探討教育成就與員工績效產出之關連性
Exploring the Relationship between Educational Attainment and Output of Employee Performance

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摘要

本研究運用 84 國家 1950~2010 年的追蹤資料來分析，以 5 年期間和三種教育水準來分隔，計算出的新資料被用來驗證員工的相關產出，以學校教育的總年數與勞工教育成就的組成來測量，在控制了員工與產出的同時性決策後，採用五年間的勞動生產量落後指數作為操作性變數，以及利用最小平方法、固定效果及隨機效果迴歸之研究方法。最後，研究結果發現學校教育對於產出有顯著正相關。

關鍵詞：學校教育，教育成就，員工績效產出，最小平方法

Abstract

The panel dataset of employees, obtained from 5-year time span and three education levels, was examined in 84 countries from 1950 to 2010 in this research. The new dataset is used to examine the relationship between schooling of educational attainment and output of employee performance. After simultaneously controlling the factors of employment and output, we investigate the impact on employee's education and output with 5-year lag index, a computational variable, to verify labor productivity by using methods of Ordinary Least Square, fixed-effect, and random-effect regression. Consequently, the result shows schooling has a significant, positive correlation to the employee's output of performance.

Keywords: schooling, educational attainment, output of employee performance, ordinary least square method

I. INTRODUCTION

Many observers have emphasized the relation between educational attainment and employment, to economic progress [1-4]. An abundance of well-educated people goes along with a high level of labor productivity. It also implies larger numbers of more skilled workers and greater ability to absorb advanced technology from developed countries. The level and distribution of educational attainment also have impact on labor market outcomes, economic outcomes, and social outcomes, such as education of children, and income distribution [5-8]. There have been a number of attempts to measure educational attainment across countries in order to quantify the relationship between it and economic and social outcome variables [5, 9-10].

Barro and Lee construct measures of educational attainment for 146 countries [10-13]. Their figures are constructed at 5-year intervals from 1950 to 2010. The data are distributed educational attainment for population groups of 5-year age, 15-year age and over and 25-year age and over by gender at three levels of schooling (primary, secondary, and tertiary). They also construct measures of average years of schooling at three levels for each country and for regions in the world.

The Barro-Lee's dataset uses a perpetual inventory method, through the census/survey observations on the educational attainment of the population groups in many ranges of ages [10-13]. The flow estimates are estimated using information on school-enrollment ratios and population structure over time. However, this method is subject to bias due to inaccuracy in estimated enrollment ratios and in benchmark censuses. Therefore, using the way of observations in 5-year periods is suggested in order to reduce measurement error.

The new dataset of Barro-Lee is adopted in this paper constructing measures of educational attainment for 84 countries. The paper constructs the dataset omitting 62

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countries due to missing data of some other factors. The figures are constructed from 1950 to 2010 with 5-year lag. The data show the distribution of educational attainment of the adult population aged 25 and over at three levels (primary, secondary, and tertiary levels) of schooling. The data also show the figures of average years of schooling and average years of each level for each country (Fig. 1).

The Barro-Lee's dataset improved in 2010 raises more concerns in the earlier studies [9, 14]. They note that the previous dataset of [10-12] shows implausible time-series profiles of educational attainment for some countries. The new dataset has resolved these problems [13]. These new data is used to estimate the relationship between education and output based on a simple production-function approach. The experiment investigates how output is related to human capital stock, measured by overall years of schooling as well as by the composition of attainment of workers at various levels of education. They also find the impacts of schooling on output. The estimated rate-of-return to an addition year of schooling is higher at secondary and tertiary levels than at primary level.

In section 2, the previous researches are introduced. In section 3, the data are summarized and the methodology for constructing the estimates of educational attainment is discussed. The main features of the new dataset are highlighted. Section 4 illustrates empirical findings on the relationship between education and persons employed according to the new dataset. Section 5 proposes conclusions.

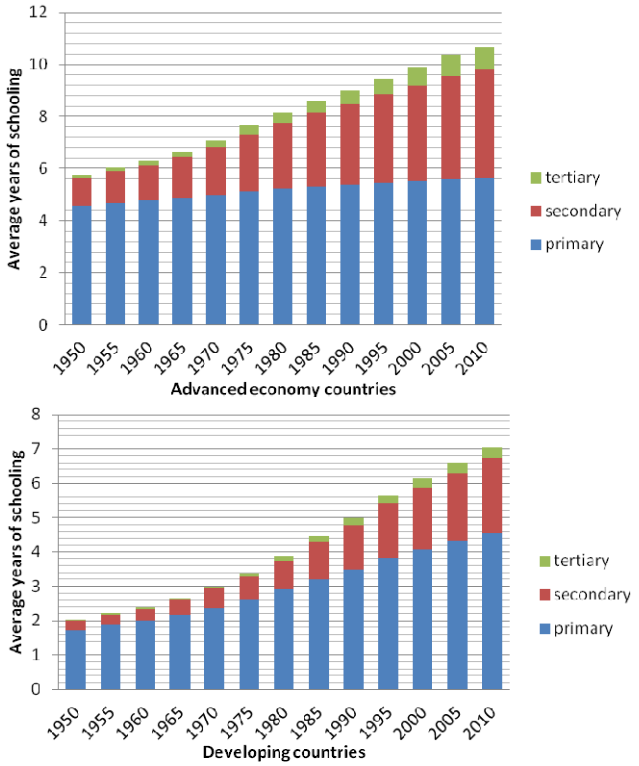

Fig. 1 Educational attainment of the total population aged 25 and over

II. LITERATURE REVIEW

Relevant to measuring educational attainment, Cohen and Soto construct a dataset for average years of schooling for 95 countries at 10-year intervals during periods 1960-2010 [9]. They adopt data and methodology similar to [10-12]. Besides, they also use forward-flow and backward-flow methods to fill-in missing observations by extrapolating the census/survey observations on educational attainment by 5-year age group. Furthermore, uses OECD sources for OECD countries and UNESCO sources for non-OECD countries.

Barro and Lee collect the data on school attainment from census/survey information of UNESCO, Eurostat, and OECD sources [10-13]. Their earlier estimates of educational attainment have been used in many studies. Up to February 2010, their papers on educational attainment data published in 1993, 1996, and 2001 have been cited in journals over 740 times, according to the Social Science Citations Index. The total number of citations by all journal articles, books, and working papers amounts to over 5,100, according to Google Scholar. The updated Barro-Lee's dataset in 2010 recalls the important relationship between education and income. This improved dataset of Barro-Lee on educational attainment should be helpful for a variety of empirical work. Their articles mention that people may invest more in education when they have higher income.

Additionally, on the other side, many researchers argue that educational attainment has an important impact on labor market outcomes such as employment, labor productivity, and so on [1-4].

III. METHODOLOGY

This paper adopts a part of the new dataset [13] on the distribution of educational attainment among the population, combined with the information for each country on the duration of school at each level, generate the number of years of schooling achieved by the average person at various levels and at all levels of schooling. Besides, this paper uses the Barro-Lee's dataset on educational attainment of population group aged 25 and over during 1950-2010 with 5-year lag in three levels of schooling: primary, secondary, and tertiary. Furthermore, the paper also uses data on population and on average years of schooling from the updated Barro-Lee's dataset [13]. The dataset shows the figures of population and average years of schooling at primary, secondary, and tertiary levels for each country (Table 1).

According to [13], the distribution of educational attainment is calculated at percentage of no schooling, percentage of primary uncompleted, percentage of primary completed, percentage of secondary uncompleted, percentage of secondary completed, percentage of tertiary uncompleted, and percentage of tertiary completed. Then, the average years of schooling at primary, secondary, and tertiary levels for each country are generalized. The completion rate at the primary level is expressed as a ratio

Table 1 Brief of panel data

Country	year	yr_sch	primary	secondary	tertiary	population
Albania	1950	2.9537	2.2599	0.6721	0.0216	512
Albania	1955	3.2156	2.4898	0.6931	0.0328	574
Albania	1960	5.2435	4.0647	1.1179	0.061	650
Albania	1965	5.5405	4.2817	1.1774	0.0814	747
Albania	1970	5.6693	4.3758	1.1975	0.0961	854
Albania	1975	6.1775	4.646	1.4041	0.1274	964
Albania	1980	6.8012	4.9906	1.6499	0.1607	1142
Albania	1985	7.582	5.4048	1.9953	0.182	1330
Albania	1990	8.5015	6.036	2.2648	0.2007	1571
Albania	1995	9.266	6.572	2.4711	0.2229	1608
Albania	2000	9.8659	7.0274	2.5928	0.2457	1622
Albania	2005	10.204	7.2491	2.714	0.2409	1704
Albania	2010	10.3798	7.379	2.7507	0.2501	1832
…	…	…	…	…	…	…
Zimbabwe	1950	1.9117	1.6722	0.2007	0.0387	1072
Zimbabwe	1955	1.9817	1.7025	0.2344	0.0448	1216
Zimbabwe	1960	2.1354	1.7933	0.2872	0.0549	1374
Zimbabwe	1965	2.3533	1.9313	0.3558	0.0662	1557
Zimbabwe	1970	2.544	2.0536	0.4149	0.0755	1770
Zimbabwe	1975	2.8922	2.2643	0.5373	0.0906	1986
Zimbabwe	1980	3.2347	2.4734	0.6558	0.1055	2295
Zimbabwe	1985	3.9902	2.82	1.0307	0.1394	2862
Zimbabwe	1990	4.5266	3.0582	1.307	0.1613	3549
Zimbabwe	1995	5.5391	3.5821	1.8488	0.1083	4053
Zimbabwe	2000	5.8899	3.7944	2.0448	0.0506	4334
Zimbabwe	2005	6.7478	4.4957	2.2097	0.0424	4524
Zimbabwe	2010	7.248	4.9944	2.2183	0.0352	4940
…	…	…	…	…	…	…

of people who completed or uncompleted primary schooling but do not enter secondary schooling. The completion rate at the secondary level is expressed as a ratio of people who completed or uncompleted secondary schooling but do not enter tertiary schooling. The completion rate at the tertiary level is expressed as a ratio of people who completed or uncompleted tertiary schooling but do not enter higher schooling.

The dataset of this paper is a panel consisting of 1092 observations at 5-year lag over the periods 1950 to 2010 for 84 countries. The dataset includes data from 22 advanced economy countries and 62 developing countries. The developing countries group is divided into six regions: East Asia and the Pacific region (9 countries), Europe and Central Asia region (4 countries), Latin America and the Caribbean region (16 countries), Middle East and North Africa region (15 countries), Sub-Saharan Africa region (14 countries), and South Asia region (4 countries). The new dataset of [13] is a panel data which included 1898 observations at 5-year interval during the years 1950-2010 for 146 countries. However, the new estimates of [13] based on 10-year differences. Most of the improvements in developing countries are stressed on primary and secondary completion while tertiary completion account for most of the improvements in years of schooling in advanced countries. This is similar to the result of [13].

All the estimates in this paper are calculated by using Stata software version 11 [15]. Firstly, the relationship between output and persons employed is estimated:

$$log(GDP_t) = \beta_t + \beta_1 (e_t) + \beta_2(s_t) + \varepsilon_t \quad (1)$$

Where GDP per capita is the outcome variable, persons employed and schooling are the predictor variables. The coefficient β_1 is the persons employed (α) and β_2 is the marginal rate-of-return to average years of schooling. The regression includes some other variables, which represents openness to trade at constant price and life expectancy at birth over time (1950-2010) [16].

The paper uses OLS, and then applies random-country-effect and fixed-country-effect panel estimation procedures, as well as an instrument variable (IV) estimation procedure. The estimate on persons employed in equation (1) is subject to potential bias that may come from several sources. There can be omitted variable bias. It is plausible that some important institutional and economic factors that are not included as explanatory variables in the specification of the production function model can influence both output and persons employed simultaneously. If an omitted variable varies by country, but is constant over time, an inclusion of country-fixed-effects term eliminates this source of endogeneity bias. The other potential source of bias comes from simultaneity. The significantly positive effect of education on output may reflect reverse causality. People may invest more in education to get more job opportunities and to improve employment status. This simultaneity bias can be, in principle, handled with instruments. Therefore, appropriate instrumental variables are needed, so that "education variables" are assumed endogenous. And, the measures of labor productivity or total trade or population are used as instruments for education variables in the IV estimation.

The paper extends another analysis to examine whether the return to GDP per capita varies across regional groups. The specifications are estimated as the following equations (2) and (3):

$$Log(GDP_{r,t}) = \beta_t + \beta_1(e_t) + \beta_{2r}(s_t * D_r) + \varepsilon_{r,t} \quad (2)$$

Where D_r is dummy for region r.

The paper also examines whether the link between education and income changes by three levels of education.

$$Log(GDP_t) = \beta_t + \beta_1 log(e_t) + (\theta_{pri}s_{t,pri} + \theta_{sec}s_{t,sec} + \theta_{ter}s_{t,ter}) + \varepsilon_t \quad (3)$$

An alternative approach is to consider a linear relationship among log-transformed variables. This is a log-log model -- the dependent variable as well as all explanatory variables is transformed to logarithms. The parameters of the log-log model have an interpretation as elasticity. So the log-log model assumes a constant elasticity over all values of the data set.

Table 2 Rate-of-return to schooling: Total population, aged 25 and over

Log(GDP per capita)	(1)	(2)	(3)	(4)	(5)
	OLS	Fe	Re	FeIV	ReIV
Persons employed	-9.278e-07	9.953e-07	6.832e-07	9.951e-07	5.623e-07
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.032)**
Ave. years of schooling	0.0183	0.0512	0.0499	0.2096	0.2071
	(0.007)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
R^2	0.67	0.61	0.61	0.03	0.42
Observations	1092	1092	1092	1092	1092
Number of countries	84	84	84	84	84

Notes: Robust t/z statistics in brackets. ** significant at 5%; *** significant at 1%.

IV. DATA ANALYSIS AND EMPIRICAL RESULTS

The paper adopts five variables of Barro-Lee's data, namely average years of schooling, average years of primary, average years of secondary, average years of tertiary, and total population aged 25 and over (in thousands of person). Besides, there are other variables from other sources that participate in the estimates. Those are labor productivity per person employed in 2009US$ (converted to 2009 price levels), persons employed (in thousands of persons), and GDP per capita (2009 base) from [16] and total export, total import, total trade, life expectancy at birth (years), and openness to trade (constant price) from a study of [17].

1. Estimations of return to employment by total population aged 25 and over

The relation between education and persons employed is tested by a regression. The results show that an average year of schooling is significant related to persons employed. Then, estimate log(GDP per capita) equation by OLS with persons employed (in thousands of person) (employed), average years of schooling (yr_sch), net export (total export − total import) (net), life expectancy at birth (years), openness to trade (at constant price). Statistically speaking, the general form for determining neighborhood effects in OLS models is:

$$Y = \alpha + \beta_1 employed_i + \beta_2 schooling_i + \beta_3 net_i + \beta_4 life_i + \beta_5 open_i + \mu_i \quad (4)$$

The results show that the p-values of schooling, net export, life expectancy at birth (years), and openness to trade (at constant price) are significantly. It means these five variables have positive effects to GDP per capita. We apply fix-effects to estimate log(GDP per capita) equation with schooling, net export, life expectancy at birth (years), and openness to trade. The fixed effect model takes on the following form:

$$Y_{ij} = \alpha_j + \beta_1 employed_j + \beta_2 schooling_{ij} + \beta_3 net_{ij} + \beta_4 life_{ij} + \beta_5 open_{ij} + \mu_{ij} \quad (5)$$

Apply random-effects to estimate log(GDP per capita) equation with schooling, net export, life expectancy at birth (years), and openness to trade. A Hausman test cannot be used with robust or cluster-robust. Therefore, Breusch and Pagan Lagrangian multiplier test for random effects should be used. The resutls show that the p-value is equal to zero. It means the random effects model is good. A reduced form equation for average years of schooling is estimated containing all the previous explanatory variables and the dummy variables: labor productivity, population, and total trade. The restuls show that p-values of labor productivity, population, and total trade are expectively significant. It means labor productivity and total trade are practically and statistically significant correlated to schooling. Average years of schooling will increase $1.51e^{-05}$ year when labor productivity increase one unit, will increase $9.79e^{-06}$ when total trade increase one unit. Thus, labor productivity and total trade are good instruments for schooling.

Estimate log(GDP per capita) equation by instrument variable (IV), using labor productivity and total trade as instruments for average years of schooling. Compare with the earlier OLS estimate, the coefficient value of schooling is greater (0.048 > 0.018). It means the instruments labor productivity and total trade are good for schooling. Besides, 99.9% confidence interval of the return to average years of schooling by IV is (-0.014, 0.11). It is wider than 99.9% confidence interval of the return to average years of schooling by OLS, which is (-0.004, 0.041). The fixed-effects IV and random-effects IV regressions are estimated using labor productivity and total trade as instruments for schooling. Due to the fact that robust and cluster are not allowed in fixed-effects IV as well as random effects IV regressions, so Bootstrap should be chose. Then, five models OLS, fixed-effects, random-effects, fixed-effects IV and random-effects IV are compared with each other. The results are showed in Table 2.

Columns (1), (2) and (3) of Table 1 present the OLS, fixed-effects and random-effects estimates. The estimated coefficients on the educational attainment variable are always positive and statistically significant, though marginal. The fixed-effects estimate for the rate-of-return to education (5.12%) is greater than the random-effects estimate (4.99%). Besides, in both fixed-effects and random-effects settings, the estimates for the rate-of-return

Table 3 OLS log(GDP per capita) by region

```
. reg lngdp employed yr_sch net life_expect trade_open d*, r level(99.9)
note: d6 omitted because of collinearity

Linear regression                                      Number of obs =    1092
                                                       F( 11,  1080) =  808.66
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.7708
                                                       Root MSE      =  .28319

------------------------------------------------------------------------------
             |               Robust
       lngdp |      Coef.   Std. Err.      t    P>|t|     [99.9% Conf. Interval]
-------------+----------------------------------------------------------------
    employed |  -9.71e-08   1.11e-07    -0.88   0.381    -4.63e-07    2.69e-07
      yr_sch |   .0380465    .005964     6.38   0.000     .0183678    .0577252
         net |   1.97e-07   1.74e-07     1.13   0.258    -3.77e-07    7.71e-07
 life_expect |   .0176456   .0018893     9.34   0.000     .0114119    .0238794
  trade_open |   .0014457   .0002675     5.40   0.000      .000563    .0023284
          d1 |   .6967433   .0330305    21.09   0.000     .5877572    .8057295
          d2 |   .1333658   .0312568     4.27   0.000     .0302323    .2364992
          d3 |   .2900358   .0422845     6.86   0.000     .1505155     .429556
          d4 |   .4869953   .0277616    17.54   0.000     .3953944    .5785963
          d5 |   .5688494   .0408836    13.91   0.000     .4339516    .7037472
          d6 |  (omitted)
          d7 |   .0803974   .0365035     2.20   0.028    -.0400479    .2008428
       _cons |   1.916412   .0894712    21.42   0.000     1.621196    2.211627
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to education are around 0.051 and 0.049. The estimates suggest that, holding other things constant, output for the world economy as a whole would increase by around 5% for every additional year of schooling.

Columns (4) and (5) present the estimates for fixed-effects IV and random-effects IV models. The estimated coefficients on the educational attainment variable are statistically significant. The fixed-effects IV estimate for the rate-of-return to education (20.96%) is greater than the random-effects IV estimate (20.71%).

Comparing the results with instruments in columns (4) and (5) and without instrument in columns (2) and (3), both fixed-effect IV and random-effect IV estimates for the rate-of-return to education are higher than the OLS estimates, and both random-effect and fixed-effect estimates.

2. Estimations of return to employment by region

Seven dummy variables are used to represent seven regions, namely Advanced Economies (d1), East Asia and the Pacific (d2), Europe and Central Asia (d3), Latin America and the Caribbean (d4), Middle East and North Africa (d5), South Asia (d6), and Sub-Saharan Africa (d7). A regression OLS for log(GDP per capita) is estimated by region with persons employed, schooling, net export (total export-total import) life expectancy at birth (years), and total trade. Please refer to the Table 3. One of dummy variables is omitted because of collinearity. So, one dummy variable should be dropped in the regression. Almost the results are significant except persons employed and net export. The other variables all have positive effect to GDP per capita.

Fixed-effects regression is estimated by region with persons employed, schooling, net export, life expectancy at birth (years), total trade, and all the dummy variables. The dummy variables, in principle, will be all omitted because dummy variables are not consistent in fixed-effects model. A next, random effect is estimated by region with all the same variables. In principle, one dummy variable is omitted so it should be dropped in the regression. However, the omitted variables will be dropped automatically and five models will be compared with each other later so all the variables are kept in the next regressions. An IV 2SLS regression is estimated to test if two variables labor productivity and total trade are good for schooling. The results show that p-value of schooling is significant. 99% confident interval for the return to schooling is (0.107, 0.371), wider than the return to schooling in OLS estimate which is (0.018, 0.057). Then, fixed-effects IV and random-effects IV regressions are estimated by region. The results of five models will be compared with each other in Table 3.

Columns (6), (7), (8), (9) and (10) in Table 4 present regional estimates for the fixed-effects and random-effects models with and without instruments are partially significant. Consistent with the earlier results (in Table 2 columns 1-5), the IV estimates for the rate-of-return to education, by region, are higher than the estimates without instruments, for both fixed-effects and random-effects models. Rates of return to education estimates vary across regions. Rate-of-return estimates in the groups of advanced economy countries, Latin America and Caribbean, and Middle East and North Africa are higher than in the other regions. The group of Middle East and North Africa countries has the highest IV random-effects rate-of-return estimate (102%). This figure suggests that on average years of schooling, the persons employed differential in this region is around 102%. By contrast, the estimated rate-of-return to education is quite low in East Asia and the Pacific (2.3%) and South Asia (0.5%).

Table 4 Rate-of-return to schooling by region

Log(GDP per capita)	(6)	(7)	(8)	(9)	(10)
	OLS	Fe	Re	FeIV	ReIV
Persons employed	-9.714e-08	9.953e-07	8.474e-07	9.951e-07	9.530e-07
	(0.381)	(0.000)***	(0.000)***	(0.721)	(0.490)
Ave. years of schooling	0.0380	0.0512	0.0504	0.2096	0.2094
	(0.000)***	(0.000)***	(0.000)***	(0.011)**	(0.001)***
Advanced economies countries (d1)	0.6967	Omitted	0.7984	Omitted	0.8192
	(0.000)***		(0.000)***		(0.000)***
East Asia and the Pacific (d2)	0.1333	Omitted	0.0818	Omitted	0.2379
	(0.000)***		(0.467)		(0.259)
Europe and Central Asia (d3)	0.2900	Omitted	0.3667	Omitted	0.3246
	(0.000)***		(0.014)**		(0.021)**
Latin America and Caribbean (d4)	0.4869	Omitted	0.5408	Omitted	0.7021
	(0.000)***		(0.000)***		(0.000)***
Middle East and North Africa (d5)	0.5688	Omitted	0.6035	Omitted	1.0186
	(0.000)***		(0.000)***		(0.000)***
South Asia (d6)	Omitted	Omitted	-0.0765	Omitted	0.0500
			(0.427)		(0.730)
Sub-Saharan Africa (d7)	0.0803	Omitted	Omitted	Omitted	Omitted
	(0.027)**				
R^2	0.77	0.61	0.61	0.03	0.23
Observations	1092	1092	1092	1092	1092
Number of countries	84	84	84	84	84

Notes: Robust t/z statistics in brackets. ** significant at 5%; *** significant at 1%.

Table 5 Rate-of-return to schooling by levels educational attainment

Log(GDP per capita)	(11)	(12)	(13)	(14)	(15)
	OLS	Fixed	Random	Fixed IV	Random IV
Log(Persons employed)	-0.0837	-0.0969	-0.0918	1.4099	0.2709
	(0.000)***	(0.035)**	(0.001)***	(0.788)	(0.875)
Ave. years of schooling					
Log(Primary)	-0.1582	-0.0671	-0.0793	-8.905	-5.211
	(0.000)***	(0.125)	(0.048)**	(0.743)	(0.770)
Log(Secondary)	0.0999	0.0754	0.0789	6.182	3.094
	(0.000)***	(0.005)***	(0.002)***	(0.779)	(0.890)
Log(Tertiary)	0.0637	0.0306	0.0337	-2.9392	-1.2407
	(0.000)***	(0.002)***	(0.000)***	(0.825)	(0.921)
Observations	1092	1092	1092	1092	1092
Number of countries	84	84	84	84	84
R-squared	0.71	0.63		0.63	0.02

Notes: Robust t/z statistics in brackets. ** significant at 5%; *** significant at 1%.

3. Estimations of return to employment by levels of educational attainment

OLS regression is estimated with log(persons employed), log(average years of primary), log(average years of secondary), log(average years of tertiary), log (net export), log(life expectancy in birth), and log(openness to trade). The log transformation is only applicable when all the observations in the dataset are positive. [18] notes that this can be solved by using a transformation like $\log(X+k)$ where k is a positive scalar chosen to ensure positive values. In this case, net export variable include some negative numbers so when this variable is taken logarithm transformed, the missing values will be replaced by zero.

Fixed-effects and random-effects regressions are estimated with all the same variables. IV 2SLS regression

Table 6 OLS, Fixed-effects, random effects, and IV Regression Results for persons employed

A. Rate-of-return to Schooling: Total Population, aged 25 and over					
Log(GDP per capita)	(1)	(2)	(3)	(4)	(5)
	OLS	Fe	Re	FeIV	ReIV
Persons employed	-9.278e-07	9.953e-07	6.832e-07	9.951e-07	5.623e-07
	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***	(0.032) **
Ave. years of schooling	0.0183	0.0512	0.0499	0.2096	0.2071
	(0.007) ***	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***
R^2	0.67	0.61	0.61	0.03	0.42
B. Rate-of-return to Schooling by Region					
	(6)	(7)	(8)	(9)	(10)
	OLS	Fe	Re	FeIV	ReIV
Persons employed	-9.714e-08	9.953e-07	8.474e-07	9.951e-07	9.530e-07
	(0.381)	(0.000) ***	(0.000) ***	(0.721)	(0.490)
Ave. years of schooling	0.0380	0.0512	0.0504	0.2096	0.2094
	(0.000) ***	(0.000) ***	(0.000) ***	(0.011) **	(0.001) ***
Advanced economies	0.6967	Omitted	0.7984	Omitted	0.8192
	(0.000) ***		(0.000) ***		(0.000) ***
East Asia and the Pacific	0.1333	Omitted	0.0818	Omitted	0.2379
	(0.000) ***		(0.467)		(0.259)
Europe and Central Asia	0.2900	Omitted	0.3667	Omitted	0.3246
	(0.000) ***		(0.014) **		(0.021) **
Latin America and Caribbean	0.4869	Omitted	0.5408	Omitted	0.7021
	(0.000) ***		(0.000) ***		(0.000) ***
Middle East and North Africa	0.5688	Omitted	0.6035	Omitted	1.0186
	(0.000) ***		(0.000) ***		(0.000) ***
South Asia	Omitted	Omitted	-0.0765	Omitted	0.0500
			(0.427)		(0.730)
Sub-Saharan Afric	0.0803	Omitted	Omitted	Omitted	Omitted
	(0.027) **				
R^2	0.77	0.61	0.61	0.03	0.23
C. Rate-of-return to Schooling by levels educational attainment					
	(11)	(12)	(13)	(14)	(15)
	OLS	Fe	Re	FeIV	ReIV
Log(Persons employed)	-0.0837	-0.0969	-0.0918	1.4099	0.2709
	(0.000) ***	(0.035) **	(0.001) ***	(0.788)	(0.875)
Ave. years of schooling					
Log(Primary)	-0.1582	-0.0671	-0.0793	-8.905	-5.211
	(0.000) ***	(0.125)	(0.048) **	(0.743)	(0.770)
Log(Secondary)	0.0999	0.0754	0.0789	6.182	3.094
	(0.000) ***	(0.005) ***	(0.002) ***	(0.779)	(0.890)
Log(Tertiary)	0.0637	0.0306	0.0337	-2.9392	-1.2407
	(0.000) ***	(0.002) ***	(0.000) ***	(0.825)	(0.921)
R-squared	0.71	0.63		0.63	0.02
Observations	1092	1092	1092	1092	1092
Number of countries	84	84	84	84	84

Notes: Robust t/z statistics in brackets. ** significant at 5%; *** significant at 1%.

is estimated with all the variables and using log(labor productivity), log(total trade), and log(population) as instruments for log(primary), log(secondary), and log(tertiary). From the results above, log(primary), log(secondary), and log(tertiary) have p-values significant. Thus, log(labor productivity), log(total trade), and log(population) have related to log(GDP per capita) so they can be instruments for log(primary), log(secondary), and log(tertiary). Fixed-effects IV and random-effects regressions are estimated. Then, a comparison between 5 models is showed together and the results are showed in Table 5.

Columns (11), (12), (13), (14) and (15) in Table 4 present the estimates for fixed effects and random-effects models with and without instruments are partially significant. The results confirm that the return to persons

employed varies across different levels of education. Based on the OLS estimates, the return to every additional year of schooling is almost 9.99% at the secondary level and 6.37% at the tertiary level. It means when average years of secondary increase 9.99%, number of persons employed will decrease 8.37% and when average years of tertiary increase 6.37%, number of persons employed will decrease 8.37%.

The results indicate that the return is negative, though statistically significant, at the primary, and increasingly positive in secondary and tertiary levels. Some earlier cross-country studies that trends in rate-of-return are decreasing by level of education [19, 20] and are increasing with levels of schooling [21, 22]. However, the negative return to years of primary schooling is also found in the recent study of [13] and they could not explain.

Finally, seemingly unrelated regression (SUR) is estimated to test the return to persons employed is the same for all regardless of educational attainment. The estimated results show p-value of chi-square test is statistically equal to zero. Thus, the null hypothesis is rejected, and persons employed increases expected additional years of primary, additional years of secondary and additional years of tertiary by the different amount, not by the same amount. The hypothesis that the return to persons employed is the same for all regardless of educational attainment (H0: $\theta_{pri} = \theta_{sec} = \theta_{ter}$ vs. HA: $\theta_{pri} \neq \theta_{sec} \neq \theta_{ter}$) is always rejected (Table 6).

V. CONCLUSION

The dataset on educational attainment applies to 84 countries at five-year lag from 1950 to 2010. The estimates are disaggregated by levels of education. The paper adopts the new schooling data to investigate the relationship between education and persons employed. However, OLS regression estimates show that the output results of persons employed are always negative. The empirical results confirm that the schooling of workers has a significantly positive effect on the number of persons employed at the country level.

The estimates of years of schooling attainment provide a good proxy for amount of persons employed for a broad group of countries. The results again prove that the new dataset of [13] is useful for studying the linkages cross countries between education and important economic, labor markets outcomes and social variables, such as life expectancy, openness to trade, free-trade, labor productivity and persons employed. The paper expects that the results will help to improve the quality of the estimations.

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