Allocation of Human Capital across Regions and Economic Growth in Indonesia

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I. Background and Objectives

There has been a growing consensus that human capital is a major factor in economic growth process in the modern neoclassical economic literatures since the 1950s (Mincer 1958, Schultz 1961, Becker 1964). In the competitive market economy, mobility of skilled labor to a subnational region offering higher returns results in increased income in that region and causes its economy to become skilled-labor intensive. In contrast, a subnational region offering the lower return becomes a less skilled-labor intensive economy because of the presence of regional comparative advantage.

However, the existing empirical literatures in the cross-country (-region) study have not reached common results. The difference is generated by the diversity in institutions, difference in labor markets and education quality across economies, presence of direct and indirect role of human capital on the economies, the measurement error of human capital, and construction of human capital proxies (Van Leeuwen and Folvali 2008, Son 2009, Yueh 2013).

Given an Indonesia's horizontally long insular geography, large population, and extraordinary natural and social diversity, its subnational regions show various stages of economic development from a traditional labor-intensive agricultural economy to a knowledge-intensive business service economy. The nation is beset by an uneven distribution of resources among regions. Besides, this is indicated by the oft-cited fact that the Java-Bali region constitutes less than 10% of Indonesia's total land area but accounts for almost two-thirds of its economic activity (Hill, 2000). There are several studies to examine the role of human capital on the economies in Indonesia (Table 1). The existing literatures vary by application of human capital proxy variables and don't focus on human capital distribution across provinces.

Table 1 Existing Literatures

Studies	Proxy	Findings: Effects of HC
Van Leeuwen and Folvali (2008)	Average years of education	Positive effects on the LR national economic growth for 1890–2000
Garcia and Soelistianingsih (1998)	Province's working-age population share with secondary education and # of the student per teacher	Positive effects on the provincial income growth and on reduction in regional income inequality for 1975–1993
Balisacan et al. (2003)	Adult literacy, years of schooling, or distance to the secondary school. Years of schooling.	Positive effects on the regional economic growth, not on the poverty reduction.
Vidyattama (2010)	Average year of schooling in the working-age population	Positive effects on the provincial per capita GDP for 1985-2005, but weak statistical significance.

There are two main objectives in this study: 1) to explore the factors contributing to inequality in per capita human capital across subnational regions, employing the Theil population-weighted decomposition index and 2) to estimate the regional production functions to examine the effects of human capital on the economies.

II. Method

II.1 Inequality decomposition of per capita employment with tertiary education: Theil L index

Let $N_{it}, L_{it}, E_{it}, L_{Hit}$ and E_{Hit} represent population, labor force, employment, labor force and employment with tertiary education attainment, in a region *i* and year *t*, respectively. We disaggregate labor force and employment into two-education group: those with and without the tertiary education. The variable of labor (employment) with the tertiary education is defined as human capital variable. A nation consists of *n* regions.

The per capita employment with tertiary education in region *i*, $x_{hit} = E_{Hit}/N_{it}$, can then be multiplicatively expressed as

$$x_{hit} = l_{it} \cdot h_{lit} \cdot e_{hit} \quad (i = 1 \cdots n), \tag{1}$$

where $l_{it} = L_{it}/N_{it}$ is the per capita labor force in region *i*,

$h_{lit} = L_{Hit}/L_{it}$ is labor force with tertiary education per labor force in region *i*, and

$e_{hit} = E_{Hit}/L_{Hit}$ is the employment rate with tertiary education in region *i;* this relation in a nation can be expressed as

$$x_{ht} = l_t \cdot h_{lt} \cdot e_{ht} \, . \tag{2}$$

The aforementioned variables without the subscript *i* represent the corresponding national values.

Interregional inequality in per capita employment with tertiary education—as measured by the Theil population-weighted method, so-called Theil L index—is given by

$$T(x_{hit}) = \sum_{i=1}^{n} p_{it} \log(x_{ht}/x_{hit}) \tag{3}$$

where $p_i = N_i/N$ stands for the share of region *i* in the national population. Using the relations shown in equations (1) and (2) and the properties of natural logarithms, equation (3) can be additively decomposed as follows:

$$\begin{aligned} T(x_{hit}) &= \sum_{i=1}^{n} p_{it} \log(l_t/l_{it}) + \sum_{i=1}^{n} p_{it} \log(h_{lt}/h_{lit}) + \sum_{i=1}^{n} p_{it} \log(e_{ht}/e_{hit}) \\ &= T(l) + T(h_l) + T(e_h) \end{aligned} \tag{4}$$

Equation (4) shows the additive decomposition of the Theil L index of per capita employment with tertiary education into the sum of three factors, $T(l)$, $T(h_l)$, and $T(e_h)$, referring to the approach of Duro and Esteban (1998). The first two terms are regarded as interregional inequalities in endowment while the last term is regarded as interregional inequality in efficiency. Note that in equation (4), each additive decomposition factor, with the exception of $T(l)$, is not a strict Theil L index, which is defined as the multiplicative probability represented by its population share and its occurrence.

Similarly, Equation (1) can be rewritten as

$$x_{hit} = l_{it} \cdot e_{it} \cdot h_{eit} \tag{5}$$

where $e_{it} = E_{it}/L_{it}$ is employment rate in region *i*, and

$h_{eit} = E_{Hit}/E_{it}$ is employment with tertiary education per employment in region *i*. Similarly, Equation (4) can be represented as

$$T(x_{hit}) = T(l) + T(e) + T(h_e) \tag{6}$$

II.1 Regional Production Function

Type of production function: Cobb-Douglass production function for each province *i*.

Assumptions

The behaviors differ by production factors.

a. Labor (L), human capital (H) and private capital (K_P) follow profit-maximizing behaviors.
   →It relocates to regions offering higher returns.
b. Public capital (K_G) follows the government's resource distribution policies.
   →It relocates to regions offering either higher or lower returns.

Formula Specification

a. Elasticity values of L, H and K_P are the same across provinces.
b. Elasticity values K_G differ by provinces.

$$Y_{it} = \alpha_{it} + \beta_1 L_{it} + \beta_2 H_{it} + \beta_3 K_{Pit} + \beta_{4i} K_{Git} + \varepsilon_{it} \, , \tag{7}$$

Y : GDP L : Labor H : Human Capital K_P : Private Capital K_G : Public Capital

α : constant β_k : *elasticity* $\left(\sum_k \beta_k = 1\right)$ *i: province t: year k: prodcution factor*

III. Data

III. 1 Output and Input Variables

- GDP (Constant Price 2000, 1986-2010)
  - *Gross Regional Domestic Product of Provinces in Indonesia* (BPS)
- Labor and employment by educational attainment (1986-2010)
  - *Labor Force Situation in Indonesia* (BPS)
- Capital (Estimated, Constant Price 2000 , 1983-2010)
  - Data on capital stock have not been officially published in Indonesia. As substitutes, the estimates are employed from Kataoka (2013), based on perpetual inventory method (PIM).
  - In PIM, capital is calculated by the past summation of gross fixed capital formation (GFCF) from provincial expenditure statistics.
  - GFCF values in Indonesia's provincial/national expenditure statistics are shown through the aggregated values of private and public capital. This study is constrained to use the aggregated capital data, assuming the coefficients of capital differ across provinces in this study. The equations (7) are thus rewritten as

$$Y_{it} = \alpha_{it} + \beta_1 L_{it} + \beta_2 H_{it} + \beta_{3i} K_{it} (= K_{Pit} + K_{Git}) + \varepsilon_{it}, \quad (8)$$

where K is the aggregate figures of private and public capital. In this estimation, we define the labor force with and without tertiary education as variables of human capital and labor, respectively.

III.2 Number of Provinces: Aggregated 33 provinces into 26 Provinces

- From the year of 1998, 7 new provinces were split from the existing ones and East Timor province became independence. (27 provinces →33 provinces)
- BPS published 33 provincial GDP variables only from 2002 and employment variables from 2006, respectively. However, no retroactive adjustment of those data series has been published so far.

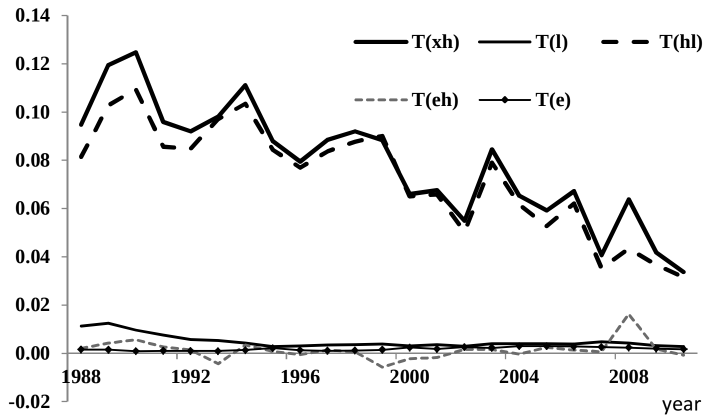
Thus, we use data pertaining to 26 provinces and aggregate the data of the new and existing provinces, and define the sum of each variable value for the 26 provinces as the national value for each year.

IV. Empirical Results

IV.1 Inequality factor decomposition

Figure 1 shows the inequality decomposition in per capita employment with tertiary education across provinces and its determinant factors, using Equation (4). Comparing the inequality in labor market efficiency by education attainment, the inequality in overall employment rate T(e) is also shown. Several interesting observations are summarized as follows.

Figure 1: Population weighted Theil decomposition analysis



- The population weighted Theil index of per capita employment with tertiary education T(xh) decreased over the years with several fluctuations. It infers the employment opportunity with the higher education attainment has been spreading across provinces.

- In the factor decomposition analysis, the interprovincial inequality in labor force with tertiary education per labor force T(hl) was a predominant factor in T(xh). It accounts for more than 85 percent in overall inequality throughout years, with an exception in 2008.
- Other two factors play minor roles in most years. In other words, endowment in labor force with higher education varies across provinces, but neither endowment in labor force nor efficiency in its labor market does much.
- The inequality in employment rate with the tertiary education T(eh) plays a major role in 2008, the year of the global recession. On the other hand, the inequality in overall employment rate T(e) does not. It infers that the impact from the 2008 recession was more serious in the employment with the higher education and varied by provinces. The resource rich provinces, such as Aceh, North Sumatra, and South Kalimantan, which have a strong linkage with global demands in the mining goods, increased more unemployment with higher educational attainment than other provinces.

IV.2 Provincial Production Function

- 650 Panel Observations: 26 provinces and 25 years (1986–2010)
- Crisis dummy takes a value of 1 in the case that GDP values in a province after 1998 were less than the corresponding values in 1997, and takes a value of 0 in other cases.
- A Levin–Lin–Chu test rejects the null hypothesis of a common unit root in log-transformed GDP variables.
- Regression results with periodic fixed effect specifications are omitted in Table 2 due to their statistically insignificant and economically meaningless coefficient values.

Table 2: Estimates of Provincial Production Function

Model	Constant c	L β_1	H β_2	K $B_{3(3i)}$	Crisis Dummy	Adj-R sq.	F-Statistic
1: Pooled Model	-0.059 (-0.4)	0.157*** (6.8)	-0.037* (-1.8)	0.850*** (48.9)	-0.074** (-2.1)	0.939	F^c = 147.2
2: Fixed-Effects (FE) Model	a	0.158*** (2.7)	0.116*** (6.6)	0.517*** (21.3)	-0.141*** (-9.3)	0.991	F^d =16.1
3: Capital Dummy Model	2.968*** (8.2)	0.090* (1.7)	0.111*** (6.3)	b	-0.138** (-8.8)	0.990	

Notes: t-ratios are shown in parentheses.
[a] Differs by prefecture, ranging between 1.879 and 3.264.
[b] Differs by prefecture, ranging between 0.503 and 0.625. See Table 4 for more details.
[c] Shows the null hypothesis H_0: $A = A_i$, $B = B_i$.
[d] Shows the null hypothesis H_0:$A_i = A_i$, $B = B_i$.
*, **, and *** denotes significance at the 0.10, 0.05, and 0.01 level, respectively.

Estimation Results by Models

1. Model 1 (Pooled Model) and Model 2 (Provincial FE Model) shows economically meaningful coefficient values with statistical significance, and a sufficiently high coefficient of determinant. However, F-statistics strongly rejected both null hypotheses of the different constant term (A) and parameters (B), confirming that the presences of province-specific individual effects on the parameters of production factors should be taken into account.
2. Model 3 (Provincial Capital Dummy w/o FE Model) shows economically meaningful parameter values with statistical significance and a sufficiently high coefficient of determinant. The coefficients of capital dummy all take on positive values, ranging from 0.503 to 0.625, as is shown in Table 3.
   - The human capital has positive effects on the regional economies, but shows one fifth of coefficient values of capital. This indicates that one percent increase in human capital contribute

the increase in an economy in a region by 0.1%, which is about one-fifth of the contribution in capital increase.

- Table 3 shows that the coefficients of the capital dummy are positive by provinces. The resource rich provinces, such as Aceh (0.622), East Kalimantan (0.625), and Riau (0.599) take on the higher coefficient values for capital. The less-developed provinces, such as West Nusa Tenggara (0.504), East Nusa Tenggara (0.503), and Maluku (0.507), take on the lower coefficient values. The provinces of Yogyakarta and Bali, which have higher per capita labor with tertiary education attainment, show the relatively lower coefficient values of capital. Human capitals in those provinces take relatively more significant roles to contribute to the economy.

Table 3: Coefficients for Capital in Model 3

Province	β3i	Province	β3i	Province	β3i	Province	β3i
Aceh	0.622	Lampung	0.557	W. Kalimantan	0.536	SE. Sulawesi	0.515
N. Sumatra	0.590	W. Java	0.599	C. Kalimantan	0.520	W. Nusa Tenggara	0.504
Riau	0.599	Jakarta	0.588	E. Kalimantan	0.625	E. Nusa Tenggara	0.503
W. Sumatra	0.556	C. Java	0.579	S. Kalimantan	0.575	Maluku	0.507
Jambi	0.522	Yogyakarta	0.513	N. Sulawesi	0.541	Papua	0.563
Bengkulu	0.507	E. Java	0.595	C. Sulawesi	0.520	Mean	0.554
S. Sumatra	0.570	Bali	0.543	S. Sulawesi	0.558		

i: All coefficient values are statistically significant at the 0.01 level.

IV.3 Effects of human capital on TFP

It is broadly believed that human capital facilitates development and adoption of new technology. We examine effects of human capital on technological progress, referring to the approach of Benhabib et al. (1994). Using total factor productivity (TFP) growth as its proxy and taking into account on the human capital spillover of the technology across region, our specification can be shown as

$$\dot{TFP}_{it} / TFP_{it} = c + g(H_{it}) + m(H_{it})\left[\frac{\max_j Y_{jt} - Y_{it}}{Y_{it}}\right] \quad (i, j = 1, \cdots n, i \neq j) \tag{9}$$

where a dot is indicative of a periodic change. Equation (9) presents that the TFP growth depends on the three factors: the exogenous technological growth, the technological growth associated with the ability of a region to innovate domestically (endogenous growth), and the technological spillover effects from the leading region. The second term indicates that the human capital independently enhances technological progress and the third term infers catch-up effects that the region with the lower initial output experiences faster productivity growth. The notation of *g* and *m* are parameter values. The human capital and output variables are taken in natural logarithm value.

Table 4 Effects of human Capital on TFP growth (n=26)

	Aggregate		Per capita	
C	-2.963	**	0.749	
	(-3.949)		(0.257)	
g	0.409	*	0.649	
	(2.363)		(1.144)	
m	2.454	**	-0.039	**
	(5.097)		(-2.433)	
Adj-R	0.490		0.149	

Notes: t-ratios are shown in parentheses.
* and ** denotes significance at the 0.05 and 0.01 level, respectively.

Table 4 shows the empirical results, which consist of two valuations of the dependent and independent variables expressed by the aggregate and per capita values, using Equation (9).

Considering the effects of business cycle, we use the periodical change in TFP for 1987–2010 to examine the presence of the long-run effects of human capital on TFP.

The estimation results in the aggregate values model shows economically meaningful parameters with the statistically significant values and the fit is sufficient with adjusted R^2. Human capital has exogenous, endogenous growth effects and spillover effects on technological progress in the corresponding provinces. Regarding spillover effects, technology adoption from other provinces is more effective for provinces at the smaller economies. On the other hand, per capita value model show most of parameters are statically insignificant in terms of effects of human capital.

V. Future Improvements and Extensions

Our empirical results are sensitive with respect to the human capital proxy and the specification of regional production functions. Therefore, there are several potential extensions for this study.

1. Data employment for human capital variables could be considered. In the existing literature, some use the average years of schooling and employment/labor with the secondary education attainment as a proxy. Besides, Indonesia’s Ministry of National Education publishes the number of the university, student, and lecturer by provinces.
2. This study employs the simple Cobb-Douglass province-specific production functions with provincial capital dummy. The specification form varies by assumptions. The alternative approach could be applied.

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