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Does Human Capital Spillovers Promote Economic Growth in Indonesia? (Panel Data Analysis with Gravity's Approach)

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The aim of this paper was to investigate the existence and effect of human capital spillover on economic growth in Indonesia. The human capital spillover is measured using composite variable comprising of educated worker share, distance, and income per capita gap. This composite variable implies that there is a human capital interaction among regions provided gaps in the distance and income per capita. Using FEM, the result showed that capital and human capital have positive effect on the economic growth. However, the estimation fails to reflect positive effect of human capital spillover on economic growth. This implies that given higher interaction among regions the spillover of human capital has not yet been the source to promote economic growth in Indonesia.

Keywords: Human Capital Spillover, Economic Growth, Gravity's Approach, Income Per Capita Gap, Fixed Effect Model (FEM).

1. INTRODUCTION

The effect of spillover on economic growth has received much attention in recent years from policymakers and economists. There are some components determine the economic growth, i.e., physical capital, human capital, and technological progress. In the exogenous model, Solow used technological progress as exogenous component to be an engine of economic growth on the long terms. Based on technological progress, the firms can produce more output with input in the same quantity. Technological progress is embodied on physical capital, human capital, or independent (not embodied both physical and human capital). This paper uses Harrods approach in which technological progress embodied on human capital. Based on endogenous model, human capital has also an important role as an engine of economic growth on the long terms.

Some economists speculated that human capital will increase spillover significantly. For example, Moretti (2004) found that within a city, spillover between industries that are economically close are larger than spillover between industries that are economically distant. Empirical evidence indicated that spillover may be important in some high-tech industries. Yet, despite significant policy implications, there is little systematic empirical evidence on the magnitude of human capital spillover. There are some authors attempted to estimate the size of spillover from education by comparing the wages of otherwise similar individual who work in cities or states with different average levels of educations.[3,7–9,11]

Many recent endogenous growth models emphasize the link between human capital spillovers and growth. For example, in Lucas and Jr.[6] model, worker productivity depends on the aggregate skill level, whereas Romer (1990) suggested that societies with more skilled workers generate more ideas and grow faster.[11] This paper focuses on the role of human capital spillovers to economic growth. The importance of human capital spillovers on economic growth is shown by the plots the logarithm of output (Gross Regional Domestic Product, GRDP) relative to the Indonesia for 33 provinces against human capital spillover of educated workers (HCS-EW) in 2006 to 2013. Consistent with this view, the plots shows a strong correlation between output and spillover. In fact, the correlation between output and human capital spillovers of educated workers has an r of 0.68.

This paper takes gravity's approach to the estimation of human capital spillovers. The method of gravity's approach is using composite variable comprising of educated worker share, distance, and income per capita gap. This composite variable implies that there is a human capital interaction among regions provided gaps in the distance and income per capita. The paper probes the relationship between economic distance and spillovers using the model of Benhabib and Spiegel.[1] This paper uses longitudinal panel data set relative to the Indonesia for 33 provinces from 2006 to 2013. The method of this paper is by using ordinary

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least-squares (OLS) estimates with *fixed effect model* (FEM). The most robust estimation in this paper indicates that human capital spillover for gravity's approach had positive effect but not significant to Indonesia's economic growth during 2006 to 2013. However, because the stock of human capital grows slowly over time, the contribution of human capital spillovers to economic growth is not large.

2. LITERATURE REVIEW

There are many sets of papers in the literature which have sought to measure spillover. Coe et al.[4] suggested that the R&D spillovers from North to South—as measured by elasticity of total factor productivity in South with respect to R&D capital in the North—are substantial. On average, a 1% increase in the R&D capital stock in the industrial countries raises output in the developing countries by 0.06%. In addition, they also suggested that in 1990 the total spillover effect from R&D in the industrial countries may have boosted output in developing countries by approximately 22 billion U.S. dollars. Branstetter[2] have done so, using country-level data to assess the relative impact of intranational and international knowledge spillovers on innovation and productivity at firm level. Branstetter[2] suggested that knowledge spillovers are primarily intranational in scope, providing empirical confirmation of an important assumption in much of the theoretical literature.

Branstetter[2] emphasized that spillover, especially knowledge spillovers, is primarily an intranational phenomenon. On the contrary, Crespo et al.[4] showed that spillover, especially technology spillovers, is an international phenomenon. Crespo et al.[4] explored the role of imports as a mechanism of transmission of international technology spillovers and it is significant for the growth of the OECD countries. They found that the existence of international technology spillovers have had a favorable impact on the economic growth of the OECD countries, albeit to a much lesser extent than the stock of own technological knowledge capital. Secondly, Crespo et al.[4] showed that the capacity of countries to take advantage of the spillovers associated with the technical advances made by its trading partners largely depends on both its human and R&D capital endowments.

A number of researchers found that spillovers effect depend on the economic distance and spillover is generally decline within the economic distance. For example, Moretti[8] stated that within a city, spillovers between industries that are economically close are larger than spillovers between industries that are economically distant. Plants located in cities where the fraction of the college graduates grow faster experiences large increase in productivity than similar plants in cities where the fraction of college graduates grows more slowly Moretti.[8] Another researcher, Rosenthal and Strange,[10] also found that the attenuate of human capital spillovers is sharply within the distance. Rosenthal suggested that the concentration of economic activity continues to be valuable.

Fleisher et al.[5] agreed that the spillover limited by friction and costs positively associated with distance. A region that is closer to the most advanced region is assumed to have better access to new technology than distant regions.[5] To capture this effect, Fleisher et al.[5] define "human-capital spillover variable" as proportion of people who have at least college degrees interact with gap of distance and income per capita from advanced or leader region. In concluding this section, we noted that a number of researchers have recently taken alternative approaches to measure of spillover Fleisher et al.[5] and a number of co-authors have examined human capital spillovers through the econometric analysis. These researchers have generally found that human capital spillovers have positive relationship to economic growth across countries.

3. METHODOLOGY

3.1. Data

This paper used the longitudinal database from Indonesia Statistics Central Bureau (BPS) and Indonesia Database for Policy and Economic Research (INDO-DAPOER) World Bank. This paper used Gross Regional Domestic Product (GRDP) of Provinces in Indonesia as dependent variable, whereas for independent variables this paper used Gross Fixed Capital Formation (GFCF) of Provinces in Indonesia as a proxy for capital variable. Human capital variable was proxy by years of schooling (YS), total of labor (L), educated worker share (EWS), and uneducated worker share (UWS) of Provinces in Indonesia. The method of gravity's approach is using composite variable comprising of educated worker share, distance, and income per capita gap. This composite variable implies that there is a human capital interacted among regions provided gaps in the distance and income per capita. This paper used longitudinal panel data set relative to the Indonesia for 33 provinces from 2006 to 2013. The method of this paper used *ordinary least-squares* (OLS) with *fixed effect model* (FEM).

3.2. Empirical Model

This paper used "Solow Growth Model" with Harrods-Neutral approach in which technological progress embodied on human capital. The empirical model assumed that technology can be described by the following Cobb-Douglass production function:

$$Y = f(K, AH) \tag{1}$$

Then, Eq. (1) is estimated by time differently:

$$\frac{dY}{dt} = \frac{dK}{dt} \cdot f(AH) + K \cdot \frac{dAH}{dH} \cdot \frac{dH}{dt} + K \cdot \frac{dAH}{dA} \cdot \frac{dA}{dt} \tag{2}$$

Equation (2) is divided by (Y):

$$\frac{\dot{Y}}{Y} = \frac{\dot{K} \cdot f(AH)}{Y} + K \cdot \frac{dAH}{dH} \cdot \frac{\dot{H}}{Y} + K \cdot \frac{dAH}{dA} \cdot \frac{\dot{A}}{Y} \tag{3}$$

$$\frac{\dot{Y}}{Y} = \frac{\dot{K}}{K} + K \cdot \frac{dAH}{dH} \cdot \frac{\dot{H}}{Y} + K \cdot \frac{dAH}{dA} \cdot \frac{\dot{A}}{Y} \tag{4}$$

where: $Y = f(K, AH)$, so Eq. (4) can be rewrite as:

$$\frac{\dot{Y}}{Y} = \frac{\dot{K}}{K} + \frac{dAH}{dH} \cdot \frac{\dot{H}}{AH} + \frac{dAH}{dA} \cdot \frac{\dot{A}}{AH} \tag{5}$$

$$\frac{\dot{Y}}{Y} = \frac{\dot{K}}{K} + \left[\frac{dAH}{dH} \cdot \frac{H}{AH} \cdot \frac{\dot{H}}{H}\right] + \left[\frac{dAH}{dA} \cdot \frac{A}{AH} \cdot \frac{\dot{A}}{A}\right] \tag{6}$$

or

$$GwY = \beta_1 GwK + \beta_2 GwH + \beta_3 GwA \tag{7}$$

assuming that $(\beta_1 = 1)$.

Fleisher et al.[5] define "human capital spillovers variable" as proportion of people who have at least college degrees interact with gap of distance and income per capita from advanced or leader region. The formula of human capital spillovers is captured by Eq. (8):

$$\frac{\dot{A}_i(t)}{A_i(t)} = h_{it}\left[\frac{1}{d_{\max\_i}}\left(\frac{y_{\max,t} - y_{it}}{y_{it}}\right)\right] = GwS \tag{8}$$

Finally, this paper can write the empirical model as:

$$GwY = \beta_1 GwK + \beta_2 H + \beta_3 GwS \tag{9}$$

where: GwY is output growth, GwK is capital growth, GwH is human capital growth, GwS is human capital spillovers growth, and $[\beta_1, \beta_2, \beta_3]$ is elasticity of input variable.

3.3. Econometric Specification

The method of this paper used *ordinary least-squares* (OLS) with *fixed effect model* (FEM). This paper identified human capital spillovers by comparing the productivity of labor in provinces with different level of human capital; assuming that technology can be described by the following Cobb-Douglass production function:

$$\ln Y_{i,t} = \alpha + \beta_1 \ln K_{i,t} + \beta_2 \ln H_{i,t} + \beta_3 \ln S_{i,t} + \alpha_1 D1_i + \alpha_2 D2_i + \alpha_3 D3_i + \cdots + \alpha_n Dn_i + \omega_{i,t} \tag{10}$$

where: $Y_{i,t}$ is output of province-i and year-t, $K_{i,t}$ is capital of province-i and year-t, $H_{i,t}$ is human capital of province-i and year-t, $S_{i,t}$ is a human capital spillover of province-i and year-t, $\sum_1^n D$ is dummy cross section of province-i, and $\omega_{i,t}$ is error term of province-i and year-t. The human capital variable was measured by years of schooling (YS), total of labor (L), educated worker share (EWS), and uneducated worker share (UWS). In addition, human capital spillovers variable was estimated from gravity's approach by comparing educated worker share for otherwise similar individuals who work in provinces with different of distance and income per capita. The benchmark region was DKI Jakarta Province.

The formula of human capital spillovers captured by Eq. (8), where: $h_{i,t}$ is human capital of province-i and year-t, measured by educated worker share (EWS); $d_{\max\_i}$ is distance gap of province-i to leader region (i.e., DKI Jakarta Province); $y_{\max,t}$ is income per capita of leader region andyear-t; and y_{it} is income per capita of province-i and year-t. Equation (10) is also called as the formula of human capital spillovers with gravity's approach.

4. EXPERIMENTAL RESULT

Table I shows the result obtained using econometric analysis with *fixed effect model* (FEM). As can be seen, the capital at the first model (M1) was positive significant to output. On average, a 1% increase in the capital (Gross Fixed Capital Formation, GFCF) raised output (Gross Regional Domestic Product, GRDP) in Indonesia by 0.35%. At the same model (M1), the human capital measured by years of schooling (YS) had also positive significant to output. On average, a 1% increase in the human capital (years of schooling, YS) raised output (Gross Regional Domestic Product, GRDP) in Indonesia by 1.87%. These results were consistent with the results obtained in the previous studies. Meanwhile, the human capital spillover was positive but not

Table I. Robustness estimates of human capital spillovers–gravity's approach.

Var.	Proxy	M1 b/se	M2 b/se	M3 b/se	M4 b/se
K	Log GFCF	0,345** (0,10)	0,498*** (0,09)	0,421*** (0,06)	0,501*** (0,08)
HC	Log YS	1,874** (0,63)			
HC	Log L		0,131 (0,14)		
HC	Log EWS			0,768*** (0,21)	
HC	Log UWS				−0,257 (0,14)
S	Log HCS−EW	0,018 (0,06)	0,050 (0,06)	−0,546** (0,16)	0,107 (0,07)
Constant		1,872** (0,54)	2,160** (0,75)	3,531*** (0,31)	3,155*** (0,42)
_BA		−0,382** (0,13)	−0,286 (0,14)	−1,854*** (0,41)	−0,214 (0,15)
_BB		−0,581*** (0,15)	−0,391 (0,19)	−1,861*** (0,37)	−0,508* (0,20)
_BE		−0,637*** (0,13)	−0,333* (0,15)	−1,708*** (0,35)	−0,413* (0,16)
_BT		−0,075 (0,07)	−0,095 (0,08)	−0,979*** (0,24)	0,008 (0,08)
_GO		−0,996*** (0,15)	−0,750*** (0,19)	−2,268*** (0,38)	−0,901*** (0,20)
_JA		−0,457*** (0,12)	−0,299* (0,14)	−1,668*** (0,35)	−0,305* (0,15)
_JB		0,342** (0,10)	0,098 (0,10)	−0,883** (0,29)	0,426** (0,13)
_JI		0,438** (0,16)	0,142 (0,14)	−1,305** (0,41)	0,538** (0,19)
_AC		−0,323* (0,15)	−0,131 (0,16)	−1,861*** (0,45)	−0,075 (0,17)
_JT		0,265* (0,12)	−0,004 (0,12)	−1,168** (0,33)	0,343* (0,15)
_KB		−0,259 (0,15)	−0,305* (0,15)	−1,682*** (0,36)	−0,225 (0,16)
_KI		−0,022 (0,21)	0,152 (0,22)	−1,880** (0,53)	0,211 (0,23)
_KR		−0,399 (0,21)	−0,129 (0,24)	−2,077*** (0,50)	−0,186 (0,24)
_KS		−0,254 (0,15)	−0,155 (0,16)	−1,811*** (0,43)	−0,088 (0,17)
_KT		−0,575** (0,17)	−0,426* (0,19)	−2,036*** (0,41)	−0,438* (0,19)
_LA		−0,214* (0,09)	−0,219* (0,10)	−1,206*** (0,26)	−0,110 (0,10)
_MA		−0,738*** (0,18)	−0,241 (0,18)	−1,824*** (0,40)	−0,360 (0,19)
_MU		−0,886*** (0,18)	−0,383 (0,19)	−2,066*** (0,42)	−0,534* (0,21)
_NB		−0,413** (0,14)	−0,432** (0,14)	−1,822*** (0,36)	−0,370* (0,15)
_NT		−0,400** (0,13)	−0,351* (0,14)	−1,820*** (0,39)	−0,264 (0,15)
_PA		−0,367 (0,22)	−0,377 (0,22)	−2,287*** (0,50)	−0,323 (0,23)
_PB		−0,683** (0,19)	−0,363 (0,25)	−2,289*** (0,48)	−0,525* (0,25)
_RI		−0,102 (0,17)	−0,043 (0,17)	−1,632*** (0,42)	0,045 (0,18)
_SA		−0,574** (0,17)	−0,290 (0,20)	−2,134*** (0,48)	−0,303 (0,20)
_SB		−0,293* (0,14)	−0,161 (0,15)	−1,770*** (0,42)	−0,090 (0,16)

Table I. Continued.

Var.	Proxy	M1 b/se	M2 b/se	M3 b/se	M4 b/se
_SG		−0,658***	−0,461*	−2,118***	−0,490*
		(0,15)	(0,18)	(0,42)	(0,18)
_SN		−0,158	−0,167	−1,744***	−0,033
		(0,14)	(0,14)	(0,42)	(0,15)
_SR		−0,674***	−0,428*	−1,967***	−0,556**
		(0,14)	(0,18)	(0,38)	(0,20)
_SS		−0,135	−0,160	−1,467***	−0,030
		(0,13)	(0,13)	(0,35)	(0,14)
_ST		−0,477**	−0,295	−1,998***	−0,287
		(0,15)	(0,17)	(0,44)	(0,18)
_SU		−0,026	0,005	−1,702***	0,248
		(0,16)	(0,15)	(0,47)	(0,18)
_YO		−0,584***	−0,402**	−1,721***	−0,386**
		(0,10)	(0,12)	(0,34)	(0,12)
N		264,000	264,000	264,000	264,000
F (3, 32)		49,770	42,370	86,410	49,150
Prob > F		0,000	0,000	0,000	0,000
R^2		0,822	0,782	0,841	0,788
R^2-Adj		0,820	0,779	0,839	0,786

Source: Data Processed by Author with Stata 13, (2016).
Notes: *Means significant at 90% level of confidence, **means significant at 95% level of confidence, ***means significant at 99% level of confidence. Number in bracket indicates robust standard error. "*Benchmark Region*" is DKI Jakarta Province (JK). GRDP is Gross Regional Domestic Product, GFCF is Gross Fixed Capital Formation, YS is Years of Schooling, L is Total of Labor, EWS is Educated Worker Share, UWS is Uneducated Worker Share, and HCS-EW is Human Capital Spillover of Educated Worker.

significant to output, which was not consistent with the results obtained in the previous studies.

In the second model (M2), capital was positive significant to output. On average, a 1% increase in the capital (Gross Fixed Capital Formation, GFCF) raised output (Gross Regional Domestic Product, GRDP) in Indonesia by 0.50%. The result indicated that it was consistent with the results obtained in previous studies. At the same model (M2), human capital measured by the total of labor (L) has positive but not significant to output. Meanwhile, the human capital spillover was also positive but not significantly to output, which was not consistent with the results obtained in the previous studies.

Subsequently at the third model (M3), capital was positive significant to output. On average, a 1% increase in the capital (Gross Fixed Capital Formation, GFCF) raised output (Gross Regional Domestic Product, GRDP) in Indonesia by 0.42%. At the same model (M3), the human capital measured by educated worker share (EWS) had also positive significant to output. On average, a 1% increase in the human capital (educated worker share, EWS) raised output (Gross Regional Domestic Product, GRDP) in Indonesia by 0.77%. These results were consistent with the results obtained in the previous studies. Meanwhile, human capital spillover is negatively significant to output, which was not consistent with the results obtained in the previous studies.

Finally, the capital at the fourth model (M4) was positive significant to output. On average, a 1% increase in the capital (Gross Fixed Capital Formation, GFCF) raised output (Gross Regional Domestic Product, GRDP) in Indonesia by 0.50%. This result indicated it is consistent with the results obtained in the previous studies. At the same model (M4), human capital measured by uneducated worker share (UWS) has negative but not significant to output. Meanwhile, human capital spillover is also positive but not significantly to output, which was not consistent with results obtained in previous studies.

5. CONCLUSIONS

This study finds that capital (Gross Fixed Capital Formation, GFCF) is the most stabilize component to promote economic growth in all models. Meanwhile, human capital measured by years of schooling (YS) and educated worker share (EWS) have positive significance to economic growth, whereas the other's human capital proxy have no significance to economic growth. The last component, human capital spillovers is not consistent with the results obtained in the previous studies. In some of models, human capital spillovers have positive effect but not significant, and the other result has significance but negative effect to economic growth. Using this approach, the uncertainty of the model prediction for this study is less than 23% acceptability limit defined by Fleisher et al.[5] However, the estimation fails to reflect the positive effect of the human capital spillover on economic growth. This implies that given higher interaction among regions the spillover of human capital has not yet been the source to promote economic growth in Indonesia.

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