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Human Development Index and Labor Productivity in Central Sulawesi Province: Granger Causality Test and Panel Data Regression

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Abstract

This study aims to analyze the effect of the human development index (HDI) on labor productivity. This study used panel data by district/city in Central Sulawesi Province in 2017-2020. The analytical method used is the Granger Causality Test and the panel data regression model. This study found that first labor Productivity (LP) had a positive and significant effect on the productivity index (PI). Second is the open unemployment rate (OUR) has a positive and significant effect on the human development index (HDI). Third, the open unemployment rate (OUR) has a negative and significant effect on the labor force participation rate (LFPR).

Keywords
Productivity; productivity index; HDI; OUR; LFPR

I. Introduction

Economists have long highlighted and emphasized the importance of human capital to economic growth and Productivity (Xiang and Wei, 2013). Human capital is a critical component of economic growth (Azorin, and De La Vega, 2015). According to Lucas (1988), Romer (1990), and Barro (2001), the accumulation of human capital leads to higher growth since it generates positive externalities and contributes to the development of new LPucts, hence accelerating technological advancement.

In the meantime, productivity has garnered much attention in recent macroeconomic research. Where human capital (health and education) drives labor Productivity, it becomes extremely significant. The health and education workforce quality is critical and has an impact on labor Productivity (Ezoji et al., 2019).

Chandran et al. (2020) stated that boosting productivity is vital not only for enhancing competitiveness but also for gaining additional benefits. Mate (2015) found that the association between education and Productivity development is valid when analyzing time-series panel data from diverse nations.

Previous empirical studies conducted by Fuente and Demenech (2000; 2002), Arnold et al. (2007), Cohen and Soto (2007), indicating a direct influence of human capital on productivity and economic growth, or empirical findings by Fuente and Demenech (2000; 2002), Arnold et al. (2007), Cohen and Soto (2007), support this condition. It demonstrates how human capital is crucial to technological advancement. Durlauf et al. (2008) and Henderson et al. (2010) investigated the existence of empirical evidence of the relationship between human capital and technological development (2012). According to Chandran et al. (2020), boosting Productivity is vital not only for increasing competitiveness but also for improving wellbeing. However, empirical research suggests that economic growth and gains in human capital have little or a limited link. However, empirical research suggests that economic growth and gains in human capital have little or a limited link. On the other hand, Pritchett's findings support the presence of a weak link between the variables of economic growth and human capital (2001).

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Investment in human capital, which stresses formal and informal education, is one of the most significant procedures in generating a quality workforce to meet labor market demands (Rukumnuaykit and Pholphirul, 2015). Increased labor productivity leads to higher earnings, better living conditions, and economic prosperity, which may be judged as a success in human capital investment.

According to data given by Central Sulawesi Province's Central Statistics Agency (CSA), HDI values have increased in all districts/cities. Palu City has a very high HDI rating (81.5), and there are three districts with high HDI values: Morowali Regency (72.02), Poso Regency (71.28), and Banggai Regency (70.52). In Central Sulawesi Province, on the other hand, the open unemployment rate (OUR) in 2020 was 3.77 percent, up 0.66 points from the previous year. According to the data, there are 83 thousand unemployed persons in Central Sulawesi Province, divided among districts and cities. Palu City, with 9.78 percent unemployment, Morowali Regency, with 7.19 percent unemployment, and Poso Regency, with 4.48 percent unemployment, are the three regions with the highest unemployment rates. This study explores the impact of human capital development on broad labor Productivity and economic growth in Central Sulawesi Province based on these empirical settings. Human Resources (HR) is the most important component in a company or organization to run the business it does. Organization must have a goal to be achieved by the organizational members (Niati et al., 2021). Development is a change towards improvement. Changes towards improvement require the mobilization of all human resources and reason to realize what is aspired (Shah et al, 2020). The development of human resources is a process of changing the human resources who belong to an organization, from one situation to another, which is better to prepare a future responsibility in achieving organizational goals (Werdhiastutie et al, 2020).

Human development in Central Sulawesi continues to grow, according to data from the Central Statistics Agency (CSA) of Central Sulawesi Province, as evidenced by an increase in the Human Development Index (HDI). The HDI for Central Sulawesi Province will be 69.79 in 2021. This HDI increased by 0.24 percent from 2020 when it was 69.55, a 0.35 percent rise. The quality of human development in Central Sulawesi remains moderate in 2021, as it was in 2020. The enhancement in the dimensions of HDI production is responsible for the increase in HDI. In February 2021, the working-age population will be 2.28 million individuals. The workforce employs the majority of the working-age population, which totals 1.58 million people. Meanwhile, the rest of the population is unemployed. The labor force participation rate (LFPR) in February 2021, on the other hand, was 68.93 percent, 0.51 percent lower than in August 2020. Meanwhile, in February 2021, the open unemployment rate (OUR) was 3.73 percent, 0.04 points lower than in August 2020. Meanwhile, 973.27 thousand persons, or 64.17 percent of the population, were employed in the informal sector in February 2021, down 3.20 percent from August 2020. Meanwhile, the highest percentage of full-time workers (at least 35 hours per week) was 61.88 percent in February 2021. Meanwhile, 38.12 percent of the population worked part-time (less than 35 hours per week), accounting for 8.3 percent of the unemployed and 29.82 percent of part-time workers.

II. Review of Literature

The concept of human capital became popular in the 1960s (Le et al, 2019). Human capital is a collection of skills and knowledge that is manifested in the ability to labor and so generates economic value. Human capital can encompass information, skills, and traits that benefit individuals, society, and the economy as a whole (Rodriguez and Loomis,

2007). According to Le et al (2019) labor Productivity can rise in the short or long term through any lessons, including learning from mistakes and beneficial experiences, or owing to workers' ability to learn on their own. In addition, according to Le et al (2019), the twenty-first century is an economic period centered on knowledge and the creative economy. Science and technology are transformed into LPuctive forces in society. In developing and poor countries, there has been a growing demand to enhance worker Productivity and LPuct quality on a national level. Based on empirical facts, the countries of Korea, Taiwan, and Singapore have demonstrated that innovation and creativity are critical determinants in enhancing worker productivity and growth. Meanwhile, according to Silver (2014), the labor Productivity index is defined as GDP per hour worked, whereas labor input is defined as the average hours worked by all employed persons multiplied by the number of workers in each country.

Empirical data suggest that if the workforce owns the correct circumstances of health care and education, LPuction will increase. For Pakistan, studies by Khan et al (2005) and Afridi (2016), for Greece, Benos and Karagiannis (2016), Tsai et al (2010), and Li and Wang (2018), and China, research by Tsai et al (2010) and Li and Wang (2018). Sustainable output growth and enhanced labor productivity, according to Ezoji et al (2019), are dependent on the availability of human capital, which improves because of improved education, better health, and new learning and training activities. Investing in human capital entails making investments in areas such as health and education, all of which lead to higher employee productivity. Training and investment in education have been demonstrated to not only reduce mortality and malnutrition but also to raise life expectancy, according to empirical research.

Hermannsson and Lecca (2016) found that the key transmission mechanism depends on the interaction between the labor market and trade, which leads to overall results, when looking at the impact of human capital on economic development, particularly the impact of labor Productivity on macroeconomic performance through two processes, namely, boosting worker Productivity and enhancing competitiveness to stimulate exports. Baker et al. (2020) investigated the mediation effect of internet use on the connection between human capital and total labor Productivity, as well as labor Productivity by sector. The results of the mediation model, which used panel data regression with a fixed effect (fixed effect) and bootstrapping, revealed that internet use has a mediating effect of 24.20 percent on total human capital, 27 percent on labor Productivity in the service sector, and 23 percent in industry, but the mediating effect was inconsistent in agriculture.

The findings of Merchante and Ortega's (2012) research, which identified the key factors of labor Productivity, demonstrate that there is a gap between employee education and the education required for a certain worker. Where hotel personnel (employees) with work-related education are more LPuctive than those with non-work-related education. Furthermore, hotel personnel (workers) with lower levels of education are less efficient than those with greater levels of education. This research also discovered that hotel personnel (workers) with an average tenure of more than ten years perform better in terms of Productivity.

According to Van Zottum and Van Zanden's (2014) findings on the relationship between labor productivity and human capital in the European maritime sector in the 18th century, the level of human capital on board European ships was relatively high. In addition, there was a strong relationship between labor productivity and the quality of the workforce in the shipping sector. This is a clear result that shipping is a high-tech industry that not only utilizes high-quality capital goods but also requires high-quality people to manage ships. Moreover, their increasingly sophisticated equipment is a complementary input.

III. Research Method

The Granger causality test and the Danel data regression model were used to analyze the data in this investigation, which was done in two stages. In stage 1, a Granger causality test was used to determine the relationship between variables, allowing the direction of each variable to be determined. As shown in Table 3.1, the Granger causality test model is as follows.

Table 1. Granger Causality Test

Model	Granger Causality Test
1. Model I	$LP_{it} = \vartheta_i + \theta_1 \, IPROD_{it} + \epsilon_{it}$
2. Model II	$PI_{it} = \vartheta_i + \theta_1 \, PROD_{it} + \epsilon_{it}$
3. Model III	$HDI_{it} = \vartheta_i + \theta_1 \, PROD_{it} + \epsilon_{it}$
4. Model IV	$LP_{it} = \vartheta_i + \theta_1 \, IPM_{it} + \epsilon_{it}$
5. V model	$LFPR_{it} = \vartheta_i + \theta_1 \, PROD_{it} + \epsilon_{it}$
6. Model VI	$LP_{it} = \vartheta_i + \theta_1 \, TPAK_{it} + \epsilon_{it}$
7. Model VII	$OUR_{it} = \vartheta_i + \theta_1 \, PROD_{it} + \epsilon_{it}$
8. Model VIII	$LP_{it} = \vartheta_i + \theta_1 \, TPT_{it} + \epsilon_{it}$
9. Model IX	$HDI_{it} = \vartheta_i + \theta_1 \, IPROD_{it} + \epsilon_{it}$
10. Model X	$PI_{it} = \vartheta_i + \theta_1 \, IPM_{it} + \epsilon_{it}$
11. Model XI	$LFPR_{it} = \vartheta_i + \theta_1 \, IPROD_{it} + \epsilon_{it}$
12. Model XII	$PI_{it} = \vartheta_i + \theta_1 \, TPAK_{it} + \epsilon_{it}$
13. Model XIII	$OUR_{it} = \vartheta_i + \theta_1 \, IPROD_{it} + \epsilon_{it}$
14. Model XIV	$PI_{it} = \vartheta_i + \theta_1 \, TPT_{it} + \epsilon_{it}$
15. Model XV	$OUR_{it} = \vartheta_i + \theta_1 \, IPM_{it} + \epsilon_{it}$
16. Model XVI	$HDI_{it} = \vartheta_i + \theta_1 \, TPT_{it} + \epsilon_{it}$
17. Model XVII	$LFPR_{it} = \vartheta_i + \theta_1 \, IPM_{it} + \epsilon_{it}$
18. Model XVIII	$HDI_{it} = \vartheta_i + \theta_1 \, TPAK_{it} + \epsilon_{it}$
19. Model XIX	$OUR_{it} = \vartheta_i + \theta_1 \, IPM_{it} + \epsilon_{it}$

20. Model XX	$HDI_{it} = \vartheta_i + \theta_1 TPT_{it} + \epsilon_{it}$
21. Model XXI	$OUR_{it} = \vartheta_i + \theta_1 TPAK_{it} + \epsilon_{it}$
22. Model XXII	$LFPR_{it} = \vartheta_i + \theta_1 TPT_{it} + \epsilon_{it}$

Following the results of the Granger causality test study in Table 3.1 (first stage), analysis was conducted using a panel data regression model with three primary forms. Those are CEM (common effect model), FEM (fixed-effect model), and REM (random effects models). The effect of each independent variable (influential variable) on the dependent variable (influenced variable) will be displayed in the regression analysis stage of the panel data.

IV. Result and Discussion

4.1 Granger Causality Test Results

Table 2. Granger causality test results

Null Hypothesis:	Obs	F-Statistics	Prob.
PI does not Granger Cause LP	26	290.997	5.E-16
LP does not Granger Cause PI		1.42093	0.2638
HDI does not Granger Cause LP	26	0.32276	0.7277
LP does not Granger Cause HDI		0.69848	0.5085
LFPR does not Granger Cause LP	26	2.08731	0.1490
LP does not Granger Cause LFPR		0.50128	0.6128
OUR does not Granger Cause LP	26	0.09331	0.9113
LP does not Granger Cause OUR		0.04070	0.9602
HDI does not Granger Cause PI	26	0.10325	0.9024
PI does not Granger Cause HDI		0.89712	0.4228
LFPR does not Granger Cause PI	26	0.32396	0.7268
PI does not Granger Cause LFPR		0.81211	0.4574
OUR does not Granger Cause PI	26	0.52702	0.5980
PI does not Granger Cause OUR		0.50179	0.6125
LFPR does not Granger Cause HDI	26	5.07691	0.0159
HDI does not Granger Cause LFPR		0.45880	0.6382
OUR does not Granger Cause HDI	26	0.85769	0.4385
HDI does not Granger Cause OUR		4.77352	0.0195
OUR does not Granger Cause LFPR	26	0.17754	0.8386
LFPR does not Granger Cause OUR		2.78283	0.0847

Causation test by Granger several variables in Table 4.1 have a one-way relationship, and none of the variables have a two-way relationship. The following variables have a one-way relationship:

1. Productivity Variable (LP) Affects Productivity Index (PI) and not vice versa;
2. The Human Development Index (HDI) variable affects the Labor Force Participation Rate (LFPR) and not vice versa;
3. Variable Open Unemployment Rate (OUR) affects the Human Development Index (HDI) and not vice versa;
4. The Open Unemployment Rate (OUR) variable affects the Labor Force Participation Rate (LFPR), and not vice versa.

Based on the Granger causality test findings in table 4.1, the second step of the analysis, namely the panel data regression model for each variable with a directional relationship (the Granger causality test results), is carried out as follows:

Table 3. Panel Regression Model

Model	**Form**
1. Model A	$PI_{it} = \varphi_i + \theta_1 \, PROD_{it} + \epsilon_{it}$
2. Model B	$LFPR_{it} = \varphi_i + \theta_1 \, IPM_{it} + \epsilon_{it}$
3. Model C	$HDI_{it} = \vartheta_i + \theta_1 \, TPT_{it} + \epsilon_{it}$
4. Model D	$LFPR_{it} = \vartheta_i + \theta_1 \, TPT_{it} + \epsilon_{it}$

According to Table 4.2, the relationship between human capital and productivity is studied using four (four) panel regression models.

Table 4. Results of Model A. Panel Regression

Independent Variable	Dependent Variable: PI		
	Common Effect Model	Fixed Effect Model	Random Effect Model
LP	3.347070***	4.857655***	3.247070***
R-squared	0.318962	0.435907	0.318962
Adjusted R-Square	0.305341	0.24297	0.305341
F-statistics	23.41731	2.258825	23.41731

Note: ***) significant at α= 1%; **) Significant at α= 5%; *) Significant at α= 10%.

Based on the results of the panel regression model A above, it can be explained that the labor Productivity variable (LP) has a positive and significant effect on the Productivity index variable (PI) according to districts/cities in Central Sulawesi Province. Panel data regression analysis based on the three common effect models (CEM), fixed effect model (FEM), and random effect model (REM) that were used gave the same results. This condition indicates that if the labor Productivity variable (LP) increases, the productivity index (PI) will also increase.

Table 5. Panel Regression Results Model B

Independent Variable	Dependent Variable: LFPR		
	Common Effect Model	Fixed Effect Model	Random Effect Model
HDI	0.071053	0.077276	0.076360
R-squared	0.022134	0.774956	0.049264
Adjusted R-Square	0.002576	0.697967	0.030249
F-statistics	1.131731	10.068584	2.590821

Note: ***) significant at α= 1%; **) Significant at α= 5%; *) Significant at α= 10%.

Based on the results of panel regression model B in the table above, it can be concluded that while all three-panel regression models state that the relationship between the HDI and the LFPR is positive, none of the three models provide significant results in explaining the effect of HDI on LFPR by regencies/cities in Central Sulawesi Province. Meanwhile, according to the Granger causality test, the human development index (HDI) variable has an effect on the LFPR variable in a one-way and significant relationship. However, it is not empirically confirmed in the panel regression model analysis.

Table 6. Panel Regression Results Model C

Independent Variable	Dependent Variable: HDI		
	Common Effect Model	Fixed Effect Model	Random Effect Model
OUR	2.345130**	-1.160386	1.709567
R-squared	0.094350	0.457826	0.043820
Adjusted R-Square	0.076237	0.272345	0.024696
F-statistics	5.208986	2.4468323	2.291385

Note: ***) significant at α= 1%; **) Significant at α= 5%; *) Significant at α= 10%.

Only the common effect model (CEM) yields the results indicating the open unemployment rate (OUR) variable has a positive and substantial effect on the variable human development index (HDI) per district/city in Central Sulawesi Province, based on the results of the panel regression model C above. This implies that those with secondary education (SMU/SMK/MI) and higher education (D1/D2/D3/Bachelor) account for the majority of the open unemployment rate (OUR).

Table 7. Panel Regression Results Model D

Independent Variable	Dependent Variable: LFPR		
	Common Effect Model	Fixed Effect Model	Random Effect Model
OUR	-0.979916**	-0.338691	-0.511200
R-squared	0.072223	0.763216	0.023367
Adjusted R-Square	0.053668	0.682211	0.003834
F-statistics	3.892282	9.421826	1.196302

Note: ***) significant at α= 1%; **) Significant at α= 5%; *) Significant at α= 10%.

Only the common effect model (CEM) yields the finding that the variable open unemployment rate (OUR) has a negative and substantial effect on the labor force participation rate (LFPR) by district/city in Central Sulawesi Province, based on the results of the panel regression model D above. That is, the lower the open unemployment rate (OUR), the greater the labor force participation rate (LFPR), and vice versa, the higher the OUR, the lower the LFPR.

V. Conclusion

It can be inferred as follows based on the results and discussion utilizing the Granger causality test analysis model and the panel data regression model.

1. Productivity (LP) has a positive and significant effect on the productivity index (PI) by district/city in Central Sulawesi Province.
2. The open unemployment rate (OUR) has a positive and significant effect on the human development index (HDI) by district/city in Central Sulawesi Province.
3. The open unemployment rate (OUR) has a negative and significant effect on the labor force participation rate (LFPR) by Regency/City in Central Sulawesi Province.

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