

# Article

by SusetyoDidik

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**Submission date:** 18-Apr-2023 10:43PM (UTC+0700)

**Submission ID:** 2068412569

**File name:** 2022\_07\_Eka\_Thanomutira\_et\_al\_MODERN.pdf (1.37M)

**Word count:** 5036

**Character count:** 32073

ISSN 2521-6392



МИКОЛАЇВСЬКИЙ НАЦІОНАЛЬНИЙ  
АГРАРНИЙ УНІВЕРСИТЕТ

# MODERN ECONOMICS

ЕЛЕКТРОННЕ НАУКОВЕ ФАХОВЕ  
ВИДАННЯ З ЕКОНОМІЧНИХ НАУК

**#33 (2022)**

Червень 2022

DOI: [HTTPS://DOI.ORG/10.31521/MODECON](https://doi.org/10.31521/MODECON)

МИКОЛАЇВ | 2022

 <https://modecon.mnau.edu.ua>

**JEL Classification:** A10; R10; R12.

**DOI:** [https://doi.org/10.31521/modecon.V33\(2022\)-15](https://doi.org/10.31521/modecon.V33(2022)-15)

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### Determinant of Total Factor Productivity Growth In South Sumatra

**Abstract. Introduction.** Total Factor Productivity (TFP) is size productivity, more high the Total Factor Productivity index is getting high productivity, so more high economic growth. Growth of the economy of South Sumatra province in some years experience a significant increase even more tall than the national average. Role technology in growth is very important. For that need, existence is a known determinant of TFP growth. Potential Output Variables Becomes moderating variable for variable Natural resources Nature and Income per capita against variable Dependent Total Factor Productivity.

**Purpose.** This research aims to determine and measure whether potential output variable as a moderating variable is able to strengthen or weaken the relationship between other input variables, such income per capita and natural resources towards variable Total Factor Productivity.

**Results.** Research results show that Potential Output Variables could Become variable Moderating variable Natural resources Nature and Income per capita, yield equality Moderating regression shows that Potential Output has moderation to variable Natural resources Nature and Income per capita by strong and significant weaken growth in Total Factor Productivity (TFP) of South Sumatra Province.

**Conclusions.** Based on the results coefficient determinant is known to score coefficient determination  $R^2$  of 0.92 while the coefficient determinant first equation (natural resource) state amount 0.89 dan second equation (income per capita) is 0.81, it is indicate that Potential Output as moderating variable able to weaken input variable natural resources and income per capita towards Total Factor Productivity (TFP) growth of Sout Sumatera Province.

**Keywords:** Total Factor Productivity (TFP); Moderating; Potential Output (OP); Natural resources Nature (SDA); Income Per capita (IC).

УДК 339.7

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### Детермінанта зростання загальної продуктивності факторів у Південній Суматрі

У статті доведено, що загальна продуктивність факторів виробництва (TFP) — це продуктивність за розміром, при цьому чим вищий індекс загальної продуктивності факторів виробництва, тим вищий рівень продуктивності, що означає більш високий рівень економічного зростання. Зростання економіки провінції Південна

<sup>1</sup>Стаття надійшла до редакції: 30.06.2022

Received: 30 June 2022

Суматра протягом досліджуваного періоду є значно вищим, ніж у середньому по країні. Роль технологій у зростанні є досить важливою. При цьому відомим визначальним фактором зростання є TFP. Потенційні змінні випуску стають модеруючою змінною для змінної «природні ресурси» та «дохід на душу населення» на відміну від змінної «залежна загальна продуктивність факторів виробництва».

Метою дослідження є визначити та виміряти, чи здатна змінна потенційного результату як модеруюча змінна посилити або послабити зв'язок між іншими змінними вхідних даних, такими як дохід на душу населення та природні ресурси, до змінної «загальна продуктивність факторів виробництва».

Результати дослідження свідчать, що потенційні змінні виробництва можуть бути модеруючими змінними природних ресурсів і доходу на душу населення, рівня врожайності. Модеруюча регресія показує, що потенційний випуск характеризується помірністю до змінних «природні ресурси» і «дохід на душу населення» внаслідок сильного та значного послаблення зростання загальної продуктивності факторів (TFP) у провінції Південна Суматра.

За результатами дослідження встановлено, що детермінант коефіцієнта оцінки R2 становить 0,92, тоді як детермінант коефіцієнта першого рівняння (природні ресурси) становить 0,89, а друге рівняння (дохід на душу населення) становить 0,81. Таким чином, потенційний випуск як модеруюча змінна здатна послабити вхідні змінні природні ресурси та дохід на душу населення в бік зростання загальної продуктивності факторів виробництва (TFP) у провінції Південна Суматра.

**Ключові слова:** загальна продуктивність факторів (TFP); модерація; потенційний випуск (OP); природні ресурси (SDA); дохід на душу населення (IC).

**Formulation of the problem.** Growth economy for the area is an indicator important for knowing success development that has been achieved as well as useful for determining direction development in the future come. Growth healthy economy is accompanied by growth and increasing productivity (Sigit, 2001). Growth economy in general occurs because enhancement use factors production such as capital, energy work as well as an increase in Total Factor Productivity (Suryadi, 2001). Growth economy by macro have multiplier impact of increase sector economy, however so in general started by existence factor investment. Investation is key main in an effort reach enhancethe growth economy, which reflects the ability to increase rate growth and rate income. Besides that investment can also expand

opportunity work, push progress technology and specialization in production so that minimize fare production as well as excavation natural resourcesnature, industrialization and necessary market expansion for progress economy area (Kuncoro, 2004).

South Sumatra Province with various superior natural resources nature and other endowment factors have enough potential \_ strong for becoming a developed area that has an impact on the progressing economy by national. Based on Ministry data Finance 2019 is known that the rate of growth in South Sumatra's economy experienced the increase and the highest on the island of Sumatra, following data on the rate of growth economy island Sumatra (Fig. 1).

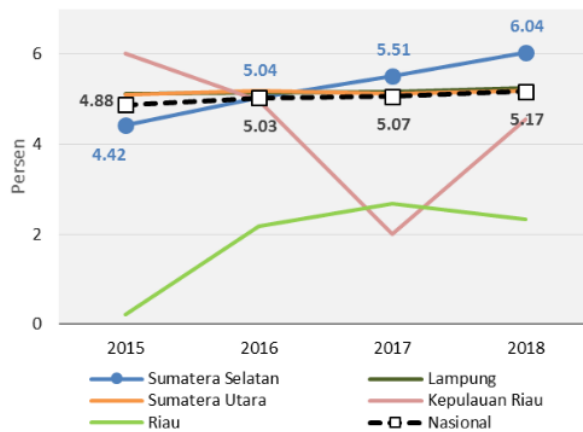


Figure 1- Rate Economic Growth of Sumatra Island (2015-2018)

Source: BPS data (processed)

Since years 2017-2018, LPESouth Sumatra has always been taller compared to four Province other and also

National. Lampung Province also has a good trend of increasing LPE with an average of 5.17%. Lowest LPE

occurred in 2015 which was 5.13% and the highest LPE achievement occurred in 2018 which was 5.25%. The LPE trend in Lampung Province is the same case as in North Sumatra Province, however, had a time fallont 2017 and

back experienced an increase in 2018 which was 5.18% with the average LPE being 5.15 %. The LPE of the Riau and Riau Islands is below the provincial average other than nationally. Riau Archipelago's average LPE is 4.39%, the lowest LPE occurred in 2017 which was 2% and the highest LPE achievement occurred in 2015 which was 6.02%. The average LPE of Riau Province is 1.86%, a percentage this is the lowest LPE if compared to four Province other. However though thereby The contribution of the GRDP of Riau Province to the National GDP is the highest.

Total Factor Productivity (TFP) is defined as size growth performance productivity economy shown from advantages output/ value growth plus after growth power, labor and capital are issued (Sulthani and Kurniawan, 2001). In other words, concerning productivity, so with GDP can also calculate the Total Factor Productivity (TFP) of a country/ region. TFP describes to what extent is capital and energy? work could synergize so that produce more output big. When seeing countries that have up like Japan and Singapore then capital and energy work no again become factor main in contributor score to GDP however it is TFP that becomes factor mainly (Nugroho, 2005). Low progress technology could cause low productivity (Todaro, 2003). Low productivity will become dangerous because the input factor of the sector's sustainable economy decreased. Size productivity that can be described as influencing the use of technology in the production process is Total Factor Productivity (TFP). TFP is size from comprehensive productivity because capable explain a change in production caused by changes in the number of inputs used, changes in technology, and utilization capacity and quality factor production, for that, 'important is known factors that only affects TFP growth direct nor no directly in the province of South Sumatra.

**Analysis of recent research and publications.** Productivity Productivity is a ratio of the resulting output with the input used. Measurement productivity could be conducted partially and totally. Measurement productivity Partial for example is productivity power work for the company and productivity land on agriculture. Size productivity Partial this could produce a wrong indication of productivity on whole. Whereas total productivity or Total Factor Productivity (TFP) is size productivity that involves all outputs and inputs in measurement (Coelli, 2005). TFP can also be interpreted as part of the output that is not can be explained by its conventional input (Comin, 2006). Base theory growth economy used many refer to the neoclassical growth model where level growth a country only explained with emphasis to function production aggregate with factor production power labor and capital. Other influencing factors are growth economy besides power labor and capital considered as exogenous progress technology (Solow in Mankiw, 2003). The Solow Model used for measuring TFP comes from function Cobb Douglas production. Romer in 1986 developed the theory of

endogenous growth that can resolve several problems in the theory neo-classical growth, one of which is the removed assumption of exogenous Daru progress technology. Though there is a different assumption, function production used same as that proposed by Robert M, Solow.

The Cobb-Douglas Theory was first introduced through something articles and published in the magazine American Economic Review 18 (supplement). And when this is known with theory function production and is one function that has two variable or more namely endogenous and exogenous, because that rules regression applies in solution function Cobb Douglas production, as for equality geometric he could be written as follows:

$$Q_i = f(K_i, L_i)$$

$$Q_i = K_i^\alpha L_i^{1-\alpha} \text{ Where } \alpha + 1 - \alpha = 1 \dots \dots \dots (1)$$

Description :

$Q_i$  = Output

$K_i$  = Capital/Capital

$L_i$  = Labor/ energy work

the constant return to scale is an assumption based on the Cobb Douglas function where summation elasticity substitution that shows scale the return amount one or  $\alpha + 1 - \alpha = 1$ . In progress, Cobb Douglas functions evolve and give rise to models new where variables input exogen into the Cobb Douglas function not limited only to capital and energy work but can also be added to other input variables following need. For example, enter the technical progress variable as another variable that has a role in affecting the output. This thing is due to output growth that occurs not forever caused by an accumulation of input growth, there is a possibility caused by the presence of mastery more technology good.

Total Factor Productivity (TFP) is something draft known by various names namely: Solow residual, residual productivity ( residual productivity ), total factor productivity, and multifactor productivity, all of these labels refer to residual or growth that is not can be explained in various input functions production ( Bureau of Labor Statistics, 2007). The Total Factor Productivity (TFP) Model is a research model empirically general ( majority ) that emphasizes the level variable, not at level growth. Different things with estimation model level growth where our lost information relationship at the level connection between variable. Likewise, the same opinion was put forward by Hall and Jones (1999) with the argument that more TFP model research could answer a question about the difference in productivity, or difference in income that reflects the difference in prosperity, and level of growth that can seen the effect on the level variable.

Residual in results Solow's analysis that increased output produced from production process changes no could be directly connected with input growth. If the input is not yet could be measured by the truth that can reflect a change in technology new and innovation so the

result will ambiguous. Economists classic experience / do ambiguous this by assuming that factor production paid

through the value of their marginal product (value of their marginal product) so that amount of innovation new that improves production will be paid taller than it should be and this will be reflected in every that input stage alone. The Cobb-Douglas function model proposed by economists neoclassical if it is assumed that the market is characterized as a competitive market perfect (imperfect competition) then assumption neoclassical now will hold and return ambiguous. typical of what happened in estimation empirical function production is if occur some adjustment (change) in input factor then will be reflected/felt changes in input quality and in progress technical by embodied (technical progress embodiment). After adjustment, this made size from progress disembodied technical (disembodied technical progress) or total factor productivity (total factor productivity) which is often called TFP.

Notes empirical showing that when same technology used for adapting input factor than the proportion of the output of industrialized countries because of more TFP disembodied small from middle countries developed in Asia (Dowling & Summers, 1998) the Cobb-Douglas theory as a production function explains the correlation between the output (Output) and input (input) factors, as shown by the equation follows:

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha} \dots \dots \dots (2)$$

Where:

Y<sub>t</sub> = output

K = capital

L = power work

A<sub>t</sub> = development technology disembodied which includes: efficiency power work, capital efficiency, improvement skills (skill improvement) and factors other, all this usually called as residual or effectiveness of inputs to outputs.

Amount of and 1-α describe constant returns to scale.

With enter index quality from power work (index of labor quality) in the equation could obtain equality following this:

$$Y_t = A_t K_t^\alpha (LQ)_t^{1-\alpha} \dots \dots \dots (3)$$

Where Q is index quality from power work. If the equation formed in the log then with the used differential could calculate level growth, such as seen in the equation following this:

$$Y_t = a_t + \alpha K_t + (1-\alpha)L_t \dots \dots \dots (4)$$

Where:

y = level output growth

a<sub>t</sub> = level growth from development technology (TFP)

and 1-α in a competitive market perfectly describes the value of the marginal product (value of the marginal product) of capital and energy work.

The residual estimated value of equality could be obtained with regression where from the residual value will obtain score total factor productivity (TFP) as in the equation following this:

$$a_t = Y_t - \alpha K_t - (1-\alpha)L_t \dots \dots \dots (5)$$

Where:

a<sub>t</sub>: Residual, as TFP estimation

α: Estimate from contribution capital against income

1-α: Contribution of labor to income.

Several studies regarding the Total Factors of Production have been conducted by some researchers including:

Saleem, H. S. et al. (2019). The study was conducted to see factor total driving factors of productivity and the growing economy in Pakistan. The method used is the function model Cobb-Douglas production with research data from the years 1972 - 2016. Research results show Pakistan's average growth is still experiencing some tough challenges. Growth of the economy is determined especially through technology congested works and activities manufacture oriented to export. However, the total productivity factor assessed from function production Cobb-Douglas aggregates that allow expansion of output and construction of inputs simultaneously. by overall almost all significant variables by statistics, even innovation by significant contribution to a growth economy.

Akihiro Otsuka, Mika Goto (2016), This study measures TFP in Japan using regional data and performs statistical tests to explain whether TFP growth in Japan is accompanied by regional disparity convergence. In addition, this study examined the impact of three effects on TFP growth and the effect of covariance. The results show that TFP increased over the long term, over 30 years, from 1980 to 2010, an impact on TFP and small covariance effects occurred. In addition, the results show that TFP does not grow in tandem with economic expansion, which is achieved by the concentration of industrial production in certain areas such as large metropolitan city areas. The results showed the role of growth in total factor productivity (TFP) on the convergence of regional disparities, the results showed the role of a high growth TFP would be able to reduce inequality, but high growth in TFP was not accompanied by growth in economic expansion.

Hermawan and Prayoga (2014), namely To do analysis productivity use the TFP approach and know factor determinants of TFP growth in the Sugar Industry in Indonesia. by short, the setback sugar industry in Indonesia is caused by a decline in productivity and power domestic sugar competition to imported sugar, if no quick overcome so could effect on independence food national. With thereby studies this is very important done, one of through application method TFP measurement, TFP is size widest from productivity and efficiency use natural resources. The study does its observation on 48 companies from the period 1993-to 2011 time. Processed data with use panel data regression model selection, estimation model first use function Cobb-Douglas production, fixed effect (FEM) and estimation second use random effect (REM) as estimation determinant TFP growth. The results showed that the average growth rate of TFP was low indicating that the industry experienced a drop in productivity so which caused the entry of imported sugar and has implications for domestic sugar

prices so that prices are no again competitive. Application TFP method shows that the sugar industry is *capital intensive* and highly dependent on input material raw sugar cane. Repair more technology Up or called investigation machines and energy consumption ( electricity ) can be effect TFP growth positive. These two variables could take effect significantly on the characteristics sugar industry which is *Capital Intensive*.

Fazri, et al., (2017), conducted research on the processing industry in Indonesia through a total production approach and a frontier statistical approach. Estimate use score *stochastic frontier analysis* with translog model approach Sirait (2007) and Modjo (2006). TFP growth model refers to Lovell (2000). TFP model based on equality Cobb-Douglas function. The results show that the role of TFP is very important in the industrial world, TFP represents the effectiveness of industrial performance, and with TFP measurement information will be obtained about the effectiveness of industrial performance which will ultimately increase company income.

**Formulation of research goals.** This research aims to determine and measure whether potential output variable as a moderating variable is able to strengthen or weaken the relationship between other input variables, such income per capita and natural resources towards variable Total Factor Productivity.

**Outline of the main research material.** Study this use approach quantitative with panel data. Time series data used covers the period 2010 – 2020 research. Meanwhile, the cross-section data used are 14 districts/cities for which data and information are available by complete in support study this.

Study this use method Ordinary Least Square (OLS) regression and regression moderating equation is done with reviews 10 program help.

Total Factor Productivity (TFP) is calculated with the use Growth Accounting approach with equality as follows:

$$At = Yt - 1 FDI - 2 ID - 3 L \dots \dots \dots (6)$$

Description :

At = Total Factor Productivity / Residual Solow

Yt = Economic Growth

FDI = Investment Foreign

ID = Investment Local

L = Labor

Equality Regression :

$$TFP = C + 1 PO + 2 IC + 3 SDA + \dots \dots \dots (7)$$

Description:

TFP = Total Factor Productivity

PO = Potential Output

IC = Revenue per capita

SDA = Natural resources Natural

Error Term

5 Study it also uses the interaction test. Interaction test or often called **Moderated Regression Analysis (MRA)** is an application of **special regression linear multiples**

where inequality the regression contains element interaction ( multiplication of two or more variable independent ). Method this used for test effect variable free to variable bound use variable moderation. Variable moderation will strengthen/weaken connection variable independent and variable bound (Ghozali, 2013).

Model selection is done with step first is the chow test for choosing the best model between the common effect model and the fixed-effect model. when the chosen one is the command effect continued with the BP-LM test for choosing the best model Among command effect and random effect. If the chosen one in the Chow test is the fixed effect model, then next with the Hausman test to choose **the best model between fixed effect and random effect models**

Assumption Test Classic. Inspection assumption classic conducted by method estimates used. If using the OLS method then assumptions that must-have classic fulfilled are normality, non-multicollinearity, homoscedasticity, and autocorrelation. But if method estimation uses other than OLS. When panel data is used then according to Verbeek (2000), Gujarati (2003), Wibisono (2005), and Aulia (2004) concluded that testing using panel data can ignore normality and autocorrelation tests, while to test assumptions classic only used multicollinearity and heteroscedasticity test.

Multicollinearity Test

When number count or correlation metrics < 0.9 then concluded free from symptom multicollinearity.

Heteroscedasticity Test

A variable bully who has variant no constant is called heteroscedasticity ( Widarjono, 2007). In the white test, if Prob. Chi-square > 0.05, then free from symptom heteroscedasticity.

Test Statistics

Statistical test in a study includes significant test by partial ( statistical t-test ), significant test by simultaneous ( statistical F test ), and coefficient determination (R<sup>2</sup> test).

1. t-test performed for knowing the existence of effect Among variable independent ( Potential Output, Revenue Per capita, Natural resources Nature ) against variable dependent (Total Factor Productivity).
2. F test used for knowing effect the significance of the variable free to variable bound by the whole.
3. Coefficient Determination (R<sup>2</sup>) R<sup>2</sup> test aims to determine the proportion or percentage of the total variation in variable bound which is explained by the variable free.

Moderating Regression (moderating variable) is variables that effect (strengthen or weaken) relationship Among variable independent and variable dependent. In a study, this potential output variable Becomes moderating variable.

Research Results

1. Model Selection



2

The model test, carried out with three stages namely study this is the Common Effect with table test results as the Chow, Hausman, and Langrane Multiplier (LM) tests, follows (Table. 1). obtained the best and selected model results in a

6

Table 1. Langrange Multiplier Test (LM Test)

Null (no rand. Effect) Alternative	Cross-section One-sided	Period One-sided	Both
Honda	16.19208 (0,0000)	-0,309077 (0,6214)	11,23098 (0,0000)
King-Wu	16.19208 (0,0000)	-0,309077 (0,6214)	10.44438 (0,0000)
SLM	19,25278 (0,0000)	-0.124784	-- --
GHM	-- --	-- --	262.1836 (0.0000)

Source: Eviews 10, data is processed

So that produces equality regression as follows (Table. 2).

Table 2. Equation Common Effect Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.614021	0.008997	68.24791	0.0000
SDA	0.030911	0.002109	14.65978	0.0000
IC	0.037402	0.005142	7.273407	0.0000
OP	0.000974	0.000738	1.320424	0.1887

Source: Eviews 10, the data is processed

## 2. Test Assumption Classic

### a. Multicollinearity

Equation model Determinant Technical Efficiency \_  
 general correlation between exogenous variables no

correlate > 0.9. could conclude that both models are free from symptom multicollinearity (Table. 3).

Table 3. Multicollinearity Test

	SDA	IC	OP
SDA	1.000000	0.778569	0.076595
IC	0.778569	1.000000	0.415697
OP	0.076595	0.415697	1.000000

Source: Eviews 10, data is processed

b. Based on the heteroscedasticity test showing no there is symptom heteroscedasticity in that model with all probability values variable results count is

above 0.05, so the model is believed to avoid symptom Heteroscedasticity (Table. 4).

4

Table 4. Heteroscedasticity Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.015376	0.005209	2.951842	0.0037
SDA	0.000112	0.001221	0.091464	0.9272
IC	-0.005077	0.002977	-1.705355	0.0902
OP	-0.000530	0.000427	-1.240365	0.2168

*Dependent Variable: RESUBS*

*Total panel (balanced) observations: 154*

Source: Eviews 10, data is processed

### 3. Test Statistics

F Uji test

F test results ( simultaneous ) obtained the result of F statistic is 488,9104 with Prob (F-Statistic) of 0.0000,

figure calculates more statistics small than 0.05. could conclude that all variable free effect variables are bound together (Table. 5).

4

Table 5. T. test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.614021	0.008997	68.24791	0.0000
SDA	0.030911	0.002109	14.65978	0.0000
IC	0.037402	0.005142	7.273407	0.0000
OP	0.000974	0.000738	1.320424	0.1887

Source: Eviews 10, data is processed

In table 5 it is known that by Partial Natural resources Nature and Income per capita effect variable bound, while Potential Output No have significant effect.

Coefficient determination or  $R^2$  gives information that big variable free could explain variable bound, data processing is obtained the R-Squared result is 0.0907220

and the adjusted R-Squared is 0.905365, p this means that 90.5 percent variable free could explain variable tiedup, while the rest effectd by variable another.

### 4. Moderating Regression

Moderation 1 (Table. 6).

Table 6. Equation Source Moderating Regression Power Natural

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.381194	0.043321	8.799340	0.0000
SDA	0.074978	0.006977	10.74624	0.0000
OP	0.043933	0.008726	5.035007	0.0000
M1	-0.006506	0.001418	-4.586652	0.0000

Source: Eviews 10, data is processed

Moderation 2 (Table. 7).

Table 7. Equation Income Moderating Regression per capita

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.532192	0.036511	14.57619	0.0000
IC	0.222461	0.022732	9.786379	0.0000
OP	0.033187	0.006771	4.901295	0.0000
M2	-0.022822	0.004147	-5.502690	0.0000

Source: Eviews 10, data is processed

Discussion:

a. Effect Natural resources Natural to Total Factor Productivity with Potential Output as Moderating variable

Research results show that the Potential Output moderating variable has a significant effect on Total Factor Productivity, with a level significance of  $0.0000 < 0.05$ , thereby could conclude that the Potential Output variable could moderate variable Natural resources Natural to Variable Total Factor Productivity (TFP). Based on the results coefficient determinant is known that score coefficient initial ( $R^2$ ) determinant of 0.90 while Coefficient

determination ( $R^2$ ) result equality moderation of 0.89, while index M1 coefficient shows of -.006506. see

results existing research return concluded that able moderating variable weakens by significant variable Natural resources Natural to Total Factor Productivity (TFP).

b. Effect Income per capita to Total Factor

Productivitywith Potential Output as Moderating variable Research results show that Potential output

moderating variable capable Becomes moderating variable \_ variable Income per capita to Total Factor Productivity strong. Probability significance level  $M_2$  obtained of  $0.0000 < 0.05$ , with thereby Potential output variable, can be stated moderate Income per capita based on calculation results coefficient initial ( $R^2$ ) determinant obtained index  $R^2$  of 0.90, while score

coefficient determinant ( $R^2$ ) result calculation moderation of 0.81 means Potential Output variable capable by significant decrease variable income per capita to Total Factor Productivity, however when seen from index coefficient obtained from results equality moderation  $M_2$  of -0.022822, with see index coefficient this so could conclude that Potential output variable capable effect by strong weaken variable Income per capita to Total Factor Productivity (TFP).

**Conclusions.** Research results show that the Potential Output moderating variable impacts negative and significant on the growth of Total Factor Productivity of

South Sumatra province in 2010 - 2020. Variable Natural resources Nature moderated by Potential Output negative and significant impact to variable Total Factor Productivity year research 2010-2020. Variable Income Per capita moderated by Potential Output negative and significant impact to growth in Total Factor Productivity of South Sumatra province. So that could conclude that the Potential output variable is capable of moderate weakening by significant variable Natural resources Nature (SDA) and Income Per capita (IC) against growth in Total Factor Productivity (TFP) of South Sumatra Province.

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