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Total Factor Productivity Calculation of The Indonesian Micro and Small Scale Manufacturing Industry

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ABSTRACT

The purpose of this research is to determine the total factor productivity (TFP) of Indonesia's micro and small-scale manufacturing industries. The production function estimation approach established by Levinsohn-Petrin as the basis for computing TFP is employed in this study, with value added as the dependent variable and the value of labor costs and capital value proxied by the value of investment as the independent variables. This study uses secondary data from the Central Statistics Agency (BPS), which includes 23 sub-sectors of Indonesia's micro and small scale manufacturing industries that are included in the 2-digit ISIC, with the exception of the ISIC code 19 sub-sector, and covers the years 2010 to 2019, excluding 2016. The TFP value in the micro-scale Indonesian manufacturing industry was often higher than the TFP value on the small scale, according to this study. This research also demonstrates that low-tech sub-sectors, such as the food processing industry, have low productivity. On a small size, the estimated TFP value shows a decreasing trend, but on a micro scale, the estimated TFP value indicates an increasing trend.

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1. Introduction

The manufacturing industry plays a significant role in the Indonesian economy. Indonesia's manufacturing economy is growing more inclusively, as evidenced by the growing contribution of micro-small businesses, particularly in terms of the number of business units and workers absorbed. According to statistics from the Indonesian manufacturing industry with a two-digit KLBI period 2011-2019, the average growth rate of micro-small scale enterprise units was 5.44 percent, while the average growth rate of large-medium scale enterprise units was only 3.44 percent. The importance of micro-small scale firms in the Indonesian manufacturing industry can also be observed in their worker absorption rate, which is higher than that of large-medium size enterprises. During the period 2011-2018, the average growth rate of workers absorbed in the micro-small scale manufacturing industry was 5.69 percent, whereas the average growth rate of workers absorbed in the large-scale manufacturing industry was 4.19 percent.

The development of the contribution of the micro-small scale industry output value to the total output value of the Indonesian manufacturing industry has not remained consistent with the growth rate of enterprise units and workers in the Indonesian micro-small scale manufacturing industry. During the period 2010-2019, large and medium-scale firms generated 90% of the entire output of Indonesia's manufacturing industry, while micro-small scale enterprises contributed just 10%. Furthermore, as measured by the ratio of output value to input value, the productivity of the micro-small scale manufacturing industry is declining. Micro, small, and medium-sized businesses in the Indonesian manufacturing industry have been found to have low efficiency and productivity in previous studies (Setiawan et al., 2016; Setiawan & Indiastuti, 2015). This situation demonstrates that Indonesia's micro-small-scale manufacturing industry's productivity needs to be improved. Micro-small firms play an essential role in the manufacturing industry, particularly in employment generation, hence efforts to boost productivity in the Indonesian micro-small scale manufacturing industry are critical. As a result, a thorough examination of the precise productivity calculation is required.

Research into the productivity of Indonesia's micro-small-scale manufacturing industry is very scarce. Previous research on the subject of micro-small industry in Indonesia has largely focused with the performance of micro-small industry in general rather than the productivity calculation. Setiawan et al., (2016), for example, solely examines the elements that influence the technological efficiency of Indonesia's micro-small sector, but does not quantify productivity. Other studies looked into the elements that influence operating profit in Indonesia's micro-small sector, as well as the state of the industry at a regional and national level (Sudaryo & Permatasari, 2017; Tambunan, 2019; Tusianti et al., 2019).

In Indonesia, research on industrial manufacturing productivity is often conducted for large and medium-sized businesses. Several studies, for example, have estimated productivity levels and growth in Indonesia's manufacturing industry as a whole (Ikhsan, 2007; Muryani & Chiputyani, 2019; Setiawan et al., 2018; Sugiharti et al., 2017; Surjaningsih Bayu & Permono, 2014; Vial, 2006; Widodo et al., 2014; Yasin, 2021b), as well as productivity estimates in specific medium and large manufacturing industry sub-sectors (Margono & Sharma, 2006; Okamoto & Sjöholm, 2000; Yasin, 2021a), but none of these studies specifically calculate productivity for micro and small scale manufacturing industries.

Within the method of productivity calculation, investigating the productivity of micro and small scale manufacturing enterprises in Indonesia is a continuous interest. Several earlier studies (Okamoto & Sjöholm, 2000; Surjaningsih Bayu & Permono, 2014; Widodo et al., 2014; Yasin, 2021b) used non-parametric approaches such as computing index numbers and non-parametric frontier estimate to assess the productivity level of the Indonesian manufacturing industry. The productivity level was measured in another study utilizing the total factor productivity (TFP) calculation method, which was determined using the parametric stochastic frontier approach,ordinary least squares, fixed effect, random effect (Ikhsan, 2007; Setiawan et al., 2018; Sugiharti et al., 2017), and the Levisohn-Levin technique were used to assess the level and growth of Indonesian manufacturing industry TFP (Faradila & Kakinaka, 2020; Vial, 2006). TFP is estimated for large, medium, and small scale firms in the Indonesian manufacturing industry. Furthermore, earlier TFP research has primarily focused on estimating TFP growth rather than quantifying TFP levels. It's still uncommon to come across research that uses the parametric stochastic frontier approach, particularly the Levinsohn-Petrin (LP) method, to compute TFP levels in the Indonesian micro-small scale manufacturing industry. This method has been utilized to compute TFP in the Indonesian large-medium scale manufacturing industry so far.

Based on the limitations of previous studies in calculating TFP levels in the Indonesian manufacturing sector, the goal of this research is to use the Levinsohn-Petrin (LP) method to calculate TFP levels in the micro-small scale manufacturing industry. This will be the first study to use the Levinsohn-Petrin estimation method to determine TFP in the Indonesian micro-small scale manufacturing industry. This study divides the manufacturing industry TFP calculation into two parts: (1) micro-small scale TFP and (2) small-scale TFP. All calculations are based on data from the micro-small scale manufacturing industry from Badan Pusat Statistik (BPS) Indonesia, which encompasses sub-sectors 10 to 33, with the exception of sub-sector ISIC number 19.

This paper is divided into four sections. The first section will go through prior research that calculated TFP in the Indonesian manufacturing industry. In the second section, it will explain the estimate model and dataset that will be used in the TFP calculation. The results of the TFP computation as well as the analysis will be reported in the third section. The study's findings will be presented in the final part.

2. Literature Review

The research of Setiawan et al. (2018) calculates and analyzes TFP as the productivity level of the Indonesian manufacturing industry. The Central Statistics Agency provided data from the medium and large scale manufacturing industry (IBS) for this study (BPS). Total factor productivity (TFP), which is computed via residual translog of the Cobb Douglas production function, is used to quantify productivity at the company and industrial level. The findings of this study revealed that Indonesia's manufacturing industry productivity remained consistent across the research period, with an average of 2.291.

Vial conducted a similar study in which the TFP for the entire Indonesian manufacturing industry was assessed using nine 2-digit ISIC (International Standard Industrial Classification) sub-sectors (2006b). In contrast to Setiawan et al., (2018), Vial's study used the Levinsohn and Petrin (2003) production function estimator to analyze data on value added, fixed assets, labor, and electricity consumption from 1988 to 1995. The TFP estimation results demonstrate that the TFP value calculated using the fixed asset value reported by the company and the TFP value estimated using the fixed asset value prediction in the sample firm are not significantly different. The average TFP value from those two estimations was 5.80 and 5.81, respectively (Vial, 2006).

Faradila and Kakinaka (2020) employ the Levinsohn-Petrin (LP) method to estimate TFP. This study employed company level data from the big and medium size Indonesian manufacturing industries from 2011 to 2013, which was separated into a treatment and control group. If a company is located within an industrial estate, it is classed as a treatment group. In Levinsohn-Petrin estimations, the value added case is employed (Petrin et al., 2004). The TFP value for the treatment group was 9.041, according to the calculations. TFP values in the control group were 12% lower than those in the therapy group. This evidence implies that businesses located within an industrial estate are more likely to be more productive (Faradila & Kakinaka, 2020).

There are several studies that calculate TFP level and TFP growth for specific Indonesian manufacturing industry sub-sectors, such as TFP in the food and beverage, automotive, textile and textile products, chemical, and metal products industries (Margono & Sharma, 2006; Okamoto & Sjöholm, 2000; Yasin, 2021a; Wafi & Sari, 2021), in addition to

TFP estimation for the entire Indonesian manufacturing industry sub-sectors in general (Margono & Sharma, 2006; Okamoto & Sjöhol, 2000).Yasin (2021a) used firm-level panel data from the food and beverage industry. Yasin (2021a) assessed TFP growth using a fixed effects model and discovered that the food and beverage industries saw positive TFP increase from 2008 to 2015 (Yasin, 2021a). Another study, similar to Yasin's, employed the Solow residual estimation model and the Ordinary Least Square (OLS) regression to estimate the TFP of Indonesia's Foods and Beverage Industries (Ikhsan, 2007). Ikhsan used the Cobb-Douglas production function with two production elements, capital and labor in his research. During the period 1988-2000, the average TFP growth for the entire sample was 2.87 percent per year, according to this study (Ikhsan, 2007). The stochastic frontier model was used to estimate TFP growth in the Indonesian food, textile, chemical, and metal goods industries from 1993 to 2000 (Margono & Sharma, 2006). The findings of this study revealed that between 1993 and 2000, TFP in all three sub-sectors was decreasing.

The TFP of the manufacturing industry is also calculated at the regional level in Indonesia. For example, a study in Banten Province that analyzes the value of TFP growth in the medium-large scale manufacturing business. The output variable was employed as the dependent variable in this study, with the production factors of the number of workers, the value of capital, and the value of intermediate inputs as the production factors. According to the calculations, the TFP growth of the medium-large scale manufacturing industry in Banten Province from 2006 to 2017 was positive, averaging 4.39 percent per year (Yusuf et al., 2021). Other previous studies reported that the TFP at the provincial level in Indonesia during the 2011-2017 period averaged 0.990 (Purwono et al., 2021).

3. Research Method

TFP can be calculated using the stochastic frontier approach (SFA) with a variety of production functions, including the Cobb Douglas production function, which has been utilized in multiple earlier research (Faradila & Kakinaka, 2020; Setiawan et al., 2018; Sugiharti et al., 2017; van Beveren, 2012; Vial, 2006; Yasin, 2021a). The Cobb-Douglas production function, which was used in this study, can be written as follows:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it} \quad (3.1)$$

Where y is the logarithm of output, which can be measured as gross revenue or value added; l and m are the logarithms of freely labor and intermediate inputs, respectively; k is the logarithm of capital input; i is the notation for each sub sector in the manufacturing industry with two-digit ISIC (ISIC 10 through 33, excluding ISIC 19); t is the notation for the yearly period (2010-2019); $\eta$is the error term that is unrelated to the input choices, and is the transmitted productivity component. The firm's decision criteria are influenced by productivity, but this is not visible. Estimation methods that ignore the connection between inputs and this unobservable element, such as the ordinary least squares (OLS) technique, can produce inconsistent results.

As a result, (Petrin et al., 2004) stated that the demand for intermediate inputs (m) is influenced by the firm's capital (k) and productivity (ω). The following is a formula for expressing the demand for intermediate input:

$$m_{it} = m_{it}(k_{it}, \omega_{it}) \quad (3.2)$$

That demand function for the intermediate input is monotonically increasing in ω_{it}. So, the intermediate demand function can be inversed, and ω_{it}can be written as a function of $k_{it}$and m_{it}as follows:

$$\omega_{it} = \omega_{it}(k_{it}, m_{it}) \quad (3.3)$$

The equation (3.3) show that unobservable productivity term is now function of the two observed inputs, capital and raw materials. Petrin et al., (2004) also assume that productivity is governed by first-order Markov process with this function:

$$\omega_{it} = E\langle \omega_t | \omega_{t-1} \rangle + \xi_{it} \quad (3.4)$$

where $\xi_{it}$is an innovation to productivity that is uncorrelated with k_{it}, but not necessarily with l_{it}. This part is the source of simultaneity problem.

The estimation of the productivity using the Levinsohn-Petrin (LP) regression method (Petrin et al., 2004) can be calculation with value added and gross revenue as the dependent variable. In this research used the value added as the dependent variable.

Value added (va_{it})is gross output (y_{it}) minus intermediates or raw material (m_{it}). In this value added case, now only labor as the freely input. Supposed the value added for the sub sector *i* in year *t* notion is $v_{it}$and the production function in equation (3.1) now can be written as follows:

$$va_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it} \quad (3.5)$$
$$va_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it}(k_t, m_t) + \eta_{it} \quad (3.6)$$
$$va_{it} = \beta_l l_{it} + \phi_{it}(k_{it}, m_{it}) + \eta_{it} \quad (3.7)$$

where

$$\phi_{it}(k_{it}, m_{it}) = \beta_0 + \beta_k k_{it} + \omega_{it}(k_t, m_t) \quad (3.8)$$

From that the Levinsohn-Petrin approach (Petrin et al., 2004) formulation, omega (ω_{it}) as a predicted productivity or TFP level can be formulated as follows:

$$\widehat{\omega_{it}} = \exp(va_{it} - \widehat{\beta}_l l_{it} - \widehat{\beta}_k k_{it}) \quad (3.9)$$

where $\widehat{\beta}_l$ and $\widehat{\beta}_k$ were the coefficients of the regression equation (3.6). The estimation of equation (3.6) uses the regression formulation introduced by the Levinsohn-Petrin (Petrin et al., 2004). The estimation of equation (3.6) is carried out twice, each for the micro-scale manufacturing industry and the small-scale manufacturing industry. Based on the regression results, then the TFP value for the micro-scale manufacturing industry and TFP for the small-scale manufacturing industry is calculated using equation (3.9). The TFP calculation is based on the regression results using Levinsohn-Petrin regression method. The consideration of the selection of this regression methods is to avoid endogeneity problems in the production function regression which is the basis for the TFP calculation (Van Beveren, 2012).

The Bureau of Central Statistics provided secondary balanced panel data for this study (BPS). The 2-digit ISIC Indonesian micro and small scale manufacturing industry sub-sectors make up the object series data. There are 23 subsectors, ranging from ISIC 10 to ISIC 33, with the exception of ISIC 19. The research time series data spans the years 2010 to 2019, with the exception of 2016. The data for 2016 was not included, since the data for the Indonesian micro and small-scale manufacturing industry was not divided into micro-scale and small-scale sub-sectors explicitly in that year. The only data available is for the entire micro-small scale manufacturing industry. In 2016, the 2-digit ISIC Indonesian micro and small scales manufacturing industry sub-sectors data did not differentiate between micro small and small scales manufacturing. As a result, there are 207 observations in this study.

The value added variable is utilized as the dependent variable in the production function regression, which is used as the basis for the TFP computation. The independent variables are capital value, labor expenses, and intermediate inputs. The monetary dimension in million rupiah units is used by all of these variables, and the operational descriptions of each variable are shown in Table 1.

Table 1. Variables Operationalization

Symbol	Variable	Variables Operationalization
va	Value added	Output value minus intermediate input cost. Inputs or intermediate costs are costs incurred in the production process, including cost of: (1) raw and auxiliary materials used in the production process, (2) fuel, electric power and gas; (3) rental of buildings, machinery and equipment, and (4) non-industrial services.
k	Kapital	Since secondary data on asset values in the 2-digit ISIC sub-sector of Indonesian manufacturing industry is not available, asset value is proxied by using the percentage of investment value from the total output value of each Indonesian micro and small business each year. This data is obtained from book "Perkembangan Data Usaha Mikro, Kecil, Menengah, dan Usaha Besar" published by Ministry of Cooperatives and Small and Medium Enterprises of Indonesia. Assuming the percentage of investment value in each sub-sector of Indonesian manufacturing industry 2-digit ISIC are the same, the value of assets or capital in each sub-sector can be predicted by multiplying the percentage by the output value of each sub-sector in every year.
l	Labor cost	Labor cost consist of regular salary and allowance, overtime wages, transportations and food allowance, grand and bonuses, pension fund, and labor insurance.
m	Inputor intermediate cost	Inputs or intermediate costs are costs incurred in the production process, including cost of: (1) raw and auxiliary materials used in the production process, (2) fuel, electric power and gas; (3) rental of buildings, machinery and equipment, and (4) non-industrial services.

Source: BPS-Statistics Indonesia, 2021; Ministry of Cooperatives and Small and Medium Enterprises of Indonesia, 2021.

As can be observed from Table 2, the summary statistics of the research data demonstrate that all data are very heterogeneous, with standard deviations greater than the mean value of the variables. The value of the micro-scale manufacturing industry's output and input materials is higher than the value of the small-scale manufacturing industry's production. This is hardly surprising, given that the micro-scale manufacturing industry has a higher unit number of businesses than the small-scale manufacturing industry.

Labor costs, on the other hand, have a lower value on a micro size than they do on a small one. On the other hand, the number of workers on a micro size is more than the number of workers on a tiny scale. This demonstrates that the wage rate per worker in the micro-scale manufacturing industry is lower than in the small-scale manufacturing industry.

Table 2. Descriptive Statistic of the Variables

Variable	Mean	Std. Dev.	Min	Max
Output of micro-scale industry (qm)	10,090,078	22,473,234	5,704	159,600,000
Input materials of micro-scale industry (mm)	5,633,839	14,137,489	3,251	108,800,000
Labor cost of micro-scale industry (lcm)	907,791	1,472,269	234	6,704,369
Value added of micro-scale industry (qm)	4,456,239	8,657,172	880	52,106,912
Capital of micro-scale industry (km)	560,392	1,210,759	318	8,281,569
Output of small-scale industry (qs)	8,205,741	16,359,143	52	119,800,000
Input materials of small-scale industry (ms)	4,933,916	11,241,083	19	83,088,282
Labor cost of small-scale industry (lcs)	1,282,925	2,172,010	4	14,623,190
Value added of small-scale industry (qs)	3,271,826	5,451,799	33	36,715,970
Capital of small-scale industry (ks)	5,297,227	10,849,734	25	86,174,134

Source: Authors' Calculation, 2021.

Additional information about capital value can be gathered from Table 2. The capital value of small-scale industries, as measured by investment value, is greater than the investment value of micro-scale industries. However, when measured in terms of added value, small-scale industry has a lower contributed value than micro-scale industry.

Differences in the added value conditions, labor prices, input material values, and capital values between micro- and small-scale businesses can result in disparities in the productivity levels of the two industrial scales. This can be deduced from the results of the two industrial scales' TFP calculations.

4. Results and Discussion

Table 3 presents the results of a regression analysis using the LP method on the equation (6) for Indonesian micro and small scale manufacturing industry with value added as the dependent variable. According to Table 3, the terms m and s in the variable notation relate to microscale (m) and smallscale (s) industry. The findings in Table 3 indicate that capital and labor costs have a considerable impact on the value added of the Indonesian industrial manufacturing sector, both on a micro and small scale.

We also present the total of the coefficients for each estimator at the bottom of Table 3; constant returns to scale correspond to a sum of one. The Wald test demonstrates that we cannot reject the hypothesis of constant returns to scale in both micro and small scale manufacturing industries' production functions. This result demonstrates that both micro and smallscale production functions exhibit constant returns to scale. This conclusion corroborates prior studies indicating that the average returns to scale for the Indonesian manufacturing industry between 1988 and 2000 is approximately 0.99 (Ikhsan, 2007). Constant returns to scale also exist in the small-scale manufacturing industries in the United States of America and China (Nguyen & Lee, 2002; Ren & Jie, 2019).

Table 3. Results of the Production Function Regression Using the LP Method with Value Added as the Dependent Variable

Variables	(1) lnva_m	(2) lnv_s
lnl_m	0.085**	
	(0.0396)	
lnk_m	0.938***	
	(0.0523)	
lnl_s		0.228***
		(0.0369)
lnk_s		0.749***
		(0.0387)
Observations	207	207
Sum of coefficients	1.0228	0.977
Prob. Wald test of constant returns to scale	0.3685	0.1783

Notes: All estimations using the user-written command *levpet*. Micro-scale's estimation command: levpet lnvam, free (lnlcm) proxy (lnmm) capital (lnkm) value added. Small-scale's estimation command: levpet lnvas, free (lnlcs) proxy (lnms) capital (lnks) value added.

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' Calculation, 2021.

The coefficient values for capital (lnk_m and lnk_s) and labor (lnl_m and lnl_s) obtained from the production function estimation results in Table 3 are then used to calculate the TFP value for micro and small scale Indonesian manufacturing industries using equation (9). Table 4 summarizes the findings of the computation of the TFP value at the micro (tfp_m) and small (tfp_s) scale. As illustrated in Table 4. The mean TFP value at the microscale (tfp_m) is greater than the mean at the small scale (tfp_s). This finding implies that Indonesia's microscale manufacturing industry is more productive than its smallscale counterpart. In the micro and small scale manufacturing industries, the average TFP value is 6.15 and 1.43, respectively. The TFP value indicates that the output value produced by the micro-scale manufacturing industry is 6.15 times the value of the input or production factors used, whereas the output value produced by the small-scale manufacturing industry is 1.43 times the value of the input or production factors used.

These findings are congruent with those of previous research. The TFP value of the Indonesian manufacturing sector in general, without regard for its business scale, is 5.80 on average (Vial, 2006), and the range of the TFP value of the Indonesian manufacturing industry from 2012 to 2015 is 0.62-1.57 (Muryani & Chiputyani, 2019). The TFP value for the medium-large scale manufacturing industry was derived from 2001 to 2005 using an average TFP value of 1.39 (Eskani, 2010). Another study that assesses the TFP value of Indonesian manufacturing businesses on a small, medium, and big scale finds that the TFP value ranges between 1.2 and 1.5 (Saliola et al., 2012). The phenomenon where the productivity level of smallscale manufacturing industries is higher than the productivity of largescale enterprises is also found in several countries. For example, a Czech study showed that firms with fewer workers had higher levels of productivity (Dvouletý, O. and Blažková, I., 2021). The results of similar studies in India and Vietnam suggest that smaller firms tend to be more productive than the bigger ones. (De, P.K., Nagaraj, P., 2014; Giang, M., Xuan, T., Trung, B., Que, M., & Yoshida, Y., 2014).

Table 4. Summarized TFP Micro and Small Scale Manufacturing 2-Digit ISIC with LP Method

Variable	Obs	Mean	Std. Dev.	Min	Max
tfp_m	207	6.146	1.508	1.386	11.899
tfp_s	207	1.427	.494	.279	4.498

Source: Authors' Calculation, 2021.

There are various plausible factors for small-scale industry's poorer productivity in comparison to micro-scale. This outcome could be explained by the differential in labor costs between the two industrial sizes. Labor costs are higher in small industries than in microscale businesses. This is evident from the figures in Table 6 regarding the average cost of labor. Labor expenses are higher in smallscale manufacturing sectors than in micro-scale manufacturing industries, because certain small enterprises that are legal entities are compelled to pay employees the provincial minimum wage. Whereas workers in microenterprises, which comprise the majority of the informal sector, are typically paid less than the provincial minimum wage.

The higher labor expenses in these small-scale manufacturing enterprises are not offset by the increased value of the output. As a result, the small-scale processing industry's productivity is lower than the microscale processing industries. This condition suggests that, in the instance of Indonesia's micro-small scale manufacturing industry, scaling up from micro to smallscale does not result in economies of scale that can result in increased productivity. According to Barco C., et al. (2018), if a smallscale enterprise increases in size, it will initially experience conditions of economies of scale which have a positive effect on its productivity. However, after growing beyond a certain scale of production, diseconomies of scale have a dominating effect, resulting in a negative impact on productivity.

To compare the TFP values in each subsector of Indonesia's micro and small scale manufacturing industries, Tables 5 and 6 rank the subsector according to their average TFP values, from highest to lowest, for micro and small scale manufacturing industries, respectively. The Machine and Equipment Repair and Installation subsector (ISIC code 33) has the highest productivity in the microscale manufacturing industry, while the food processing sub-sector has the lowest productivity (ISIC code 10). Productivity conditions in smallscale manufacturing enterprises are slightly different. The subsector with the highest productivity in this smallscale industry is the Machines and Equipment That Cannot Be Classified Elsewhere (ISIC code 28), whereas the subsector with the lowest productivity is still the Food Processing subsector (ISIC code 10).

Table 5. Average Micro Scale's TFP by Sub Sector

2-Digit ISIC	Sub Sector	Average Micro Scale's TFP
33	Repair and Installation for Machines and Equipment	7.05
11	Beverage	7.01
12	Tobacco Processing	6.92
21	Pharmaceuticals, Chemical Medicinal Products and Traditional Medicines	6.91
27	Electrical Equipment	6.86
23	Non-Metal Excavated Goods	6.43

2-Digit ISIC	Sub Sector	Average Micro Scale's TFP
29	Motorized Vehicles, Trailers and Semi-Trailers	6.40
30	Other Transport Equipment	6.37
22	Rubber, Rubber and Plastic Products	6.34
13	Textile	6.34
17	Paper and Paper Goods	6.33
14	Apparel	6.31
26	Computers, Electronic and Optical Goods	6.17
18	Printing and Reproduction of Recording Media	6.12
28	Machines and Equipment That Cannot Be Classified Elsewhere	6.12
24	Metal Base	6.09
25	Metal Goods, Not Machinery and Equipment	5.75
16	Wood, Wood and Cork Products Excluding Furniture and Woven Products from Bamboo, Rattan and The Like	5.73
15	Leather and Leather Goods and Footwear	5.49
32	Other Manufacturing	5.42
31	Furniture	5.28
20	Chemicals and Articles of Chemicals	5.23
10	Food	4.68

Source: Authors' Calculation, 2021.

Based on the projected TFP value for each subsector, both micro scale industry (Table 5) and small scale industry (Table 6) exhibit comparable results, subsectors with a high degree of technology often having higher TFP values than subsectors with a lower level of technology. Thus, the findings of this study demonstrate that the greater the level of technology in Indonesia's micro and small scale manufacturing businesses, the better the productivity. The current findings appear to be consistent with studies from Indonesia and other countries that there is a favorable association between technology and productivity in manufacturing industry (Carlaw & Kosempel, 2004; Padilla, M. A. E., 2018; Lee & Xuan, 2019; Korkmaz, S., & Korkmaz, O., 2017; Haider et al., 2021).

Table 6. Average Small Scale's TFP by Sub Sector

2-Digit ISIC	Sub Sector	Average Small Scale's TFP
28	Machines and Equipment That Cannot Be Classified Elsewhere	1.6541
25	Metal Goods, Not Machinery and Equipment	1.6076
30	Other Transport Equipment	1.5551
27	Electrical Equipment	1.5545
23	Non-Metal Excavated Goods	1.5297
12	Tobacco Processing	1.5272
13	Textile	1.4776
21	Pharmaceuticals, Chemical Medicinal Products and	1.4652

2-Digit ISIC	Sub Sector	Average Small Scale's TFP
	Traditional Medicines	
18	Printing and Reproduction of Recording Media	1.4468
11	Beverage	1.4397
33	Repair and Installation for Machines and Equipment	1.4302
29	Motorized Vehicles, Trailers and Semi-Trailers	1.4301
26	Computers, Electronic and Optical Goods	1.4243
20	Chemicals and Articles of Chemicals	1.4184
22	Rubber, Rubber and Plastic Products	1.4044
15	Leather and Leather Goods and Footwear	1.3969
17	Paper and Paper Goods	1.3601
31	Furniture	1.3590
16	Wood, Wood and Cork Products Excluding Furniture and Woven Products from Bamboo, Rattan and The Like	1.3273
14	Apparel	1.3208
32	Other Manufacturing	1.2339
24	Metal Base	1.2276
10	Food	1.2273

Source: Authors' Calculation, 2021.

Table 7. Average Micro and Small Scale's TFP by Year

Year	Average Micro Scale's TFP	Average Small Scale's TFP
2010	5.82	1.99
2011	5.12	1.28
2012	5.31	1.42
2013	5.39	1.40
2014	6.42	1.49
2015	7.16	1.17
2017	5.84	1.46
2018	6.85	1.30
2019	7.41	1.33

Source: Authors' Calculation, 2021.

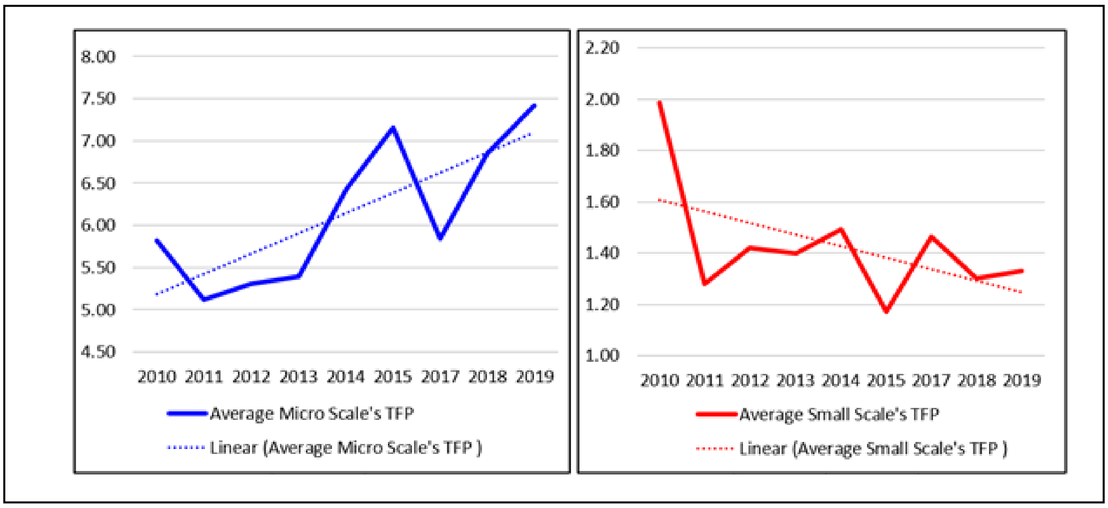

Figure 1. Trend of Estimated TFP Value
Source: Author's Calculation, 2021.

Additionally, research findings indicate that, from 2010 to 2019, the average projected TFP value in Indonesia's microscale manufacturing industry has been increasing, while smallscale productivity has been dropping. As evidenced by the data in Table 7 and Figure 1, These findings imply that a more appropriate strategy is required for managing business in the smallscale Indonesian manufacturing sector in order to boost efficiency and sustain stability.

5. Conclusion

The primary objective of this study was to discover the Levinsohn-Petrin (LP) method for calculating the TFP level in the microsmall scale manufacturing business. This study discovered that, on average, the TFP value in Indonesia's microscale manufacturing industry was bigger than the TFP value in the smallscale manufacturing industry. Additionally, the TFP calculation indicates that in both micro and small scale industries, subsectors classified as high-tech subsectors have a larger TFP value than those classified as low-tech subsectors. Another significant finding is that the estimated TFP value in small-scale enterprises is decreasing, in contrast to micro-scale industries, where the estimated TFP value is increasing.

The conclusion that can be derived from this research is that the prerequisites for economies of scale have not been formed in a small scale sector, which often evolves from a micro size industry. This occurs as a result of an expansion in business activity at a larger scale, which results in an increase in total costs. This increase in total expenses was not accompanied by a commensurate increase in production value, resulting in worse business productivity in smallscale businesses than in microscale industries. Conditions such as these that allow for poor production values on a small scale have a tendency to persist. Thus, increased attention is required to ensure that the expansion of company scale in Indonesia's manufacturing industry, particularly at the micro and small business level, is balanced by an increase in productivity.

Finally, a number of critical constraints must be considered. To begin, capital value data must be used in micro and small industries in conjunction with existing asset values on both industrial scales. As a result, it is preferable to employ microdata at the firm level, where asset value data is available. Second, the calculation of the TFP value on a micro and small scale in the Indonesian manufacturing industry should be examined further to ascertain the determinant elements.

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