JURNAL RISET ILMU EKONOMI
www.jrie.feb.unpas.ac.id
ISSN 2776-4567

Sources of Indonesia Manufacturing Productivity Growth

Rini Wulandari[1], Alvin Sugeng Prasetyo[2]*, M Devis Susandika[1]

Afiliasi Universitas Airlangga[1]
Universitas Trunojoyo Madura[2]
Email alvin.prasetyo@trunojoyo.ac.id*
DOI https://doi.org/10.23969/jrie.v4i2.90
Sitasi Wulandari, R., Prasetyo, A. S., & Susandika, M. D. (2024). Sources of Indonesia Manufacturing Productivity Growth. Jurnal Riset Ilmu Ekonomi, 4(2), 101–114. https://doi.org/10.23969/jrie.v4i2.90

ABSTRACT

Manufacturing industry productivity is a basic element in Indonesia's economic progress, so it is needed to accelerate Indonesia's economic growth. The advantage of the Manufacturing industry sector is that it has forward and backward linkages between sectors so that through manufacturing industry development, Indonesia higher economic growth. This research examines and analyzes the sources of manufacturing industry productivity growth in Indonesia for the 2010-2022 period. The research method used is panel data regression. The estimation results show that based on the panel data regression results the selected model is the FEM model so that all independent variables (raw materials, labor, energy, and capital) have a significant positive effect on the output of the Indonesian manufacturing industry. The estimation results in this study also found that labor and capital are inelastic.

Keywords: Industry Sector, Total Factor Productivity, Fixed Effect Model

JEL Classification: C01, D24, L60

INTRODUCTION

The productivity of the manufacturing industry is a basic element in economic progress. This is because the productivity of the manufacturing industry is needed to economic growth. The manufacturing industry is a sector that has many advantages,

such as having forward and backward linkages between sectors, and has fast growth and creates investment capital (Kurniati & Yanfitri, 2010; Rostiana et al., 2022).

Relies on the productivity of the manufacturing industry Indonesia chose an industrialization strategy because the manufacturing industry is carried out by the majority of 301 developing countries. This strategy was also chosen because Indonesia is trying to build its own manufacturing industry to meet domestic demand.

The role of the manufacturing industry in driving the Indonesian economy can be seen from the large contribution of industrial sector output to national GDP. The contribution of the manufacturing industry to GDP formation is more than 20 percent. This shows that the industrial sector is strategic in strengthening the Indonesian economy (Djulius et al., 2019, 2022; Surjaningsih & Permono, 2014). Considering the important role of the manufacturing industry sector, an analysis of the development of productivity in the Indonesian manufacturing industry is deemed necessary, especially to see the sustainability of output growth in this sector. This industrial sector output analysis is carried out by looking at the influence of the inputs used in the production process (Li et al., 2018).

The production function states that labor input is considered one of the production factors that has a positive impact on output (Sadiq et al., 2023). A larger workforce means increasing production levels. The production function also states that the production process also requires capital. Almost all economists emphasize the importance of capital as a determinant of output. Capital in the long term can lead to increased manufacturing sector output and create new economic activity, new markets, and higher demand for new consumer products (Setiawan et al., 2021; Shen et al., 2020).

The theoretical basis used in this study is the production function. The production function can also be defined as an equation that shows the maximum amount of output produced with a certain combination of inputs (Pindyck, 2018). Inputs used in the production process are also called production factors, which generally include labor, capital, and raw materials. Solow's theory explains that there are three sources of productivity growth, namely changes in the amount of capital, changes in the amount of labor, and changes in TFP, for TFP cannot be observed directly so it is measured first (Mankiw, 2018). This TFP growth is calculated as a residual and is referred to as the Solow Residual. The residual is the amount of output growth remaining after calculating the measurable determinants of growth (Shen et al., 2020). TFP can change for various reasons. Changes are often caused by increasing knowledge about production methods. Therefore, Solow Residue is often used as a measure of technological progress. So, it can be concluded that TFP includes everything that changes the relationship between input and output (Abidin et al., 2020).

Reseach on the sources of growth of the manufacturing industry in Indonesia find all inputs have a significant effect on the output of the manufacturing industry, while the

source of industrial growth in Indonesia is raw materials (Sari, 2004; Suryaman, 2024). Research on TFP was also carried out by Ahmadi & Ahmadi, DEA with the Malmquist Index approach. The estimation results show that TFP change in Iran is highest in the food and beverage industry sector (Ahmadi & Ahmadi, 2014).

This research aims to analyze the level of productivity and influencing factors in the meat processing industry in Indonesia. The data used is data from 1990 to 2013. The level of productivity is estimated using the Total Factor Productivity approach and the Data Envelopment Analysis-Malmquist (DEA-Malmquist) method. The findings show that the average productivity is 127.9%, which consists of 114.29% technological growth. In addition, efficiency growth was 95.5%, and economic scale growth was 98.33% (diseconomy and inefficiency). The industry market structure is a strict oligopoly where the average concentration of the four largest companies (CR4) is 62.5%. Based on regression analysis using Weighted Least Square (WLS), it is known that concentration, capital intensity, and number of business units have a positive and significant effect on productivity. Collusion and import intensity have a significant negative influence on productivity. There are differences in productivity levels before and after the implementation of anti-monopoly regulations; productivity levels increased once the regulations were established. On the other hand, productivity levels decreased after the meat import quota regulation was established when compared to the time when the regulation had not been established.

Surjaningsih & Permono conducted research to calculate and analyze Total Factor Productivity (TFP) for large and medium-scale industries in Indonesia covering the period 2000-2009 (Surjaningsih & Permono, 2014). Using the Data Envelopment Analysis (DEA) method, the results show that there is a shift in supporting factors in TFP growth in the manufacturing sector in the 2 (two) sample periods. In the 2000-2004 period, changes in efficiency became the main contributor to TFP growth. Even though in the 2005-2009 period, technical change was the main supporting factor for TFP, but along with the growth of negative efficiency changes or a decrease in ability the effect of catching up with companies to adapt to more advanced technology. Grouping the sample across sectors, technical changes, and also changes in efficiency shows a decline in the number of manufacturing industries with superior productivity. Furthermore, numbers are low and.

Similar research was also carried out by Wafi & Wulan Sari who conducted TFP research in medium-large industries in Indonesia from 2005 to 2009. This research used a stochastic frontier analysis (SFA) approach (Wafi & Sari, 2021). The results of this research indicate that there has been a change in the level of efficiency of production factors in medium-large scale industries in Indonesia with an increasing trend. On the other hand, the results of this research also found that the TFP development of medium-scale industries in Indonesia tends to experience a downward trend. This decline in TFP indicates that the level of technological progress of medium-large industries in Indonesia tends to decline further.

Dewi & Marhaeni researched the output of the textile industry in Bandung Regency. Data collection methods used in this research include observation, interviews, and in-depth interviews (Dewi & Marhaeni, 2016). The data analysis techniques used are path analysis, path analysis, and the Sobel test to analyze indirect effects through intervening variables. The research results show that capital has a significant effect on the output of the textile industry. The updates in this study consist of a more recent research period, measuring TFP based on the Solow formula, and measuring input elasticity. Next, to test the effect using panel data regression.

METHOD

This research uses a panel data regression approach. The research period used is 2010-2022. The dependent variable used is 2-digit manufacturing firm output, while labor input, raw materials, capital and energy are independent variables.

Table 1. Variable, Type & Source Data

Variable	Type	Source	Notation
Output	Secondary data	https://www.bps.go.id/id/publication	lnq
Capital	Secondary data	https://www.bps.go.id/id/publication	lnk
Labor	Secondary data	https://www.bps.go.id/id/publication	lnl
Raw Material	Secondary data	https://www.bps.go.id/id/publication	lnm
Energy	Secondary data	https://www.bps.go.id/id/publication	lne

Source: Data Processed

Table 1 shows that the data used in this research is secondary data with 2-digit ISIC data, meaning that the data was obtained through BPS. The data source comes from the BPS website then all variables were transformed into natural logarithms. This is done by following the rules in the Cobb-Douglas model. Table 2 shows the cross-section used in this study. The number of cross-sections is 24, while the number of time series is 13. So, the total panel data processed using panel data regression is 312.

Table 2. ISIC 2 Digit

ISIC 2 Digit	Code Description
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparels
15	Manufacture of leather and related products and footwear
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, bamboo, rattan and the like
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of pharmaceuticals, medicinal chemical and botanical products
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products

ISIC 2 Digit	Code Description
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, excepts machinery and equipment
26	Manufacture of computers, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c
29	Manufacture of motor vehicles, trailers and semi_trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment

Source: Data Processed

The panel data regression model in this study is as follows:

$$q_{it} = k^{\beta_1} l^{\beta_2} m^{\beta_3} e^{\beta_4} \quad \text{.....(1)}$$

Equation 1 shows a non-linear model for variables so that it can be linearized with a natural logarithm transformation. The natural logarithm transformation can be written in equation 2 it can be written as follows:

$$lnq_{it} = \alpha_0 + \beta_1 lnk_{it} + \beta_2 lnl_{it} + \beta_3 lnm_{it} + \beta_4 lne_{it} + \varepsilon_{it} \quad \text{.....(2)}$$

Model selection in panel data regression is as follows Lagrange Multiplier test is a test to find out whether the Random Effect Model or Pooled Least Square model is the most appropriate used. Then a Hausman Test was performed to compare the Fixed Effect Model and the Random Effect Model with the aim of determining which model should be used. Furthermore, the Classical Assumption Test aims to ensure that the research results are valid with the data used theoretically unbiased, consistent, and efficient estimation of the regression coefficient (Gujarati, 2021; Manik et al., 2023; Setiawan et al., 2021). Next, to estimate the TFP growth rate, use the following equation:

$$\frac{\Delta q}{q} = \frac{\Delta TFP}{TFP} + \alpha 1 \frac{\Delta k_1}{k_1} + \alpha 2 \frac{\Delta l_2}{l_2} + \alpha 3 \frac{\Delta m_3}{m_3} + \alpha 4 \frac{\Delta e_4}{e_4} \quad \text{... (3)}$$

The TFP formula in the equation above can be reformed into:

$$\frac{\Delta TFP}{TFP} = \frac{\Delta q}{q} - \alpha 1 \frac{\Delta k_1}{k_1} - \alpha 2 \frac{\Delta l_2}{l_2} - \alpha 3 \frac{\Delta m_3}{m_3} - \alpha 4 \frac{\Delta e_4}{e_4} \quad \text{... (4)}$$

The variables q, k, l, m, e are output, capital, labor, raw materials, and energy. TFP is the Total Factor Productivity, then Δ is growth. ΔTFP is the Total Factor of Productivity growth. Δq, Δk, Δl, Δm, Δe is manufacturing industry output growth, capital growth, labor growth, raw material growth, and energy growth.

RESULT AND DISCUSSION

The panel data regression model consists of the Pooled Least Square, Fixed Effect Model, and Random Effect Model. The three models were chosen as the best, so they were used to analyze the influence of the independent variable on the dependent variable. The following are the estimation results using panel data regression:

Table 4. Panel Regression Estimation

Variable	Parameter	Description	Model of Estimation		
			PLS	FEM	REM
Constanta	$\hat{\alpha}$	Coefficient	2,4081	2,1390	2,1219
		Standart Error	0,0043	0,0112	0,0049
lnk	$\widehat{\beta 1}$	Coefficient	0,1728	0,1397	0,1677
		Standart Error	0,0016	0,0006	0,0007
lnl	$\widehat{\beta 2}$	Coefficient	0,1780	0,1347	0,1774
		Standart Error	0,0022	0,0023	0,0018
lnm	$\widehat{\beta 3}$	Coefficient	0,4869	0,4316	0,4321
		Standart Error	0,0034	0,0026	0,0018
lne	$\widehat{\beta_4}$	Coefficient	0,2641	0,2141	0,2213
		Standart Error	0,0044	0,0017	0,0014
LM test		0,000***			
Hausman Test		0,000***			
***, **, * significant on 1%, 5%, 10%					

Source: Data Processed

Based on the LM and Hausman tests, it can be concluded that the best panel data regression model is FEM. The lnk variable in the PLS model has a coefficient of 0.17, meaning that an increase in capital of (1) percent increase the output of the Indonesian manufacturing industry by 0.17 percent. The FEM model has a coefficient of 0.13, meaning that an increase in capital of 1 percent can increase the output of the manufacturing industry by 0.13 percent. The REM model has a coefficient of 0.16, meaning that an increase in capital of 1 percent can increase the output of the Indonesian manufacturing industry by 0.16 percent. The lnl variable has a coefficient of 0.17 in the PLS model, 0.13 in the FEM model, and 0.17 in the REM model, meaning that an increase in the labor of 1 percent can encourage an increase in manufacturing industry output of 0.17 percent, 0, 13 percent, and 0.17 percent. The lnm variable has a coefficient of 0.48 in the PLS model, 0.43in the FEM model, and 0.43 in the REM model, meaning that an increase in the labor of 1 percent can encourage an increase in manufacturing industry output of 0.48 percent, 0,43 percent, and 0.4321 percent. The lne variable has a coefficient of 0.26 in the PLS model, 0.21 in the FEM model, and 0,22 in the REM model, meaning that an increase in the labor of 1 percent can encourage an increase in manufacturing industry output of 0,26 percent, 0,21 percent, and 0,22 percent.

Table 5. Classical Assumptions of the FEM Model

Method	Value	Description
VIF	32,39	There is Multicollinearity
Wald test	0,0000***	There is Heteroscedasticity
Wooldridge test	0,0000***	There is Autocorrelation
***, **, * significant at 1%, 5%, 10%		

Source: Data Processed

Table 5 is the result of investigating classical assumptions in the selected FEM model. The selected FEM model has an average VIF value of 32.39. This value is above 10, so it can be said to have a multicollinearity problem, but this problem does not violate the Gauss Markov assumption, meaning the parameters are still BLUE (Best Linear Unbiassed Estimator). Apart from that, the variables have also been transformed into natural logarithms. The Wald test is a test to detect heteroscedasticity. The detection results show that the Wald test probability is less than 1 percent, so the selected FEM model contains heteroscedasticity problems, so it needs to be cured with a Robust test. The Wooldridge test is a test to detect autocorrelation. The detection results turned out that the probability of the Wooldridge test was less than 1 percent, so the selected FEM model contained an autocorrelation problem, so it needed to be cured with Generalized Least Square.

Table 6 shows the estimation results that have used the Robust test and GLS test to cure heteroscedasticity and autocorrelation. The estimation results show that the variables capital, labor, raw materials, and energy have a significant positive effect on the output of the manufacturing industry in Indonesia. These results are consistent with the results before healing or reduction. This result is also by production theory and Cobb Douglas, where the input used can encourage production results. The biggest coefficient influencing the output of the manufacturing industry in Indonesia is raw materials. This indicates that raw material stock is an input that must be available in carrying out the production process. Therefore, raw material supplies must continue to be monitored properly.

Table 6. FEM Robust and FEM GLS Estimation Results

Variable	Parameter	Description	Model of Estimation	
			FEM-RO	FEM-GLS
Constanta	$\hat{\alpha}$	Coefficient	2,629475***	2,2011***
		Standart Error	0,0157909	0,0013
lnk	$\widehat{\beta 1}$	Coefficient	0,1437497***	0,1438***
		Standart Error	0,0015849	0,0036
lnl	$\widehat{\beta 2}$	Coefficient	0,1495885***	0,1622***
		Standart Error	0,0008515	0,0032
lnm	$\widehat{\beta 3}$	Coefficient	0,4506791***	0,4413***
		Standart Error	0,0025577	0,0014
lne	$\widehat{\beta_4}$	Coefficient	0,2343025***	0,2762***
		Standart Error	0,0022532	0,0054
***, **, * significant at 1%, 5%, 10%				

Source: Data Processed

The lnk variable has a coefficient of 0,14 in the FEM-RO model, and 0,14 in the FEM-GLS model, meaning that an increase in the labor of 1 percent can encourage an increase in manufacturing industry output of 0,14 percent, and 0,14 percent. The lnl variable has a coefficient of 0,14 in the FEM-RO model, and 0,16 in the FEM-GLS model, meaning that an increase in the labor of 1 percent can encourage an increase in manufacturing industry output of 0,14 percent, and 0,16 percent. The lnm variable has a coefficient of 0,45 in the FEM-RO model, and 0,44 in the FEM-GLS model, meaning that an increase in the labor of 1 percent can encourage an increase in manufacturing industry output of 0,45 percent, and 0,44 percent. The lne variable has a coefficient of 0,23 in the FEM-RO model, and 0,27 in the FEM-GLS model, meaning that an increase in the labor of 1 percent can encourage an increase in manufacturing industry output of 0,23 percent, and 0,27percent.

The estimation results show that capital has a significant influence on the output of the manufacturing sector. The estimation results show that capital has a significant positive effect on the output of the manufacturing industry in Indonesia. This means that increasing capital can cause the expansion of manufacturing industry output in Indonesia. The results of this research are in line with research by Dewi & Marhaeni (Dewi & Marhaeni, 2016) which states that capital has a positive and significant effect on the output of the textile industry. Dhiman & Sharma research results show that capital, labor, and raw materials had a significant influence on the output of the textile industry in India during the 1991-2015 period. These results also support the theory built by Cobb-Douglas (Dhiman & Sharma, 2017).

If the amount of capital available can meet all needs in the production process, then the production process will run smoothly and will affect increasing production results (Kuosmanen & Maczulskij, 2024). If industrial entrepreneurs increase the amount of their capital, it will increase the amount of production. By increasing the amount of capital, industrial entrepreneurs can add raw materials to be processed, so that the output capacity will be greater (Jajri, 2007). If the amount of production increases, the profits earned by industrial entrepreneurs will also increase so that apart from being used to pay employees' salaries, it can also be used for installments to pay capital debts at banks or cooperatives (Sadiq et al., 2023).

Capital in the industry comes from investment. Investment in industry can be done by promoting business opportunities in Indonesia. Few investors are interested in investing in the industry because of problems in the electricity and road infrastructure sectors which affect business activities. Low electricity supply for businesses and poor road conditions results in high operational costs and lower returns on capital so investors who are capital donors are unwilling to invest in the manufacturing industrial sector. Investment needs, namely transportation and electricity infrastructure, are expected to come from the government (Huang et al., 2019). Investors for the development of the manufacturing industrial sector can come from within the country and abroad. Actors in developing the manufacturing industrial sector still rely on private companies, the state, and the home industry. Banking also plays a role in

providing capital. Banking has a role in intermediating relationships with debtors. The function of banking as an intermediary institution is to collect funds from people who have excess funds (surplus units) in the form of savings and distribute them to people who lack funds (deficit units) in the form of credit (Beugelsdijk et al., 2018). Banking credit has an important role in financing the industrial sector manufacturing. Credit distribution by banks is indeed able to support the manufacturing industrial sector in Indonesia, but credit also has the potential to create problems that can disrupt the Indonesian economy.

The provision of industrial capital in Indonesia comes from working capital credit, so working capital credit can boost the real sector very high. Thus, the growth of working capital credit which slows down and even decreases every year will affect the productivity of the business world in the industrial sector which will have an impact on macroeconomic conditions. Several policy suggestions to encourage investment growth in the industry in Indonesia are (Rudi Purwono & Yasin, 2020): (1) building connecting roads, (2) providing processing equipment in production centers that can streamline transportation costs and improve product quality, (3) reducing or eliminating taxes (tax value added and income taxes) which are the burden of business actors in the industry, (4) harmonization of tariffs, namely applying higher import tariffs for processed products, and (5) investment incentives, especially in downstream industries.

The next discussion is the influence of labor on the output of the manufacturing industry in Indonesia. Labor is the population of working age (aged 15-64 years) or the total population in a country who can produce goods and services (Kis-Katos & Sparrow, 2015). Labor refers to the human capabilities that can be contributed to enable the production of goods and services. Labor is one of the inputs used in the production process. The labor production factor is an important production factor to pay attention to in the production process in sufficient quantities, not only looking at the availability of employment but also the quality and type of labor (Mohi & Dai, 2022).

The estimation results show that labor has a significant positive effect on the output of the manufacturing industry in Indonesia. Labor plays an important role in every Indonesian industrial activity, even though the role and function of labor have been largely replaced by industrial machines, in reality, to date, labor is still an important factor in determining the course of the production process. Production function theory shows that labor and output have a positive relationship. Every production process in the industry must be provided with sufficient labor, and the amount of labor used must be adjusted to needs to a certain level so that it is optimal (Efendi et al., 2022). A production process will not run smoothly without labor in it, because labor is a resource for carrying out a production process so labor is very important and considered in the production process. In an industry that is labor intensive, the use of labor of appropriate quality and quantity can increase production. In the manufacturing industry, it is hoped that the abilities and skills of the workforce will

always be improved, both through formal and non-formal education, so that the quality of work they get will also be better so that they become professional workers where professional workers require special knowledge, skills, abilities, and expertise (Hohberg & Lay, 2015). There are 3 main problems in the manufacturing labor sector, namely undocumented work relationships, the absence of a wage increase mechanism, and many workers who are known to have not been registered as participants in BPJS.

Raw materials are the main ingredients in the production process until they become finished goods. Raw materials include all goods and materials owned by the company and used for the production process. Company policies regarding raw material inventory are very important to support the production process in a company, especially in manufacturing companies, where errors in determining the amount of inventory can hamper the production process, this of course also results in a decrease in company profits. Production function theory shows that raw materials and output have a positive relationship. Every production process in the industry must be provided with sufficient raw materials, and the raw materials used must be adjusted to the needs of a certain level so that the output produced is efficient and optimal. The estimation results show that raw materials have a significant positive effect on the output of the manufacturing industrial sector. In the industrial world in general, raw materials are fundamental things that must be prepared before production starts. Raw materials are called fundamental because the size of the raw materials determines the amount of industrial output produced so the supply of raw materials has a very important role in the industry, although other factors are important, the supply of raw materials will greatly influence the implementation of the production process, so that raw materials standards need to receive great attention from industry.

Professionalism and good management in organizing existing raw materials are a must to achieve this. Raw materials are influenced by estimates of fluctuations in raw material prices, government regulations regarding material supplies, and the rate at which materials become damaged or decrease in quality. Efforts to extract and collect raw materials are closely related to the location of the source of the raw materials. Efforts to process raw materials must take into account the content of raw material sources and the market share of the results of industrial activities. So industry must take into account locations that support all materials and processes for industrial activities to take place (Wafi & Sari, 2021).

One form of energy that is often used for human life in modern times is electrical energy. As time progresses, the opposite process occurs towards electrical energy, namely the increasingly unbalanced use of electrical energy with its generation. This is due to the increasing use of electrical energy in daily activities, therefore the need for appropriate action to regulate the use and conservation of this energy. One of the government's efforts towards energy is energy conservation measures which are cost reduction through energy management strategies. Energy conservation can be achieved through the use of energy-saving technology in the supply of both renewable and non-renewable energy sources and by implementing an energy-saving

culture in energy utilization (Shen et al., 2020). The application of energy conservation includes planning, operation, and monitoring of energy utilization. In industry, the effectiveness and efficiency of energy use is very important. Not only from the planning side but also from the operational side.

The estimation results show that energy has a significant effect on the output of the Indonesian manufacturing sector. Energy has a positive coefficient. These results indicate that energy needs for the industrial sector absolutely must be met because energy is one of the main factors in the progress of the production process. Every production process in the industry must use sufficient energy because the energy used must be adjusted to needs to a certain level so that the output produced is efficient and optimal.

Energy used in the production process in the manufacturing industry, for example, electricity. In the long term, along with increasing economic growth, the need for national electrical energy will also experience quite rapid growth. PLN should improve the condition of its generators and increase the number of generators to guarantee the national electricity supply. To avoid fluctuations in world energy prices, it is necessary to diversify energy. This is to reduce risks and ensure certainty in the supply of national electrical energy. The need for electric power continues to increase with the level of industrialization and the nation's level of prosperity. About the National Energy Policy, the electricity sector development plan must consider the efforts that have been established to achieve the policy objectives. The first policy is intensification, namely increasing surveys and exploration of energy resources in Indonesia. Second is diversification, namely strategically reducing dependence on one energy resource. And the third is conservation, namely producing and using energy as economically and efficiently as possible.

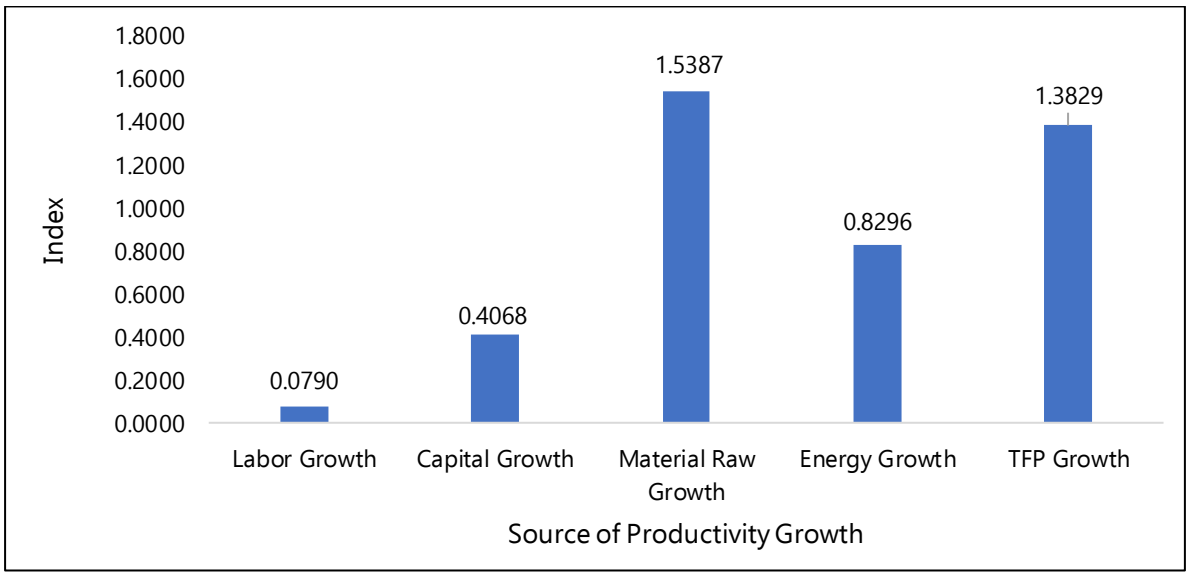

Figure 1. Mean of *Total Factor Productivity* Growth

Source: Data Processed

The final discussion is related to Total Factor Productivity Growth. The Solow residual accurately measures TFP growth if (i) the production function used is neoclassical, (ii) there is perfect competition in factor markets, and (iii) the input growth rate is measured accurately. Figure 1 shows that the average annual TFP growth value is positive. Positive TFP growth shows that technological progress has a significant role in the economy of West Java Province, one of which is caused by high capital accumulation which has an impact on technology transfer. These results mean that the Indonesian manufacturing industry has been able to combine various inputs in its production process to achieve the expected results efficiently. The average industrial TFP in Indonesia was the highest in 2018, while the average industrial TFP in Indonesia was the lowest in 2020-2021. This is due to the impact of COVID-19 because the Indonesian government limits production, consumption, and distribution activities. The greatest growth value is raw materials, so the source of growth for the manufacturing industry in Indonesia is raw materials, then followed by input growth in energy, capital, and finally labor. The raw materials used to drive the production process in the manufacturing industry in Indonesia are mostly imported. Therefore, the majority of industries are vulnerable to fluctuations in the rupiah exchange rate against the United States dollar. The raw materials used to drive the production process in the manufacturing industry in Indonesia are mostly imported. Therefore, the majority of industries are vulnerable to fluctuations in the rupiah exchange rate against the United States dollar.

CONCLUSIONS

The estimation results in this study show that the variables capital, labor, raw materials, and energy have a positive and significant effect on the output of the manufacturing industry in Indonesia. Increases in capital, labor, raw materials, and energy have led to an increase in the output of the manufacturing industry in Indonesia. This estimation result also means that the theory expressed by Cobb-Douglas is valid. Companies will combine inputs to maximize output. Furthermore, it is related to the source of productivity growth in the manufacturing industry in Indonesia. The average annual TFP growth value is positive. Positive TFP growth shows that technological progress has a significant role in the economy of West Java Province, one of which is caused by high capital accumulation which has an impact on technology transfer. These results mean that the Indonesian manufacturing industry has been able to combine various inputs in its production process to achieve the expected results efficiently. The greatest growth value is raw materials, so the source of growth for the manufacturing industry in Indonesia is raw materials, then followed by input growth in energy, capital, and finally labor. The raw materials used to drive the production process in the manufacturing industry in Indonesia are mostly imported.

REFERENCE

Abidin, N. Z., Yussof, I., & Karim, Z. A. (2020). Total factor productivity shock and economic growth in selected asean+ 3 countries: A new evidence using a panel var. *International Journal of Business and Society*, *21*(3), 1366–1383.

Ahmadi, V., & Ahmadi, A. (2014). Evaluating the Total Factor Productivity Growth in Manufacturing Industries of Iran (Data Envelopment Analysis Approach). *Journal of Economics and Business Research*, 33.

Beugelsdijk, S., Klasing, M. J., & Milionis, P. (2018). Regional economic development in Europe: the role of total factor productivity. *Regional Studies*, *52*(4), 461–476.

Dewi, A. A. Y. H., & Marhaeni, A. (2016). Pengaruh Modal, Tingkat Upah dan Teknologi terhadap Penyerapan Tenaga Kerja dan Output pada Industri Tekstil di Kabupaten Badung. *E-Jurnal Ekonomi Pembangunan Universitas Udayana*, *5*(10), 165167.

Dhiman, R., & Sharma, M. (2017). *Export competitiveness of Indian textile industry: Revealed comparative advantage analysis*.

Djulius, H., Lixian, X., Lestari, A. N., & Eryanto, S. F. (2022). The Impact of a Poor Family Assistance Program on Human Development in Indonesia. *Review of Integrative Business and Economics Research*, *11*(4), 59–70.

Djulius, H., Wongyu, C., Juanim, J., & Santy, R. D. (2019). Nexus of foreign direct investment, domestic investment, and manufacturing industry value added in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *8*(1), 1–8.

Efendi, F., Aurizki, G. E., Auwalin, I., Kurniati, A., Astari, L. D., Puspitasari, I. T., & Chong, M. C. (2022). The paradox of surplus and shortage: A policy analysis of nursing labor markets in Indonesia. *Journal of Multidisciplinary Healthcare*, 627–639.

Gujarati, D. N. (2021). *Essentials of econometrics*. Sage Publications.

Hohberg, M., & Lay, J. (2015). The impact of minimum wages on informal and formal labor market outcomes: evidence from Indonesia. *IZA Journal of Labor & Development*, *4*, 1–25.

Huang, J., Cai, X., Huang, S., Tian, S., & Lei, H. (2019). Technological factors and total factor productivity in China: Evidence based on a panel threshold model. *China Economic Review*, *54*, 271–285.

Jajri, I. (2007). Determinants of total factor productivity growth in Malaysia. *Journal of Economic Cooperation*, *28*(3), 41–58.

Kis-Katos, K., & Sparrow, R. (2015). Poverty, labor markets and trade liberalization in Indonesia. *Journal of Development Economics*, *117*, 94–106.

Kuosmanen, N., & Maczulskij, T. (2024). Going green while getting lean: Decomposing carbon and green total factor productivity. *Journal of Environmental Management*, *352*, 120046.

Kurniati, Y., & Yanfitri, Y. (2010). The dynamics of manufacturing industry and the response toward business cycle. *Bulletin of Monetary Economics and Banking*, *13*(2), 131–164.

Li, W., Wang, W., Wang, Y., & Ali, M. (2018). Historical growth in total factor carbon productivity of the Chinese industry–a comprehensive analysis. *Journal of Cleaner Production*, *170*, 471–485.

Manik, E., Affandi, A., Priadana, S., Hadian, D., & Puspitaningrum, D. A. (2023). Comparison of normality testing with chi quadrat calculations and tables for the statistical value departement of elementary school education student at the University of Jember. *AIP Conference Proceedings*, *2679*(1), 020018.

Mankiw, N. G. (2018). *Brief principles of macroeconomics*. Cengage Learning.

Mohi, M., & Dai, S. I. (2022). The Effect of Investment and Labor on Economic Performance in Indonesia. *European Journal of Research Development and Sustainability*, *3*(1), 19–22.

Pindyck, R. S. (2018). *Microeconomics*.

Rostiana, E., Djulius, H., & Sudarjah, G. M. (2022). Total Factor Productivity Calculation of the Indonesian Micro and Small Scale Manufacturing Industry. *Ekuilibrium: Jurnal Ilmiah Bidang Ilmu Ekonomi*, *17*(1), 54–63.

Rudi Purwono, D., & Yasin, M. Z. (2020). Does Efficiency Converge of Economy Promote TFP? A Case of Indonesia. *Journal of Economic Development*, *45*(4), 69–91.

Sadiq, M., Moslehpour, M., Qiu, R., Hieu, V. M., Duong, K. D., & Ngo, T. Q. (2023). Sharing economy benefits and sustainable development goals: Empirical evidence from the transportation industry of Vietnam. *Journal of Innovation & Knowledge*, *8*(1), 100290.

Sari, D. W. (2004). The Source of Growth of Indonesia's Manufacturing Industry. *Proceedings of the 16th MEA Convention, 29th Conference of the Federation of ASEAN Economic Associations*.

Setiawan, M., Indiastuti, R., Hidayat, A. K., & Rostiana, E. (2021). R&D and Industrial Concentration in the Indonesian Manufacturing Industry. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(2), 112.

Shen, Y., Yue, S., Sun, S., & Guo, M. (2020). Sustainable total factor productivity growth: The case of China. *Journal of Cleaner Production*, *256*, 120727.

Surjaningsih, N., & Permono, B. P. (2014). The Dynamics Of Total Factor Productivity Ofmedium And Large Manufacturing In Indonesia. *Bulletin of Monetary Economics and Banking*, *16*(3), 259–288.

Suryaman, R. A. (2024). Identification of Economic Impact Valuation on Small Industrial Centers (Study on the Sukaregang Leather Tannery Industrial Center). *Gorontalo Development Review*, 57–69.

Wafi, M. N., & Sari, D. W. (2021). Analysis of Total Factor Productivity Growth in the Industry of Textile and Textile Products in Indonesia. *Jurnal Ilmu Ekonomi Terapan (JIET)*, *6*(1), 15–31.