Asean International Journal of Business

Vol.2, No.1, 2023
e-ISSN: 2809-6673
pp. 49-64

Optimization of Cooperative Production Function in The Philippines And Indonesia

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DOI: https://doi.org/10.54099/aijb.v2i1.439

ARTICLE INFO

Research Paper

Article history:
Received: 8 December 2022
Revised: 22 January 2023
Accepted: 25 January 2023

Keywords: cooperative, production function, optimization

ABSTRACT

Purpose – The study aims to identify production function equation between labour and capital also optimal cost of labour and capital of the cooperatives. In order to raise the level of this research to be international, this study compares two countries, namely the Philippines and Indonesia by applying performances of cooperatives in both countries.
Methodology/approach – Cobb Douglass production function equation of labour and capital is applied in this research. Optimal cost using partial differential equation also used between cost of wage of labour and cost of capital. Cooperatives in 15 regions in Philippines and 33 provinces in Indonesia were the object of the research
Findings – Philippines has an increasing scale of return because the value of the constant is greater than one, on the other hand Indonesia has a declining scale of return. However, the two countries have in common that capital is correlated with cooperative output, while labour is not correlated with output significantly.
Novelty/value – This study highlights the important of the use of economic analytical of the capital and labour to the cooperatives in Philippines and Indonesia. Both cooperatives have significant correlation between output and capital, but did not correlate significantly to labour.

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INTRODUCTION

Cooperative contribution in Philippines was 350 billion Php in 2018 while total GDP 16 trillion Php and one comes up with 2.4% share of cooperatives (Czachorska-jones, 2019). Furthermore, the contribution

of cooperatives to Indonesia's GDP in 2016, which was 3.99 % and is targeted at 5.1% in 2022 to 5.5% in 2024, and the participation of residents who become members of new cooperatives is 8.41%. This figure is still below the global average of 16.31%. It seems that cooperatives have not been seen to make a major contribution to the economy compared to the private sector.

Research in cooperatives generally uses statistical methods with polynomial linear regression equations (Buthelezi & Zondo, 2022), (Chawviang & Kiattisin, 2022), (Hussain, 2022), (Azman et al., 2022), (Juma, 2022), (Nayak, 2022). The use of mathematical power equations instead of statistics is an opportunity to fill in research, namely by using the production function equation from Cobb Douglas production function and cost optimization that usually used in companies (Cobb & Douglas, 1928), (Arrow et al., 1961). Variables of production from Cobb Douglas consists of output of the organization, labor and capital as inputs.

Cooperative in Philippines

Cooperatives have long been seen as important economic actors in the Philippines. They are well recognized in law; their promotion by State agencies was written into the constitution in 1987, and they have their own most recent Cooperative Code, amended in 2008. They have become 'an instrument of government policy in promoting social justice and economic development which means those who have preferred status in economic and social policy. The cooperative movement in the Philippines developed through different stages characterized by different colonial governments.

The first stage is marked by the period between 1896 and 1941, which is known as the period of formation of cooperatives in the Philippines. Characterized by the Spanish and American colonial regimes, cooperatives were first established in 1896 as local "gremios" and self-help associations that included agricultural marketing cooperatives, commercial marketing cooperatives and workers' associations. Then, in the early twentieth century, rural agricultural cooperatives based on the Raiffeisen model were introduced in the Philippines by Irish-American missionaries and teachers. Apart from credit cooperatives, this period also witnessed the growth of farmer marketing cooperatives established by the government. While State-initiated cooperatives are said to have failed in the Philippines so far, private cooperatives based on the Raiffeisen model laid the solid foundation of the cooperative movement in the country.

The second stage of 1941-1986 was under Japanese colonial rule, which began with a tremendous growth in the number of consumer and producer cooperatives. They were involved in distributing food supplies to war-affected urban areas in the Philippines and Japanese war posts in other Asian countries. This was followed by a rehabilitation phase where a law on cooperatives was passed to establish such cooperatives, which were supported in relief and rehabilitation programs. After the rehabilitation phase, the government began to organize farmer cooperatives as a strategy to counter revolutionary activities in the country. While State-initiated cooperatives were on the rise, the period between 1950 and 1980, was also marked by the emergence of cooperatives initiated by non-governmental organizations such as the Philippine Rural Reconstruction Movement (PRRM); and in non-agricultural sectors such as electricity, banking and transportation.

The third phase, from 1986 to 2000, was an important period in the evolution of the cooperative movement in the Philippines. With the reinstatement of democratic governance in the country, the new 1987 Constitution provides for promoting the growth and survival of cooperatives as instruments of equity, social justice and economic development under the principles of subsidiarity and self-reliance. Cooperatives together with NGOs and community organizations (as they are called in the Philippines) are considered the Philippines' third sector to promote community development. The constitution not only provides a more detailed definition of cooperatives but also offers regulatory guidelines (Alliance, 2020). In the Table 1, it can be seen the cooperatives in all 15 regions of Philippines related to the labor, capital and output.

Table 1: Cooperative in Philippines

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No	Region		Labor	Capital (Pesos Millions)	Output (Pesos Millions)
1	Region 01	Ilocos (Luzon)	7,400	1,830	60
2	Region 02	Cagayan Valley (Luzon)	8,000	1,860	60
3	CAR	Cordillera Administrative Region (Luzon)	4,900	1,770	80
4	Region 03	Central Luzon	17,500	2,570	140
5	NCR	National Capital Region	236,000	10,490	810
6	Region 04	Calabarzon	42,800	3,480	360
7	Region 05	Bicol	5,800	750	20
8	Region 06	Western Visayas	14,300	2,140	90
9	Region 07	Central Visayas	14,000	3,590	240
10	Region 08	Eastern Visayas	6,400	1,030	30
11	Region 09	Zamboanga (Mindanao)	6,600	840	20
12	Region 10	Northern Mindanao	22,200	3,080	140
13	Region 11	Davao (Mindanao)	35,100	2,820	110
14	Region 12	Soccsksaregn (Mindanao)	54,700	1,370	60
15	Region 13	Caraga	11,500	630	40
					2260

Source: (Czachorska-jones, 2019) processed

Cooperative in Indonesia

The cooperative movement in Indonesia has a long and rich history. The role and importance of cooperatives in the Indonesian economy and society continues to grow as it undergoes a transformation through a process of rehabilitation, reorientation, and revitalization to meet current and future needs.

The seeds of the cooperative movement in Indonesia were first sown during the Dutch occupation. The first cooperative, the Civil Servant Bank (now called BRI-Bank Rakyat Indonesia), was established in 1896 in Purwokerto to address the people's debts to moneylenders. The idea of cooperatives is contained in Article 33 of the 1945 Constitution Paragraph 1 which states that "the economy is organized as a joint effort based on the principle of kinship". The first Cooperative Congress in 1947 led to the establishment of DEKOPIN -Indonesian Cooperative Council. Village Unit Cooperatives or Village Unit Cooperatives (KUD) supported by Presidential Instruction No. 2 of 1978 functions as a credit institution for farming, distributor of production facilities and other services, processing and marketing of agricultural products and other economic activities. The growth of agricultural cooperatives from the 1970s to the 1990s was closely related to the government's policy to increase agricultural production through KUD. The 1997 Asian financial crisis and the 1998 national reform movement affected the status of KUDs. The number of KUD decreased from 9,635 in 1997 to 6,946 in 2000 and with it agricultural cooperatives. In the late 1990s, the strategic focus of the government and DEKOPIN shifted to a new type of non-agricultural cooperative.

Since 2000, a growing number of non-agricultural cooperatives (from 42,571 in 1997 to 109,632 in 2001) have been more profit-oriented, not financed by government programs, and put more emphasis on management strategies to improve operations and competitiveness to ensure sustainability. Cooperatives are considered an important tool to tackle youth unemployment in the country by the government, as evidenced by the ten-year action plan drawn up with the ILO in 2000. In 2005, the Ministry of Cooperatives and SMEs launched the National Long-Term Development Plan (2005-2025) to increase the bargaining power and collective efficiency of cooperatives. Between 2010 and 2015, the average profit of cooperatives increased by 5-7% and so did their contribution to the economy. The

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government imposed a provision to cancel the registration of cooperatives found to be inactive. DEKOPIN's Cooperative Vision Strategy 2045 (prepared in 2014-15) aims to gradually develop cooperatives by increasing agroforestry and food production, developing alternative energy sectors, and creating employment and entrepreneurial opportunities for young people (Partnership, 2020). In the Table 2, it can be seen the cooperatives in all 33 provinces of Indonesia related to the labor, capital and output.

Table 2: Cooperative in Indonesia

No	Province	Labor	Capital (Rupiahs trillions)	Output (Rupiahs trillions)
1	Aceh	407	349.9663392	22.44927603
2	Sumatera Utara	4459	3,971.16	182.1964
3	Sumatera Barat	1964	2,151.69	106.6609432
4	Riau	2365	1,856.09	174.320776
5	Jambi	295	172.6519455	20.52197463
6	Sumatera Selatan	1249	662.7954459	34.45349846
7	Bengkulu	483	423.2615627	18.47070144
8	Lampung	4580	2,833.28	141.1803709
9	Bangka Belitung	357	171.2476262	10.81598299
10	Kepulauan Riau	224	112.433873	9.911388111
11	DKI Jakarta	3478	2,889.61	256.1121081
12	Jawa Barat	13948	7,047.77	342.2312548
13	Jawa Tengah	14791	6,935.61	181.7408436
14	Jawa Timur	18279	8,838.33	320.5791982
15	Banten	3546	1,988.76	140.2548122
16	Bali	3606	3,228.85	72.17341115
17	Nusa Tenggara Barat	1860	787.035865	55.40562262
18	Nusa Tenggara Timur	2122	1,180.84	44.89444242
19	Kalimantan Barat	3331	3,213.65	76.41706474
20	Kalimantan Tengah	720	319.2318646	47.77739481
21	Kalimantan Selatan	1810	806.2788348	88.02699924
22	Kalimantan Timur	2335	1,106.97	67.02923723
23	Kalimatan Utara	42	17.94393083	3.85734451
24	Sulawesi Utara	548	70.04086611	7.286358954
25	Sulawesi Tengah	699	305.8421584	34.92204932
26	Sulawesi Selatan	2672	1,374.17	182.6370357
27	Sulawesi Tenggara	317	52.91092197	5.640886553
28	Gorontalo	349	42.00648592	4.431805442
29	Sulawesi Barat	183	57.36020024	7.195412298

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30	Maluku	128	16.37608135	1.444839908
31	Papua	370	34.93468015	6.326785632
32	Maluku Utara	458	22.84434968	5.345145606
33	Papua Barat	23	3.08100595	1.22081445
				2673.932179

Source: (Koperasi, 2016) processed

METHOD

Cooperatives in the Philippines and Indonesia were selected as research objects due to the similarity in ASEAN country. The limitations of the data obtained are the latest figures from the Philippines in 2017 with all 15 provinces or areas and Indonesia in 2016 with all 33 provinces. All data on cooperatives at that location were analyzed including the labor of the cooperative, the capital invested in the cooperative and the cooperative's output in this case was the surplus or deficit of the cooperative. Cooperatives use the terms surplus and deficit rather than loss or profit. The results of this data were processed by mathematical model. Data processing was done by transferring existing data into natural logarithmic form. The five classical assumptions of regression equation were also applied.

In finding the minimum cost, the cost equation was formulated in terms of employee wages and the cost of capital of discount factor embodied in the inflation of capital. For the Philippines, the minimum wage in 2017 was Php 12.013 (Peso) and the inflation rate was 1.25%, exchange rate was $1 = Php 49.34043 (Peso), while for Indonesia, the average minimum wage in 2016 was Rp 1.997.819, the inflation rate was 3.02% and exchange rate was $1 = Rp 12 310,- (IDR/Rupiah)

RESULT AND DISSCUSION

Bangun by using Cobb Douglass function production stated that labor and investment production factors have a significant effect on Indonesia's economic growth. Meanwhile, technological production factors have little influence on Indonesia's economic growth (Bangun, 2020). Furthermore, Bangun explained that Indonesia has the lowest skilled human resources in ASEAN, only slightly above the Philippines and CLMV (Cambodia, Laos, Myanmar and Vietnam). This situation resulted in Indonesia's lowest competitiveness in ASEAN-4. (Bangun, 2016)

The Cobb Douglas production function was originally proposed by the American mathematician Cobb and economist Paul Douglas in the early 1930s to study and explore mathematical models of the relationship between inputs and outputs in US (Cobb & Douglas, 1928), (Varian, 2010). After a long period of development and improvement, the economic model commonly used by academics to predict the production of countries and regions or large enterprises and analyze how production develops, was referred to as the production function (Guo, 2018). Furthermore, the Cobb Douglas equation was also applied to analyze inter-industry effectiveness in two countries, Taiwan and Japan (Lin, 2002).

As an implementation of the Cobb Douglas cooperative, it can be formulated as follows:

$Q = AL^{\alpha}K^{\beta} \ldots\ldots (1)$

Where, Q = Output, in this case is volume of surplus or deficit of the cooperative, L = Labors of the cooperative, K= Capital invested in cooperative, α = Constant of L and β = Constant of K.

The production function exhibits increasing returns to scale at $\alpha+\beta>1$, decreasing returns to scale at $\alpha+\beta<1$ and constant returns to scale at $\alpha+\beta=1$. The increasing returns mean that an increase in the levels of all inputs leads to a greater than the increase of the output. The decreasing returns mean that an increase in the levels of all inputs leads to a smaller than the increase of the output In the case of constant returns to scale, the function is linearly homogeneous that he function, and the output increases linearly with respect to a proportional increase of all inputs: an increase of all inputs produces exactly the increase of the output (Ricardo, 1817), (Samuelson & Nordhaus, 2009), (Arrow et al., 1961), (Ume et al., 2021) (DELGADO, 2022).

To solve the Cobb Douglas equation, it is transferred into logarithm natural in both side

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$\mathcal{L}nQ = \mathcal{L}nA + \alpha\mathcal{L}nL + \beta\mathcal{L}nK$ …… (2)
$Y = c + \alpha X_1 + \beta X_2$ …… (3)
Where: $Y = \mathcal{L}nQ$, $c = \mathcal{L}nA$, $X_1 = \mathcal{L}nL$ and $X_2 = \mathcal{L}nK$

In order to minimize the cost (C) of production, a function of Hamiltonian (Ħ) and Lagrange multiplier (λ) are applied. Cost consists of ω as the wages of the Labor (L) and ρ as the discount factor of Capital (K) that is denoted by inflation rate (Hritonenko & Yatsenko, 2013), (Rahim, 2016), (Lin, 2002).

$C = \omega L + \rho K$ …… (4)
$Q = AK^{\alpha}L^{\beta}$
$AK^{\alpha}L^{\beta} - Q = 0$
$Ħ = \omega L + \rho K - \lambda(AK^{\alpha}L^{\beta} - Q)$
$\frac{\partial Ħ}{\partial K} = \omega - \lambda\beta AK^{\alpha}L^{\beta-1} = 0$
$\frac{\partial Ħ}{\partial L} = \rho - \lambda\alpha AK^{\alpha-1}L^{\beta} = 0$
$\frac{\partial Ħ}{\partial \lambda} = AK^{\alpha}L^{\beta} - Q = 0$
$\lambda = \frac{\omega}{\beta AK^{\alpha}L^{\beta-1}}$
$\rho = \lambda\alpha AK^{\alpha-1}L^{\beta}$
$\rho = \frac{\omega}{\beta AK^{\alpha}L^{\beta-1}}\alpha AK^{\alpha-1}L^{\beta}$
$\rho\beta AK^{\alpha}L^{\beta-1} = \omega\alpha AK^{\alpha-1}L^{\beta}$
$\rho\beta\, L^{-1} = \omega\alpha K^{-1}$
$\rho\beta K = \omega\alpha L$
$L = \frac{\beta\rho K}{\alpha\omega}$
$AK^{\alpha}L^{\beta} = Q$
$AK^{\alpha}(\frac{\beta\rho K}{\alpha\omega})^{\beta} = Q$
$AK^{\alpha+\beta}(\frac{\beta\rho}{\alpha\omega})^{\beta} = Q$
$K^{\alpha+\beta} = \frac{Q}{A}(\frac{\alpha\omega}{\beta\rho})^{\beta}$
$K = (\frac{Q}{A})^{\frac{1}{\alpha+\beta}}(\frac{\alpha\omega}{\beta\rho})^{\frac{\beta}{\alpha+\beta}}$ …… (5)
$L = (\frac{Q}{A})^{\frac{1}{\alpha+\beta}}(\frac{\beta\rho}{\alpha\omega})^{\frac{\alpha}{\alpha+\beta}}$ …… (6)

Cost equation is (Lin, 2002)

$C = \omega L + \rho K$ … (4)
$C = \omega(\frac{Q}{A})^{\frac{1}{\alpha+\beta}}(\frac{\beta\rho}{\alpha\omega})^{\frac{\alpha}{\alpha+\beta}} + \rho(\frac{Q}{A})^{\frac{1}{\alpha+\beta}}(\frac{\alpha\omega}{\beta\rho})^{\frac{\beta}{\alpha+\beta}}$
$C = (\omega\,(\frac{\beta\rho}{\alpha\omega})^{\frac{\alpha}{\alpha+\beta}} + \rho(\frac{\alpha\omega}{\beta\rho})^{\frac{\beta}{\alpha+\beta}})((\frac{Q}{A})^{\frac{1}{\alpha+\beta}})$
$C = (\omega\,(\frac{\rho}{\omega})^{\frac{\alpha}{\alpha+\beta}}(\frac{\beta}{\alpha})^{\frac{\alpha}{\alpha+\beta}} + \rho(\frac{\omega}{\rho})^{\frac{\beta}{\alpha+\beta}}(\frac{\alpha}{\beta})^{\frac{\beta}{\alpha+\beta}})((\frac{Q}{A})^{\frac{1}{\alpha+\beta}})$
$C = (\omega\,(\frac{\rho}{\omega})^{\frac{\alpha}{\alpha+\beta}}(\frac{\alpha}{\beta})^{-\frac{-\alpha}{\alpha+\beta}} + \rho(\frac{\omega}{\rho})^{\frac{\beta}{\alpha+\beta}}(\frac{\alpha}{\beta})^{\frac{\beta}{\alpha+\beta}})((\frac{Q}{A})^{\frac{1}{\alpha+\beta}})$

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$$C = \left(\frac{\omega^{\frac{\alpha+\beta}{\alpha+\beta}}}{\omega^{\frac{\alpha}{\alpha+\beta}}}\ \rho^{\frac{\alpha}{\alpha+\beta}}\left(\frac{\alpha}{\beta}\right)^{-\frac{-\alpha}{\alpha+\beta}} + \frac{\rho^{\frac{\alpha+\beta}{\alpha+\beta}}}{\rho^{\frac{\beta}{\alpha+\beta}}}\ \omega^{\frac{\beta}{\alpha+\beta}}\left(\frac{\alpha}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}\right)\left(\left(\frac{Q}{A}\right)^{\frac{1}{\alpha+\beta}}\right)$$

$$C = \left(\omega^{\frac{\beta}{\alpha+\beta}}\ \rho^{\frac{\alpha}{\alpha+\beta}}\left(\frac{\alpha}{\beta}\right)^{-\frac{-\alpha}{\alpha+\beta}} + \rho^{\frac{\alpha}{\alpha+\beta}}\ \omega^{\frac{\beta}{\alpha+\beta}}\left(\frac{\alpha}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}\right)\left(\left(\frac{Q}{A}\right)^{\frac{1}{\alpha+\beta}}\right)$$

$$C = \omega^{\frac{\beta}{\alpha+\beta}}\ \rho^{\frac{\alpha}{\alpha+\beta}}\left(\left(\frac{\alpha}{\beta}\right)^{-\frac{-\alpha}{\alpha+\beta}} + \left(\frac{\alpha}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}\right)\left(\left(\frac{Q}{A}\right)^{\frac{1}{\alpha+\beta}}\right) \ldots . (7)$$

Linearization of regression dan classic assumptions would be applied for both country, Philippines and Indonesia as follow.

Philippines

Data from table 1 is changed in logarithmic form (Ln) which is shown in table 3.

Table 3: Cooperatives of Philippines in Logarithmic

No	Labor (Ln)	Capital (Ln)	Output (Ln)
1	8.91	7.51	4.09
2	8.99	7.53	4.09
3	8.50	7.48	4.38
4	9.77	7.85	4.94
5	12.37	9.26	6.70
6	10.66	8.15	5.89
7	8.67	6.62	3.00
8	9.57	7.67	4.50
9	9.55	8.19	5.48
10	8.76	6.94	3.40
11	8.79	6.73	3.00
12	10.01	8.03	4.94
13	10.47	7.94	4.70
14	10.91	7.22	4.09
15	9.35	6.45	3.69

Source: Processed by author

Classics Assumptions

Classics assumptions are applied by using SPSS. The results are as below.

Normality

Table 4: Normality of Philippines

One-Sample Kolmogorov-Smirnov Test

	Labor	Capital	Output
N	15	15	15

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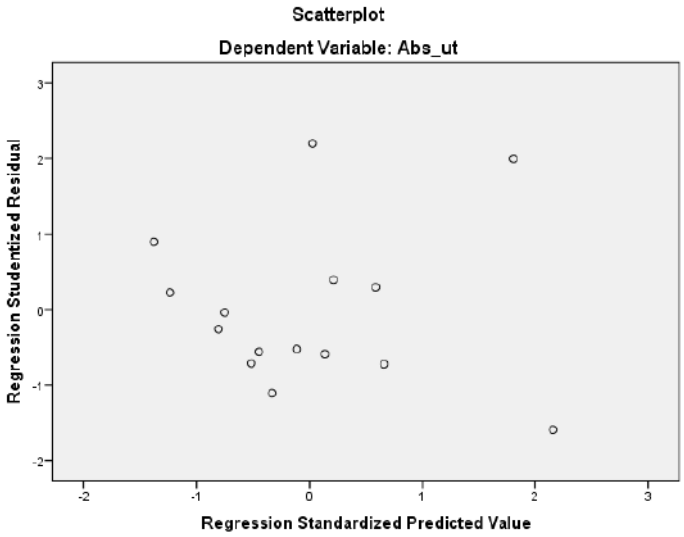
Normal Parameters[a,b]	Mean	9.6853	7.5713	4.4593
	Std. Deviation	1.05924	.72747	1.03578
Most Extreme Differences	Absolute	.144	.131	.121
	Positive	.144	.131	.121
	Negative	-.132	-.117	-.094
Kolmogorov-Smirnov Z		.559	.507	.470
Asymp. Sig. (2-tailed)		.914	.959	.980

a. Test distribution is Normal.
b. Calculated from data.

Asymp.Sig for labor, capital and output respectively are 0.914; 0.959; 0.980 are > 0.05, so the data is normal

Linearity

Table 5: Linearity of Philippines



In the graph it can be seen that the point pattern is spread out, therefore there is no linearity.

Autocorrelation

Table 6: Autocorrelation of Philippines

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.956[a]	.914	.900	.32835	1.997

a. Predictors: (Constant), Capital, Labor
b. Dependent Variable: Output

In the Table of Durbin-Watson (Junaidi, n.d.), n=16 with independent variables=2, the value of dl = 0.9455 and du= 1.5432, so
du<DW< 4-dl
0.9455 < 1.997 < 4 – 1.5432
0.9455 < 1.889 < 2.4568
There is no autocorrelation

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Multicollinearity

Table 7: Multicollinearity of Philippines

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Labor	.464	2.155
	Capital	.464	2.155

a. Dependent Variable: Output

Tolerance of the labor and capital are 0.464 > 0.1 and VIFs are 2.155 < 10
There is no multicollinearity in this data.

Heteroscedasticity

Table 8: Heteroscedasticity of Philippines

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.411	.472		.870	.401
	Labor	.058	.061	.383	.947	.362
	Capital	-.095	.089	-.433	-1.071	.305

a. Dependent Variable: Abs_ut

Significance of labor is 0.362> 0.05 and 0.305> 0.05, so the data is heteroscedasticity

Correlation Analysis

Table 9: Correlation Analysis of Philippines

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.956[a]	.914	.900	.32835

a. Predictors: (Constant), Capital, Labor
b. Dependent Variable: Output

Table 10: Coefficient of Philippines

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-6.036	.938		-6.435	.000
	Labor	.163	.122	.167	1.343	.204
	Capital	1.177	.177	.827	6.648	.000

a. Dependent Variable: Output

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In the table 9, it can be seen that overall of two independent variables, capital and labor have strong correlation to output with R= 0.95, nearly 1. However, in table 10, the only capital has significant correlation to the output because of significance less than 0.05. And the labor does not have correlation because the significance is 0.204 more than 0.05.

Form the classical assumption, calculation can be continued for Cobb Douglas equation as follow.

$Q = AL^{\alpha}K^{\beta}$

Transfer to logarithm natural in both side

$\mathcal{L}nQ = \mathcal{L}nA + \alpha\mathcal{L}nL + \beta\mathcal{L}nK$

$Y = c + \alpha X_1 + \beta X_2$

Where: $Y = \mathcal{L}nQ$, $c = \mathcal{L}nA$, $X_1 = \mathcal{L}nL$ and $X_2 = \mathcal{L}nK$

$Y = -6.063 + 0.163X_1 + 1.177X_2$

$\alpha = 0.163$

$\beta = 1.177$

$A = e^{C}$

$A = 2.71828182846^{-6.063}$

A= 0.0023274082

$Q = 0.0023274082L^{0.163}K^{1.177}$

$\alpha + \beta = 0.163 + 1.177 = 1.34 > 1$

Increasing to scale because the result is more than 1

$\omega = 8{,}453$

$\rho = 0.0125$

$C = \omega^{\frac{\beta}{\alpha+\beta}} \rho^{\frac{\alpha}{\alpha+\beta}} \left(\left(\frac{\alpha}{\beta}\right)^{-\frac{-\alpha}{\alpha+\beta}} + \left(\frac{\alpha}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}\right) \left(\left(\frac{Q}{A}\right)^{\frac{1}{\alpha+\beta}}\right)$

$C = 4873.61644610959\ Q^{0.746268656716418}$

Average Q = 150.666666666667

$C = 4873.61644610959\ x150.666666666667^{0.746268656716418}$

C= 47.37 (transferring in $ from Peso)

The result of the calculation for cooperative in Philippine will be compared with cooperative in Indonesia

Indonesia

Data from table 2 is changed in logarithmic form (Ln) which is shown in table 11.

Table 11: Cooperatives of Indonesia in Logarithmic

No	Labor (Ln)	Capital (Ln)	Output (Ln)
1	6.01	5.86	3.11
2	8.40	8.29	5.21
3	7.58	7.67	4.67
4	7.77	7.53	5.16
5	5.69	5.15	3.02
6	7.13	6.50	3.54
7	6.18	6.05	2.92
8	8.43	7.95	4.95
9	5.88	5.14	2.38

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10	5.41	4.72	2.29
11	8.15	7.97	5.55
12	9.54	8.86	5.84
13	9.60	8.84	5.20
14	9.81	9.09	5.77
15	8.17	7.60	4.94
16	8.19	8.08	4.28
17	7.53	6.67	4.01
18	7.66	7.07	3.80
19	8.11	8.08	4.34
20	6.58	5.77	3.87
21	7.50	6.69	4.48
22	7.76	7.01	4.21
23	3.74	2.89	1.35
24	6.31	4.25	1.99
25	6.55	5.72	3.55
26	7.89	7.23	5.21
27	5.76	3.97	1.73
28	5.86	3.74	1.49
29	5.21	4.05	1.97
30	4.85	2.80	0.37
31	5.91	3.55	1.84
32	6.13	3.13	1.68
33	3.14	1.13	0.20

Source: Processed by author

Classics Assumption

Classics assumptions are applied by using SPSS. The results are as below.

Normality

Table 12: Normality of Indonesia

One-Sample Kolmogorov-Smirnov Test

		Labor	**Capital**	**Output**
N		33	33	33
Normal Parameters[a,b]	Mean	6.9221	6.0318	3.4824
	Std. Deviation	1.57794	2.06986	1.59822
Most Extreme Differences	Absolute	.128	.106	.100
	Positive	.079	.078	.098
	Negative	-.128	-.106	-.100
Kolmogorov-Smirnov Z		.734	.609	.573
Asymp. Sig. (2-tailed)		.654	.852	.898

a. Test distribution is Normal.

b. Calculated from data.

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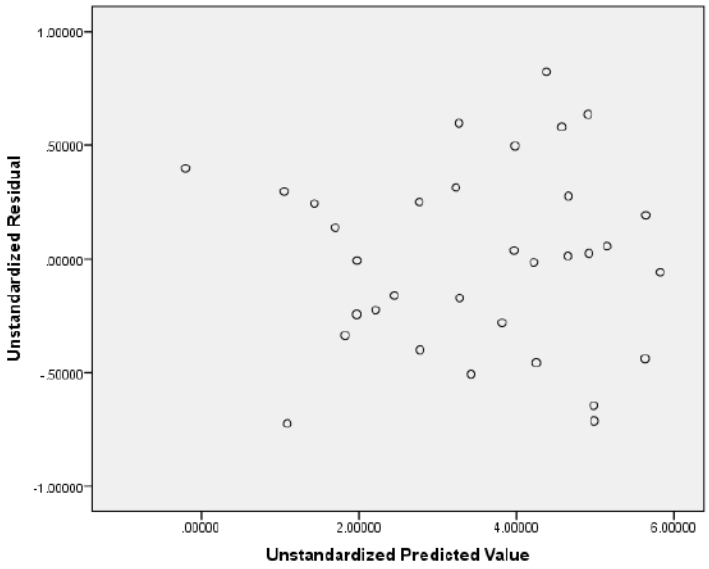
Asymp.Sig for labor, capital and output respectively are 0.654; 0.852; 0.898 are > 0.05, so the data is normal

Linearity

Table 13: Linearity of Indonesia



In the graph it can be seen that the point pattern is spread out, therefore there is no linearity.

Autocorrelation

Table 14: Autocorrelation of Indonesia

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.967[a]	.936	.931	.41850	1.889

a. Predictors: (Constant), Capital, Labor
b. Dependent Variable: Output

In the Table of Durbin-Watson (Junaidi, n.d.), n=33 with independent variables=2, the value of dl = 1.3212 and du= 1.577, so
du<DW< 4-dl
1.3212< 1.889 < 4 – 1.577
1.3212< 1.889 < 2.423
There is no autocorrelation

Multicollinearity

Table 15: Multicollinearity of Indonesia

Model	Collinearity Statistics	
	Tolerance	VIF

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	(Constant)		
1	Labor	.102	9.761
	Capital	.102	9.761

Tolerance of the labor and capital are 0.102 > 0.1 and VIFs are 9.761 < 10. There is no multicollinearity of the data.

Heteroscedasticity

Table 16: Heteroscedasticity

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.436	.252		1.733	.093
	Labor	-.050	.084	-.336	-.593	.558
	Capital	.039	.064	.344	.606	.549

a. Dependent Variable: Abs_ut

Significance of labor is 0.558> 0.05 and 0.549> 0.05, so the data is heteroscedasticity

Correlation Analysis

Table 17: Model Summary of Indonesia

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.967[a]	.936	.931	.41850

a. Predictors: (Constant), Capital, Labor
b. Dependent Variable: Output

Table 18: Coefficients of Indonesia

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.257	.439		-2.862	.008
	Labor	.092	.146	.091	.630	.534
	Capital	.680	.112	.881	6.089	.000

a. Dependent Variable: Output

In the table 17, it can be seen that overall of two independent variables, capital and labor have strong correlation to output with R= 0.967, nearly 1. However, in table 18, the only capital has significant correlation to the output because of significance less than 0.05. And the labor does not have correlation because the significance is 0.534 more than 0.05.

Form the classical assumption, calculation can be continued for Cobb Douglas equation as follow.

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$\mathcal{L}nQ = \mathcal{L}nA + \alpha\mathcal{L}nL + \beta\mathcal{L}nK$
$Y = c + \alpha X_1 + \beta X_2$
$Y = -1.257 + 0.092X_1 + 0.680X_2$
$\alpha = 0.092$
$\beta = 0.680$
$C = \mathcal{L}nA$
$A = e^C$
$A = 2.71828182846^{-1.257}$
A= 0.2845062663
$Q = 0.2845062663L^{0.092}K^{0.680}$
$\alpha + \beta = 0.092 + 0.680 = 0.772 < 1$
Decreasing to scale because the result is less than 1
$\omega = 1997819$
$\rho = 0.0302$
$C = \omega^{\frac{\beta}{\alpha+\beta}} \rho^{\frac{\alpha}{\alpha+\beta}} ((\frac{\alpha}{\beta})^{-\frac{-\alpha}{\alpha+\beta}} + (\frac{\alpha}{\beta})^{\frac{\beta}{\alpha+\beta}}) ((\frac{Q}{A})^{\frac{1}{\alpha+\beta}})$
$C = 450027.6253\ Q^{1.295336788}$
Average Q = 81.02
C= 33.83 (transferring in $ from rupiah)

The result of calculation in Indonesia can be compared with Philippine. And the summary, all mathematical calculation result can be seen in the table 19.

Table 19: Summary

Constant/ Factor	Philippines	Indonesia
α	0.163	0.092
β	1.177	0.680
α + β	1.34 >1	0.772<1
R square	0.956 ~ 1	0.967 ~ 1
Sig Labor	0.204>0.005	0.534 >0.005
Sig Capital	0.000<0.005	0.000 <0.005
ω	8,453	1,997,819
ρ	0.0125	0.0302
Cost ($)	47.37	33.83

Important results that are depicted from Table 19 as follow

a. The production function of Philippines of α+β>1 or 1.34>1 is increasing returns to scale, the increasing returns mean that an increase in the levels of all inputs leads to a greater than the increase of the output.
b. The production function of Indonesia of α+β<1 or 0.772<1. The decreasing returns mean that an increase in the levels of all inputs leads to a smaller than the increase of the output
c. Two both countries have strong correlation between capital and production, however, both countries have weak correlation between labor and production.
d. Labor and capital costs in the Philippines are higher than Indonesia, even so, the Philippines has an increasing return to scale.

CONCLUSION

The production function equation of Cobb Douglas is usually used in companies to be able to provide an analysis of return to scale. The use of analytical tools commonly used in companies will be very helpful

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for cooperative development. To raise the level of this research to be international, the study compared two countries, namely the Philippines and Indonesia. In this study it is used on the performance of cooperatives, where the Philippines has an increasing return to scale because the constant value is greater than one, on the other hand, Indonesia is experiencing a decreasing return to scale. However, both countries have in common that capital is correlated with cooperative output, while labor is not correlated with output significantly.

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