RESEARCH ARTICLE

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Does Age Economy Affect Productivity?—A Survey on Sub National of Central Java Province

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As the performance of the nation's economy is in accordance with the productivity development, every country needs to build the productive areas to provide jobs for its population. Therefore, each region should be able to identify, explore, and optimize local potencies to encourage regional economy. The aim of this study was to analyze the relationship between the age of cities-district and the productivity of the labor in 35 cities-district in Central Java Province using production function calibrated using Mincer Equation that refer to Bils and Klenow model's. Relevant data from 2004 to 2013 were collected. Panel data with Fixed Effect Within Group Method was used to analyze the contribution of age of economy towards productivity. The result showed the age of economy remains as a one of determined factor in the creation of productivity in 35 cities-district Central Java Province.

Keywords: Age of Economy, Human Capital, Productivity.

1. INTRODUCTION

As a part of a province in a country, cities and district have been in used to mean a metropolitan area and a hinterland. Cities, as a growth center, serve as a platform for economic entities. Krugman[1] identifies cities as economic self-organization with complex economic and social systems as cities live in trading and service sector. Meanwhile, district play an important role as a basic commodities provider; therefore, most people in district live in agrarian sector.

As time goes by, cities and district arise and evolve largely out of the individual daily micro-behaviors of myriads of economic agents. Cities and district will come through what we called economic ages. The older the age of the cities-district, the more experience they are in exploring their potencies that generate higher productivity to form newly areas, the more experience the cities-district will be. In this case, experience means accumulative knowledge obtained during the life cycle of cities-district starting and continuing immediately after cities-district was born. Later, the accumulative knowledge generated in line with the economic age of cities-district is classified as human capital, so that we can say that higher economic age, the higher productivity.

By taking the object of study in 35 cities-districts in Central Java Province, scatter plot diagram in Figure 1 illustrates the relationship patterns between average Productivity and age of cities-districts. It is clearly shows random pattern. We can conclude that, there is no correlation or maybe very low correlation between Average Productivity and Age of city districts.

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Previous studies, such as Sanchez-Vidal, Gonzales-Val and Viladecans-Marsal,[2] ascertained that difference population growth rate of cities is caused by their difference age. They confirmed that when cities appear, they grow very rapidly and, as the decades pass, their growth slows or even falls into a declining. But Giesen and Suedekum[3] used more than 10,000 American Census showed that older cities in the US tend to be larger than younger ones and no appearance of declining or diminishing.

To investigate the relationship between Productivity and age of city-district we refer to classic economic studied by Mincer.[5] Mincer[5] investigated at personal earnings as a proxy for individual productivity level for a function of years of education age and experience of personal education, this called Micro-Mincer. This studied proved that the upward sloping individual wage profile occurs as human capital, or skills, increase with the education and experience. However, Mincerian regression only capture on the pecuniary aspects of experience—private return, instead of its social return. The absence of externalities analysis in the micro-mincerian analysis motivates the macro analysis. In order to bring this analysis to aggregate level, Klenow and Rodriguez-Clare[7] and Bils and Klenow[4] use the micro evidence to examine cross country differences in experience, called Macro-Mincer.

The aim of this paper was to analyze the relationship between the age of cities-district and the productivity of the labor in 35 cities-district in Central Java Province using a calibration model from Bils and Klenow.[4] Bils and Klenow use the standard approach of Mincer equation;[5] a single-equation model that explains earnings as a function of schooling and experience. This method assumes that the marginal contribution to output of one

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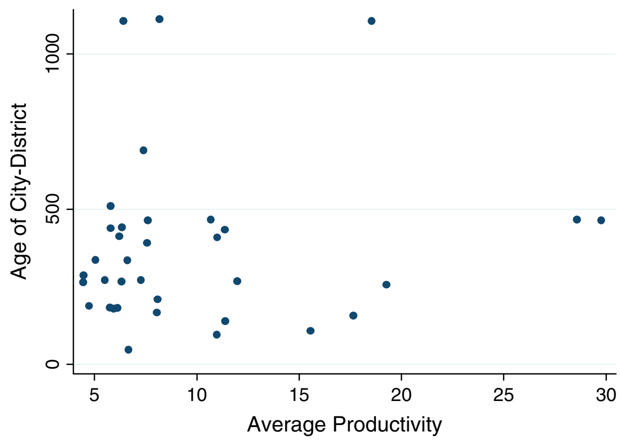

Fig. 1. Average productivity and age of city-district scatter plot.

additional year of schooling is equal to the Education Rate of Return. It is the rate of return from schooling that is estimated by Mincer Equation used as building blocks to directly measure a country's stock of human capital.

2. THE GROWTH MODEL

Consider a constant return to scale production function that at time t from Hall and Jones[6] is given by:

$$Y(t) = K(t)^{\alpha}[A(t)H(t)]^{1-\alpha} \tag{1}$$

K is capital, A is knowledge level expressing the effectiveness of Labor, H is the total labor's productivity in all level of skills; while, t describes the continuous time dimension. This production function is in term of Labor Augmenting model. In order to perform the decomposition of output differences per workers and to see the capital contribution per workers, both sides of Eq. (1) is divided by Lt and is written in the following logarithm:

$$\ln\frac{Y_t}{L_t} = \alpha\ln\frac{K_t}{L_t} + (1-\alpha)\ln\frac{H_t}{L_t} + (1-\alpha)\ln A_t \tag{2}$$

By referring to the Solow residual concept, the estimation of Eq. (2) calculates A as residual. Thus, the Eq. (2) explains the role of physical capital per worker and human capital per worker towards the output growth per worker. Hall and Jones[6] and Klenow and Rodriguez-Clare[7] transform the Eq. (2) by deducting the left and right side of the equation with:

$$\alpha\ln\frac{Y_i}{L_i}$$

into:

$$(1-\alpha)\ln\frac{Y_t}{L_t} = \left(\alpha\ln\frac{K_t}{L_t} - \alpha\ln\frac{Y_t}{L_t}\right) + (1-\alpha)\ln\frac{H_t}{L_t} + (1-\alpha)\ln A_t \tag{3}$$

After that, Eq. (3) is divided by

$$\ln\frac{Y_t}{L_t} = \frac{\alpha}{1-\alpha}\ln\frac{K_t}{Y_t} + \ln\frac{H_t}{L_t} + \ln A_t \tag{4}$$

Equation (4) explains output per worker as the function of *physical capital intensity* (capital–output ratio, K/Y), labor *services per worker*, H/L and residual. If $H/L = G(E)$, then $G(E)$ is the function of human capital production with *years of schooling* (E) as the only input.

3. HUMAN CAPITAL STOCK: BILS AND KLENOW MODEL

Bils and Klenow[4] develop a structural model to analyze the sense of casualty among education and economic growth. Using Barro and Lee's[8] educational attainment database, Bils and Klenow calculate a correlation of 0.023 (statistically significant) between economic growth and initial schooling attainment. This correlation can be explained by two possible answers; first, schooling attainment helps economic growth through different channels, and second, economic growth gives incentives to people to study more because of higher expected future outcomes.

In order to solve this question, a mathematical formulation is used. Referring to Eq. (1), two channels from schooling to growth may exist; first, a direct channel by increasing the level of human capital H_t, and second, indirect channel by increasing the level of technology use or adoption A_t. The direct channel can be formulated in the following way. If $h(a.t)$ is the level of human capital for cohort a at time t and $L(a,t)$ as its size. Suppose that individuals go to the school from age 0 to s, and work from s to T. Therefore:

$$H(t) = \int_s^T h(a,t)L(a,t)\,da \tag{5}$$

Now, suppose teachers are n years older, so they influence their pupil's human capital:

$$h(a.t) = h(a+n,t)^{\varnothing} e^{f(s)+g(a-s)} \quad \forall a > s \tag{6}$$

with $(a-s)$ as a proxy for individual's experience and ϕ is a key parameter of the model. It's measures the influence of teachers in human capital. If $\phi = 1$, h grows from cohort to cohort even if s remains constant. Otherwise, either s or T is increase and it is necessary.

Applying logs, then:

$$\ln h(a.t) = \varnothing\ln h(a+n,t) + f(s) + g(a-s) \quad \forall a > s \tag{7}$$

Where $h(a)$ is human capital level per labor, $f(s) = \theta s$, s is years of schooling, $(a-s-6)$ is experience calculated from age at time t (a) minus years of schooling (s), early school ages (6—count yearly), and $(a-s-6)^2$ is experience square. When $\phi = 0$, taking $h(a+n,t) = K$, $f(s) = \theta s$, and $g(a-s) = \gamma_1(a-s) + \gamma_2(a-s)^2$ we get the typical Mincerian specification. By Bils and Klenow, Eq. (7) defined as human capital stock and written as in Eq. (8).

$$\ln[h(a)] = f(s) + \gamma_1(a-s-6) + \gamma_2(a-s-6)^2 \tag{8}$$

As written above, knowledge accumulation referring to age of cities-district can be defined as experience. Therefore, for the purpose of the research purposes, the parameter of the experience (γ_1) will be calculated from the age of cities-district.

4. METODOLOGY

With the parameterization function of Eq. (4) as below:

$$\ln\frac{Y_t}{L_t} = \frac{\alpha}{1-\alpha}\ln\frac{K_t}{Y_t} + \ln\frac{H_t}{L_t} + \ln A_t \tag{9}$$

is written down as: $\dot{y} = \ln(Y_t/L_t)$, $\dot{k} = \ln(K_t/Y_i)$, $\dot{h} = \ln(H_t/L_t)$, $\dot{A} = \ln A_t$ then obtained the equation below:

$$\dot{y} = \frac{\alpha}{1-\alpha}\dot{k} + \dot{h} + \dot{A} \tag{10}$$

Since A's contribution will be measured as a residual, it reflects not just technology or knowledge but all forces that determine output for given amounts of physical capital and labor services. Then, as Topel,[9] performed the calibration of the production function with Mincer Equation, the next step is substituting individual human capital stocks from Bils and Klenow model's (Eq. (7)) to production function. The substitution of Eqs. (8) and (10) is written as:

$$\dot{y} = \dot{A} + \frac{\alpha}{1-\alpha}\dot{k} + \theta s + \gamma_1(a-s-6) + \gamma_2(a-s-6)^2 \quad (11)$$

If, $\beta_1 = \alpha/(1-\alpha)$, $\beta_2 = \theta$, $\beta_3 = \gamma_1$, $\beta_4 = \gamma_2$.

Equation (11) become:

$$\dot{y} = \alpha + \beta_1\dot{k} + \beta_2 s + \beta_3(a-s-6) + \beta_4(a-s-6)^2 \quad (12)$$

This equation above is the main model of this research.

5. MODEL AND RESULT

In highlighting the model, write down Eq. (12) and parameterized as econometric function as:

$$y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \varepsilon_{it} \quad (13)$$

Where: $X_1 = (k)$, $X_2 = s$, $X_3 = (a-s-6)$, $X_4 = (a-s-6)^2$.

The data used in the model were annual data for the period 2004–2014 from the *Badan Pusat Statistik*. Research object of this study was 35 sub national cities-district in Central Java Province. The dependent variable y_{it} was *Labor Productivity* calculated by Logarithm Regional Gross Domestic Product per labor (LnRGDPL). As independent variables: X_1 was *Stock Capital per Output* calculated from share national Gross Fixed Capital Formation to Regional Gross Domestic Product per Output (LnCap_KY), X_2 was *Average Years of Schooling* (YOS), X_3 was *Experience* calculated from Age of Cities-district (AGE), and X_4 is *Squared Experience* calculated by Age of Cities-district squared (AGE2), ε is a stochastic element and α, β are parameters to be estimated.

Refer to Heckman, Lochner and Todd,[10] demography variables was add to this model in order to solved omitted bias in Mincer Equation model. In this model, we added X_5 *Dependency Ratio* (DR) calculated from number of people aged 0–14 and those aged 65 and over devided by number of people aged 15–64, X_6 *Sex Ratio* (SR) calculated from ratio males to females in a population, and X_7 *Area ∗ Education*, the interactive variable (area_edu) defined as year of education multiplied by area's dummy variable. This variable estimates parameter for return to education in separate urban and rural areas. This model was analyzed using *Fixed Effect Panel Regression Within Group Model*, since both cross region and specific changes in different periods influenced the relationship between indicators.

Table I. Descriptive statistics of variables.

Variable	Obs	Mean	Std. dev	Min	Max
	Summarize				
ln_yL	350	2.134	0.511	1.304	3.552
ln_ky	350	−1.603	0.082	−1.778	−1.493
Yos	350	7.326	1.215	5.000	11.000
Agecity	350	370.300	264.274	38.000	1112.000
Agecity 2	350	206763.5	324149.4	1444	1236544
dr	350	49.412	5.227	37.258	67.711
sr	350	98.439	3.640	86.539	110.911
Area_edu	350	5.709	2.682	0	1

Table II. Fixed effect panel model in 2004–2013 period 35 cities-regencies in central java province.

Variable	Coef.	Std. err	t	Prob.
ln_ky	−0.329295	0.1372745	−2.40	0.017*
Yos	−0.074869	0.0295074	−2.54	0.012*
Agecity	0.045855	0.0041355	11.09	0.000*
Agecity2	0.000003	0.0000022	1.42	0.155
dr	0.006063	0.0014739	4.11	0.000*
sr	0.002378	0.0013887	1.71	0.088**
area_edu	0.074908	0.0299046	2.50	0.013*
_cons	−16.429700	1.6111530	−10.20	0.000*

Notes: Numbers in the table are the coefficients of each variables, ***1% significance level, **5% significance level, *10% significance level.
Source: Stata13 output, 2016.

Table II presents the results of statistical descriptive of dependent and independent variables in the model, mean, maximum and minimum value, and the standard deviation. Statistical descriptive analysis of the series shows standard deviations vary in reaching an extremely wide range, depending on the unit and the indicator used.

The chosen model was with fixed effects for cross and periods since both national and specific changes in different periods influenced the relationship between indicators. Within Group Method was chosen instead of LSDV (Least Square Dummy Variable) because we did not see variation across group. In Table II, this model shows regression result for all objects. From the regression, the F test was 155,90 and probability F test was 0.000 remain significance under 5% significance level, R-squared was 0.9874 meaning the impact of the independent variables through dependent variable was 98,74% and 1,26% affected by variables outside the model. The high point of coefficient determination (R-Square) showed multicollinearity presence in the model. This was the consequence using experience and square experience. This omitted bias could be solved by adding more instrument variables in the model. Next part was that Age of cities-district (AGE) showed a positive effect and significant on RGDP per capita. This could be seen from the coefficient positive and it was statistically significant under 5% significance level. But in variable (AGE2), the output showed that there was no relationship between Square Age of cities-district (AGE2),

Negative relationship with average years of schooling was less than the theoretically expected. This result was consistence with Pritchett.[11] However, an explanation could be heterogeneous group of countries analyzed. To confirm this hypothesis in the future, research required a differentiated analysis according to the level of economic development of region. Regression result from Eq. (16) is shown in Table II above.

6. CONCLUSION

This paper highlighted the importance of knowledge accumulation expressed by age of cities-regencies in ensuring productivity. The estimation revealed a positive relationship and statistically significant between RGDP per capita and age of cities-regencies consistence with economic theory. The negative and significant value for Capital per Output shows that economic is going to be more efficient. Then positive and significant *area_edu* variables show that different productivity between rural and urban area truly exists. The unexpected is the negative relationship between year of schooling and RGDP per capita, a possible explanation is the heterogeneity of countries considered, although this negative result consistence with Pritchet.[11–14] Further, indirect effect analysis should be considered as a negative result of years of schooling to RGDP per capita.

According to the result of this research, age of cities-regencies age can be included as one of the determinants of economic productivity. Then, the younger cities-regencies should be more pro-active to learn from the older cities-regencies.

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