71	72	72

Heteroskedasticity corrected standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

completion rates. Third, an increase in political instability significantly affects school completion rates of males and females and the results show that females are more likely to stay on in school if there is an increase in political instability, while males are more likely to drop out.

4.3. Reverse Causation

So far we have seen that income levels have a statistically significant effect on school attainment and school completion rates. In fact, one could also argue that lower school attainment/completion rates could in turn result in lower income levels (the usual endogenous growth story of low schooling resulting in low levels of human capital accumulation resulting in lower income levels). Essentially this implies that there could be a problem of reverse causation and the two income variables *LNGDP* and *LNGDPSQ* in equations (1) and (2) could be potentially endogenous.

To correct for this possible endogeneity we re-estimate equations (1) and (2) using instruments for *LNGDP* and *LNGDPSQ*. This is the Fixed Effects Instrumental Variable estimation.[8] Needless to say, the use of the instrumental variable approach is dependent on the availability of valid instruments. To obtain valid instruments for *LNGDP* and *LNGDPSQ*, we need variables that are determinants of income growth but are exogenous with respect to school attainment/completion rates. The large body of empirical literature on the cross-country determinants of growth provides a number of variables that can be used as instruments. Easterly et al. (1993) have shown that growth rates of income over five-year periods are in part explained by terms of trade shocks. This suggests the use of terms of trade (*TOT*) as an instrument because changes in terms of trade can be regarded as being exogenous. We also use two other instruments: the ratio of investment to GDP (*INVSH*) and the black market premium in the foreign exchange market (*BMP*). Levine and Renelt (1992) show that the ratio of investment to GDP is robustly related to growth, and Fischer (1993) shows that a large black market premium on foreign exchange is negatively related to growth. In addition, both are exogenous to the level of GDP. We use each of these instruments separately and also jointly (to check whether there is an incidental association between these instruments). The methodology that we use is similar to that used by Pritchett and Summers (1996). Note that we present the IV estimation results only for the sample of developing countries. The results for the sample of all countries are available on request. Also because of space considerations, the results presented correspond to the case where all the instruments are included jointly. The results for the individual instruments are also available on request.

Before proceeding further, we need to examine whether there are sufficient reasons to warrant instrumental variable estimation in the first place. We use the Davidson and MacKinnon (1993) augmented regression test: include the predicted values of each endogenous right-hand side variable, as a function of all exogenous variables, in a regression of the original model. A test of exogeneity is that the coefficients of the predicted values of the regressors included are jointly equal to zero. In Table 6 we present the results from the Davidson and MacKinnon (1993) augmented regression tests. Note that the null hypothesis of exogeneity of *LNGDP* and *LNGDPSQ* is rejected in only two of the seven cases: primary school attainment and high school attainment. Table 7 presents the corresponding IV results. Notice that the income variables no longer have a statistically significant effect on school attainment rates. However, more disappointingly, all of the other explanatory variables also lose their statistical significance.

Table 6. Davidson–MacKinnon Test for Exogeneity

Regression Specification	*Test statistics*	*p-value*
No Schooling	0.711	0.493
Primary School Attainment	2.710	0.070
Secondary School Attainment	2.209	0.114
High School Attainment	2.776	0.066
Primary School Completed	1.326	0.269
Secondary School Completed	0.633	0.533
High School Completed	0.606	0.547

Table 7. Results from Instrumental Variable Regression

	Primary School Attainment	*High School Attainment*
LNGDP	–9.878	–31.273
	(8.465)	(26.036)
LNGDPSQ	0.638	1.993
	(0.582)	(1.778)
LSHPUPP	–0.021**	0.001
	(0.010)	(0.005)
PINSTAB	0.467**	–0.275
	(0.236)	(0.635)
CONSTANT	37.429	116.200
	(30.644)	(94.973)
Observations	204	200
Number of countries	67	67

Standard errors are in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

5. Conclusion

This paper uses panel data from 138 countries to examine the relationship between school attainment and completion and economic development. In doing so it examines the effect of other macroeconomic variables such as government expenditure on education, and political instability on school attainment and completion. Our results show that income levels, government expenditure on education, and political instability all generally have statistically significant effects on school attainment and completion rates, but interestingly the direction and significance varies across the different levels of school attainment and completion. In addition, there is significant nonlinearity in the effect of income in school attainment and completion rates. There are some interesting gender differences. In general the income effects are stronger for female school attainment and completion rates. Government expenditure on education has a stronger effect on female educational attainment and an increase in political instability significantly affects school completion rates of both males and females, and the results show that females are more likely to stay on in school if there is an increase in political instability while males are more likely to drop out.

From a policy point of view this is an important issue. In recent years the issue of school dropouts and non-completion of secondary schooling has been a major concern to policymakers around the world. All agree that the consequences of dropping out of school early can be quite severe. The use of cross-country datasets (as in this paper) allows us to examine the relationship between macroeconomic variables and educational attainment. This in turn allows policymakers to identify different instruments to target the problem of non-completion of schooling at different stages.

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Notes

1. In the earlier version of this paper, we had computed dropouts as the difference between the proportion of the population that was enrolled at a certain level of schooling and the proportion that actually completed that level. However, this definition is problematic since it uses statistics on the whole population and not just for school-age children as correctly pointed out by an anonymous referee.
2. However, the reported results are not qualitatively sensitive to the transformation.
3. Note that in the estimating equation for secondary and high school attainment and completion, we instead use *SHPUPS*, the ratio of real government current educational expenditure per pupil at secondary school to real per capita GDP (in percent).
4. *PINSTAB* = 0.5 * number of assassinations per million of population per year + 0.5 * number of revolutions per year.
5. Their analysis deals with the issue of placement of health services, but the argument holds with respect to all "supply side" variables.
6. The unavailability of the political variables after 1980 does not permit us to use the data beyond 1980 for the regression analysis.
7. While these non-parametric regressions were conducted for both all countries and developing countries, we only present the results for the sample of developing countries. The results for the full set of countries are available from the authors on request.
8. Note that in this case we do not account for country-specific error variances–instead we consider the standard Fixed Effects estimation.