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High-skilled Workforce and Productivity Growth: the Knowledge-based Economics Perspective

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***Abstract*--Knowledge-based economics has been characterized by productivity growth based on advances in science and technology. The conditions as such will require the existence of human capital with adequate capabilities to improve competitiveness and economic productivity in a country. In this context, higher education graduates can be seen as entities that have an important role as a channel for knowledge transfer from universities to the industry. In turn, the knowledge spillover will be useful for the realization of industrial innovation in order to increase productivity. In this connection, this study aims to examine the role of higher education graduates as high-skilled workforce for various industrial sectors in Indonesia. Using national labor force surveys data as the main data source, this study contributes to filling research gaps on human resources and knowledge-based economic development in the contexts of developing country such as Indonesia.**

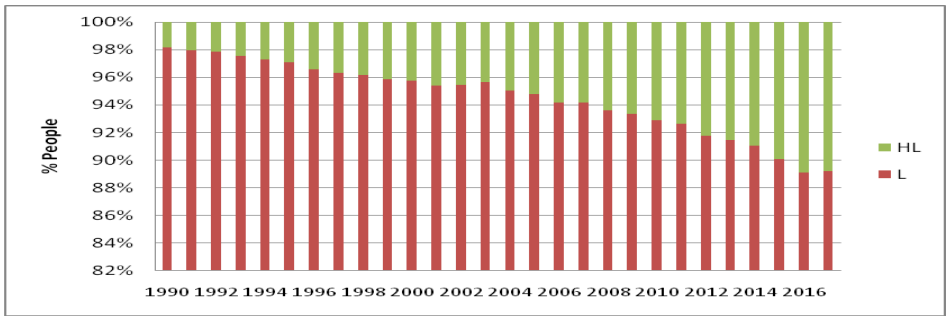
Keywords--Knowledge-based economy; Higher education graduates; Labor; Productivity growth

I. INTRODUCTION

Science and technology (S&T) is a term that often appears in discussions about economic productivity growth, where it has long been recognized that the use of high technology is the secret behind the success of leading companies and developed countries. The idea of the importance of science and technology to the economy is in line with a paradigm called "knowledge-based economy", which is characterized by conditions where competitiveness and growth are increasingly based on knowledge (Benos et al., 2015). The intensive use of science and technology in economic production activities requires the availability of human capital that has adequate capabilities to realize productivity improvements, where more output is produced with the same quantity of inputs, which is the key to long-term economic growth.

In this context, the important actors that also need to be mentioned here are universities and its graduates as those who are closely linked to the development and utilization of science and technology. Universities play a role as suppliers of human capital, sources of innovation, and as supporters of democratic values, which are important for economic growth (Valero & Reenen, 2018). Furthermore, university graduates act as transfer channels of science and technology from universities to the industry (Paunov et al., 2017). In this case, university graduates enter various industries, either self-employed or as workers, and through this inflow there is an externality of science and technology, in which the provision of science and technology brought by college graduates provides positive benefits for increasing productivity in these industries.

The results of the latest labor force survey conducted by the Indonesian national statistics agency (BPS) show that the share of labor in Indonesia is dominated by groups that have a level of secondary to lower education. From this data we can also see that the proportion of workers with a higher education qualification continues to grow over time, but still constitute the smallest proportion of total Indonesian workforce, that is 12,07% (BPS, 2017). The World Economic Forum (WEF) in the global competitiveness report published recently stated that the level of technological readiness (technological readiness) of Indonesian labor is generally low. It was also stated that innovative activities were able to be carried out, but the benefits were not evenly distributed (Schwab, 2018).



Source: BPS (2017), processed.

FIGURE 1. COMPARISON BETWEEN THE TOTAL NUMBER OF WORKERS AND NUMBER OF HIGH- EDUCATED WORKERS (HL)

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The positive growth of the number of tertiary graduates in the total workforce in Indonesia as indicated by the data creates hopes as well as question: what is the impact of the existence of college graduates as a group of highly skilled workforce on productivity growth in various industries. Another question that also needs to be addressed is how is the variation in productivity growth in various industries with the existence of highly skilled workforce produced by universities? Therefore, this study aims to identify the contribution of university graduates as a group of high skilled labor towards economic productivity in various industries in Indonesia.

II. LITERATURE REVIEW

There are some literatures that discusses the role of university graduates in relation to economic productivity, both in micro and macro aspects. Cadence Economics (2016) reports that in Australia the entry of tertiary graduates into the workforce has created positive effects enjoyed by workers with lower education qualifications, among others creating new jobs in significant numbers and causing an increase in wage rates. In addition, at the industry level, the presence of a highly educated workforce has led to an increase in the industrial competitiveness in this country. Meanwhile Leten et al (2014) found that highly educated workers gave a positive contribution on patents produced by companies in Italy in the machinery, electrical, chemical and pharmaceutical industries. Another important study to note is as done by AWPA (2013), which states that the productivity effects of higher education tend to be more significant in developed regions where high educated workers are more needed in order to absorb latest technology and innovation compared to lagged region.

Recent studies such as done by Hanushek, Ruhose, & Woessmann (2017) shows that differences in knowledge capital have caused differences in GDP per capita by 20-30 percent among states in the US. These results are obtained through development accounting analysis, where the school exam scores (cognitive aspects) and the mean year of schooling of the population in each state are used as a measure of knowledge capital.

From a microeconomic perspective, Carlier et al (2017) argues that the choice of corporate strategy to create and maintain competitive advantage is limited by several factors, where one important factor is the level of human resource development. This is because the quality of the product / service of a company is determined by the level of human capital of its workforce. Furthermore, Papakonstantinou (2017) examines whether the composition of human capital is important for economic growth. In her conceptual framework, it is explained that economic output (GDP) is a function of technology, fixed capital and quality workforce. Furthermore, she defined the quality workforce as a result of multiplication between the number of workers and their mean years of schooling. She distinguished the effects of education from various levels (high, medium, and basic) on TFP growth, and found that higher education had a significant and positive impact on TFP increase in 106 countries, both developed and developing countries.

More specifically about the quality of human resources, several studies have been conducted on the relationship between the existence of college graduates on the one hand and economic productivity on the other. In its report, Cadence Economics (2016) mentioned that there are some positive impacts of the existence of college graduates on economic productivity growth. First, higher educated workers encourage their lower educated colleagues to jointly improve team performance so that resulting in increased productivity. Second, with the increase in the number of higher educated workforce in the population of a country, the number of lower educated workers will decrease which results in increased demand for lower educated workers, which in turn will increase their wage rates. The third impact is in the form of consumption effects, where an increase in the wages of higher educated workers will increase their consumption of goods and services offered by lower educated workers. And lastly, on the fiscal side, the increase in income received by higher educated workers will cause greater tax revenue for the Australia.

Furthermore Leten, Landoni, & Looy (2014) examined the positive influence of the existence of university graduates working in companies in the machinery, electrical, chemical and pharmaceutical industries in Italy, as measured by the number of patents achieved by these companies. They found that skills and scientific knowledge obtained by these graduates during their study in the university enable them to carry out tasks related to R&D such as complex problem solving activities and offered novelty to industrial issues where they worked. Meanwhile, other studies examine the role of university graduates as transfer channel for science and technology transfer from universities to industries [i.e., Paunov et al (2017)], a positive and significant influence of the entry of university graduates as labor inputs for companies [i.e., Braunerhjelm et al, (2018)], and variations between regions on the contribution of higher educated labor to economic productivity growth [i.e., AWPA 2013]].

III. METHOD

In studying the contribution of university graduates to productivity growth in various industries, we use labor force survey data as the main data in addition to macroeconomic data such as gross domestic product and others sourced from the Indonesian national statistical agency (BPS). The classification of industries here refer to the International Standard Industrial Classification of all Economic Activities (ISIC) Revision 2.0 defined by the United Nations Statistics Division. As a first step to do data processing, we compile a dataset with several main variables, among others, GDP by industry as the economy output, gross fixed

capital formation as capital stock, the number of workers by industry, and the number of higher education qualified workers by industry. The author also compiled a number of other variables needed in processing data in accordance with the objectives of this study. All variables are presented with the 1990-2017 data series sourced from several BPS publications.

The contribution of highly educated workers to economic productivity growth can be studied through measurement of total factor productivity (TFP) growth in various industries. The use of the TFP growth as a dependent variable cannot be separated from the breakthroughs made by Benhabib & Spiegel (1994) who found that the contribution of human capital on output growth per capita was not significant or even negative when estimated through the model of standard Cobb-Douglas production function , but positive when regressed against the variable of TFP growth. Recent research that also uses TFP growth variables to estimate the effect of labor force education attainment on economic productivity growth is as done by Papakonstantinou (2017), which found that higher education had a significant and positive impact on TFP growth in 106 countries, both on developed and developing countries.

In line with the two previous studies above, this study estimates the impact of the existence of highly educated workforce on TFP growth in various industries in Indonesia through the following main models.

$$G\_TFP_{i,t} = \beta_0 + \beta_1\, S\_HL_{i,t} + \varepsilon_{i,t} \tag{1}$$

where, the dependent variable $G\_TFP_{i,t} = \Delta\, ln\left(TFP_{i,t}\right) = ln\left(TFP_{i,t}\right) - ln\left(TFP_{i,t-5}\right)$ denotes TFP growth at 5-year intervals based on industry *i*, and the independent variable $S\_HL_{i,t}$ denotes the ratio of highly educated workers to the total number of workers based on industry *i*.

To calculate TFP, we use the Tornqvist index as a method that is very well used to explain changes in input quality. As stated by Rosegrant & Evenson (1992), the Tornqvist index provides aggregation of inputs and outputs through several assumptions, including a constant return scale. Adapting Papakonstantinou (2017), the calculation of TFP growth variables was carried out using the Tornqvist quantity index for the input factor as the first step.

$$ln\left(Q^T_{t,t-1}\right) = \frac{1}{2}\left(SK_t + SK_{t-1}\right) ln\left(\frac{K_t}{K_{t-1}}\right) + \left(1 - \frac{1}{2}\left(SK_t + SK_{t-1}\right)\right) ln\left(\frac{L_t}{L_{t-1}}\right) \tag{2}$$

where, Q^T denotes Tornqvist quantity index for factor input, $SK \equiv 1 - SL$ denotes share of capital stock to output, *K* denotes capital stock, and *L* denotes labor.

Furthermore, the TFP inter-temporal comparison is obtained through the formulation suggested by Inklaar & Timmer (2013) as follows

$$TFP^i_{t,t-1} = \frac{K^i_t}{K^i_{t-1}} \Big/ Q^T_{t,t-1} \tag{3}$$

The data used in this study as well as other time series data are not stationary so that certain methods are needed to avoid the results of spurious regression. Given the difference in the degree of stationarity between the dependent variable and the independent variable, we uses the Autoregressive-Distributed Lag (ARDL) model in this study as a model that has been used for decades in the analysis of various cases.

IV. Results and Discussion

The estimation results using the ARDL model show that the existence of higher educated workforce has a significant and positive influence on TFP growth in several industries as can be seen on Table I. The Real Estate and Business Services (sector 8) is one of the industrial sectors that experience positive and significant productivity growth from the input of highly educated workforce in the sector. Indeed, descriptively the number of university graduates in the composition of labor in that sector is higher than in other sectors. This result is not much different from what was found by Lee & McBibbin (2018) where sector 8 is one of the sectors that has experienced high productivity growth in the Asian economies.

The result also shows that empirically the results do not always support normative expectations that the input of highly educated labor will have a positive influence on productivity growth in all sectors. The different responsiveness of these sectors to the input of highly educated workers has been demonstrated by previous literature, such as Paunov, Planes-Satorra, & Moriguchi (2017) who found that the input of highly educated workforce had different impacts on productivity growth of industry sectors. For example, the agricultural industry will not experience an increase in productivity with the entry of university graduates into

the industry. On the other hand, the field of industry of service as well as manufacturing experienced a significant productivity growth with the entry of the university graduates that bring along knowledge to that Industries.

TABLE I. ESTIMATION RESULT OF ARDL MODEL

Sector	*G_TFP*			*S_HL*			*Lag Method*
	Coef.	*Prob*	*Lag*	*Coef.*	*Prob*	*Lag*	
1	-0,69673	0.0024***	(-2)	9,572873	0,2324	(-5)	Auto
2	0,407764	0.099*	(-1)	-3,77179	0,3299	(-5)	Auto
3	0,486511	0.0955*	(-3)	10,16181	0,3389	(-6)	Fixed
4	-0.57235	0.0245**	(-10)	1.802.152	0,1216	(-8)	Fixed
5	-1.079.66	0,0162**	(-2)	-1.845.38	0,1145	(-6)	Fixed
6	-0,19527	0,5266	(-2)	7,273359	0,5667	(-9)	Fixed
7	-0,72454	0.0097***	(-5)	-4,10499	0,2786	(-8)	Fixed
8	-0,16925	0,4507	(-1)	0,596696	0.0599*	(-5)	Auto
9	-0,34318	0,3573	(-2)	4,63952	0,2596	(-9)	Fixed

V. CONCLUSIONS

There is a challenge for Indonesia to become the country with knowledge-based economy. At least this was reflected in the very small proportion of university graduates in the total workforce in this country. However, the empirical analysis carried out in this study has shown that the existence of human capital with higher education has enabled the realization of productivity growth in certain sectors.

It is a very good thing if the lessons learned from the productivity growth that has occurred in the sectors mentioned above can also be realized in the sectors that are main contributor to GDP in Indonesia such as the manufacturing sector and the agricultural sector, so that the existing level of productivity growth will get a large multiplier factor.

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