Economics Letters 156 (2017) 48–52

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Threshold effects of human capital: Schooling and economic growth

Humna Ahsan [a,b], M. Emranul Haque [a,*]

[a] Department of Economics and Centre for Growth and Business Cycles Research, The University of Manchester, UK

[b] Department of Economics, Forman Christian College, Lahore, Pakistan

HIGHLIGHTS

- A dynamic panel threshold model is used to test non-linear effect of human capital.
- Capital stock per capita, a proxy for development, is used as the threshold variable.
- Positive effect on schooling can be realized after a threshold level of development.

ARTICLE INFO

Article history:
Received 28 October 2015
Received in revised form
7 April 2017
Accepted 10 April 2017
Available online 15 April 2017

JEL classification:
I21
I25
O15
O40

Keywords:
Human capital
Schooling
Dynamic threshold model
Panel data analysis
Growth

ABSTRACT

Empirical growth studies have often found average years of schooling to be unrelated with economic growth. This note shows that the significant positive effect of schooling can only be realized after an economy crosses a threshold level of development.

1. Introduction

There has been a dramatic rise in schooling in developing countries between 1970 and 2010 with the average years of schooling rising by more than double (from 2.99 to 7.02).[1] While microeconometric studies find high private rates of return for schooling, empirical growth studies have often found an insignificant, and even negative, impact of human capital on economic growth for these countries. This has prompted a big question "Where has all the education gone?" (Pritchett, 2001). In this note, we argue that an economy needs to cross a certain level of development in order to acquire the capacity to utilize the productivity of human capital efficiently.

Explanations offered to account for these apparent contradictions can broadly be divided into two strands. According to the first, it is the issue of data and differences in methodologies, for example, misspecification and measurement error (Benhabib and Spiegel, 1994; Krueger and Lindahl, 2001), existence of outliers (Temple, 1999), and lack of data quality (de la Fuente and Doménech, 2006; Hanushek and Kimko, 2000; Hanushek and Wößmann, 2007; Cohen and Soto, 2007). But more recent studies emphasize economic reasons for these differences. Such examples include Rogers (2008) who shows that country specific characteristics such as corruption, black market premium and brain drain make human capital unproductive while Schündeln and Playforth (2014) emphasize the need to consider the social returns to human capital.

We argue that there may be a much simpler explanation, where schooling may not automatically transform into human capital because of poor educational institutions, nor be channelled

* Correspondence to: Department of Economics, The University of Manchester, Oxford Road, Manchester M13 9PL, UK.
E-mail address: emranul.haque@manchester.ac.uk (M.E. Haque).

[1] Source: Barro–Lee data set with the World Bank definition of developing country (92 countries available in the sample).

http://dx.doi.org/10.1016/j.econlet.2017.04.014
0165-1765/

Table 1
GMM and FE estimation for developing and developed countries (Dependent variable: Growth rate of GDP per capita).

Regressors	Developing countries			Developed countries		
	1 GMM	2 GMM without outliers	3 FE without outliers	4 GMM	5 GMM without outliers	6 FE without outliers
Average schooling	0.259	0.716	−0.012	1.437	1.863	0.514
	[0.786]	[0.459]	[0.192]	[0.916]	[0.934]*	[0.200]**
Investment	3.151	4.027	3.416	4.643	4.512	4.652
	[1.513]**	[1.256]***	[0.578]***	[3.365]	[3.724]	[1.249]***
Trade	−0.206	−0.016	1.052	1.696	−0.556	2.450
	[1.860]	[1.910]	[0.575]*	[2.584]	[2.865]	[0.732]***
M2/GDP	−0.243	−0.833	−0.729	−1.853	−0.133	−0.642
	[1.657]	[1.514]	[0.312]**	[3.095]	[2.056]	[0.575]
Government size	−3.168	−10.058	−3.125	−10.320	−8.695	−6.965
	[6.414]	[6.476]	[1.556]**	[4.829]**	[5.342]	[2.299]***
Population growth	−1.546	−2.616	−0.675	−0.613	−0.164	−0.611
	[0.843]*	[0.493]***	[0.238]***	[0.742]	[0.446]	[0.152]***
Log of initial	−0.149	−2.170	−2.420	−2.457	−1.060	−4.016
GDP per capita	[1.606]	[1.496]	[0.577]***	[1.442]*	[1.769]	[0.460]***
Observations	612	572	572	296	278	278
R^2			0.355			0.457
F	9.946	9.647	17.194	13.930	7.063	21.040
Hansen (p)	0.362	0.341		0.324	0.306	
AR2 (p)	0.959	0.979		0.693	0.756	
Countries	80	79	79	46	46	46
Instruments	23	23		23	23	

Notes: Standard errors in brackets. Columns (1), (2), (4) and (5) are estimated by one-step system GMM estimator. The models include time dummies. Columns (1) and (4) are without excluding outliers and columns (2), (3), (5) and (6) are after excluding outliers. Columns (3) and (6) are estimated by fixed effects estimation. The Hansen test is distributed as χ^2 under the null hypothesis that the over identifying restrictions are valid.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

into productive use due to lack of institutional efficiency in the economy,[2] both of which improve with the level of development of the economy. Using a dynamic panel threshold model developed by Kremer et al. (2013), which is essentially an extension of the Hansen (1999) static set up, this note shows that the positive impact of human capital may not arise unless an economy is above a threshold level of development.

This note is organized as follows. Section 2 describes the data and tests for heterogeneity in the impact of average years of schooling. Section 3 presents the dynamic thresholds model and its results while Section 4 presents the robustness tests. Section 5 concludes.

2. Data and initial test for heterogeneity

We use an unbalanced panel of 126 countries covering the period from 1970 to 2012. Following convention, long-run effects on growth are investigated using non-overlapping 5 year averages giving a total of 911 observations and 9 data points for each country.[3] The dependent variable is the growth rate of GDP per capita taken from the World Development Indicators (WDI) 1960–2013. Human capital is measured as average years of schooling taken from Barro and Lee (2013).

As control variables we use log of initial GDP per capita, gross capital formation as a percentage of GDP, population growth, trade openness (trade/GDP), financial development (M2/GDP) and government size (i.e., government expenditures as a percentage of GDP), all taken from World Development Indicators (WDI) 1960–2013. The threshold variable, capital stock per capita, proxies the level of development and is taken from Penn World Table 8.0.

Separating the samples of developed and developing countries, we estimate the following equation using fixed effects (FE) and one-step system GMM estimators:

$$growth_{it} = \alpha_i + \beta_1 human\_capital_{it} + \beta_2 initial + \sum_j \beta_{jt} z_{jt} + \varepsilon_{it} \quad (1)$$

where *growth* is the growth rate of GDP per capita, *human_capital* is average years of schooling, *initial* is log of initial GDP per capita, ε is the error term, i indicates country, and t indicates time period. z_{jt} includes all other explanatory variables.

Fixed effects averages Eq. (1) over time for each i and subtracts it from Eq. (1) to remove county-specific effects, while GMM estimation controls for endogeneity. To remove outliers, we first run one-step GMM estimation of the model and then apply the Hampel Identifier (HI), as suggested in Wilcox Rand (2005), to the regression residuals stacked over time and individual countries (R_i) and treat any observation as an outlier for which the following is true:

$$HI = \frac{|R_i - M|}{MAD/0.6745} > c \quad (2)$$

where M is the median of observations $R_1, R_2, \ldots, R_n$, MAD is the median of the centred absolute values $|R_1 - M|, \ldots, |R_n - M|$, 0.6745 is the 75th quantile of the standard normal distribution, and $c = 2.24$ is a cut-off point.

Table 1 reports the effects of human capital on economic growth for a sample of developing and developed countries. Columns 1–3 show that human capital has an insignificant effect on growth in developing countries in case of both GMM and fixed effects estimation. But for developed countries, while the impact of human capital on growth is insignificant in column 4, after accounting for outliers in column 5, the human capital coefficient not only increases in magnitude but also becomes significant

[2] This may be due to a lack of institutional quality, good governance, better rule of law, freedom of speech, all of which emerge as an economy develops.

[3] Due to the availability of data until 2012, the last data point is the average of three years; 2010–2012. In order to see if this has biased our results, we ran the whole analysis after dropping this period. We find the same results which are available on request.