Non-linear return to human capital for workers of productive sectors in Indonesia

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Abstract

This study is aimed to investigate a typical return to human capital for workers of productive economic sectors in Indonesia. Instead of satisfying Mincer's linearity assumption, we use a piecewise linear spline function in order to trace marginal returns to education and job tenure and to find out how large the returns to both variables could be moderated by certain variables. The research is conducted on 2609 individuals who work for Indonesian top-five productive sectors in 2016, as recorded in National Work Force Survey (SAKERNAS). We implement quantile regression analysis to produce three levels earning model. The result shows that the return to education varies across schooling level and apparently negative for academy schooling. We also find that job training participation does not always enhance the return to education especially for higher earning workers. The return to job tenure is found to diminish during career length. However, graduating from certain college majors significantly slowdown the diminishing return to job tenure and thus promoting better career. Based on these findings, we outline several ideas concerned to developing higher education and job training provision in national scale for more efficient supply of human capital in the productive sectors.

Keywords: *Human capital, Education, Job tenure, Marginal return*

JEL classification: I2, J3

INTRODUCTION

According to BPS (2017, 2017b), among the seventeen economic sectors of Indonesia, the real estate (RE); information and communication (IC); mining and excavation (ME); electricity and gas (EG); and financial services (FS) are the highest in worker productivity and wage rate offered. It is also revealed by BPS (2017, 2017b) that each sector has its special advantages or potentials beside leading in productivity. ME has become one of the largest national output contributors. FS and IC are the fastest in growing output and predicted to take over ME's position in top five large output sectors within the next eight years. RE incorporation with other service sectors are globally offering more future job opportunities along with the declining labor demand in agricultural and manufacture sectors. Given this advantages, Indonesia should have be more prepared and be oriented to supply qualified labor for these sectors.

It is commonly known in economics that high productivity could be achieved through input efficiency or by maximizing output. Since human capital has become a factor that enhances individual and sectoral work efficiency (Kim & Mohtadi, 1992; Saraswati, 2012; Wilson & Briscoe, 2004; Fahmy, Bachtiar & Sari, 2016), higher labor productivity in Indonesian productive sectors should also reflect higher level of human

capital embodied by the workers. This motivates us to examine a typical effect of human capital in the productive sectors which distinguish it from workers of other economic sectors. Also, we consider that it is urgent to yield a more relevant estimate of the return to human capital by specifying the effects into a number of earning quantiles that may reflect earning levels. To reach this objective, we attempt to implement a non-linear approach in estimating the return to human capital via quantile regression. With major transitions in economic view on education after Mincer's era, the non-linear return to human capital is considered to be a more relevant tool for explaining today's labor supply dynamics (Heckman, Lochner & Todd, 2003).

The human capital theory, introduced by Becker (1962), Schultz (1961) and Mincer (1974), has long become a cornerstone to human resource planning for its practicality in specifying earning relationships. The theory has also been widely applied in various scale of studies in Indonesia. Elfindri & Bachtiar (2003) compiled a number of similar studies nationwide and succesfully highlighted the advantages of vocational education in giving larger returns and labor market signals. Some positive individual benefits of schooling concerning the rise of income had also been found in the studies of Purnastuti, Wahyuni, & Mustofa (2015), Suhardan, Riduwan & Enas (2012), and Magdalyn (2013). Lastly, Fahmy, Bachtiar & Sari (2016) examined the effect of human capital on earning of migrant workers and found that improving formal education, formal job experience and participating in particular job training resulted in higher wage and better job status when working abroad.

Valuable inputs and criticism to the human capital theory has also been consistently contributed. The linear assumption of education which established Mincer's model (1974) was then examined for relevancy. Non-linear approaches such as Sheepskin Effects, quadratic estimate or some more flexible wage functions have been introduced into many estimation strategies instead of Mincer's model within recent two decades. Soderböm (2004) revealed that when using a continous spline wage function, the marginal returns to additional years of schooling could be documented for the case of Kenyan and Tanzanian manufacturers. Trostel (2005) used quadratic approaches and showed that Mincer's model overestimates the returns to elementary and tertiary education and underestimate those to middle education. Akguç (2011), using a stepwise wage function, found that the return to high education was larger for developed countries, meanwhile the return to lower education was larger for poorer countries.

We appraise that by using a typical non-linear estimation strategy, it would provides better precision in the measures of return to human capital for workers in Indonesian most productive sectors. Indonesia like many other developing countries, has a large number of workers with lower education yet shows a promising rise of highly-educated workers (those who graduate from academy and university) (BPS, 2016, 2017a, 2017b). The phenomenon in Indonesian productive sectors could be the opposite, that the workers may receive better education and training to compete for better productivity and career. It would be intriguing to find out for these sectors, how additional years of schooling give marginal effects to certain levels of earning. We would like to prove if higher education gives larger benefit, as those found in developed countries in which the race between education and career is competitive. However, since the case takes place in Indonesia, socio-demographic influences are not unavoidable.

Male preference in labor market has been becoming the persisting factor that often relates to earning gap problems. It structurally affects earning in the way it affects education opportunities in Indonesian society. For instance, within the same level of education, Indonesian male workers benefit more than females by acquiring better job

position, thus have bigger wage (BPS, 2017). It is clarified by Purnastuti, Miller & Salim (2011) that female workers reveive greater return to their education. Wahyuni & Monika (2016) found that at certain point of higher education, Indonesian female workers may advance their wages over male, thus the earning gap between both genders could be reduced by increasing female's schooling level in general. These evidences lead us to examine if male sex could be a strong moderator for marginal effect of additional years schooling on workers earning.

Other studies had also revealed the earning differentials emerging among workers who graduated from equal schooling level: general and vocational middle-high school. Elfindri & Bachtiar (2003) found that labor market signals were stronger for the vocational school graduates and thus promised better earning. Furthermore, Adrimas (2004) argued that the return to vocational education were potentially higher in an industrialized region or country. Despite these advantages, developing vocational education at the moment becomes more challenging and complex since the demands for manufacturing skills decline and and shift to globally competitive service skills which seems to be less anticipated by vocational curriculum in Indonesia. The global weakening in the return to vocational education had been revealed by Brunello & Rocco (2015). They found that the earning profile of vocational graduates were only superior in young ages and became inferior in the rest of their working age. They argued that such weakining was caused by the lack motivation of vocational graduates to invest more in human capital. Taking these facts into account, we predict that Indonesian vocational education could potentially become an indeterminate or insignificant moderator for the modern return to education, especially in productive sectors.

Investigation of how participating in job training could moderate the return to education is appropriately considered. As proposed by Lynch (1992) that completing the job training resulted in the earning increase for highly-educated workers. Becker (1992) argued that a profit-maximizing firm could avoid the training cost for its educated labor and in returns, the educated labor would be offered a higher wage rate. He also argued that specific training could strengthen the connection between labors and firm, meaning that trained labors would have less intention of job turnover. These implies that job training possibly is a positive moderator for the return to education. However, the effectiveness of job training depends on the time that spans from its completion to the date. Lillard & Tan in Smith (2001) found that a on-the-job training raised the earning in approximately 13 years and decreased afterwards, while the school-job-training is found to be beneficial in about 7 years since its completion.

Job experience has become another prominent time-based investment beside schooling. It accumulates human capital of a worker through practical learning (Schultz, 1961; Mincer, 1974). As known that Mincer (1974) used what is so called "potential labor market experience", defined as the rest of worker's age after finishing his/her schooling, to be his proxy of job experience. In this context of this study we consider to use a different proxy of job experience for some reasons. First, the Indonesian workers seem to have a high tendency of job turnover if they work in informal sectors and in the opposite, formal Indonesian workers seem to have less tendency as they are also threatened under contract-canceling penalty (BPS, 2017). Secondly, a higher wage rate offered in productive sectors (BPS, 2017) may attract workers to stay longer in the current job and invest more for their career. Therefore, we would rather use "job tenure" as our proxy of job experience and expect that a real career moderation effect could also be estimated by using this proxy.

Graduating from certain education has also been known to benefit someone's

career. The idea was studied by Cho, Kam, & Lee (2017) and found that completing education in certain college majors in South Korea determined higher labor market participation, earning level and job position. This idea is analogous to what Adrimas (2004) proposed about the the effectiveness of vocational education in certain phases of economic development in a region or country. For the case of Indonesia, we prefer to investigate the moderation effect of graduating from engineering, economics and sciences college majors in the return to job tenure. According to some studies in Suhardan, Riduwan & Enas (2012), studying in these college majors had returned the greatest individual and social benefits for Indonesian graduates.

METHODS

Empirical framework

Let X to be a set of human capital embodied by a worker of productive sector as and E to be the nominal earning of the worker. As we examine the effect of X on E, we state our baseline estimation model as follows:

$$\ln E = f(X) = f_1\left(Sch, m_i^{Sch}\right) + f_2\left(Exp, m_k^{Exp}\right) + \alpha X_c + \varepsilon \quad \text{.....} \quad (1)$$

where f is a earning function, Sch is the years of schooling, $m_i^{Sch} \in \{0,1\}$ is a number of i moderators for the return to education, f_1 is a subfunction with typical slope given Sch and m_i^{Sch}, Exp is years of job tenure, $m_k^{Exp} \in \{0,1\}$ a number of j moderators in the return to job tenure, f_2 is a subfunction with typical slope given Exp and m_k^{Exp}, $X_c = (dTrai, age, age^2, dSex, dLoc, dMar)$ is a vector of other characteristics of a worker that includes respectively the participation in the job training (equals 1 if participating, 0 otherwise), age, squared age, male sex (equals 1 if male, 0 otherwise), living in urban areas (equals 1 if living in urban, 0 otherwise), and marital status (equals 1 if married or ever married, 0 otherwise). α is estimated parameter of X_c and ε is the residual or unobserved abilities.

By involving a number of moderations and applying a non-linear assumption for the return to education, we define f_1 as a piecewise spline function as suggested by Soderbom (2004), declared as follows:

$$f_1\left(Sch, m_i^{Sch}\right) = \begin{cases} \left(\beta_0 + \gamma_{i0} m_i^{Sch}\right) Sch, & 0 \le Sch \le S_1 \text{.....} \quad (2) \\ \sum_{j=1}^{N} \left(\left(\beta_j + \gamma_{ij} m_i^{Sch}\right) \mathbf{max}\left(Sch - S_j, 0\right) \right), & S_j < Sch \le S_{j+1} \text{.....} \quad (3) \end{cases}$$

where $S_{j=1,2,\ldots,N}$ denotes the j-th level of schooling. The basic return to the lowest education level ($0 \le Sch \le S_1$) is given by the slope of equation piece-(2) as large as $\beta_0 + \gamma_{i0} m_i^{Sch}$. Changes of slope in the next j schooling levels ($S_j < Sch \le S_{j+1}$), noticed as the marginal returns to education, is given by the slope of equation piece-(3) as large as $\beta_j + \gamma_{ij} m_i^{Sch}$. If the marginal returns to education in all schooling intervals $[S_j, S_{j+1}]$ are not detectable, that is

$$\beta_1 + \gamma_{i1} m_i^{Sch} = \cdots = \beta_N + \gamma_{iN} m_i^{Sch} = 0 \quad \text{.....} \quad (4)$$

then the schooling function f_1 is linear[1].

To specify the pieces of f_1, we categorize years of schooling into certain intervals commonly known as 'schooling levels or education attainment' in Indonesian labor

[1] This is our main hypothesis to prove non linearity of the effect of education on earning. Rejection to this hypothesis is based on p-value generated by Wald's test for joint significance for selected independent variables.

market: the basic/compulsory education ($S_1 = [0,9]$); continuing to middle high education ($S_2 = (9,12]$); continuing to university education ($S_3 = (12,16]$); and continuing to post graduate education ($S_2 = (16,22]$). Based on what we have proposed in the previous section, the moderators of the return to education would consist of graduating from middle-high vocational school (denoted by $dVoc$, equals 1 if graduating and 0 otherwise), participating in certified job training ($dTrai$), and the male sex ($dSex$). All moderation effects would be investigated for all schooling levels except for the $dVoc$[2].

As we also assume that the return to job tenure is non-linear, we then use quadratic approach in our estimation since the years of job tenure in the productive sectors is possibly long enough and would potentitally behaves similar to age. Therefore, we define f_2 as follows:

$$f_2\left(Exp, m_k^{Exp}\right) = \eta_1 Exp + \eta_2 Exp \cdot m_k^{Exp} + \eta_3 Exp^2 \quad \text{.....} \quad (5)$$

where the only moderator for the slope of f_2 is graduating from engineering, economics and science college majors ($dSuppMaj$, 1 if graduating and 0 otherwise). The return to job tenure is constituted by η_1, η_2 and η_3.

Data

The data for this study is compiled from National Work Force Survey (Sakernas) dataset which was recorded in August 2016 by Indonesian office of statistics: Badan Pusat Statistik (BPS). The dataset contains 2609 records of those worked in five Indonesian most productive sectors. The records consist of 131 workers in real estate, 308 workers in information and communication, 1123 workers in mining and excavation, 180 workers in electricity and gas, and 867 workers in financial services. All individuals work formally as labors/employees (i.e none with status as enterprenur, casual or family worker).

Technique of analysis

The quantile regression is implemented to examine and trace the return to human capital in certain levels of earning. There are some advantages could be gained from using this technique in processing our cross-sectional data. First, the quantile regression does not require the data to be specifically distributed (such as to be normal in OLS) or satisfy other classical assumptions. Secondly, this technique is robust to outliers as it is median-based (Wahyuni dan Monika, 2016) and thus, is considered to be very appropriate to handle earning/income distribution data which is not .

According to Saidah, Yanuar, & Devianto, (2017) and Wahyuni dan Monika (2016), a regression equation at τ-th quantile is written:

$$y_i = \mathbf{x}_i^T \beta_\tau + \mu_i, \quad i = 1, 2, \dots, n \quad \text{.....} \quad (6)$$

where the parameters β_τ is estimated by

$$\hat{\beta}_\tau = \underset{\beta_\tau}{\operatorname{argmin}} \sum_{i=1}^{n} \rho_\tau(y_i - \hat{y}_i) \quad \text{.....} \quad (7)$$

given $\rho_\tau(\cdot)$ is an asymmetric loss function of residuals, defined as:

$$\rho_\tau(\mu) = \begin{cases} \tau\mu, & \mu \geq 0 \\ (1-\tau)\mu, & \mu < 0 \end{cases} \quad \text{.....} \quad (8)$$

[2] The effect of $dVoc$ is observable at the phase of S_2. It would be a very weak assumption that the return of education for vocational high school graduates to be non linear since there is only one cutpoint for Sch. Therefore, we simply assume for this case that $dVoc$ moderates the return to education in linear fashion.

therefore the estimation can be rewritten as:

$$\hat{\beta}_\tau = \underset{\beta_\tau}{\operatorname{argmin}} \sum_{i\in\{i|y_i\geq\hat{y}_i\}} \tau\left|y_i - \mathbf{x}_i^T\beta_\tau\right| + \underset{\beta_\tau}{\operatorname{argmin}} \sum_{i\in\{i|y_i<\hat{y}_i\}} (\tau-1)\left|y_i - \mathbf{x}_i^T\beta_\tau\right| \quad \text{.....(9)}$$

which is a minimization problem solved through linear programming (Koenker dan Basset, 1978).

We use a measure of the goodness of fit for our regression models which is introduced by Koenker dan Machado (1999) as a Pseudo-R^2 that is analogous to R^2 in the OLS technique, calculated as follows:

$$R^1(\tau) = 1 - \frac{\sum_{i\in\{i|y_i\geq\hat{y}_i\}}\tau|y_i-\hat{y}_i| + \sum_{i\in\{i|y_i<\hat{y}_i\}}(\tau-1)|y_i-\hat{y}_i|}{\sum_{i\in\{i|y_i\geq\tilde{y}\}}\tau|y_i-\tilde{y}| + \sum_{i\in\{i|y_i<\tilde{y}\}}(\tau-1)|y_i-\tilde{y}|} \quad \text{..... (10)}$$

where $\hat{y}_i$ is the predicted y_i through the quantile regression between Y and all independent variables and $\tilde{y}$ is a constant prediction of y_i obtained from performing quantile regression between Y and intercept only.

RESULTS AND DISCUSSION

The profile of respondents

Table 1 shows that the average monthly earning of our respondents is Rp. 3.25 million, which is higher than national average[3]. This is close to the minimum wage of DKI Jakarta in 2017 (Rp. 3.36 million), which is the highest among all provinces of Indonesia. It indicates that the workers earning in the productive sectors is competitive as we have presumed.

Table 1. Summary statistics

No	Variables (measurement unit)	Mean	Median	S.D	Min.	Max.
1	Monthly earning (million Rp.)	3.25	2.40	3.75	0.03	60.00
2	Years of schooling (year)	11.0	12.0	4.29	0.00	18.0
3	Job training participation (yes/no)	0.27	0.00	0.44	0.00	1.00
4	Years of job tenure (year)	6.36	4.00	6.86	0.00	45.0
5	Age (year)	35.60	34.00	11.40	15.00	88.00
6	Male sex (yes/no)	0.79	1.00	0.41	0.00	1.00
7	Living in urban areas (yes/no)	0.63	1.00	0.48	0.00	1.00
8	Married/ever married (yes/no)	0.73	1.00	0.45	0.00	1.00
9	Graduating from engineering, economics and sciences college majors (yes/no)	0.20	0.00	0.40	0.00	1.00
10	Graduating from vocational high school (yes/no)	0.14	0.00	0.35	0.00	1.00
	Total sample			2609		

Based on statistics in Table 1, the sample are mainly distributed in lower earning level, shorter job tenure and younger in age, yet in higher years of schooling group. Male, urban and married workers are the largest part of the sample, indicating that even in the most productive economic sectors, demographic factors may have dominant influences on job participation. On the other sides, the representation of economic effect in the sample consisting of the proportions of job training participation, supportive college majors and vocational high school graduation are relatively low[4].

[3] According to BPS (2017a), the average of minimum wage of all 34 provinces is Rp. 1.97 million in 2016.
[4] The demographic-economic factors size imbalance in our sample may lead to some bias if estimated via quantile regression. Many literatures have suggested for using Heckman's test for selectivity (or Heckit)

By education attainment, 25.7 percent of the respondent have completed general high school education. The number of lowly educated respondent, consisting of those who never attended school, completed elementary school, and completed junior high school, are respectively 6.3; 14.2 and 13 percent. Compared to national labor composition which is dominated by elementary and junior high school graduates (BPS, 2017b), most of workers in the productive sectors attain better education and thus may give an advantage in developing potential job skills and better income.

By training history, 26.8 percent of the respondents have participated in certified job trainings. The average earning of trained respondents (Rp. 4.98 million) is almost twice the earning of those untrained (Rp. 2.62 million). It implies that job training participation induces larger impact on workers earning as proposed theoritically by Becker (1962, 1992). However, the low rate of job training participation should be concerned and may relates to certain issues. To the date, Indonesia only have around 300 vocational training centres (known as BLK, public and private) across the nation with lack of infrastructures and promotional activities to society. As the job training system in BLK is more supply-driven than demand-driven, the variation of training curriculum offered, the industrial coorporation and the quality assurance provided by these intitutions become limited (Skjaerlund and van der Loop, 2015). This is possibly the reason that the workers of the productive sectors may have participated less in formal/certified training, yet not the one that restricts them from participating non formal trainings which support their careers.

By job tenure, it is recorded that most of the respondents have been working under 6.36 years at their current jobs. Since the sample consists of more young agers, such years of tenure may indicate a low tendency in job turnover. The career in these sectors seems to be promising. We calculate the earning rise is stable if workers stay around 30 years at current jobs. This long term potential rise in earning has strong connection with the formality of jobs in these sectors.

By sex, 79.3 percent of total respondents are male with average earning 12 percent higher than females. We calculate that the female workers averagely earn more than males only in young age and gradually earn less for the rest of their career. Male workers seem to start having lower earning after the 25-29th year of working, while females are faster, after the 20-24th year of working. Contrast to male workers, most females in Indonesia tend to invest less in human capital after marriage. As stated in BPS (2017a), the social role of Indonesian females has been widely more a priority than economic one.

By place of living, around 62.6 percent of repondents live in urban areas and earn almost 60 percent higher than rural workers. The high gap is potentially caused by the wide availability of productive jobs, higher wage rate in urban areas and the migration for human capital.

By marital status, ever married respondents also earn higher than those who never-married. The earning gap between the two groups reaches 42 percent. Ever-married workers are potentially older and have longer years of career at the current job. In addition to that, ever-married workers are more motivated to invest to acquire skills and expand their networks needed to enhance their productivity.

The return to human capital of workers in Indonesian productive sectors

Table 2 shows our estimates for the coefficient of all explanatory variables using

before performing OLS technique, but as far we have studied none has suggested to run the method with quantile regression. Besides, it is strongly necessary to underlie the choosing of 'selection variables' in Heckman test with qualitative findings for cases of productive workers job participation.

quantile regression. We prove that the returns to education and career are non-linear. On education, we find that additional years of schooling does not yield equal marginal effects on workers earning for all schooling intervals observed. This satisfies the nonlinearity condition as stated in Equation (4). Precisely, we reject the linearity hypothesis at 1-5% of significance level. We also find that, for all terms that interact with schooling intervals (job training participation and male sex), the nonlinearities are significant for some quantiles. On workers career, we find that all coefficients associated to years of tenure (exp) and squared years of tenure (exp^2) are statistically significant, holding firmly the form of our non-linear definition in Equation (5).

Table 2. Full specification quantile estimates

Variables	Coefficient (standard error)		
	Q1 (0,25)	Q2 (0,5)	Q3 (0,75)
const	11.726 (0.228)***	12.245 (0.143)***	12.763 (0.164)***
sch	-0.014 (0.024)	0.042 (0.015)***	0.054 (0.018)***
dTrai	-0.357 (0.459)	0.154 (0.288)	0.661 (0.331)**
dSex	0.756 (0.162)***	0.919 (0.102)***	0.638 (0.117)***
max(sch – 9,0)	0.332 (0.068)***	0.188 (0.042)***	0.113 (0.049)**
max(sch – 12,0)	-0.110 (0.063)*	-0.088 (0.040)**	-0.049 (0.045)
max(sch – 16,0)	0.082 (0.323)	0.282 (0.202)	0.481 (0.232)**
dTrai×sch	0.083 (0.057)	0.021 (0.036)	-0.018 (0.041)
max(sch – 9,0)×dTrai	-0.119 (0.098)	-0.059 (0.061)	-0.047 (0.071)
max(sch – 12,0)×dTrai	0.004 (0.068)	0.011 (0.043)	0.018 (0.049)
max(sch – 16,0)×dTrai	-0.285 (0.235)	-0.440 (0.147)***	-0.553 (0.169)***
dSex×sch	0.044 (0.026)*	-0.022 (0.017)	-0.021 (0.019)
max(sch – 9,0)×dSex	-0.273 (0.071)***	-0.145 (0.045)***	-0.083 (0.051)
max(sch – 12,0)×dSex	0.123 (0.066)*	0.131 (0.041)***	0.099 (0.047)**
max(sch – 16,0)×dSex	0.375 (0.268)	0.235 (0.168)	0.129 (0.193)
dVoc×sch	-0.002 (0.005)	0.001 (0.003)	0.000 (0.003)
exp	0.040 (0.008)***	0.037 (0.005)***	0.044 (0.006)***
dSuppMaj×exp	0.017 (0.005)***	0.014 (0.003)***	0.015 (0.004)***
exp^2	-0.001 (0.000)***	-0.001 (0.000)***	-0.001 (0.000)***
age	0.058 (0.010)***	0.043 (0.006)***	0.042 (0.007)***
age^2	-0.001 (0.000)***	-0.001 (0.000)***	0.000 (0.000)***
dLoc	0.101 (0.040)**	0.162 (0.025)***	0.058 (0.029)**
dMar	0.024 (0.052)	0.092 (0.032)***	0.051 (0.037)
Wald-Test: linear return to education (p-value)	0.0000+	0.0000+	0.0037+
Wald-Test: linear moderation of training participation in the return to education (p-value)	0.1446	0.0104×	0.0091+
Wald-Test: linear moderation of sex in the return to education (p-value)	0.0000+	0.0031+	0.1407
pseudo-R^2	0.215	0.246	0.254

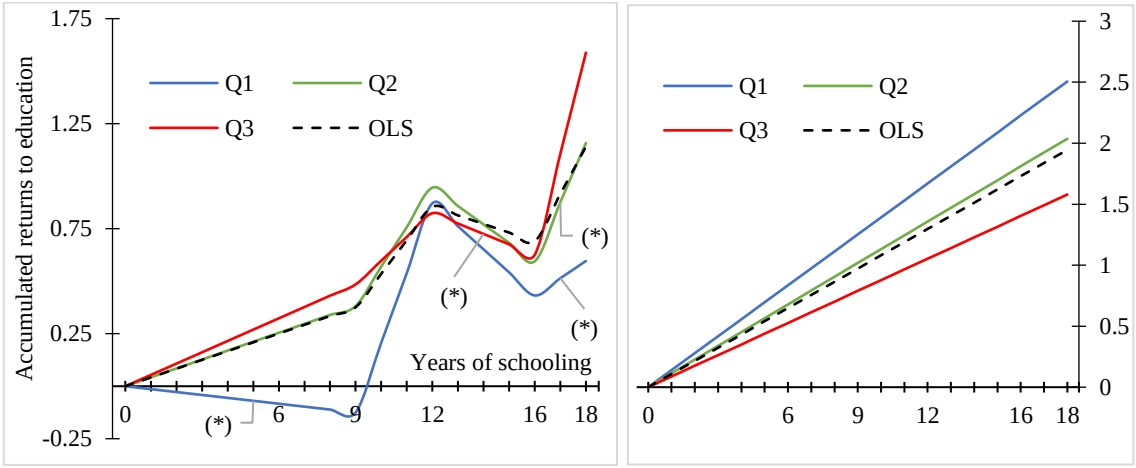
Notes: ***; **; * *significant at 1%; 5%; 10%*
+, × *rejects the linearity at 1% and 5%*

How education affects earning?

It is found that the return to education (RTE) is non linear or not equal across all schooling levels. It implies that some workers may benefit more from completing certain

level of schooling. In association to earning levels, the high-earning workers benefit more from compulsory and postgraduate schooling, meanwhile the low-earning workers benefit more from middle-high education. Using the regression estimates, we illustrate the typical curve of non linear RTE on Graph 2(a). We also provide an illustration of RTE under linear assumption (Mincer's) on Graph 2(b) based on estimates provided in Table A1 (see Appendix). One could notice potential under/over estimation may be resulted if linear estimation is performed.

In this discussion, we concern more on the form of the nonlinearity than on the magnitude of marginal return itself within each domain. Previous studies conducted by and Schady (2003) and Akguç (2011) stated that the returns to postsecondary (academy, university and postgraduate) education are commonly greater than to lower levels of education. Suhardan, Riduwan & Enas (2012) supported with finding that Indonesian workers and society benefit more from individual and public investments in university education. Apparently in this study, we find that the marginal returns to one interval of postsecondary education (12-16 years of schooling, i.e the academy and university) are smaller and in fact, are negatives. It means that additional year spent to study in college reduce workers earning by around 8-11 percent.



Graph 2. Comparison between non linear and linear return to education for workers in productive sectors

Notes: (*) insignificant marginal effect

This finding is contradictory to theories and previous empirical results and may indicate some problems in investment of higher education. Our calculation as shown in Table A4 (see Appendix) shows negative and positive changes in median earning[5] between high school and academy graduates. Therefore, we believe that this is a special case of problematic labor signaling for academy education which is a subset of (12,16] years of schooling. According to Lusia & Amelia (2018), it is quite common that in obtaining labor input, local industries prefer bachelor graduates despite their satisfaction on 'the actual On The Job achievement' contributed by vocational school trainees (including academy students) in internship programmes. In other words, signal dominates over qualification in the labor market for academy graduates. It implies that for academy education, due to such a weak labor market signals, job opportunities become small. This crisis imposes academy graduates to avoid unemployment by willing to be paid lower,

[5] Since quantile regression is a generalized method of median regression, it is more appropriate to use 25%, 50% and 75% percentiles to explain the regression results rather than using mean value.

thus contibutes to lowering the total return to the (12-16] schooling interval.

The role of vocational schooling (known as SMK) is not deterministic in Indonesian productive industries. With $dVoc$ estimates are insignificant for all earning level, it implies that either a worker in these sectors graduate from SMK or general high school, the earning remain potentially same. Since these productive sectors are competitive, SMK's graduates are demanded to invest more by participating in job training and non formal education to raise their productivity. However, according to Brunello and Rocco (2015), vocational school graduates seem to have lower incentive to invest in human capital after being employed. Beyond the supply side, low demand for vocational school graduates in national labor market may have also been a troublemaking factor. According to Kadir, Nirwansyah & Bachrul (2016), Indonesian productive and exportive industries are in shortage of suitably skilled workers and cannot absorb enough qualified SMK graduates who are mostly (49%) from business and management backgrounds.

How job training participation and sex moderates the RTE?

Overall effect of job training participation (JTP) on earning is found not to be always positive, as JTP may enhance and lower the return to schooling in some cases. From the estimates associated to $dTrai$ in Table 1, it is revealed that the moderating effects of JTP are not significant for lower-earning workers, but vary in some schooling intervals for the middle and higher earning workers.

Workers with lower earning is often attributed empirically to lower level of education, younger age, less working experience, and female. Smith (2001) found that young agers tend to change jobs more frequently and participate in various job training which lead to ineffectivity of their JTP on current job earning. Lynch (1992) found that females tend to participate less in job training and cause to receive lower wages. Regarding these facts, it is indicated that job trainings would be less or not effective when given to such worker characteristics.

For the middle and high-earning workers, the non-equal moderations of JTP on RTE across shooling levels are significant (based on Wald's test for joint significance with p-value repectively of 0.0104 and 0,0091). Apparently, JTP lower the RTE for these two groups with negative estimates values for **max**(sch – 16,0)×$dTrai$. It means that the interaction between master/doctoral schooling and JTP results in a slightly decrease in earning. It indicates there is a mismatch between higher education and job training for middle and high-earning workers in productive sectors in Indonesia. Recall our explanation on the defect of Indonesian formal training system may help one to understand the education-training complementary gap as happens in this case. Fouarge, Schils & de Grip (2010) found that the higher willingness of highly educated workers to participate in formal/certified job training does not guarantee any significant rise of earning, compared to lowly educated ones. In spite of participating more trainings, future orientation and personal traits seem to contribute to training effectivity for workers of any level of earning.

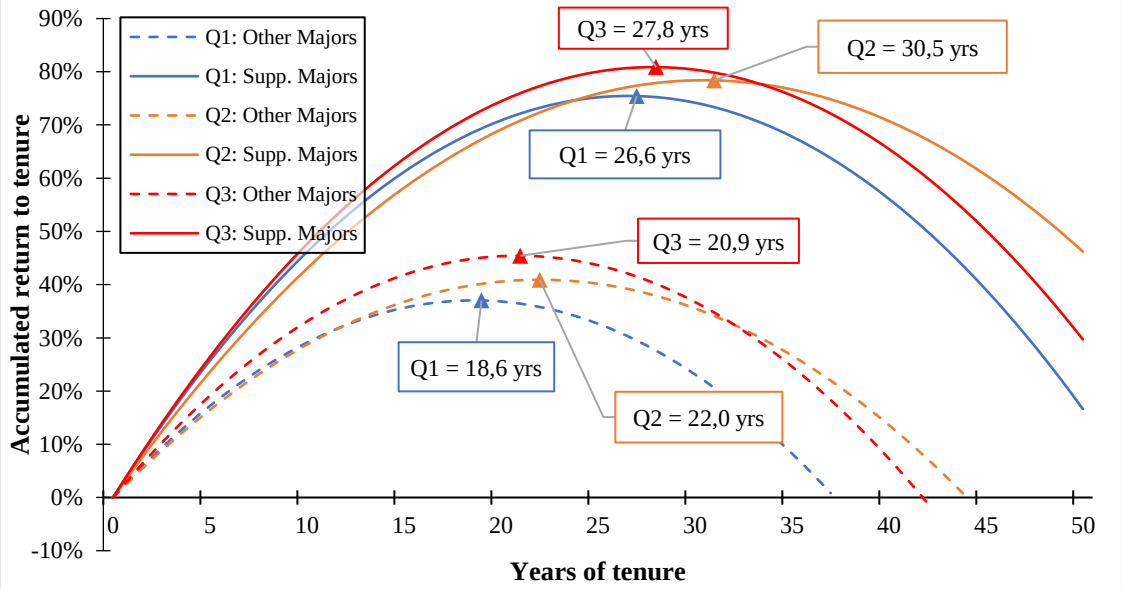
How job tenure and graduating from certain college majors affect workers career?

Job tenure is found to have non linear effect on workers earning. The estimation as shown in Table 1 with significantly negative coefficient of exp^2 implies a diminishing return to job tenure (RTT) in all levels of earning and yields a reversed U-shape earning-tenure profile. It means that workers in Indonesian productive sectors may experience some rise and fall periods throughout their career.

However, since these sectors are formal, one may assume that the retirement age is around 55 or around 30-35 years of tenure for Indonesian setting. Our calculation

(illustrated in Graph 3) shows that it could take 18-31 years of tenure for the workers earning to potentially rise. Regarding the moderation effect, we find that $dSuppEduc$ coefficients are positive, meaning that graduating from engineering, economic and science college majors results in significant increase of accumulated RTT and longer period of increase in earning. Workers who graduate from such college majors would obtain an increasing earning in 7-9 years longer than those who graduate from other majors. In fact, there is almost zero probability for workers with special education to experience drops of earning before the retirement age. This implies that achieving high education in these majors may potentially lead to better career in Indonesian most productive sectors.

This result clarifies the findings of Suhardan, Riduwan & Enas (2012) that graduating from these majors has been giving the largest individual benefit for Indonesian workers since the last three decades. This also carry out the suggestion given by Cho, Kam, & Lee (2017) about measuring the effect of college majors on human capital supply.



Graph 3. Estimated earning profile and educational moderation effects
Note: supp. majors include engineering, economics and sciences

How demographic aspects affect workers career?

Male sex ($dSex$) is found to moderate significantly the non linear RTE for the lower and middle-earning workers. For both groups, male workers seem to benefit more from completing compulsory and postsecondary educations with greater earning than females. Meanwhile, women workers have the opportunity to more closely align their earning to that of males if both have completed middle-high education. For the higher-earning group, the nonlinear moderation of sex to RTE is rejected. Therefore by using linear estimates (see Table A1 – Appendix), we find that male sex moderates negatively the RTE. It means the earning of highly educated female and male workers are more competitive in highly paid jobs. This clarifies the finding of Wahyuni and Monika (2016) which suggest to improve the formal education participation and attainment for Indonesian females in order to achieve gender economic equality in human capital.

We also highlight the marginal effect of age on earning, with the coefficeint of age^2 in Table 1 is found to be negative. Therefore, the age-earning profile of Indonesian

productive workers would be convex like most have found in earlier studies. From the estimates, we predict the peak earning is reached at the age of 39-40 years for lower and middle earning workers and at age of 43 years for high-earning worker. What could be implied from it is how human investment either by public or industries become fruitful when targeted to workers under the peak age.

As the nature of productive industries which usually set up in more infrastructural areas, living in urban areas results in earning advantage of 5.8 to 16.2 percent compared to living in rural areas. Marital status accounts for 9.2 percent of the earning increase of middle-earning workers.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

We begin this study by investigating the nonlinearity in the RTE and job tenure by using a modified wage function. We also attempt to identify some possible moderators that may affect the non-linear return to both variables based on empirical results of previous studies and demographic situation of Indonesia. We draw our attention to investigate participating in the job training, male sex and vocational schooling as the moderators for education and graduating from certain college majors as the single moderator for job tenure.

The first main result of this study shows that the RTE is non-linear with significant moderations by job training participation and male sex within some earning levels. However, the nonlinearity of RTE emerges with three major problems identified. First, we find that the RTE of academy is negative. Secondly, we find that postgraduate education is contraproductive with job training participation. Third, we cannot calculate any significant moderation of vocational schooling to the RTE.

We believe that the three problems are potentially the tips of the same iceberg. The systemic defects in the orientation and quality control of Indonesian vocational education in high and higher levels and formal training have led to lack of qualification demanded and job market signaling for its graduates, resulting in mismatch between knowledge and career. In the end, investment in vocational, academy education and formal general training become less attractive for Indonesian society.

Public-private connectionship has long become a discourse to enhance human capital of vocational school students and graduates. This has to be pursued along with a systemic restoration and improvents in Indonesian vocational education to adress future challenges. In the current era of industrial revolution 4.0, young people are demanded to have the following skills: complex problem solving; critical thinking; creativity; people management; coordination ability; emotional intelligence; judgement and decision making; service orientation; and cognitive flexibility (van Dam, 2017). Such skills are probably difficult to acquire with the current quality of job training and vocational education available in Indonesia. Therefore, the development of middle-high education should be driven toward achieving a new national standard for youth agers, from graduating-score oriented to skill-oriented.

Demographical set of aspects including sex, place of living and marital status still play important roles in determining the earning of Indonesian workers in productive industries despite the sign of losing its power on high-earning workers. Therefore, earning disparities seems to still emerge in near future until some structural revolutions especially those that concern with human investment take place in Indonesian social life and infrastructure development.

Recommendations

In order to make effective the investment of human capital for the future workers of Indonesian productive sectors especially for those who graduate from SMK and academy, we recommend that specific, industry-responsive job training as well as vocational sciences should be more provided for high school fresh graduates with regards to Indonesian regional specialisations. Not only to develop the competitiveness in Indonesian productive sectors, the policy should improve to whole economy. The vocational skill acquisition by schooling or training should utilize various media including long distance learning and actively qualified certification. Scholarships and researches should also be promoted more to developing the human capital of Indonesian teenagers.

The second main result of this study shows that workers career is quite promising in these sectors where the earning increment periods last relatively long (around 30 years). We find that studying in engineering, economics and sciences college majors significantly increase the increment periods and the amount of earning. Therefore, we recommend that the government should invest in developing these college majors by promoting research programmes and global competitions, providing more scholarships and strengthen the connectivity between colleges, industries and society fund raisers. Most importantly, the public investment should also be devoted in order to restore the labor market competitiveness of middle-high vocational education especially in these majors. The government should attract productive private firms by offering special incentives (for instances: tax relief) if participating the partnership in establishing industry-specific vocational schools.

From earning level point of view, a protective policy recommendation should be arranged mostly for lower-earning workers. From the result of this study, completing higher education should be a general suggestion to enhance human capital stock for lower earning workers. To sustain the RTE of these workers, it is necessary to provide them with sectoral training programs which encourage their willingness, personal traits, future expectations and experience beside achieveing higher degrees in schooling. Meanwhile, the higher-earning workers seem to have larger opportunity to sustain or enhance their lifetime earning by investing more in postsecondary education. This should be assisted by public and industries investment in providing sectoral scholarships to prepare expertise capabilities for accomplished workers.

Lastly, concerning our methodology in this study, it is very natural that our efforts to reveal a typical return to human capital of particular Indonesian workers need to be improved in many other aspects. We strongly recommend to investigate the dynamics of Indonesian human capital by using non-parametric methods so the research can totally escape from the rigid determination of factors involved in statistical model. In the era of big data where the capacity of statistical institution in providing richer data has gradually improved and the development of data science algorithm, one’s interest to discover the unrevealed factors and interactions among human capital aspects would likely meet the goal.

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APPENDIX

Table A1. Basic/linear quantile estimates (Mincer's)

Variables	Coefficient (standard error)		
	Q1 (0,25)	**Q2 (0,5)**	**Q3 (0,75)**
const	10,973 (0,208)***	12,088 (0,133)***	12,629 (0,194)***
sch	0,139 (0,010)***	0,113 (0,006)***	0,088 (0,009)***
dTrai	0,131 (0,209)	0,229 (0,133)*	0,518 (0,194)***
dSex	1,355 (0,126)***	0,961 (0,080)***	0,555 (0,117)***
dTrai×sch	0,009 (0,015)	-0,001 (0,010)	-0,020 (0,014)
dSex×sch	-0,081 (0,010)***	-0,060 (0,006)***	-0,034 (0,009)***
dVoc×sch	-0,003 (0,004)	-0,002 (0,003)	-0,002 (0,004)
exp	0,045 (0,008)***	0,034 (0,005)***	0,042 (0,007)***
dSuppMaj×exp	0,023 (0,005)***	0,023 (0,003)***	0,022 (0,005)***
exp2	-0,001 (0,000)***	-0,001 (0,000)***	-0,001 (0,000)***
age	0,056 (0,010)***	0,037 (0,006)***	0,048 (0,009)***
age2	-0,001 (0,000)***	0,000 (0,000)***	-0,001 (0,000)***
dLoc	0,136 (0,040)***	0,171 (0,026)***	0,077 (0,037)**
dMar	0,007 (0,053)	0,107 (0,033)***	0,029 (0,049)
pseudo-R^2	**0,205**	**0,234**	**0,233**

Source: author's calculation

Notes: ***; **; * significant at 1%; 5%; 10%

Table A2. OLS estimates

Variables	Coefficient (standard error)	
	Full spec.	**Basic spec.**
const	12,170 (0,168)***	11,885 (0,153)***
sch	0,042 (0,018)**	0,108 (0,007)***
dTrai	0,218 (0,339)	0,330 (0,153)**
dSex	0,795 (0,120)***	0,922 (0,093)***
max(sch – 9,0)	0,159 (0,050)***	
max(sch – 12,0)	-0,041 (0,046)	
max(sch – 16,0)	0,225 (0,238)	
dTrai×sch	0,016 (0,042)	-0,005 (0,011)
max(sch – 9,0)×dTrai	-0,030 (0,072)	
max(sch – 12,0)×dTrai	-0,035 (0,050)	
max(sch – 16,0)×dTrai	-0,362 (0,173)**	
dSex×sch	-0,009 (0,019)	-0,051 (0,007)***
max(sch – 9,0)×dSex	-0,130 (0,053)**	
max(sch – 12,0)×dSex	0,101 (0,048)**	
max(sch – 16,0)×dSex	0,220 (0,198)	
dVoc×sch	0,000 (0,004)	-0,004 (0,003)
exp	0,047 (0,006)***	0,046 (0,006)***
dSuppMaj×exp	0,015 (0,004)***	0,024 (0,004)***
exp2	-0,001 (0,000)***	-0,001 (0,000)***
age	0,046 (0,007)***	0,046 (0,007)***
age2	-0,001 (0,000)***	-0,001 (0,000)***
dLoc	0,124 (0,029)***	0,142 (0,029)***
dMar	0,042 (0,038)	0,028 (0,039)
R^2 (adj-R^2)	**0,409 (0,404)**	**0,393 (0,390)**

Source: author's calculation

Notes: ***; **; * *significant at 1%; 5%; 10%*

Table A3. Statistics for productive sectors in Indonesia

No	Economic Sector	Productivity (Rp. million per worker)	Average wage (Rp)	Output* (Rp. Trillion)	Output rate* (percent per year)
1	Agriculture	44.18	1,655,121	1209.7	3.25
2	Mining and excavation	608.19	4,197,869	775.5	1.06
3	Manufacturing	160.29	2,353,052	2017.6	4.29
4	Gas and electricity	549.89	3,370,398	100	5.39
5	Water and waste management	37.01		7.6	3.6
6	Construction	161.39	2,397,089	925.1	5.22
7	Trade and reparation	75.9	2,128,768	1,255.20	3.93
8	Acommodation and restaurant	57.94		282.2	4.94
9	Transportation and warehousing	130.2	3,198,413	375.8	7.74
10	Information and communication	657.12		459.2	8.87
11	Financial services	300.98	3,677,156	378.2	8.9
12	Real estate	979.06		278.5	4.3
13	Company services	147.23		159.3	7.36
14	Government/public/military services	95.99	2,682,886	320	3.19
15	Educational services	68.73		293.9	3.84
16	Health services	75.53		102.3	5
17	Other services	42.4		156.2	7.8
	Total	**4192.03**	**2,555,962**	**9096.3**	**-**

Compiled from: (1) BPS – Laporan Perekonomian Indonesia 2017
(2) BPS – Statistik Indonesia 2017

*Note: *GDP in constant prices of 2010*

Table A4. Average and quantile earning for all schooling levels

No	**Schooling level**	**Average**	**Q1**	**Q2**	**Q3**
1	Not attending school/not graduating SD	1,456,000	700,000	1,200,000	1,920,000
2	Elementary school (SD)	1,677,805	900,000	1,500,000	2,000,000
3	Junior high school (SMP)	2,246,453	1,200,000	1,800,000	2,800,000
4	General senior high school (SMA)	2,940,211	1,500,000	2,500,000	3,500,000
5	Vocational senior high school (SMK)	2,900,151	1,500,000	2,400,000	3,800,000
6	Academy/baccalaurate degree	4,211,777	1,500,000	2,400,000	3,800,000
7	University/bachelor degree	5,629,900	3,000,000	4,000,000	6,000,000
8	Postgraduate/master and doctoral degrees	12,425,000	5,000,000	8,900,000	12,500,000
	TOTAL	**3,251,667**	**1,500,000**	**2,400,000**	**3,800,000**