Economics Development Analysis Journal Vol (2) (2022)

Economics Development Analysis Journal

http://journal.unnes.ac.id/sju/index.php/edaj

Performance of Manufacturing MSEs in Bali Amidst the Covid-19 Pandemic

Taly Purwa[1]✉

BPS-Statistics Indonesia, Province of Bali, Indonesia

Article Information

History of Article
Received January 2022
Accepted March 2022
Pusblished May 2022

Keywords:
Cobb-Douglas Model, Covid-19 Impact, Micro and Small Enterprises, Production Function, Total Revenue

Abstract

This study measured the impact of Covid-19 on the total revenue of manufacturing micro and small enterprises (MSEs) in Bali, in aggregate and specifically by each type of 2-digit ISIC. Using the Cobb-Douglas model, the impact of fixed capital, the number of labors, and factors related to technical inefficiency were also evaluated. According to the findings, total revenue decreased by about one-fifth during the pandemic. Specifically, the significant impact was experienced by MSEs with 2-digit ISIC: 11 and 13 in the form of a positive impact and 14 in the form of a negative impact. As expected, the two input factors had positive elasticity on the total revenue. Education is the only non-statistically significant factor associated with technical inefficiency. MSEs with male entrepreneurs, productive age groups, capital that is not dominated by own capital, applying for a loan from people's business loans (KUR), and using the internet in the business process tend to perform better. Overall, technical efficiency before and during the pandemic is comparable, ranging between 40 and 80, while the decreasing distributional pattern of technical efficiency shows for some 2-digit ISIC.

Corresponding author :
Address: BPS-Statistics Indonesia, Province of Bali, Jl. Raya Puputan No.1, Renon, Kec. Denpasar Selatan, Kota Denpasar, Bali 80239
E-mail: taly@bps.go.id

ISSN 2252-6560

INTRODUCTION

The Covid-19 pandemic has disrupted tourism performance as the main economic sector of Bali (Purwa & Atmanegara, 2020; Yuniti, Sasmita, Komara, Purba, & Pandawani, 2020; Atmojo & Fridayani, 2021; Handayani, Sylvina, & Lestari, 2021). Through the policy of social large-scale restrictions and travel restrictions for foreign tourists, the demand for tourism products has been drastically reduced, thus hampering economic activity The decline in the level of demand for tourism product are reflected by the lower contribution and economic contraction of the accommodation and food service activities Industry of Bali in 2020 as a macro tourism indicator, i.e. 18.37% and -27.52%, respectively (BPS Provinsi Bali, 2021). The performance of the manufacturing industry, as one of the tourism supporting industries in Bali (BPS Provinsi Bali, 2019), is also affected by the Covid-19 pandemic. In 2020, the economic performance of this industry also contracted, i.e. -6.78%(BPS Provinsi Bali, 2021). The co-movement between this industry and the accommodation and food service activities industry occurs since most of the manufacturing products are focused to meet the demand of the tourism industry (BPS Provinsi Bali, 2019).

The pandemic impact hit all sizes of manufacturing enterprises but the small and medium enterprises (SMEs) are particularly vulnerable (Adian et al., 2020). The result of the Indonesian Economic Census 2016 (SE2016) conducted by BPS showed that the manufacturing industry of Bali is dominated by micro and small enterprises (MSEs), i.e. 99,37% with a share of workers of about 83,27%. These characteristics indicated that the Bali manufacturing industry is a labor-intensive sector, making it more vulnerable to economic shocks (Cucculelli & Peruzzi, 2020), such as the Covid-19 pandemic.

Several previous studies have investigated the impact of Covid-19 on manufacturing enterprises. Pakpahan (2020) and Nalini (2021) evaluated the impact of Covid-19 on micro, small and medium enterprises (MSMEs) in Indonesia using qualitative analysis and literature review. They provided solutions through policy implications to Indonesia's government on how to maintain the existence of MSMEs. Another study by Tambunan (2020) also evaluated the impact of Covid-19 on MSMEs in Indonesia but used a different method, i.e. performed descriptive analysis from secondary data. The impact of the 1997/1998 Asian financial crisis and 2008 global financial crisis was evaluated and compared to the impact of Covid-19. The latest study from Rodrigues, Franco, Sousa, & Silva (2021) also performed a descriptive analysis of the data obtained using a snowball sampling survey from SMEs in Portugal that was conducted during the lockdown. However, a comprehensive analysis to evaluate the impact of Covid-19 on micro and small industries in Bali through inferential analysis based on the author's knowledge has never been carried out.

This study fills the aforementioned research gap by performing both descriptive and inferential analysis with the stochastic frontier analysis (SFA) model (Aigner et al., 1977; Meeusen & van Den Broeck, 1977), i.e. the Cobb-Douglas production function to the data obtained from the Yearly Micro and Small Manufacturing Industry Survey (*Survei IMK Tahunan*), 2019 and 2020, conducted by BPS Province of Bali. This model has been widely used to measure the performance of technical efficiency on many fields, e.g.enterprises (Walujadi, 2004; Bohorquez & Esteves, 2008; Mahmood, 2008; Radam, Abu, & Abdullah, 2008; Barbera & Moores, 2013; Hartšenko & Sauga, 2013; Charoenrat, 2014; Noor & Siang, 2014; Prastiwi, Ayutyas, Ayunigtyas, & Saputri, 2017; Pinkovetskaia, 2018; Dagvadorj & Bo, 2019; Mbusya, 2019; Ouedraogo & Gansonre, 2020; Thuy, Le, Cuong, & Thi, 2020;), banks (Hasan, Kamil, Mustafa, & Baten, 2012; Hossain, Hossain, & Baten, 2016; Agustina, Sholihin, & Fithria, 2019;), agriculture (Trujillo & Iglesias, 2013; Mango, Makate, Hanyani-Mlambo, Siziba, & Lundy, 2015; Najjuma, Kavoi, & Mbeche, 2016; Umar, Girei, & Yakubu, 2017;Hakim, Haryanto, & Sari,

2020;Tenaye, 2020;Yilmaz, Gelaw, & Speelman, 2020; Vasyl'yeva, 2021), and macroeconomic indicators(Apostolov, 2016; Izgi et al., 2020). The total revenue would be modeled with the production inputs or factors relevant to the technical efficiency of the enterprise, such as fixed capital and labor. The dummy variable of Covid-19, type of enterprises by 2-digit International Standard Industrial Classification (ISIC/KBLI), and its interaction variable are also included in the Cobb-Douglass model to measure the impact of Covid-19 on each type of MSEs. In this study, the SFA model also incorporates the factors related to the technical inefficiency of the enterprise(G. E. Battese & Coelli, 1995), i.e. gender, age group, education of entrepreneur, capital sources, application of People's Business Loans (*Kredit Usaha Rakyat*/KUR), and internet use in the business process.

First, this study measures the aggregate impact of Covid-19 on MSEs' performance and the specific impact for each type of enterprise by 2-digit ISIC. Second, the impact of each factor on the total revenue of MSEs would be analyzed. At the end of the stage, this study calculates and compares the technical efficiency of each MSE before and during the Covid-19 pandemic. The results of this study are expected to be an important input for the Province of Bali government in making policies regarding the sustainability of manufacturing MSEs in Bali during the Covid-19 pandemic.

RESEARCH METHODS

The data used in this study was obtained from the Yearly Micro and Small Manufacturing Industry Survey (*Survei IMK Tahunan*), 2019 and 2020, conducted by BPS Province of Bali. The number of survey samples in 2019 and 2020 are 2170 and 2165, respectively. First, the preprocessing data was performed by excluding the enterprises that not operating or were non-response in the two consecutive years. The final survey sample used to analyze process were 1930 for each year or 3860 total. The number of samples for each 2-digit ISIC is presented in Table 1.

Table 1. Number of Samples by 2-Digit ISIC

2-Digit ISIC	Number of Samples
10 - Food	610
11 - Beverage	184
12 - Tobacco Processing	8
13 - Textile	300
14 - Apparel	490
15 - Leather and Leather Goods and Footwear	64
16 - Wood, Wood and Cork Products Excluding Furniture and Woven Products from Bamboo, Rattan and The Like	578
17 - Paper and Paper Goods	18
18 - Printing and Reproduction of Recording Media	26
20 - Chemicals and Articles of Chemicals	38
21 - Pharmaceuticals, Chemical Medicinal Products and Traditional Medicines	34
22 - Rubber, Rubber and Plastic Products	30
23 - Non-Metal Excavated Goods	406
25 - Metal Goods, Not Machinery and Equipment	322
26 - Computers, Electronic and Optical Goods	2
27 - Electrical Equipment	4
29 - Motorized Vehicles, Trailers and Semi Trailers	8
31 - Furniture	82
32 - Other Manufacturing	654
33 - Repair and Installation for Machines and Equipment	2
Total	3860

Source: Data Processed, 2022

Most of the previous studies that utilized the Cobb-Douglas model performed analysis only for the enterprises that produced the same

output, i.e. has the same 2-digit ISIC. While in this study, all the enterprises by 2-digit ISIC of the manufacturing sector are pooled together. The same scheme was also performed by Prastiwi et al. (2017) who used all enterprises from the Indonesian manufacturing SMEs Annual Survey in 2015 and Hartšenko & Sauga (2013) that analyzed SMEs in Estonia from all sectors of the Estonian Classification of Economic Activities (EMTAK).

Table 2. Response and Predictor Variables

Variable	Description
Response:	
rev	Total revenue (Rupiahs)
Predictor:	
$covid19$	Dummy variable of Covid-19: 0 – survey in 2019 1 – survey in 2020
$isic$	Dummy variable for the type of enterprises by 2-digit ISIC. ISIC 10 as a reference category.
cap	Fixed Capital
lab	Number of workers
Technical Inefficiency:	
$gend$	Dummy variable of entrepreneur gender: 0 – Female 1 – Male
age	Dummy variable of entrepreneur age group: 0 – 15-64 years old 1 – ≥65 years old
edu	Dummy variable of entrepreneur educational attainment: 0 – Not completed elementary school 1 – Elementary school 2 – Junior high school 3 – Senior high school 4 – University
$owncap$	Dummy variable of capital used: 0 – capital owned is ≤50% 1 – capital owned is >50%
$cred$	Dummy variable of having loan from People's Business Loans (KUR): 0 – no 1 – yes
$inet$	Dummy variable of internet use in enterprise: 0 – not using internet 1 – using internet

Source: Data Processed, 2022

The descriptive analysis was performed to reveal the impact pattern and insight from the interesting variables, i.e. total revenue of MSEs in Bali, before (2019) and during Covid-19 (2020). The variables used in the SFA model with the Cobb-Douglas production function are presented in Table 2. The total revenue was used as response variable rather than volume enterprise produced different types of products. Hence, this study assumed that the change in total revenue from 2019 to 2020 was not affected by inflation. The use of total revenue or total output value as a response variable was also found in previous studies, e.g. Hartšenko & Sauga (2013), Prastiwi et al. (2017), and Walujadi (2004).

The variables related to human capital were used to determine the technical inefficiency of MSEs. According to Schultz (1961) and Pujiati & Imron (2020), the level of human capital is an important key to the performance of the enterprise. In this case, note that the dummy variable of entrepreneur gender and educational attainment are time-invariant.

The several specifications of the Cobb-Douglas model would be utilized to check the robustness of regression coefficient estimates for the interest variables (Lu & White, 2014), i.e. the dummy of Covid-19, type of enterprises by 2-digit ISIC, and its interaction, which quantified the magnitude of Covid-19's impact on the total revenue of MSEs. The full Cobb-Douglas model in the linear form used in this study is as follows:

$$\ln(rev_{it}) = \beta_0 + \beta_1 ln(cap_{it}) + \beta_2 ln(lab_{it}) + \beta_3 covid19_t + \beta_{4.11} isic11 + \cdots + \beta_{4.33} isic33 + \beta_{5.11} covid19_t * isic11 + \cdots + \beta_{5.33} covid19_t * isic33 + \varepsilon_{it} \quad \ldots\ldots (1)$$

Where:

$$\varepsilon_{it} = v_{it} - u_{it}$$
$$i = 1,2,\ldots,1930$$
$$t = 2019,2020 \quad \ldots\ldots\ldots\ldots (2)$$

The dummy variable measures the aggregate impact of Covid-19 on the total revenue of MSEs in Bali. Meanwhile, the interaction variable *covid19$_t$*isic$_i$* assesses the impact of Covid-19 on the total revenue of each type of MSE. The Cobb-Douglas model assumed there is no different technology level in all observations. Hence, this study assumed that the possibility of differences in technology levels in each enterprise would be accommodated by the dummy variable of 2-digit ISIC.

Based on Aigner et al. (1977) and Meeusen & van Den Broeck (1977), the random error, v_{it} is assumed to be independently and identically normal distributed $N(0, \sigma_v^2)$ and the technical inefficiency term, u_{it} is assumed to be non-negative and half normally distributed with mean $\mu > 0$ and variance σ_u^2. The random error v_{it} and technical inefficiency u_{it} are independent for all $i = 1,2,\ldots,N$ and $t = 1,2,\ldots,T$.

The random error term accounts for random factors that enterprises cannot control and are not incorporated in the model, such as measurement errors, government policy, weather, etc (Battese, 1992). While the technical inefficiency term accounts for deviations produced by factors that organizations may control, such as management factor, age, skill, education, information, communication and technology (ICT) use, credit use, and so on. As a result, the technical inefficiency term in this study is a function of the following predictor variables:

$$u_{it} = \delta_0 + \delta_1 gend_i + \delta_2 age_{it} + \delta_{31} edu_{1i} + \delta_{32} edu_{2i} + \delta_{33} edu_{3i} + \delta_{34} edu_{4i} + \delta_4 owncap_{it} + \delta_5 cred_{it} + \delta_6 inet_{it} + w_{it} \quad (3)$$

where w_{it} is random error with truncated normally distributed with zero mean and variance σ^2.

Technical efficiency is the ability of an enterprise to produce maximum output using a combination of given inputs (Coelli, Rao, O'Donnell, & Battese, 2005). In other words, technical efficiency is the proportion of observed output to the frontier output or potential maximum output. The formula of technical efficiency for i-thenterprise (TE_i) is as follows:

$$TE_{it} = \frac{y_{it}}{exp(x_{it}^T \beta + v_{it})} \quad \ldots\ldots\ldots\ldots (4)$$

$$TE_{it} = \frac{exp(x_{it}^T \beta + v_{it} - u_{it})}{exp(x_{it}^T \beta + v_{it})} = exp(-u_{it}) \quad \ldots\ldots\ldots\ldots (5)$$

The zero value of technical inefficiency u_{it} indicates that an enterprise is totally efficient, while $u_{it} > 0$ indicates that technical inefficiency is exist hence diminishing the technical efficiency. In this study, the estimation of the SFA model with the Cobb-Douglass production function is performed using package frontier by Coelli & Henningsen (2020) in R statistical software.

RESULTS AND DISCUSSION

In this study, the first step was to do visual inspection to depict the impact of Covid-19 on the performance of MSEs in Bali by using the scatter plot and boxplot. Figure 1 shows the relationship between the total revenue of MSEs in 2019 and 2020 in logarithmic form. The linear regression model from these two indicators was also estimated. As shown in the figure, the slope coefficient estimate of linear regression (red line) is less than unity, i.e. 0.86, indicated that on average, the total revenue in 2020 is only 86% of total revenue in 2019. In other words, the total revenue of MSEs during the pandemic in 2020 has decreased about 14% compared to the previous year.

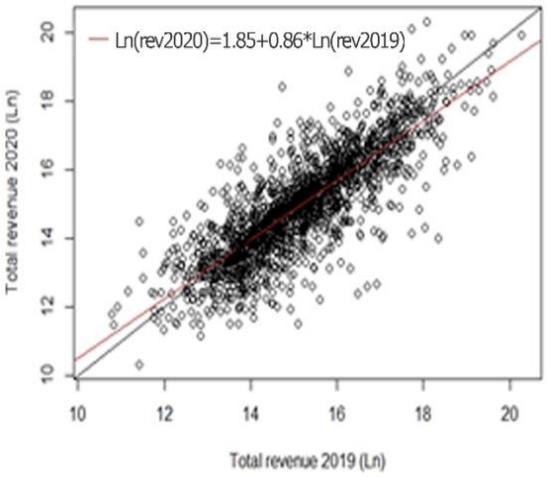


Figure 1. Scatter Plot of Total Revenue of MSEs in Bali, 2019-2020 (ln)
Source: Data Processed, 2022

The boxplot comparison of total revenue in 2019 and 2020 also show a similar pattern that there is a slight decrease in the first quartile, median, and third quartile during the pandemic, in 2020 as presented in Figure 2.

The different types of MSEs with 2-digit ISIC assumed to have different characteristics that led to the different impacts caused by the Covid-19 pandemic. Figure 3 shows that the majority of MSEs by 2-digit ISIC have experienced a decrease in total revenue, except for MSEs with 2-digit ISIC: 11, 22, 26, 27, and 29. Furthermore, this decrease in the total revenue of MSEs during the Covid-19 pandemic would be statistically tested through the SFA model with the Cobb-Douglas production function. In this study, the interpretation of the estimated coefficient for dummy variables of $(exp(\beta) - 1) \times 100\%$ is explained by Giles (2011).

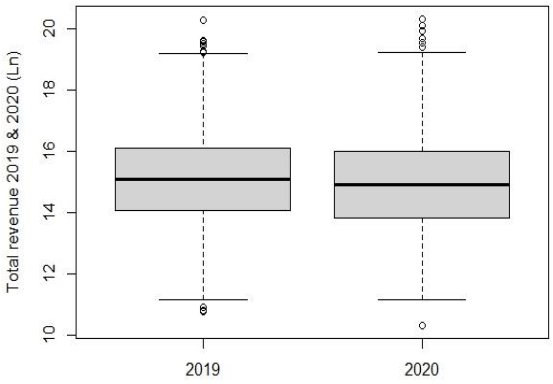


Figure 2. Boxplot of Total Revenue of MSEs, 2019-2020 (ln)
Source: Data Processed, 2022

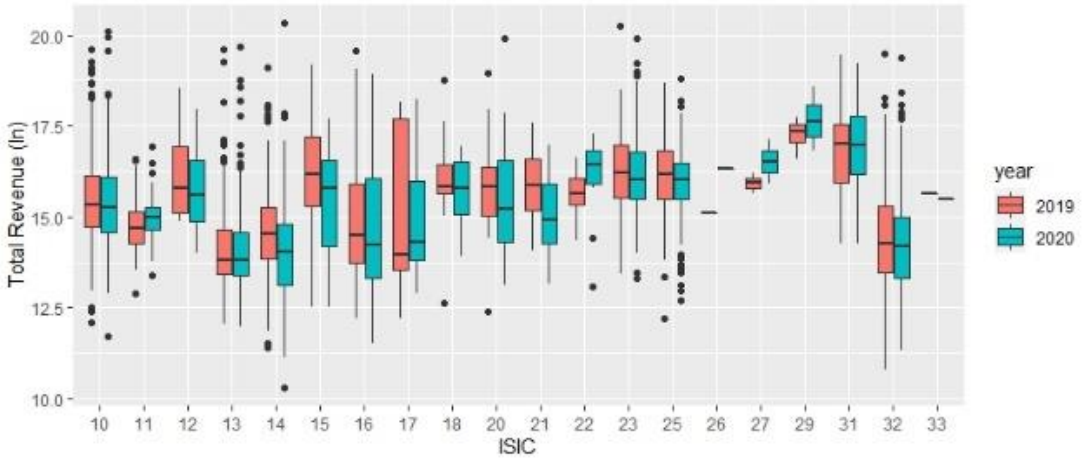


Figure 3. Boxplot of Total Revenue of MSEs by 2-Digit ISIC, 2019-2020
Source: Data Processed, 2022

There are four models used in this study with a different set of predictor variables included in the models to observe the behavior of coefficient estimates of the interest variables, such as the dummy of Covid-19, type of enterprises by 2-digit ISIC, and its interaction (Table 3). The coefficient estimates of $covid19$ variable from all the model are very similar, i.e. about -0.25 to -0.23 which indicates a robust estimation. From the full model (model 4), the measured aggregate impact of Covid-19

on the total revenue of MSEs in Bali is (exp(-0.2591)-1)×100%=-22.83%.

The dummy variables *isic* account for the heterogeneity among the MSEs by 2-digit ISIC. These variables have very similar estimation results in models 2 and 3. When the technical inefficiency variables are included in model 4, the sign of the estimate results becomes negative and shows in the dummy of two-digit ISIC: 15, 18, 21, 22, 23, 25, 27, and 31. These values indicate non-robust estimation results. The significance test ($\alpha = 0.05$) for these variables also shows statistically non-significant. The statistically significant results shown by dummy variable of 2-digit ISIC: 11, 13, 14, 16, 20, and 32 means that the total revenue of MSEs with these 2-digit ISIC is significantly different compared to the total revenue of MSEs with 2-digit ISIC: 10 (reference category).

The dummy variable of interaction covid19*isic measures the specific impact of the Covid-19 pandemic on total revenue for each type of MSEs by 2-digit ISIC. The coefficient estimates of these variables in models 3 and 4 are highly close and in the same sign, demonstrating robust estimation results. In the full model (model 4), the statistically significant results are only shown by dummy variable of interaction between Covid-19 and MSEs by 2-digit ISIC: 11, 13, and 14.

Without regarding the significance test results, the estimated coefficient of dummy variables would be compared to observe which MSEs with 2-digit ISIC received the negative impact of Covid-19 on the total revenue or which MSEs experienced the positive impact of Covid-19 instead. Note that the interpretation also refers to Giles (2011) and the impact magnitude for each 2-digit ISIC is always compared to the 2-digit ISIC: 10 as a reference category.

Table 3. Estimation Results of the SFA Model with Cobb-Douglass Production Function

Variable	Model 1	Model 2	Model 3	Model 4
$intercept$	12.4099***	12.5610***	12.5314***	13.8330***
	(0.1872)	(0.3044)	(0.2841)	(0.1706)
$ln(cap)$	0.1490***	0.1302***	0.1321***	0.1069***
	(0.0098)	(0.0092)	(0.0094)	(0.0092)
$ln(lab)$	1.6075***	1.4147***	1.4146***	1.2347***
	(0.0300)	(0.0300)	(0.0300)	(0.0301)
$covid19$	-0.2320***	-0.2333***	-0.2438**	-0.2591***
	(0.0335)	(0.0314)	(0.0775)	(0.0760)
$isic11$		-0.3597***	-0.6009***	-0.9305***
		(0.0818)	(0.1148)	(0.1124)
$isic12$		-0.4447	-0.6828	-0.6132
		(0.3398)	(0.4907)	(0.5744)
$isic13$		-0.7480***	-0.8925***	-0.8455***
		(0.0687)	(0.0959)	(0.0959)
$isic14$		-0.6556***	-0.5013***	-0.6275***
		(0.0592)	(0.0823)	(0.0817)
$isic15$		0.0037	0.1633	-0.2327
		(0.1261)	(0.1790)	(0.1699)
$isic16$		-0.3878***	-0.3449***	-0.5575***
		(0.0564)	(0.0789)	(0.0776)
$isic17$		-0.1067	-0.2354	-0.4709
		(0.2293)	(0.3261)	(0.3081)
$isic18$		0.1695	0.0749	-0.4714
		(0.1947)	(0.2748)	(0.2565)
$isic20$		-0.4142*	-0.3170	-0.7177*
		(0.1625)	(0.2278)	(0.2183)
$isic21$		0.0851	0.2350	-0.0472

Variable	Model 1	Model 2	Model 3	Model 4
		(0.1691)	(0.2396)	(0.2275)
$isic22$		0.8052***	0.4136	-0.1079
		(0.1799)	(0.2508)	(0.2405)
$isic23$		0.1811**	0.2002*	-0.1405
		(0.0625)	(0.0871)	(0.0861)
$isic25$		0.3381***	0.2702**	-0.1702
		(0.0665)	(0.0934)	(0.0923)
$isic26$		1.2379	0.6339	0.1003
		(0.6459)	(0.7352)	(0.7384)
$isic27$		0.1554	-0.3304	-0.6183
		(0.4872)	(0.6436)	(0.6261)
$isic29$		-0.1241	-0.4342	-0.5419
		(0.3583)	(0.5478)	(0.5602)
$isic31$		0.5173***	0.3561*	-0.0446
		(0.1142)	(0.1629)	(0.1532)
$isic32$		-0.7309***	-0.7320***	-0.7304***
		(0.0548)	(0.0763)	(0.0769)
$isic33$		0.5162	0.9250	0.0258
		(0.6865)	(0.7357)	(0.8848)
$covid19 * isic11$			0.4861**	0.4885**
			(0.1629)	(0.1544)
$covid19 * isic12$			0.4783	0.2879
			(0.6827)	(0.8467)
$covid19 * isic13$			0.2884*	0.2720*
			(0.1351)	(0.1338)
$covid19 * isic14$			-0.3092**	-0.3346**
			(0.1161)	(0.1138)
$covid19 * isic15$			-0.3178	-0.3276
			(0.2527)	(0.2365)
$covid19 * isic16$			-0.0840	-0.0738
			(0.1112)	(0.1077)
$covid19 * isic17$			0.2594	0.0940
			(0.4616)	(0.4369)
$covid19 * isic18$			0.1882	0.1872
			(0.3905)	(0.3607)
$covid19 * isic20$			-0.1960	-0.1571
			(0.3214)	(0.3122)
$covid19 * isic21$			-0.2998	-0.3209
			(0.3374)	(0.3178)
$covid19 * isic22$			0.7838*	0.6193
			(0.3572)	(0.3353)
$covid19 * isic23$			-0.0407	-0.0682
			(0.1225)	(0.1170)
$covid19 * isic25$			0.1330	0.1036
			(0.1318)	(0.1248)
$covid19 * isic26$			1.2107	0.8944
			(0.9082)	(0.9585)
$covid19 * isic27$			0.9661	0.9585
			(0.8805)	(0.8760)
$covid19 * isic29$			0.6072	0.7325
			(0.7829)	(0.8251)
$covid19 * isic31$			0.3173	0.2891
			(0.2295)	(0.2120)

Variable	Model 1	Model 2	Model 3	Model 4
$covid19 * isic32$			0.0044	0.0121
			(0.1076)	(0.1061)
$covid19 * isic33$			-0.8176	-0.3075
			(0.9080)	(1.2445)
Technical Inefficiency:				
$intercept$				0.8775***
				(0.0824)
$gend$				-0.5342***
				(0.0417)
age				0.3926***
				(0.0707)
edu_1				-0.0086
				(0.0504)
edu_2				-0.0766
				(0.0571)
edu_3				-0.1086
				(0.0567)
edu_4				-0.1400
				(0.0922)
$owncap$				0.1429*
				(0.0593)
$cred$				-2.5130***
				(0.4879)
$inet$				-0.3939***
				(0.0489)

Notes: Standard errors in parentheses; *p<0.05, **p<0.01, ***p<0.001
Source: Data Processed, 2022

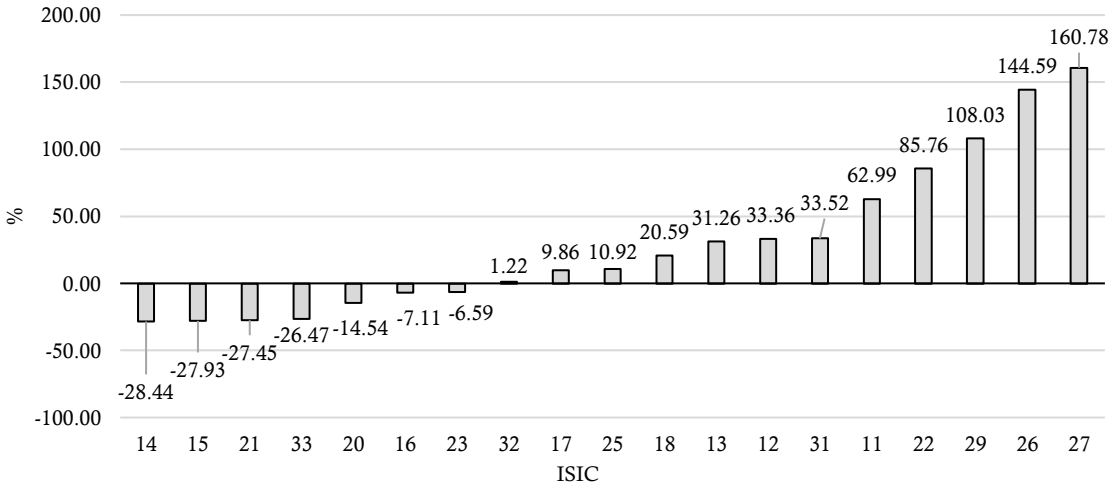


Figure 4. Impact of Covid-19 on the Total Revenue of MSEs by 2-Digit ISIC
Source: Data Processed, 2022

Figure 4 shows that the negative impact of Covid-19 on total revenue experienced by MSEs with 2-digit ISIC: 14, 15, 21, 33, 20, 16, and 23 with the impact magnitude are -28,44%, -27,93%, -27,45%, -26,47%, -14,54%, -7,11%, and -6,59%, respectively. While others MSEs with 2-digit ISIC experienced positive impact. The highest impact is 160,78% experienced by MSEs with 2-digit ISIC: 27.

As empirically shown by many previous studies, in this study the production input, i.e. fixed capital and number of labor, also have a positive impact on total revenue. 1% increase in fixed capital and number of labors would lead to an increase in 0.11% and 1.23% in total revenue, respectively. The elasticity of total revenue concerning the number of labors is higher than the elasticity of total revenue concerning fixed capital. This result confirmed that the characteristic of MSEs in Bali is labor-intensive.

In equation (2), the technical inefficiency term u_{it} has a negative form hence before interpreting the impact on the total revenue, the estimated coefficients in Table 3 need to be multiplied by -1 first. All the variables related to the technical inefficiency are statistically significant, except the entrepreneur's educational attainment. This result indicates that in MSEs with the labor-intensive characteristic, the education for the entrepreneur is not quite an important factor to improve the total revenue. Chaniago (2021) stated that formal education attainment usually does not match with business field and was not the important factor determining the performance of the small business which has characteristics, i.e relatively few workers, simple technology, no complex activities, and has limited capital. A previous study by Yilmaz et al. (2020) also showed that the education factor was not statistically significant.

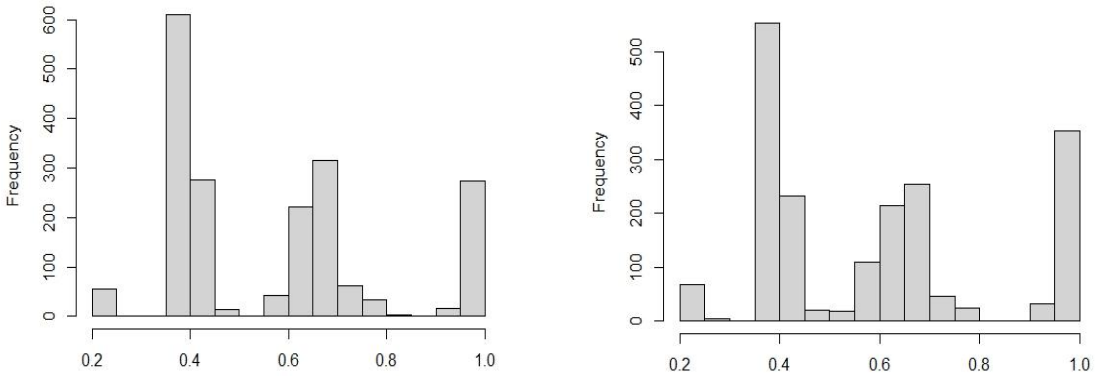
On average, the MSEs with male entrepreneurs have better performance than MSEs with female entrepreneurs. The different impact is about $(exp(0.5342) - 1) \times 100\% = 70.61\%$ shows that there is a gender disparity in terms of MSEs' performance in Bali. The females business owner have lower productivity and tend to avoid risks in business (Istiandari & Anandhika, 2019) and have a less strong entrepreneurial spirit compared to males enterpreneurs (Kolvereid, 1996). Moreover, MSEs with female entrepreneurs are dominated by home-based businesses in which the owner also has the principal responsibility to take care of her family and hence has less time in business operation (Tunggal, H.P., Joesron, 2019). The same result was also empirically shown by previous studies, i.e. Mango et al. (2015), Najjuma et al. (2016), Tenaye (2020), Istiandari & Anandhika (2019), Mazzarol et al. (1999), Prayudi et al. (2019), Robichaud et al. (2013), and Rosa & Sylla (2016). The different results are shown by Mbusya (2019) that female entrepreneurs have better performance than male entrepreneurs. Other studies found that gender has different impact patterns based on the type of business. Chaniago (2021) found that females have better performance in the food industry and males are better at managing the business with particular activities, for example, MSEs with 2-digit ISIC: 16 and 23.

The entrepreneur age group has a negative impact on total revenue indicating that MSEs with non-productive age entrepreneurs have less performance, i.e. $(exp(-0.3926) - 1) \times 100\% = -32.47\%$, compared to MSEs with productive age entrepreneurs. There were two different findings about the impact of entrepreneur age on the output. First, the findings stated that the younger or productive age entrepreneur tends to be more efficient than the older or non-productive entrepreneur as reported by Battese & Coelli (1995), Bozoğlu & Ceyhan (2007), Goldman (2013), Mango et al. (2015), and Najjuma et al. (2016). Most previous studies argued that in productive age the entrepreneurs are more aggressive and ambitious, have greater a chance of success, and are more efficient to manage business hence have better business performance compared to non-productive age entrepreneurs(Acs et al., 2005; Istiandari & Anandhika, 2019; Sari & Rahmantika, 2018; Tunggal, H.P., Joesron, 2019).

Second, earlier research concluded that older or non-productive entrepreneurs have more expertise in the business process than younger or productive entrepreneurs, and hence perform better in terms of output, as reported by Abate, Dessie, & Mekie (2019), Ayele, Haji, & Tegegne (2019), and Tenaye (2020).

Surprisingly, the MSEs that use their own capital with a proportion >50% have less performance, i.e$(exp(-0.1429) - 1) \times 100\% = -13.32\%$, compared to the MSEs that use their own capital with the proportion ≤50%. The

access to obtain credit from KUR has a positive impact on the total revenue of MSEs, i.e. $(exp(2.513) - 1) \times 100\% = 1134\%$. In other words, the MSEs that utilize KUR tend to have total revenue of more than 11 times than the MSEs that do not utilize KUR. This result also confirmed the results from the previous studies such as researches conducted by Hakim et al. (2020), Mango et al. (2015), Trujillo & Iglesias (2013) and Hartšenko & Sauga (2013). The use of the internet in the business process of MSEs also increases the total revenue, i.e. $(exp(0.3939) - 1) \times 100\% = 48.28\%$. The same result was also reported by Rachman et al. (2015).



(a) (b)

Figure 5. Histogram of Technical Efficiency of MSEs, 2019 (a) and 2020 (b).
Source: Data Processed, 2022

The technical efficiency of MSEs in 2019 and 2020, finally, would be compared to observe the impact of Covid-19, visually. Figure 5 shows that the frequency distribution of technical efficiency in 2019 and 2020 has a very similar pattern with most of MSEs have the technical efficiency between 40% and 80%. This means that the potential maximum revenue achieved by MSEs using given inputs is between 40% and 80%. Only a few MSEs have a technical efficiency of around 20%. Interestingly, there are about 300 MSEs in 2019 and 2020 that have a technical efficiency very close to 100%. This condition highlights that MSEs is very diverse (ILO, 2015) in term of technical efficiency caused by the heterogeneous factors related to technical inefficiency. As stated by Chaniago (2021), the performance of small enterprises is highly relied on the quality of entrepreneurs reflected by the demographic characteristics. Figure 6 shows that the highest and lowest technical efficiency is experienced by almost all 2-digit ISIC of MSEs, indicating that there is no certain pattern of technical efficiency by type of business.

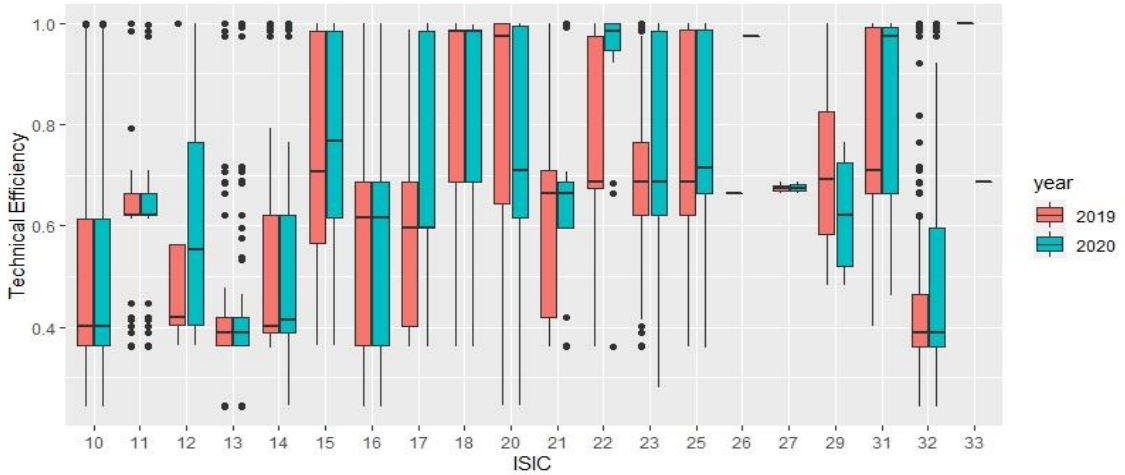


Figure 6. Box plot of Technical Efficiency of MSEs by 2-Digit ISIC, 2019-2020
Source: Data Processed, 2022

It is shown in Figure 6 above that from all the 2-digit ISIC of MSEs in Bali, there are seven with a relatively similar distribution of technical efficiency in 2019 and 2020, i.e. 10, 11, 13, 16, 18, 25, and 27. While the other 2-digit ISIC experience a distributional change of technical efficiency during the Covid-19 pandemic. The significant increase visually appears for MSEs with 2-digit ISIC: 12, 15, 17, 21, 22, 23, 26, 31, and 32. While the significant decrease visually appears for MSEs with 2-digit ISIC: 14, 20, 29, and 33.

CONCLUSION

This study measured the impact of the Covid-19 pandemic on the total revenue of MSEs in Bali, in aggregate and specifically for each type of enterprise by 2-digit ISIC, by utilizing the SFA model with the Cobb-Douglas production function. The impact of input factors, i.e. fixed capital and number of labor, on the total revenue is also observed through this model. Various factors related to the technical inefficiency of MSEs are taken into account in affecting technical efficiency. At the last stage, the comparison of the technical efficiency of MSEs by 2-digit ISIC before and during the Covid-19 pandemic was performed.

The results showed that the Covid-19 pandemic had negative effect on the total revenue of MSEs in Bali. On average, total revenue declined by around one-fifth during the pandemic compared to total revenue before the pandemic. In more detail, through the dummy variable interaction, there statistically significant impact of Covid-19 experienced by MSEs with 2-digit ISIC: 11, 13, and 14. The latest experienced the highest negative impact on the total revenue. Otherwise, the first two have a positive impact on the total revenue. Without regarding the significance test result, there are six types of MSEs that experienced a negative impact, i.e. with 2-digit ISIC: 15, 21, 33, 20, 16, and 23. The government should pay greater attention to MSEs with these 2-digit ISIC with the top priority is MSEs with 2-digit ISIC: 14 since it has a significant impact.

The two input factors employed in the model have a positive impact on total revenue, with the elasticity of labor being greater than the elasticity of fixed capital, indicating that MSEs in Bali are labor-intensive. Education is the only factor related to the technical inefficiency that statistically not significantly affected the total revenue of MSEs. The fact that the male entrepreneur outperforms female entrepreneur implies that there is a gender disparity in MSEs in Bali. Moreover, the disparity also appears between the productive and non-productive age entrepreneurs where the former has better performance.

The result also showed that the MSEs with capital dominated by their own capital tend to have less performance compared to the MSEs with capital dominated by a loan. The MSEs that utilize credit from KUR tend to have better performance. These two results showed that capital assistance from the banking institutions and the government is very important to help MSEs improve their performance.

Internet use in the business process of MSEs also has a positive impact on the total revenue. In this digital age and also during the pandemic, the use of ICT for marketing and transaction is important key to maintaining the performance of the enterprise by keeping the connection of MSEs with the consumers. As a result, the implementation and practical use of ICT in business processes must be enhanced, as according to BPS (2020), only a small number of MSEs in Indonesia (11,94%) used the internet in their business process in 2019.

Overall, the technical efficiency of MSEs before and during the Covid-19 pandemic is comparable, ranging between 40% and 80%. In more detail, the relative significant changes in technical efficiency are depicted in MSEs by 2-digit ISIC. Unfortunately, the MSEs with 2-digit ISIC: 14 have decreasing distributional patterns making these MSEs need more attention and business assistance from the government during the Covid-19 pandemic.

The government, financial institutions, entrepreneurs, and communities play an important role to improve the performance of

MSEs in Bali. The government needs to provide intensive assistance for MSEs with the female, non-productive age entrepreneurs, and also for a certain types of MSEs that experienced negative impact due to Covid-19 pandemic. The government and financial institutions need to provide low-interest credit as capital assistance that would help MSEs to improve their performance. Socialization is also needed to increase the participation of MSEs in credit applications. The ICT use for marketing and transaction needs to be implemented immediately for bridging the MSEs and consumers in the time of pandemic under mobility restrictions. Moreover, a suitable marketplace needs to be provided by the government alongside support from the communities.

This study utilizes the SFA model with the Cobb-Douglas production function for two years of panel data. While the model specification used is only a common effect since there are two time-invariant variables related to the technical inefficiency in the model. Therefore, for future studies the panel specification model either fixed effect or random effect needs to be considered. Other variables such as the age of enterprises as a proxy of an entrepreneur's experience and labor training need to be incorporated into the model. Furthermore, considering the diversity of MSEs, the SFA model needs to be performed separately by type of business or each 2-digit ISIC to determine the different impact patterns of predictor variables on the performance of MSEs.

REFERENCES

Abate, T. M., Dessie, A. B., & Mekie, T. M. (2019). Technical Efficiency of Smallholder Farmers in Red Pepper Production in North Gondar Zone Amhara Regional state, Ethiopia. *Journal of Economic Structures*, *8*(1), 1–18. https://doi.org/10.1186/s40008-019-0150-6

Acs, Z. J., Arenius, P., Hay, M., & Minniti, M. (2005). Global Entrepreneurship Monitor. Executive Report 2004. *Global Entrepreneurship Monitor*, *March 2015*, 52. https://doi.org/10.13140/RG.2.1.1977.0409

Adian, I., Doumbia, D., Gregory, N., Ragoussis, A., Reddy, A., & Timmis, J. (2020). Small and Medium Enterprises in the Pandemic : Impact, Responses and the Role of Development Finance. In *Policy Research Working Paper 9414* (Issue September). https://doi.org/10.1596/1813-9450-9414

Agustina, D., Sholihin, M., & Fithria, A. (2019). The Efficiency of Indonesian Islamic Rural Banks: A Stochastic Frontier Analysis. *International Journal of Islamic Economics and Finance (IJIEF)*, *1*(2), 229–248. https://doi.org/10.18196/ijief.1212

Aigner, D., Lovell, C. A. K., & Schmidt, P. (1977). Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of Econometrics*, *6*(1), 21–37. https://doi.org/10.1016/0304-4076(77)90052-5

Apostolov, M. (2016). Cobb–Douglas Production Function on FDI in Southeast Europe. *Journal of Economic Structures*, *5*(1). https://doi.org/10.1186/s40008-016-0043-x

Atmojo, M. E., & Fridayani, H. D. (2021). An Assessment of Covid-19 Pandemic Impact on Indonesian Tourism Sector. *Journal of Governance and Public Policy*, *8*(1), 1–9. https://doi.org/10.18196/jgpp.811338

Ayele, A., Haji, J., & Tegegne, B. (2019). Technical Efficiency of Wheat Production by Smallholder Farmers in Soro District of Hadiya Zone, Southern Ethiopia. *East African Journal of Sciences*, *13*(2), 113–120. https://doi.org/10.4314/eajsci.v13i2

Barbera, F., & Moores, K. (2013). Firm Ownership and Productivity: A Study of Family and non-family SMEs. *Small Business Economics*, *40*(4), 953–976. https://doi.org/10.1007/s11187-011-9405-9

Battese, G. E., & Coelli, T. J. (1995). A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. *Empirical Economics*, *20*(2), 325–332. https://doi.org/10.1007/BF01205442

Battese, George E. (1992). Frontier Production Functions and Technical efficiency: a Survey of Empirical Applications in Agricultural Economics. *Agricultural Economics*, *7*(3–4), 185–208. https://doi.org/10.1016/0169-5150(92)90049-5

Bohorquez, V., & Esteves, J. (2008). Analyzing SMEs Size as a Moderator of ERP Impact in SMEs Productivity. *Communications of the IIMA*, *8*(3), 67–80.

Bozoğlu, M., & Ceyhan, V. (2007). Measuring the Technical Efficiency and Exploring the Inefficiency Determinants of Vegetable Farms in Samsun Province, Turkey. *Agricultural*

Systems, *94*(3), 649–656. https://doi.org/10.1016/j.agsy.2007.01.007

BPS. (2020). [*Profil Industri Mikro Kecil 2019]*. BPS-Statistics Indonesia.

BPS Provinsi Bali. (2019). *Potensi Peningkatan Kinerja Usaha Mikro Kecil Provinsi Bali*. BPS-Statistics Indonesia, Province of Bali.

BPS Provinsi Bali. (2021). [*Produk Domestik Regional Bruto Provinsi Bali Menurut Lapangan Usaha]*. BPS-Statistics Indonesia, Province of Bali.

Chaniago, H. (2021). Demographic Characteristics and Small Business Success : Evidence from Indonesia. *Journal of Asian Finance Economics and Business*, *8*(12), 399–409. https://doi.org/10.13106/jafeb.2021.vol8.no12.0399

Charoenrat, T. (2014). An Empirical Study of Thai Manufacturing SMEs : A Stochastic Frontier Analysis (SFA). *Journal of Management Science, Ubon T=ratchthani University*, 18–52.

Coelli, T., & Henningsen, A. (2020). *A. Package 'Frontier.'* https://cran.r-project.org/web/packages/frontier/frontier.pdf

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An Introduction to Productivity Analysis* (Second Edi). Springer.

Cucculelli, M., & Peruzzi, V. (2020). Post-crisis Firm Survival, Business Model Changes, and Learning: Evidence from the Italian Manufacturing Industry. *Small Business Economics*, *54*(2), 459–474. https://doi.org/10.1007 /s11187-018-0044-2

Dagvadorj, G., & Bo, Z. Y. (2019). Factor Affecting Economic Performance of SMEs in Mongolia. *European Journal of Business and Management*, *11*(21), 139–142. https://doi.org/10.7176/EJBM

Giles, D. E. (2011). Interpreting Dummy Variables in Semi-logarithmic Regression Models: Exact Distributional Results. In *University of Victoria Department of Economics Working Paper EWP 1101* (Issue June).

Goldman, D. (2013). *Technical efficiency of rice production in India: A study using stochastic frontier analysis to estimate technical efficiency and its determinants*. Tufts University.

Hakim, R., Haryanto, T., & Sari, D. W. (2020). Analysis of Factors affecting the Technical Efficiency of Rice Farming in East java Province. *Jurnal Ekonomi Pembangunan*, *18*(2), 123–135.

Handayani, F., Sylvina, V., & Lestari, A. (2021). Toward New Normal: Bali Tourism Goes Extra Mile. *IOP Conference Series: Earth and Environmental Science*, *704*(1), 1–8. https://doi.org/10.1088/1755-1315/704/1/012025

Hartšenko, J., & Sauga, A. (2013). The Role of Financial Support in SME and Economic Development in Estonia. *Business and Economic Horizons*, *9*(2), 10–22. https://doi.org/10.15208/beh.2013.6

Hasan, M. Z., Kamil, A. A., Mustafa, A., & Baten, M. A. (2012). A Cobb-Douglas Stochastic Frontier Model on Measuring Domestic Bank Efficiency in Malaysia. *PLoS ONE*, *7*(8), 1–5. https://doi.org/10.1371/journal.pone.0042215

Hossain, M. K., Hossain, M. A., & Baten, M. A. (2016). Performance Evaluation of SME Banking in Bangladesh using Stochastic Frontier Analysis. *(APJB) Asia Pacific Journal of Business*, *7*(1), 31–42.

Ikram, A., Su, Q., & Asif Sadiq, M. (2016). Technical Efficiency and its Determinants: An Empirical Study of Surgical Instruments Cluster of Pakistan. *Journal of Applied Business Research*, *32*(2), 647–660. https://doi.org/10.19030/jabr.v32i2.9601

ILO. (2015). Small and medium-sized enterprises and decent and productive employment creation. In *International Labour Conference, 104th Session*. http://www.ilo.org/wcmsp5/groups/public/@ed_norm/@relconf/documents/meetingdocument/wcms_358294.pdf

Istiandari, R., & Anandhika, M. R. (2019). *The role of gender in micro and small enterprise business development in Indonesia: A firm-level analysis*. Asia Pacific Foundation of Canada. https://apfcanada-msme.ca/research/role-gender-micro-and-small-enterprise-business-development-indonesia-firm-level-analysis%0Ahttps://apfcanada-msme.ca/sites/default/files/2020-07/The Role of Gender In Micro and Small Enterprise Business Development in I

Izgi, B. B., Karadag, H., & Beceren, E. (2020). A Glance at Growth Accounting: Cobb-Douglas Model for G-7 (1950-2018). *European Journal of Digital Economy Research*, *1*(2), 69–75.

Kolvereid, L. (1996). Prediction of Employment Status Choice Intentions. *Entrepreneurship Theory and Practice*, *21*(1), 47–58. https://doi.org/10.1177/104225879602100104

Lu, X., & White, H. (2014). Robustness Checks and Robustness Tests in Applied Economics. *Journal of Econometrics*, *178*(PART 1), 194–206. https://doi.org/10.1016/j.jeconom.2013.08.016

Mahmood, M. (2008). Labour Productivity and Employment in Australian Manufacturing SMEs. *International Entrepreneurship and Management Journal*, *4*(1), 51–62.

https://doi.org/10.1007/s11365-006-0025-9

Mango, N., Makate, C., Hanyani-Mlambo, B., Siziba, S., & Lundy, M. (2015). A Stochastic Frontier Analysis of Technical Efficiency in Smallholder Maize Production in Zimbabwe: The post-fast-track land reform outlook. *Cogent Economics and Finance*, *3*(1), 1–14. https://doi.org/10.1080/23322039.2015.1117189

Mazzarol, T., Volery, T., Doss, N., & Thein, V. (1999). Factors influencing small business start-ups: A comparison with previous research. *International Journal of Entrepreneurial Behaviour & Research*, *5*(2), 48–63. https://doi.org/10.1108/13552559910274499

Mbusya, E. W. (2019). *Technical Efficiency of Small and Medium-sized Enterprises in Kenya* (Issue November). University of Nairobi.

Meeusen, W., & van Den Broeck, J. (1977). Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. *International Economic Review*, *18*(2), 435. https://doi.org/10.2307/2525757

Najjuma, E., Kavoi, M. M., & Mbeche, R. (2016). Assessment of Technical Efficiency of Open Field Tomato Production in Kiambu County, Kenya (Stochastic Frontier Approach). *JAGST*, *17*(2), 21–39. https://www.researchgate.net/publication/309396019

Nalini, S. N. L. (2021). Dampak Covid-19 terhadap Usaha MIkro, Kecil dan Menengah. *Jesya (Jurnal Ekonomi & Ekonomi Syariah)*, *4*(1), 662–669. https://doi.org/10.36778/jesya.v4i1.278

Noor, Z. M., & Siang, L. C. (2014). Technical Efficiency of Malaysian Manufacturing Small and Medium Enterprises. *Prosiding PERKEM Ke-9 2014*, *9*, 676–688.

Nurprihatin, F., & Tannady, H. (2017). [*Pengukuran Produktivitas Menggunakan Fungsi Cobb-Douglas Berdasarkan Jam Kerja Efektif*]. *JIEMS (Journal of Industrial Engineering and Management Systems)*, *10*(1), 34–45. https://doi.org/10.30813/jiems.v10i1.36

Ouedraogo, S. A., & Gansonre, S. (2020). *Managerial Practices and Performance of Small and Medium-sized Enterprises: Evidence from Burkina Faso*.

Pakpahan, A. K. (2020). Covid-19 dan Implikasi Bagi Usaha Mikro, Kecil, Dan Menengah. *Jurnal Ilmiah Hubungan Internasional*, *0*(0), 59–64. https://doi.org/10.26593/jihi.v0i0.3870.59-64

Pinkovetskaia, I. (2018). Modeling the Volume of Production in Small and Medium Enterprises in the Regions of Russia. *CBU International Conference Proceedings*, *6*(2008), 387–392. https://doi.org/10.12955/cbup.v6.1187

Prastiwi, E. W., Ayutyas, S., Ayunigtyas, D. K., & Saputri, V. G. (2017). Technical Efficiency Analysis of SMEs in Nusa Tenggara Timur Province 2015: An Integration of Stochastic Frontier analysis and Six Sigma Methodology. *Proceedings 2nd ISI Regional Statistics Conference*, 170–175.

Prayudi, M. A., Vijaya, D. P., & Ekawati, L. P. (2019). What drives MSME performance? The role of gender, operational aspects, and social environment. *Journal of Contemporary Accounting*, *1*(2), 65–84. https://doi.org/10.20885/jca.vol1.iss2.art1

Pujiati, A., & Imron, M. (2020). The Effect of Industrial Existence on the Environment and Socio-Economy. *Economics Development Analysis Journal*, *9*(1), 12–22. https://doi.org/10.15294/edaj.v9i1.37261

Purwa, T., & Atmanegara, E. (2020). The International Tourism Performance Amidst Several Intervention Events: More than 20 Years of Multi Input Intervention Analysis in Bali, Jakarta, and Kepulauan Riau Provinces. *Economics and Finance in Indonesia*, *66*(2), 172. https://doi.org/10.47291/efi.v66i2.870

Rachman, S., Gregory, M. A., & Narayan, S. W. (2015). The Role of ICT Services on Indonesian Small to Medium Enterprise Productivity. *25th International Telecommunication Networks and Applications Conference, ITNAC 2015*, 166–172. https://doi.org/10.1109/ATNAC.2015.7366807

Radam, A., Abu, M. L., & Abdullah, amin M. (2008). Technical Efficiency of Small and Medium Enterprise in Malaysia: A Stochastic Frontier Production Model. *International Journal of Economics and Management*, *2*(2), 395–408. https://doi.org/10.5539/ass.v10n16p131

Robichaud, Y., McGraw, E., Cachon, J.-C., Bolton, D., Codina, J. B., Eccius-Wellmann, C., & Walsh, A. D. (2013). Female entrepreneurs' motives and SME's growth: An international study. *Journal of Women's Entrepreneurship and Education*, *3*(4), 1–27.

Rodrigues, M., Franco, M., Sousa, N., & Silva, R. (2021). Covid 19 and the Business Management Crisis: an Empirical Study in SMEs. *Sustainability (Switzerland)*, *13*(11), 1–20. https://doi.org/10.3390/su13115912

Rosa, J. M., & Sylla, D. (2016). *A Comparison of the Performance of Female-Owned and Male-Owned Small and Medium-Sized Enterprises - SME research and statistics*. http://www.ic.gc.ca/eic/site/061.nsf/eng/h_03034.html

Sari, I. A., & Rahmantika, D. N. (2018). The Effect of Firm Characteristics and Enterpreneur Characteristics on the Success pg MSME Business in Central Java Province. *Daya Saing*

Jurnal Ekonomi Manajemen Sumber Daya, *23*(1), 26–35.

Schultz, T. W. (1961). Investment in Human Capital. *The American Economic Review*, *51*(1), 1–17.

Tambunan, T. (2020). MSMEs in Times of Crisis: Evidence from Indonesia. *Journal of Developing Economies*, *5*(2), 91. https://doi.org/10.20473/jde.v5i2.20848

Tenaye, A. (2020). Technical Efficiency of Smallholder Agriculture in Developing Countries: The case of Ethiopia. *Economies*, *8*(2), 1–27. https://doi.org/10.3390/ECONOMIES8020034

Thuy, L. T. T., Le, N. P., Cuong, L. Van, & Thi, N. T. T. (2020). Application of Cobb-Douglas Production Function in Analysing the Private Enterprises' ability of Job Creation In Phu Tho Province. *Journal of Science and Technology*, *21*(4), 29–39.

Trujillo, J. C., & Iglesias, W. J. (2013). Measurement of the Technical Efficiency of Small Pineapple Farmers in Santander, Colombia: A Stochastic Frontier Approach. *Revista de Economia e Sociologia Rural*, *51*(SUPPL.1), S049–S062. https://doi.org/10.1590/S0103-20032013000600003

Tunggal, H.P., Joesron, T. S. (2019). *Technical efficiency analysis of Indonesian Small and Micro industries. A Stochastic Frontier* (Issue No. 201903). https://ideas.repec.org/p/unp/wpaper/201903.html

Umar, H. S., Girei, A. A., & Yakubu, D. (2017). Comparison of Cobb-Douglas and Translog Frontier Models in The analysis of Technical Efficiency in Dry-Season Tomato Production. *Agrosearch*, *17*(2), 67–77. https://doi.org/ https://dx.doi.org/10.4314/agrosh.v17i2.6

Vasyl'yeva, O. (2021). Assessment of Factors of Sustainable Development of the Agricultural Sector Using the Cobb-Douglas Production Function. *Baltic Journal of Economic Studies*, *7*(2), 37–49. https://doi.org/10.30525/2256-0742/2021-7-2-37-49

Walujadi, D. (2004). Age, Export Orientation and Technical Efficiency: Evidence From Garment Firms in DKI Jakarta. *Makara Human Behavior Studies in Asia*, *8*(3), 97. https://doi.org/10.7454/mssh.v8i3.97

Yilmaz, H., Gelaw, F., & Speelman, S. (2020). Analysis of Technical Efficiency in Milk Production: A Cross-Sectional Study on Turkish Dairy Farming. *Revista Brasileira de Zootecnia*, *49*(e20180308), 1–10. https://doi.org/10.37496/RBZ4920180308

Yuniti, I. G. A. D., Sasmita, N., Komara, L. L., Purba, J. H., & Pandawani, N. P. (2020). The Impact of covid-19 on Community Life in the Province of Bali, Indonesia. *International Journal of Psychosocial Rehabilitation*, *24*(10), 1918–1929. https://doi.org/10.37200/IJPR/V24I10/PR300214