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An Analysis of Input Substitution Elasticity in Natural Resource-Based Industry in Indonesia. The Application of CES Function

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Abstract:

The proportion of resource-based industry groups in the industrial structure in Indonesia is 42.01%, yet its productivity is low because of its labor-intensive nature and limited capital, despite the direct contribution of the use of capital and labor to the creation of output. To optimize production, an input can be substituted by another input. However, it depends on the elasticity of substitution of the two inputs. The main objective of this research is to analyze the level of substitutability of inputs used in the natural resource-based industry group in Indonesia. Using the function of Constant Elasticity of Substitution (CES), the results of the study show that the substitutability level of capital and labor is inelastic, meaning that input substitution is relatively difficult. The results of this study imply that to increase its productivity, this industry group needs to strengthen the support from (government) policies to improve its workforce quality.

Keywords: natural resource-based industry; CES function; input substitution elasticity; substitutability level of input; production optimization.

JEL Classification: D57; D24; O13; L73

Introduction

Based on On its Web site, Badan Pusat Statistik (2014) shows that the industrial structure in Indonesia is dominated by resources-based and labor-intensive industry groups which make up to 67.79%, with 42.01% of it being from the resource-based industry. Based on ISIC 3 digits, this industry group consists of such industries as food and beverage; tobacco processing; wood, wood products (except furniture) and woven goods; paper and paper goods; rubber, and rubber goods, and plastic goods.This industry group is a potential one considering the relatively adequate availability of its inputs in Indonesia. This provides an opportunity for Indonesia to produce larger amounts of outputs, for the fulfillment of both domestic and foreign markets. Nevertheless, the productivity of this industry group is still relatively low because of the limited skilled-labor and capital. This is despite the direct

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1. A Brief Overview of Constant Elasticity of Substitution

According to Classical theory, which is in line with Neo-Classical theory, four factors might influence the growth of output, *i.e.* the number of population (labor), capital, natural wealth/land area, and technology. Among these inputs, capital and labor are important factors that can affect the size of the output produced. While the Neo-Classic growth model underlines that technological progress is an engine of economic growth, the proponents of endogenous growth theory (New Growth Theory) believe that technological progress is relatively difficult to measure. Therefore, direct input is often used as the basis of measurement to see the contribution of inputs to the output produced, in this case capital and labor.

Capital and labor are important direct inputs that can affect the amount of output produced. The relationship between input and output can be reflected in the production function. The production function shows how the input mix is used. In addition to capable of determining the size of output produced, the production function can also determine the level of efficiency of input use in the production process. Existing companies have varied abilities in substituting the inputs they use, despite the flexible nature of these inputs.

The use of direct input, especially capital and labor, has a contribution in creating a company's production or output capacity (Suharno et al. 2018). Increased capital that leads to improvements in production techniques will eventually increase efficiency. However, what often becomes a problem is determining the proportion of capital intensification to be used compared to the other production factors (especially labor). In its use, capital can be substituted by other direct inputs, namely labor and vice versa. This substitution will affect the absorption of labor as well as the capital use in the relevant industry, thus to improve the production optimization, the industry is demanded to be capable of making the right combination in their use of production factors. The ease of substitution between the inputs used in a production process provides benefits for the company. The benefir of the flexible inputs, companies can choose input combinations they can use to produce a certain level of output with the most efficient combination (Nicholson and Snyder 2010).

One production function that can be used to analyze the extent to which capital and labor can be substituted with each other is the Cobb-Douglas production function. In this production function, it is assumed that the value of substitution elasticity between inputs is one. Nevertheless, Arrow, Chenery, Minhas, and Solow (1961) introduce the function of Constant Elasticity of Substitution (CES) which allows the occurrence of various elasticity values (Henningsen and Henningsen 2011).

Substitution elasticity measures the level of substitutability between capital and labor (Zhang 2015). Some existing research results show different estimation results related to input elasticity and substitution rates between the production factors used.

The research result of Balistreri *et al.* (2003) shows that, in general, almost in all sectors and manufacturing in aggregate, the labor-capital substitution elasticity is equal to 1 (supporting the Cobb-Douglas production function), even when observed in more detail in each of these manufacturing sub-sectors, it is relatively varied. Meanwhile, the research results of Lin and Liu (2017) show that there is a strong substitution effect between capital, labor and energy. The value of substitution elasticity between capital and energy is more than 1. This indicates that it is feasible to increase the use of capital and labor and reduce energy use. Capital or labor substitution with energy supports the conservation of energy and protection of environment. Zhang's (2015) study indicates that the level of substitutability between capital and labor can affect the wage gap between skilled and unskilled labor in their use in the low- and high-tech sectors.

To the best of the author's knowledge, research on the level of ease of input substitution in the production process in Indonesia is still limited. The existing studies only examine the level of elasticity of the influence of input on its output. The Ministry of National Development Planning/Bappenas (2010) conducts a study that examines, among others, the influence of the use of capital, labor, and raw material production factors on the output of the ISIC 2 digit manufacturing sector in Indonesia using the Stochastic Frontier analysis method. The results of this research show that these three inputs have a positive inelastic effect on manufacturing industry output. Furthermore, research by Mayashita and Firdaus (2013) examines the influence of the use of capital, labor, and energy inputs on agricultural industrial output using the Cobb-Douglas production function. The results of their research indicate that these production factors have a positive inelastic effect on the output of the agricultural industry in Indonesia. Likewise, the results of Adhitya *et al.* (2013) research show that inputs, especially capital and human resources, have an inelastic positive effect on the productivity of the food crop sub-sector in Indonesia.

Some previous studies employing CES production function use the production function to determine input substitutability in machine-based industries. Meanwhile, this study uses the production function in natural resource-based industries.

Industries based on natural resources are labor-intensive ones with relatively low levels of productivity. Meanwhile, technology is one of the tools that can be used to increase this productivity. This is as stated in the endogenous growth theory, i.e. that technological progress driven by R & D can guarantee sustainable growth as happened in developed countries. This indicator of technological progress can be reflected through the large share of capital in the creation of output. It is therefore assumed that the greater the share of capital, the greater the ability to create technological progress through R & D activities (Jones 1998, Romer 2012).

Natural resource-based and labor-intensive industry groups, in general, are characterized by low productivity levels, unskilled labor, and low-tech industries. Low-tech industries are characterized by intensive labor and low-capital intensity (UNIDO 2013). According to the ILO (2013), productivity is closely related to competitiveness. Hence, manufacturing that relies on natural resources is not strong enough to be able to encourage productivity improvement.

Therefore, based on this phenomenon it is important to conduct research on the level of substitutability between labor and capital more specifically in the natural resource-based industry group in Indonesia in an effort to increase the output/productivity of the industry group.

Based on this background, in this study, we will examine how capital and labor influence the output of natural resource-based industry groups, how the production elasticity of capital and labor is in the industry group, and how the level of elasticity of capital and labor substitution is in producing output in the industry group.

This study aims to analyze the effect of capital and labor on the output produced in natural resource-based industry groups and the elasticity of inputs to outputs, as well as the level of input substitution which can be made during the production process to maintain the optimal amount of output.

2. Methodology

This study uses secondary data from the Indonesian Central Bureau of Statistics's Large and Medium Industry Statistics. The industrial data used is based on ISIC 3 Digit Large and Medium Industrial Sub-Sector Revision 3, consisting of 11 sub-sectors during 1990-2014 period. The variables used are output of the natural resource-based industrial sector, capital value, and number of workers.

To solve the problem, this study uses CES (Constant Elasticity of Substitution) production function model. This model is a contribution of ideas from Arrow, Chennery, Minhas, and Sollow (1961). In this model, it is not assumed that the substitution elasticity level is zero (as in the Leontief production function) or equal to one (as in the Cobb-Douglas production function). Without these assumptions, the CES function model is considered better, thus its empirical function becomes more appropriate. In the CES function model, every possible value of substitution elasticity can be estimated in any admissible value. In addition, this model can measure the return to scale, efficiency, and capital intensity parameters (Wirasasmita 1994).

This study adopts Kmenta's (1967) model which obtains an estimate of the 2-input classic CES production function which can be estimated using the ordinary least-squares technique. In this model, Kmenta adds a parameter *v* which indicates the possibility of a decreasing (if v <1) or an increasing return to scale (if v> 1).

The formula used by Kmenta (1967) is as follows:

$$lny = ln\gamma + v\delta lnx_1 + v(1-\delta)lnx_2 - \frac{\rho v}{2}\delta((1-\delta)(lnx_1 - lnx_2)^2 + u_i \qquad (1)$$

Using variables output (Q), capital (K), and labor (L), the formula above is changed into:

$$lnQ = ln\gamma + v\delta lnK + v(1-\delta)lnL - \frac{\rho v}{2}\delta((1-\delta)(lnK - lnL)^2 + u_i \qquad (2)$$

The analysis method used is panel data regression with a fixed effect model, from 11 sub-sectors of the natural resource-based industry group, for 25 years (1990-2014). This study adopts Kmenta's (1967) model which is referred to as the Kmenta approximation as follows (Kmenta 1986):

$$lnQ_{it} = Ln\gamma_{it} + v\delta ln(K)_{it} + v(1-\delta)ln(L)_{it} - \frac{1}{2}\rho v\delta(1-\delta)[ln(K_{it}) - ln(L_{it})]^2 - e_{it} \qquad (3)$$

Information: Q = number of outputs; $\gamma = \beta0$ = constants; $v\delta = \beta1$ = regression coefficient (elasticity) of capital; $v(1\text{-}\delta) = \beta2$ = regression coefficient (elasticity) of labor; $-1/2\ \rho v\delta (1\text{-}\delta) = \beta3$ = regression coefficient (elasticity) of factor substitution; K = capital; L = labor

The steps taken are (i) estimating the regression coefficients of the tested model; (ii) performing statistical tests: the significance of individual variables using t-test, the significance of variables simultaneously using F test, and goodness of fit test (R^2); (iii) to obtain a BLUE estimator, a classic assumption test is carried out on the model; (iv) performing regression to the model in equation (1) and followed by determining the criteria for the properties of elasticity partially:

The criteria of β1: if β1 < 1, it means the change in output is partially inelastic towards the change in capital usage; If β1 > 1, it means the change in output is partially elastic to the change in capital usage. The criteria of β2: if β2 < 1, it means the change in output is partially inelastic towards the change in labor usage; if β2 > 1, it means the change in output is partially elastic towards the labor usage. The criteria of β3: if β3 < 1, it means the change in output is partially inelastic towards the substitution process of capital and labor; if β3 > 1, it means the change in output is partially elastic towards the substitution process of capital and labor.

Determining the criteria for elasticity simultaneously: if (β1 + β2) < 1, it means the change in output is inelastic towards the change in capital and labor usages simultaneously; if (β1 + β2)> 1, it means the change in output is elastic to the change in capital and labor usages simultaneously; if (β1 + β2) = 1, it means the change in output are unitary elasticity towards the change in capital and labor usages simultaneously. Determining the elasticity of the level of substitutability of capital by labor is done using the value of elasticity of factor substitution (σ). To determine the value of ρ (substitution parameter), the formula below is used:

$$\text{Ln}\ \gamma = e^{\beta 1}$$

$$v\delta = \beta_1 \qquad \delta = \frac{\beta_1}{v}$$

$$v(1\text{-}\delta) = \beta_2 \qquad v - v\delta = \beta_2$$

$$v = \beta_2 + v\delta$$

$$v = \beta_2 + \beta_1$$

$$\delta = \frac{\beta_1}{(\beta_2+\beta_1)}$$

$$-\frac{1}{2}\rho v\delta(1-\delta) = \beta_3$$

$$-\frac{1}{2}\rho\left[\frac{\beta_1}{(\beta_2+\beta_3)}\right]\beta_2 = \beta_3$$

$$-\frac{1}{2}\rho = \frac{\beta_3}{\left[\frac{\beta_1}{(\beta_2+\beta_1)}\right]}\beta_2$$

$$-\frac{1}{2}\rho = \frac{\beta_3}{\frac{\beta_1\beta_2}{\beta_2+\beta_1}}$$

$$\rho = \frac{-2\beta_3(\beta_2+\beta_1)}{\beta_1\beta_2} \qquad (4)$$

Furthermore, the steps taken include:
Determining the σ value using the formula (Beattie and Taylor 1994):

$$\sigma = \frac{1}{1+\rho} \qquad (5)$$

$$\sigma = \frac{1}{1+\left[\frac{-2\beta_3(\beta_2+\beta_1)}{\beta_1\beta_2}\right]} \qquad (6)$$

Determining the criteria for the level of substitution elasticity between capital and labor: if σ > 1, it means the substitutions of K and L are elastic and easy to do; if σ < 1, it means the substitutions of K and L are inelastic and difficult to do; if σ = 1, it means the substitutions of K and L have unitary elasticity.

3. Result and Discussion

To get the right model in solving the research problems more validly and accurately, it is necessary to test the model specifications and proceed with the classic assumption test. The hausman test on the research model shows that the value of Chi-Sq statistic is 37.083695 with a probability of 0.0000 < α (α = 0.05). This indicates that the right model to use is the Fixed Effect Model (FEM).

The multicollinearity test is carried out by considering the value of the correlation matrix between the independent variables. As a rule of thumb, a correlation coefficient of more than 0.8 indicates that multicollinearity occurs in the model (Gujarati and Porter 2012). The correlation matrix between independent variables can be seen in Table 1.

Table 1. Correlation Matrix between Independent Variables

Variable	Q (Output)	K (Capital)	L (Labor)	(K-L)^2
Q (Output)	1	0.559059	0.569658	0.247876
K (Capital)	0.559059	1	0.444635	0.621368
L (Labor)	0.569658	0.444635	1	0.066268
(K-L)^2	0.247876	0.621368	0.066268	1

Source: Results of data processing (2018)

Based on the data in Table 1, it can be seen that the correlation value between independent variables is less than 0.8, therefore it can be said that the model does not contain multicollinearity. To test the heteroscedasticity in the research model, the Breusch-Pagan-Godfrey method is used. The test results show that the Obs*R-squared value is 5.389724 with the probability value of Chi-Square (3) is 0.1454 > α (α = 0.05). The value is insignificant, meaning that the model does not contain heteroscedasticity.

The autocorrelation test using the Durbin-Watson method shows that the d-statistic value is 1.921. The value of dL (n = 275; k = 4; α = 5%) is 1.778, and dU (n = 275; k = 4; α = 5%) is 1.823. It means the d-statistic value lies between du and 4-dU (1.823 <1.921 <2.177). This indicates that the model does not contain any autocorrelation.

Based on the classic assumption test, it is known that the model used does not contain multicollinearity, heteroscedasticity, and autocorrelation problems. Such a model is a good model to use, hence it can be the Best Linear Unbiased Estimator (Gujarati and Porter 2012). The model estimation results are shown in Table 2.

Table 2. Estimated results of Fixed Effect Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constanta	9.450797	0.722379	13.08288	0
K (Capital)	0.5528	0.068686	8.048246	0
L (Labor)	0.270366	0.070575	3.830908	0.0002
(K-L)^2	-0.01153	0.001806	-6.38337	0
Adjusted R-squared	0.849734			
F-statistic	120.1875	Durbin-Watson stat		1.921273
Prob(F-statistic)	0.0000			

Source: Results of data processing (2018)

Based on the data in Table 2, it can be seen that the value of goodness of fit (adjusted R^2) is 0.8497. This means 84.97% of the variation in the dependent variable can be determined by variations in the independent variable. This indicates that the model used is a good model. The simultaneous influence test shows a significant F statistic value of 120.19.

Based on the data in Table 2, it can be seen that the three independent variables used have significant effects on the output of the natural resource-based industry sub-sector on α = 1%. Capital has a positive effect on the output of the industry sub-sector by 0.5528. It means if the capital increases by 1%, the output will increase by 0.55%. Furthermore, labor has a positive effect of 0.2704. It means if the amount of labor used increases by 1%, the output produced increases by 0.27%. This shows that changes in output are inelastic towards changes in capital and labor. The results of this study are in line with the results of study by the Ministry of National Development Planning/Bappenas (2010) which shows that the average output elasticity for all manufacturing sectors towards capital is 0.03, and for individual industry it varies between 0.01-0.06. This indicates a relatively low productivity of capital. The average elasticity of labor to output is 0.19 and the elasticity of raw materials ranges from 0.61 to 0.69 and is the highest elasticity. The results of this study are also in line with the results of Mayashinta and Firdaus (2013) and Adhitya *et al.* (2013).

The same applies to the substitution process of capital and labor. These variables have significant negative effects. It means if there is a substitution of capital and labor, it will result in the reduction of the output of natural resource-based industry sub-sectors. The influence of these variables is also inelastic towards the change in output. Simultaneously, the effect of changes in capital and labor on changes in the output shows a positive value of 0.823166. This means if the two variables increase simultaneously by 1%, the output will increase by 0.82%. The effect of changing all inputs simultaneously on changes in output is inelastic.

Next, how easy the substitution of capital and labor is can be seen from the value of σ. Based on the calculation results, the σ value is 0.887306. This amount is less than 1. This means that the substitution rate of capital and labor in producing output from the natural resource-based industry sub-sectors is inelastic and relatively difficult to do.

The results of this research are not in line with the research result of either Balistreri *et al.* (2003) that shows the elasticity of substitution input is equal to 1or that of Lin and Liu (2017) which shows the substitution elasticity of input is greater than 1. Wacker *et al.* (2006) state that developed countries generally have high capital elasticity because they have an advanced manufacturing sector and they prioritize producing high value-added products, thus the need for capital for such countries is very high to support the development of production and productivity of the manufacturing sector. Meanwhile, the conditions in Indonesia show that most of the manufacturing sector produce natural resource- and labor-based output, hence this causes Indonesia to have small capital requirements compared to those countries which have advanced manufacturing sectors.

Conclusion

The estimation of CES functions using data from 11 ISIC 3-digit natural resource industry sub-sectors during 1990-2014 comes to a conclusion that capital and labor have significant positive effects on the output of the natural resource-based industry sector, both partially and simultaneously. The effect is inelastic. This means an increase in the use of capital and labor can increase the output of natural resource-based industry sub-sectors, yet the proportion of the increase in output that occurs is smaller than the proportion of increasing inputs. The level substitution of capital and labor is inelastic. This means that the process of substituting capital and labor in natural resource-based industry groups in Indonesia is relatively difficult to do.

Some suggestions can be provided by this research. Firstly, for further studies, the model used in this study can also be applied to examine the level of ease of input substitution in other industry groups, hence this study can be used as a reference for empirical evidence for the development of knowledge or recommendations for entrepreneurs in the industrial group in determining input combinations to optimize the production process.

Secondly, this study recommends several policies as follows: natural resource-based industry groups have labor-intensive characteristics. Since the process of substituting capital and labor in this industry group is relatively difficult to do, one of the efforts that can be made by the Government in an effort to increase the productivity of this industry group is to improve the quality of the labor. This can be done by providing easy access to education and improving skills training programs for workers. Support for the development of certified vocational training centers is very important in order to support the labor quality improvement. It is also necessary to develop formal education such as Vocational High Schools or Vocational College with a curriculum adjusted to what the market needs. This is to make the graduates of this formal educational institutions well-prepared to work with the skills which can fulfill the needs of their employers.

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References

[1] Adhitnya, F. W, Hartono, D. and Awirya A. A. 2013. Determinan Produktivitas Lahan Pertanian Subsektor Tanaman Pangan Di Indonesia. *Jurnal Ekonomi Pembangunan,* 14(1). Available at: https://www.researchgate.net/publication/314098655_Determinan_Produktivitas_Lahan_Pertanian_Subsektor_Tanaman_Pangan_Di_Indonesia (In Indonesian).

[2] Arrow, K. J., *et al.* 1961. Capital-Labor Substitution and Economic Efficiency. The *Review of Economics and Statistics,* 43(3): 225-250. Available at: http://www.jstor.org/stable/1927286

[3] Badan Pusat Statistik. Statistik Industri Besar dan Sedang Indonesia, 1990-2014. Available at: https://www.bps.go.id (In Indonesian).

[4] Balistreri, E.J., McDaniel, C. A. and Wong, E.V. 2003. An estimation of US industry-level capital–labor substitution elasticities: support for Cobb–Douglas. The *North American Journal of Economics and Finance,* 14(3): 343 - 356.

[5] Beattie, B. R., and Taylor, C. R. 1994. *Ekonomi Produksi*. Penerjemah: Gunawan Sumodiningrat. Yogyakarta: Gajahmada University Press. (In Indonesia).

[6] Boqiang, L. and Weisheng, L. 2017. Estimation of energy substitution effect in China's machinery industry–based on the corrected formula for elasticity of substitution. *Energy,* 129: 246 - 254. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0360544217306692?via%3Dihub

[7] Gujarati, D. N., and Porter, D. C. 2012. *Basic Econometrics*. Fifth edition. New York: McGraw-Hill Education.

[8] Henningsen, A., and Henningsen, G. 2011. Econometric Estimation of the Constant Elasticity of Substitution Function in R: Package micEconCES. *FOI Working Paper* 2011/9, Institute of Food and Resource Economics, University of Copenhagen. Available at: http://EconPapers.repec.org/RePEc:foi:wpaper:2011_9

[9] International Labor Organization. 2013. *World of Work Report 2013: Repairing the Economic and Social Fabric.* Available at: http://www.ilo.org

[10] Jones, C. I. 1998. *Introduction to Economic Growth.* First Edition. W.W. Norton & Company, Inc.

[11] Kmenta, J. 1967. On Estimation of the CES Production Function. *International Economic Review* 8(2): 180 – 189 Available at: https://pdfs.semanticscholar.org/e2a0/5cd3784a7e5a393c14199c8d948d8494735f.pdf

[12] Kmenta, J. 1986. *Elements of Econometrics. Second edition.* New York: Macmillan Publishing Company, a Division of Macmillan Inc.

[13] Mayashita, W., and Firdaus, M. 2013. Faktor-Faktor Yang Memengaruhi Total Factor Productivity Industri Pertanian Indonesia Periode 1981-2010. *Jurnal Manajemen & Agribisnis,* 10(2): 90 – 97. Available at: http://journal.ipb.ac.id/index.php/jmagr/article/view/8480 (In Indonesian).

[14] Ministry of National Development Planning /Bappenas. 2010. *Perubahan Produktivitas Industri Manufaktur Indonesia dan Faktor-faktor yang Mempengaruhinya, selama tahun 2000-2007.* Available at: http://www.bappenas.go.id

[15] Nicholson, W., and Snyder, C. M. 2010. *Intermediate Microeconomics and Its Application*. Eleventh Edition. USA: South-Western Cengage Learning.

[16] Romer, D. 2012. *Advanced Macroeconomics*. Fourth Edition. New York: McGraw-Hill.

[17] Suharno, Anwar, N., and Saraswati, E. 2018. Do fishers need to diversify their source of income? A special reference in vulnerable fishers of Cilacap Waters, Indonesia. Aquaculture, Aquarium, Conservation & Legislation, 11:5 1605 - 1615.

[18] UNIDO. 2013. *Industrial Development Report 2013. Sustaining Employment Growth: The Role of Manufacturing and Structural Change, Overview* United Nations Industrial Development Organization.

[19] Wacker, J. G., Yang, C.-L. and Sheu, C. 2006. Productivity of Production Labor, Non-production Labor, and Capital: An International Study. *International Journal of Production Economics* 103(2): 863 - 872. Available at: https://www.sciencedirect.com/science/article/pii/S092552730600106X

[20] Wirasasmita, Y. 1994. Fungsi Produksi: Perkembangan dan Aplikasi. *Jurnal Ekonomi Fakultas Ekonomi Universitas Padjadjaran,* 6 (in Indonesian)

[21] Zhang, J. 2015. International Factor Mobility, Elasticity of Substitution in Production and The skilled-unskilled wage gap. *International Review of Economic and Finance,* 35: 122 - 129. Available at: https://www.sciencedirect.com/science/article/pii/S1059056014001191?via%3Dihub

An Analysis of Input Substitution Elasticity in Natural Resource-Based Industry in Indonesia. The Application of CES Function

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