# Determinants of Human Capital Inequality in Developing Countries: Generalized Method of Moments (GMM)

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**Abstract:**

This paper examinesthe determinants of human capital inequality in developing Countries using the Gini coefficient as a proxy to human capital inequality. This paper uses a few variables such as average years of education, public expenditure on education, life expectancy, fertility rate and emigration rate by difference skill using dynamic panel data two-Step System Generalized Method of Moment (GMM) for 57 developing countries over the period of 1965-2017. The empirical results show that the past of human capital inequality, average years of education have a significanteffect on human capital inequality in the entire world and developing at 1% and 5% level. However, the public expenditure on education, total emigration rate, emigration by medium skill only significant in the world. For emigration rate by high skill only significant in developing countries. For life expectancy, only developing countries have a significant effect on human capital inequality at a 10% level. Other variable such as life expectancy is insignificanton human capital inequality at any level in the world and developing countries.

**Keywords:** human capital inequality; generalized method of moments.

**JEL Classification:** E24; J24.

## Introduction

The persistent and increasing income inequalities in most of the countries of the world since 1980's until now have been giving a negative effect on the economy. Theoretically, the relationship between human capital inequality and income inequality are positively correlated (Benabou 1994, Chakraborty and Das 2005, Erosa, Koreshkova and Restuccia 2010, Solt 2009). In examining the ability of human capital inequality to explain the differences of income inequality across countries will naturally raise questions on the determinants of human capital inequality. Equalizing human capital through education is widely recognized as the main way for social advancement and better life chances. In a perspective of equality of opportunity, human capital should be equally distributed in the population. Thus, the reduction in human capital is important to achieve equality of distribution in human capital and indirectly

reduce income inequality. This is also parallel with the Millennium Development Goal (MDG) to reduce human capital inequality on a global scale and provide a benchmark for educational standards (MDG 2009). Besides, most developing countries try to achieve equality in human capital in the 21th century. But, in the literature, a large body of empirical research points to the persistence of inequality in human capital across countries (Breen and Jonsson 2005, Gerhards and Hans 2013, Musibau, Yusuf and Gold 2019).

There are many determinants lead to inequality in human capital as reported by the researcher in previous studies[1]. In part of determinants two-sided driving forces influencing human capital inequality. One side is describing the household behavior (average of education and the past inequality) in education as the demand for education and another side is government provision for education and skilled migration in the labour market as a supply of education. For the demand for education, average years of education and past human capital inequality is proxy past educational inequality one of the factors influencing distribution in human capital inequality.

Most of the previous studies found a negative relationship between average years of education with its inequality and positive relationship between the past human capital inequality with its inequality.In discussing the supply side of education, nowadays increased flows of migration from developing to developed countries have attracted researchers in investigating the effect of migration on growth, development as well as inequality. Beine, Docquier and Rapoport (2008), Vidal (1998) found that migration prospects have a positive and significant impact on human capital formation especially for countries with low initial GDP per capita levels in cross-section of 57 developing countries.

However, the study of the effect of migration on inequality in terms of human capital inequality is less given attention by the researcher. Sasin and McKenzie (2007) investigated how migration affects human capital inequality. The results show that migration reduces human capital inequality. This is an important issue, as the literature on inequality has gone beyond looking at the distribution of outcomes. It is also supported by Massey *et al.* (1993), migration is the latter 'crucial determinants of outcomes' such as income, wealth and human capital. It is also important issue because inequality is an outcome of interest in its own right and the effects of migration on human capital inequality should be addressed to achieve equality in human capital as well as reduce income inequality in the future. Besides that, the effectiveness of allocation resources by government provision for public expenditure education should be also addressed in affecting human capital inequality across countries. This is one of important factors in supply side must be investigated.

This issue needs to be addressed because the equality of opportunity is a key development in achieve equality of human capital and there is also lack of studies about the effectiveness public expenditure in reducing human capital inequality in literature. From this issue, we can conclude that, can demand of education and supply of education as we discussed in this section affecting in inequality in human capital for most countries especially developing countries?

The objective of this paper is to examine the determinants of human capital inequality in developing countries such as the past of human capital inequality, average years of education, migration by skill and education, public expenditure and other significant control variables such as life expectancy and fertility rate. The importance of detecting the significant determinants of human capital inequality is to achieve equality in human capital and reduce income inequality. It is because human capital inequality has been a positive effect to income inequality. If human capital inequality can be reduced this will indirectly lead to a decrease in income inequality.

The main contribution of this paper over previous empirical literature is in several important aspects. First, this paper computed and extended data set of human capital inequality for two periods (2005-2017) using Human capital Gini for developing countries based on the latest dataset from Barro and Lee (updated in 2010). Recently, Castelló and Doménech (2002) computed the human capital Gini for theperiod 1960 to 2000, using Ludwig, Schelkle and Vogel (2012) and Barro and Lee (2013) researches.

Thus, this paper producesthe results of the study from a larger sample and longerperiods. Second, this paper employs the Generalized Method of Moments (GMM) using system GMM two-step as proposed by Arellano and Bover (1995) for broad panel data in developing countries which is different from previous studies that used OLS estimator, SUR Technique and other methods.

[1] For example of gender inequality see Stromquist (2005), Buchmann *et al* (2008) and UNESCO 2010) disability Carrier (1986), Peters (2003) social class (Erikson and Goldthorpe 1992), Jonsson *et al.* (1996), Persell (1977) and Stromquist (2004). Other studies have reported other factors which influenced human capital inequality such as the effect of political economy, natural disasters, poverty, privatization, race or ethnicity, religion, language, corruption, trade and globalization.

The rest of the paper is organized as follows. Section 2 reviews the related works of literature. Section 3 explains the empirical model, method estimation and data used in the analysis, while Section 4 reports and discusses the econometric results. The final section concludes and synthesizes the whole study.

## 1. A Brief Literature Review

In previous studies, many researchers have identified factors that lead to inequalities in human capital. Castelló and Doménech (2002), Gerhards and Hans (2013) and UNESCO (2010) it is state that inequality in gender as one of the main factors in contributing to human capital inequality, where gender referring to inequality between males and females in relation to educational attainment, access to higher education, and compounded with the disparities of minority ethnic status. While Carrier (Erosa *et al.* 2010, Ludwig *et al.* 2012) reported the disability has influenced human capital inequality. It can be defined as a term that encompasses physical, mental, emotional, and spiritual disadvantages. Erosa *et al.* (2010), Gerhards and Hans (2013), Ludwig *et al*. (2012) find that social class also influenced human capital inequality. In Rambla (2006) social class inequality is underpinned by several heterogeneous factors. Social inequality emerges from the unequal distribution of resources, which is biased against groups of individuals. This type of inequality is much more difficult to dislodge if the groups of individuals cannot develop their basic capabilities due to their disadvantaged position (Ludwig *et al*. 2012).

Other studies have reported that there are other factors which could influence human capital inequality such as the effect of globalization and political economy *(*Beine *et al.* 2008, Gerhards and Hans 2013) natural disasters (Cuaresma 2010, Neumayer 2011, Toya and Skidmore 2014), neoliberalism (Hill 2010, Lazzarato 2009, Shin and Park 2016), poverty (Cornia 2004, McKee and Todd 2011), privatization (Ganguli and Terrell 2006, Lesorogol 2003), race or ethnicity (Oliver and Shapiro 2013, Robinson *et al*. 2015, Smith 2000), religion (Cooray and Potrafke 2011, Krueger 2018) and language (Dustmann 1999, Kubota 2011, Parker, Rubalcava and Teruel 2005). Besides the determinants as described above, the public provision of education has been commonly perceived as egalitarian and viewed as a vehicle to achieve equity goals in the economy.

The relationship between public spending on education and inequality has been examined in several research studies, most of which have focused on primary, secondary, or all levels of educational spending, rather than spending on higher education specifically. Sylwester (2002) studied in the cross-sectional the role of public expenditure on education to inequality. He found that public education spending and income inequality are positively related. Checchi and Garcıa-Penalosa (2004) found that government expenditures on education were positively associated with income inequality in the most developed countries such as the United States. Besides examining the effect of public expenditure on education, Sasin and McKenzie (2007) examined the effect of migration on human capital inequality in rural Mexico. The results showed that migration reduced human capital inequality, especially for girls, by perversely reducing schooling at the top of the human capital distribution. The conclusion is that no single factor can ultimately explain the local, regional, or national disparities associated with the inequalities of education. Besides that, this study also includes the effect of emigration by skill (low, medium high) workers, fertility rate and life expectancy on human capital inequality. The results shown that, these effects are negatively with human capital inequality (Castelló-Climent 2010, Herzer and Vollmer 2012, Krueger 2018, Morrisson and Murtin 2013).

## 2. Empirical Model for Determinants of Human Capital Inequality

To analyse the determinant of human capital inequality in the developing countries, this study uses a few variables such as average years of education, previous of human capital inequality, emigration rate by skill, public expenditure on education and included life expectancy and fertility rate as control variables. The data set will use unbalanced panel data which is dynamic panel data System GMM set of 57 developing countries from 1965 to 2017. The empirical model can be specified as follows:

$$\ln HCgini_{j,t} = \beta_{0j} + \beta_1 nHCgini_{j,t-1} + \beta_2 \ln Pub_{j,t} + \beta_3 \ln Ayrs_{j,t} + \beta_4 \ln Expect_{j,t} + \beta_5 \ln Fert_{j,t} + \beta_6 \ln To_{t}\_emig_{j,t} + \beta_7 \ln Low\_emig_{j,t,} + \beta_8 \ln Medium\_emig_{j,t} + \beta_9 \ln High\_emig_{j,t} + \beta_{10} Dummy_{j,t} + \varepsilon_{j,t} \quad (1)$$

*where*: HCgini is human capital inequality using gini coefficient (human capital Gini), Ayrs is average years of education for the population of 25 age and over, pub is public expenditure on education, Expect is life expectancy, Fert is fertility rate, Tot_emig is referred to total of emigration rate, Low_emig is emigration rate by low skill, Medium_emigration rate by medium skill and high_emig is emigration rate by high skill. Lastly $\varepsilon$ is Error term and *j, i* represents index countries and periods.

### 2.1. Methods of Estimation

To estimate the model specification for determinants of human capital inequality in 57 developing countries with T=12, this paper uses dynamic panel data procedure Generalized Method of Moments (GMM). The reason of using GMM is to allow the identification of country-specific effects, controlthe unobserved effects by first-different data, and control the potential endogeneity of all the explanatory variablesand controls for a simultaneity bias caused by the possibility that some of the explanatory variables may be endogenous. Arellano and Bond (1991) proposed transforming Equation (1) into first differences to eliminate country-specific effects as follows:

$$\begin{aligned} LnHCgini_{j,t} - LnHCgini_{j,t-1} = {} & \beta_1(\ln HCgini_{j,t-1} - lnHCgini_{j,t-2}) + \beta_2(lnpub_{j,t} - lnpub_{j,t-1}) + \beta_3(\ln AYS_{j,t} - \ln AYS_{j,t-1}) \\ & +\beta_4(lnExpect_{j,t} - lnExpect_{j,t-1}) + \beta_5(lnfert_{j,t} - lnFert_{j,t-1})\ \beta_6(lnTot\_emig_{j,t} - lntot\_emig_{j,t-1}) + \\ & \beta_7(lnlow\_emig_{j,t,} - lnlow\_emig_{j,t-1}) + \beta_8(lnmedium\_emig_{j,t} - lnmedium\_emig_{j,t-1}) + \\ & \beta_9(lnhigh\_emig_{j,t,} - lnhigh\_emig\ _{j,t-1})\ (\varepsilon_{j,t} + \varepsilon_{j,t-1}) \end{aligned} \quad (2)$$

To address the possible simultaneity bias of explanatory variables and the correlation between ($\ln HCgini_{j,t-1} - lnHCgini_{j,t-2}$) and ($\varepsilon_{j,t} + \varepsilon_{j,t-1}$); Arellano and Bond (1991) proposed the lagged levels of the regressors are used as instruments. Itis valid under the assumptions such as the error term is not serially correlated, and the lag of the explanatory variables are weakly exogenous. This step is known as difference GMM estimation and the moment conditions can be listed as follow:

$$E[lnHCgini_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1}\ )] = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (3)$$

$$E[lnpub_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1}\ ) = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (4)$$

$$E[lnAyrs_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1})] = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (5)$$

$$E[lnExpect_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1}\ )\ ] = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (6)$$

$$E[lnFert_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1}\ )\ ]\ = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (7)$$

$$E[lnTot\_emig_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1})] = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (8)$$

$$E[lnlow\_emig_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1}\ ] = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (9)$$

$$E[lnMedium\_emig_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1}\ )] = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (10)$$

$$E[lnHigh\_emig_{j,t-s}\ (\varepsilon_{j,t} + \varepsilon_{j,t-1}\ )] = 0 \text{ for } s \geq 2;\ t = 3;\ldots;\ T \quad (11)$$

To consistency of the GMM estimator, this paper also examined the validity of the moment conditions by using the conventional test of over-identifyingrestrictions proposed by Hansen (1982) and Sargan 1958) and testing the null hypothesis thatthe error term is not second-order serially correlated of the difference in equation (2). Furthermore, we test the validity of theadditional moment conditions associated with the level equation with the difference Hansen test. Besides that, AR(1) and AR(2) are tested to evaluate the validity of appropriate instrumentation (Arellano Bond 1991, Bound, Jaeger and Baker 1995). The purpose to test AR is to determine the error term serial correlation, as far as the assumption of nonexistence serial correlation of $\varepsilon_{j,t}$ .It is important for the consistency for the estimators. If $\varepsilon_{j,t}$ is not serially correlated, there should exist negative series correlation (AR(1)) for the first stage and there is no proof of serial correlation in the second stage (AR(2)).

### 2.2. Data Description and Sources

This paperused several main variables and control variables as control variables to the problem of omitted variables. This paper used the Human capital Gini coefficient as a dependent variable using two sources. For periods 2005 and 2017, we extended and computed human capital Gini based on average years of education of the population aged 25-64. The average year of education is taken from Barro and Lee's data set updated in 2010 and we used the model suggested by Gersten, Keating, Yovanoff, and Harniss (2001) and also Thomas (2002). However, for periods 1970-2000, we used Castelló and Doménech (2002). They were used in thecomputed human capital Gini used Barro and Lee (2000, 2013) and computed usingthe same model from Thomas (2002). Since the Barro and Lee data set provides information on the average schooling years and attainment levels with four levels of education such as no education, primary, secondary and higher education respectively. The human capital Gini ($G^h$) can be computed as follows:

$$G^h = \frac{1}{2\overline{H}} \sum_{i=0}^{3} \sum_{j=0}^{3} \left| \hat{x}_i - \hat{x}_j \right| n_i n_j \quad (21)$$

*where*: *H* are the average schooling years of the population aged 25 years and over, *i* and *j* stand for the different levels of education, $n_i$ and $n_j$ are the shares of population with a given level of education, and $x$ ^$x_i$ and ^$x_j$ are the cumulative average schooling years of each educational level such as follows:

$$x_0 = x_0 = {}_0x_1 = x_1x_2 = x_1 + x_2x_3 = x_1 + x_2 + x_3 \quad (22)$$

From equation (17) and (18) the human capital Gini coefficient can be rewritten as follows:

$$G^h = n_0 \frac{n_1x_2(n_2 + n_3) + n_3x_3(n_1 + n_2)}{n_1x_1 + n_2(x_1 + x_2) + n_3(x_1 + x_2 + x_3)} \quad (23)$$

*where*: $x_0$= 0, $x_1$ is average years of primary schooling in the total population divided by the percentage of the population with at least primary education, $x_2$ is average years of secondary schooling in the total population divided by the percentage of the population with at least secondary education, $x_3$ is average years of higher schooling in the total population divided by the percentage of the population with at least higher, $n_0$ is the percentage population with no education, $n_1$ is the percentage in the population with primary education, $n_2$ measures the percentage in the population with secondary education, and $n_3$ the percentage in the population with higher education. This paper also included the effect of the emigration rate by skill (low, medium and high skill).

The emigration data is extracted by Docquier and Lodigiani (2010). This paper also included public expenditure on education and the average years of education. These data are taken from UNESCO and World Development Indicator (2017). One of the control variables is life expectancy. The fertility rate was obtained from the World Bank (2018) and another control variable used in the analysis is life expectancy. This data is taken from UNESCO (2017). All variables covering 10 periods of starting years 1965-2017.

## 3. Empirical Result

Table 1. Determinants of human capital inequality on income inequality in the world and developing countries (1965-2017)

| Dependent Variable (LnHCgini) | World | Developing |
|---|---|---|
| l.lnHCgini | 0.839*** | 0.838*** |
| | (0.0498) | (0.0460) |
| Lnayrs | -0.272*** | -0.173* |
| | (0.0477) | (0.0862) |
| Lnpub | -0.122* | 0.0469 |
| | (0.0540) | (0.0616) |
| Lnlifeexpec | 0.0126 | 0.00648** |
| | (0.00981) | (0.00232) |
| Lnfertility | 0.0281 | 0.00777 |
| | (0.0231) | (0.0127) |
| lntot_emig | 0.308*** | 0.0541** |
| | (0.0619) | (0.0614) |
| lnlow_emig | -0.157*** | -1.221 |
| | (0.0333) | (1.151) |
| lnmedium_emig | -0.0595* | -0.00820 |
| | (0.0260) | (0.0330) |
| lnhigh_emig | -0.102*** | -0.0347** |
| | (0.0261) | (0.0127) |
| _cons | 0.124 | 0.0936 |
| | (0.154) | (0.300) |
| *N* | 724 | 521 |
| *No of countries* | 92 | 66 |
| *AR(1)* | 0.001 | 0.000 |
| *AR(2)* | 0.155 | 0.577 |
| *Sargan Test* | 0.000 | 0.061 |
| *Hansen Test* | 0.487 | 0.071 |

*Note*: Standard errors in parentheses; *$p$< 0.05, **$p$< 0.01, ***$p$< 0.001

STATA 15.0 software is used to estimate the determinants of human capital inequality in developed and developing countries for periods 1965 - 2017 using system Generalized Method of Moment (GMM) with two steps.

Table 1 contained the results of regressions for most countries in the worldand developing countries. We found a strong significant effect of one-year lagged human capital inequality ($lnHCginit_{-1}$) on the current human capital inequality in the world, developing countries at 1% level with a coefficient is 0.839, and 0.792 respectively. For average years of education (lnayrs), we found a constant negative relationship between average years of education and human capital inequality (lnHCgini) and statistically significant at 1% in the world (-0.272), 5% indeveloping countries with coefficient -0.173. Considering other factors on the demand side education fertility rate (infertility) there is an insignificant on human capital inequality at any level in most countries in the world and developing countries. For life expectancy, the developing countries have a significant effect on human capital inequality at 10% level.

On the supply side of education, we found a negative and significant relationship between public spending on education (lnpubspen) and human capital inequality only in the world with coefficient -0.122 at 5% level. For the emigration rate effect, we found the total emigration rate (lntot_emig) are influencing human capital inequality with a positive sign at 1% significant level in the world with coefficient 0.275 and 10% in developing countries (0.0541) in Table 1. After including the effect of emigration rate by skill level, we only found emigration rate by low skill (lnlow_emig) affecting human capital inequality in the world countries with 1% and 5% level significant. However, we also found emigration rate by high skill (lnhigh_emig) is significant in the entire world, and developing countries at 1%, and 10% level significant respectively. For emigration rate by medium skill (lnmedium_emig), we only found a significant effect in the world on human capital inequality. Finally, based on the AR (2) in Table 1, the result found that no error term serial correlation in the second stage, while Hansen Test proves that the instrument used in this model is a valid instrument. Both tests AR (2) and Hansen Test do not reject the null hypothesis for full sample entire world and compared with developing countries.

## Conclusion

Based on results as discussed in this paper, the successful policies to address inequality in human capital have approached both supply-side and demand side should be taken and considered. From the empirical results, we found a negative relationship between average years of education with human capital inequality in case developing countries, an increase of educational attainment (average years of education) in the current generation will persuade higher educational attainment in future generations. At the same time, a reduction in the degree of inequality in human capital in the current generation will boost greater equality in educational attainment in the next generation. Hence it is important to increase educational attainment (average years of education and decrease the level of inequality in human capital due to a long-lasting impact on future generations.

Enhancing higher educational attainment (average number of years of schooling) will influence greater equality in educational attainment (human capital). So,the government of developing countries should be abating the population without education and enhancing population with primary education is the first stage for increasing equality attainment. As we know, many previous studies have been providing ample evidence that such bias is ultimately a political decision. Hence, to achieve equalizing in human capital around the world the issue of politics should be avoided and the public provision of education must be accessed at all national levels in a country by agencies and donors. It is because concentrating public spending on primary and lower secondary education at all levels around the world will improve the distribution of human capital in a country. By improving public expenditure on education, it will lead to influence human well-being and economic growth and reduce inequality in the world.

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