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Vector auto-regression approach: relationship between production output of manufacturer industry and FDI

Lies Maria Hamzah[1]*, Ukhti Ciptawaty[1], Edwin Russel[1], Fajrin Satria Dwi Kesumah[1]
[1] Faculty of Economic and Business, Universitas Lampung (Unila), Lampung, Indonesia
*Corresponding author: liesmh55@gmail.com

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Abstract:
This study aims to analyze the causality of the production of the manufacturing industry sub-sector of the food and beverage industry as one of the leading sectors of Indonesia. The research uses is a survey of manufacturing industry statistics of the Central Statistics Agency (BPS) based on the type of industry with reference to the International Standard of Industrial Classification (ISIC). The study uses panel data, the three-digit ISIC 15 food and beverage industry, namely processed foods (ISIC 151), milk (ISIC 152), rice processing (ISIC 153), other foods (ISIC 154) and drinks (ISIC 155) for the period of 2006─2014. Using the VAR (Vector Autoregressive) model and followed by Impulse Response Fuction. We can see the response tends to be divergent. VAR estimation results, labor and capital in the short run, show negative coefficients and long-term positive coefficient values.This situation shows in the long run the influence of externalities FDI on the production of the food and beverage industry sub-sector.

Keywords: *FDI, Food and beverage manufacturing industry, VAR.*

I INTRODUCTION

The development of the manufacturing industry has always been a top priority in Indonesia. That is because the manufacturing industry is a leading sector that can encourage other sectors. The development of a sustainable manufacturing industry is a strategy and policy of the Indonesian government. The development of the manufacturing industry requires the availability of inputs such as labor, capital, land and technology. Inputs are needed in the production process in the industrial sector, so that industrial development can be carried out.

Foreign Direct Investment (FDI) is considered an important source of sustainable development, revenue growth, and employment for developing countries. The existence of FDI will affect industrial productivity because there will be a process of transfer of knowledge such as technology that will help the development of industry on a larger scale.

The productivity concept of FDI arises from the basic idea that FDI has macro and micro impacts on the economy of the destination country. At a macro level, FDI contributes to an increase in capital accumulation, new employment, and tax revenue. At a micro level, FDI contributes in the form of knowledge externalities.

Griliches (1992) identified two types of knowledge
externalities are externalities vertical happened at inter-sectoral flow and externalities horizontal bore further innovations and changes in the production capacity of an economy. The research proves that increasing interaction between domestic industries can accelerate the development of new technology.

Wang & Blomstrom (1992) hypothesized that FDI increases industrial efficiency in the host country, and because dealing with macro analysis, increased efficiency will lead to total productivity growth or Total Factor Production (TFP).

January - February 2020
ISSN: 0193 - 4120 Page No. 6914 - 6924

Increased investment will encourage expansion in the capital stock. This is due to the accumulation of capital is a direct result of the growth of TFP and in conditions of steady state, will lead to the accumulation of capital and the growth of output. While real-world economic growth rarely meets steady-state requirements, where the effect of accumulated induction on an increase in TFP output will generate new investment flows.

Within the framework of endogenous growth, it explains how knowledge externalities take place in the industrial sector. Externalities FDI can lead to a decrease in productivity in the short term and in the long run going on increasing the productivity sector of the industry. Externalities FDI has a different effect according to the type of industry. In some types of natural resource intensive and labour intensive industries, those FDI externalities will increase the ability of the workforce in the long run and will increase industrial productivity (Lies MH, 2015).

In economic development theory it is known that investment is very closely related to economic growth, even has a positive reciprocal relationship. Hadi.YS (2003) Examining the reciprocal relationship between economic growth and investment in this case is the investment of foreign capital in Indonesia in the period 1990 - 2006, using the Vector Auto Regression (VAR) model. The results of the study that, the reciprocal relationship of investment with economic growth, the greater the investment of a country, the greater the level of economic growth that can be achieved.

FDI as a source of investment is a production function of the manufacturing industry. On the other hand, the greater the FDI of a country, the greater the level of production that can be achieved, which can be said manufacturing industry production is a function of FDI.

The contribution of the manufacturing industry sector to Indonesia's GDP in 2007 to 2016 experienced a fluctuating trend with a higher percentage value than other economic sectors, amounting to 22.14%, in 2007 and 2015 amounting to 18.19% with an average annual rate of 18.05%. The contribution of the manufacturing industry sub-sector to Indonesia's GDP during the 2014-2015 period shows that the food and beverage industry with the highest contribution continues to increase every year. The contribution of the food and beverage industry to the formation of Indonesia's GDP from 2014-2015 was 5.32 percent and 5.61 percent. (Ministry of Industry 2013 and 2016).

The research aims to analyze the reciprocal relationship between the *output* of the manufacturing industry with input production of labor, capital and FDI in the food and beverage manufacturing industry. Observations are emphasized more on the effect of FDI on other variables on the model. The study uses panel data of the Indonesian manufacturing industry on three-digit *ISIC* 15; processed food (ISIC 151), milk (ISIC 152), rice processing (ISIC 153), other foods (ISIC 154) and beverages (ISIC 155) for the period of 2006 - 2014 in Indonesia using the Vector Auto Regression (VAR) model.

II Literature Review

Growth Theory

Solow developed the growth model by adopting the form of the Neo Classic production function with the assumption of constant returns to scale, the law of decreasing yield increases, and the elasticity of substitution between positive inputs. If technological progress causes labor efficiency to grow at a constant rate g, then g is called labor-augmenting technologicalprogress. If the labor force grows at level n then the number of effective workers grows at level n + g. Technological advances actually increase results per worker over time. Technological advances cause the number of

TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 6914 - 6924

effective workers to increase. In a well-established economic condition, the level of output per worker depends only on the level of technological progress of Mankiw (2006).

Endogenous growth theory includes elements of private investment. By using the premise (1) of externalities, (2) market imperfections in intermediate input production. According to this theory with the change in technology, economic growth will continue. A business unit or area will enjoy the increased scale of the results obtained from the return of investment and human resources, knowledge externalities a Myspace company and external benefits of human resource enables to prevent a decrease in yield. Labor productivity and technological change become part of the growth process.

Theory of Production

Theory that discusses how the company carries out the production process. The production process is an activity that combines inputs (resources) to produce output. Production takes place in a certain period. In a company's production function, there are three important production concepts, namely total products, marginal products and average products (Samuelson and Nordhaus, 1997).

Evaluation of a business unit can usually be used as a ratio of output to input. Ratio is a measurement of the general level of productivity. Measurement of labor productivity, using the ratio of output per worker, and the measurement of capital productivity uses the ratio of output per capital. This measurement is called a partial measurement, which is mathematically stated:

$$Ap = \frac{y}{x_i}$$

Where:

y = output

x_i = individual input .

Technological advances not only affect capital goods but also on human resources that can improve efficiency. The use of the AP concept as a measure of efficiency is not appropriate. Paul Krugman analyzes the causes of the economic crisis in East Asia, one of which is the increased use of production factors (capital goods and labor) where there is no significant increase in efficiency. Therefore,Paul Krugman proposes Total Factor Productivity (TFP) as a measure of efficiency. This method separates the effect of capital goods, technology and human resources on economic growth. This separation will show whether technological changes lead to significant efficiency advances. The impact of technological changes can be seen from the production function:

$$Y = AF(K, L)$$

A is a measure of the latest technology level called total factor productivity. Output increases not only because of an increase in the amount of capital and labor but also because of an increase in total factor productivity. Assuming a constant returns to scale, if an increase in total factor productivity with a fixed input increases output. If we change technology into the equation, then economic growth is expressed as,

$$\frac{\Delta Y}{Y} = \alpha \frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L} + \frac{\Delta A}{A}$$

Where:

$\frac{\Delta Y}{Y}$ = output growth

$\alpha \frac{\Delta K}{K}$ = capital growth

$(1-\alpha)\frac{\Delta L}{L}$ = labor growth

$\frac{\Delta A}{A}$ = total factor productivity growth

This equation identifies three sources of growth, namely changes in capital, changes in labor and changes in total factor productivity. Total factor productivity cannot be

January - February 2020
ISSN: 0193 - 4120 Page No. 6914 - 6924

calculated directly where it $\frac{\Delta A}{A}$ is a residue that is the change in output that cannot be explained by changes in input .

Vector Autoregression (VAR)

The VAR method provides an estimation method that explains the relationship between economic variables without having too many restrictions. Testing procedures or stages in the VAR method are stationary test and cointegration test.

Stationary test is needed because economic variables are generally time series data, which are non-stationary (fluctuating), and tend to form a trend in the long run. Stationary testing is carried out to meet the assumptions ofdata time series so that they are normally and independently distributed with a fixed variant and zero covariance. Utilization of non-stationary data into a regression equation can produce spurious regression results, with a set of system values such as t-statistics, F-statistics, and R2 being invalid. While the cointegration test is carried out to find out the conditions of the relationship between two or more systems in an equation system. Cointegration tests are carried out to detect the stability of long-term relationships both in univariate and in multivariate (Gujarati, 2003; Verbeck, 2000; Thomas, 1997; Enders, 1995).

III RESEARCH METHODS

Data

The research uses survey data of the manufacturing industry of the Central Statistics Agency (BPS) based on the type of industry with reference to the *International Standard of Industrial Classification* (ISIC*)*. The study uses panel data, the three-digit *ISIC* 15 food and beverage industry; processed foods (ISIC 151), milk (ISIC 152), rice processing (*ISIC* 153), other foods (*ISIC* 154) and drinks (*ISIC* 155) for the period of 2006 – 2014.

Estimation Model

VAR is usually used to project a system of time series variables and to analyze the dynamic impact of the disturbance factors contained in the system variable. VAR analysis there are no exogenous variables in the model. Advantages of VAR Analysis: (1) This method is simple, there is no need to distinguish between endogenous and exogenous variables; (2) The estimation is simple, you can use the ordinary OLS method that is used for each equation separately; (3) The estimation results obtained using VAR are better than the results obtained using the simultaneous equation model. VAR analysis can be used in understanding the interrelationship between economic variables, as well as in the formation of a structured economic model.

VAR equation system shows each variable as a linear function of the constant and the lag value of the variable itself and the *lag* value of other variables in the system. The assumption that must be fulfilled in the VAR analysis is that all dependent variables are stationary, all the *rest* are *white noise*, that is, have zero averages, constant variance and between independent variables there is no correlation. Data stationary test can be done through testing the presence or absence of *the root unit* in the variable with the *Augmented Dickey Fuller (ADF)* test, the presence of *the root unit* will produce a *spurious* regression equation. The approach taken to overcome the *spurious* regression equation is to differentiate the endogenous and exogenous variables, so that a stationary variable with degree I (n) is obtained.

To understand the VAR analysis, which will be used in this study, then an analysis model is made as follows:

$$\log Y_{it} = \log \beta_0 + \beta_l \log L_{it-o} + \beta_k K_{it-o} + \beta_{pma} PMA_{it-o}$$

y_{it} = value *of* industrial *output* i in year t (in rupiah)

TEST Engineering & Management
January - February 2020
ISSN: 0193 - 4120 Page No. 6914 - 6924

l it = number of industrial workers i at KBLI 3 digit year t (in person)

k it = total industrial capital in KBLI 3 digit year t (in rupiah)

pma it = amount of foreign investment in the industry in KBLI 3 digit year t (in percentage)

β l , β k, β pma = parameters of labor, capital and PMA productivitybrought by foreign partners to domestic companies.

To make it easier to estimate the coefficient of elasticity of variable *inputs* . The equation in log form can be stated as:

$$y_{it} = \beta_0 + \beta_l l_{it-o} + \beta_k k_{it-o} + \beta_{pma} pma_{it-o} + \varepsilon_{it}$$

Information:

y_{it} = log Y_{it}

l_{it} = log L_{it}

k_{it} = log K_{it}

pma_{it} = *PMA* log $_{it}$

ε_{it} = *error term*

σ = length of slowness

IV ESTIMATION AND ANALYSIS RESULTS

Unit Root Test

This unit root test is used to see whether the data observed is stationary or not. VAR analysis is to assess the reciprocal relationship between the observed variables. However, if the data observed is stationary, this will increase the accuracy of the VAR analysis [1-19].

Table 1
Unit Root Tests

Method	Prob. **			
	Ln_Y	Ln_L	Ln_K	Ln_PMA
ADF-Fisher Chi-Square	0.0188	0.0000	.9995	0.0024
PP-Fisher Chisquare	0.0000	0.0000	0.0000	0.0000

Unit root test results, all variables observed were stationary.

Cointegration Test

Table 2
Cointegration Test

Kao Residual Cointegration Test
Series: LNY LNL LNK PMA

	t-Statistics	Prob.
ADF	-1.380666	0.0837

Residual variance	0.388023
HAC variance	0.306165

Augmented Dickey-Fuller Test Equation
Dependent Variable: D (RESID)
Method: Least Squares

January - February 2020
ISSN: 0193 - 4120 Page No. 6914 - 6924

Variable	Coefficient	Std. Error	t-Statistics	Prob.
RESID (-1)	-0.524830	0.081955	-6.403892	0.0000
D (RESID (-1))	-0.082678	0.078691	-1.050666	0.2943

R-squared	0.170797	Mean dependent var	0.090703
Adjusted R-squared	0.167898	SD dependent var	0.635639
SE of regression	0.579828	Akaike info criterion	1.754750
Sum squared resid	96.15334	Schwarz criterion	1.780187
Log likelihood	-250.6839	Hannan-Quinn criter.	1.764943
Durbin-Watson stat	1.596110		

Probability> 0.05 then accepts Ho that the data is not cointegrated.

Stationary tests on all variables at the level of level are as follows: with the test of test at the first different level, and the results are all passed at the first different level so that the first differentiated VAR model can be continued [20-29].

The VAR model estimation starts with determining what the appropriate lag length in the VAR model is. Optimal lag is required before estimating VAR. If the optimal lag that is entered is too short then it is feared that it cannot explain the overall dynamics of the model. However, optimal lag that is too long will result in inefficient estimates due to reduced *degree of freedom* (especially models with small samples).The length of the lag test in VAR by entering AIC shows the optimal lag length is 2.

VAR Model Estimation Results
LnY C LnL LnK PMA
Vector Autoregression Estimates
Included observations: 288 after adjustments
Standard errors in () & t-statistics in []

	LNY	LNL	LNK	PMA
LNY (-1)	0.713736	0.214888	0.500841	1.168569
	(0.10651)	(0.08615)	(0.24668)	(0.89536)
	[6,70091]	[2.49443]	[2,03033]	[1,30514]
LNY (-2)	0.183237	-0.192219	0.103575	-1.081561
	(0.10839)	(0.08766)	(0.25102)	(0.91112)

January - February 2020
ISSN: 0193 - 4120 Page No. 6914 - 6924

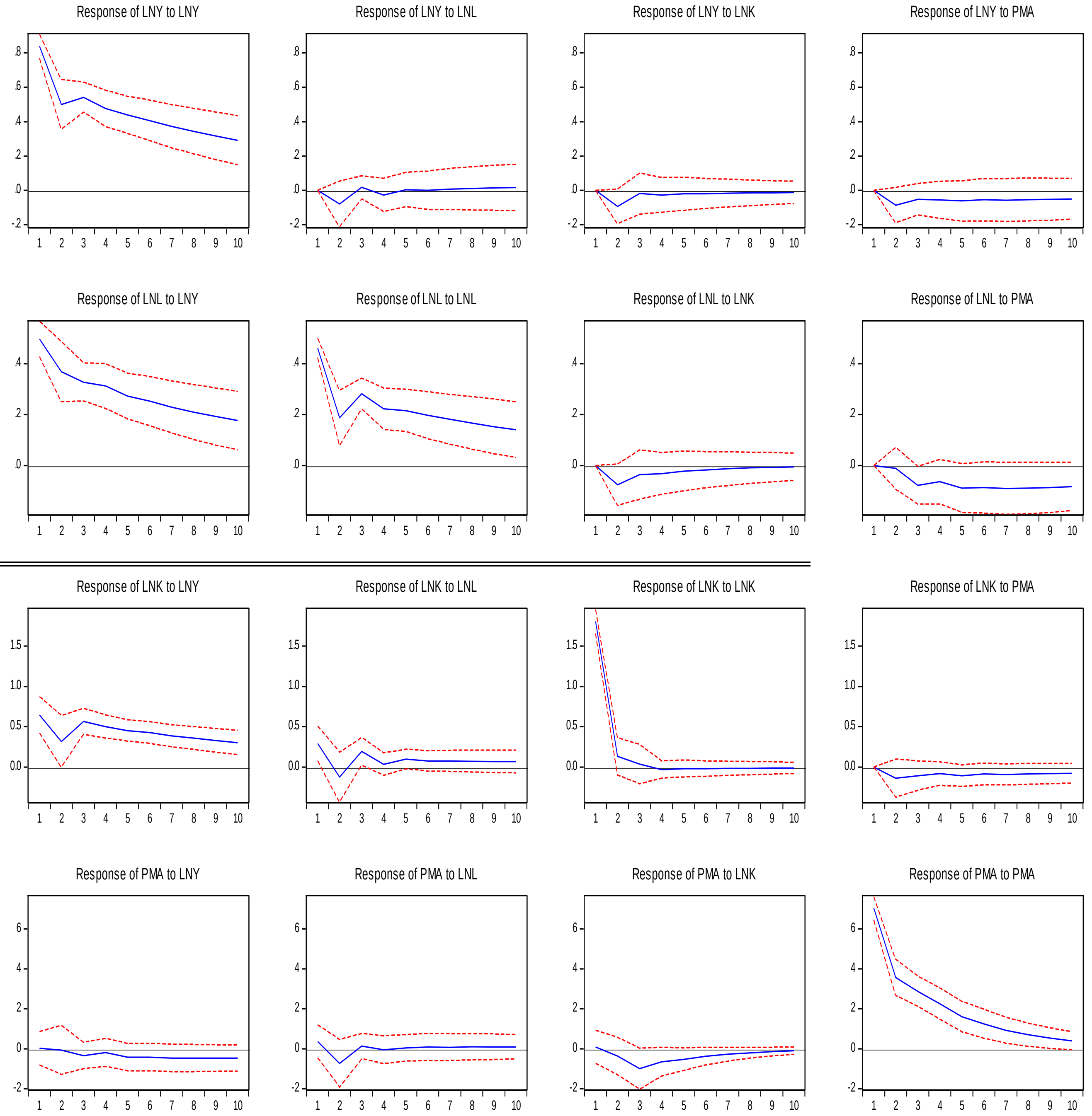
	[1.69056]	[-2,19268]	[0.41261]	[-1.18706]
LNL (-1)	-0.130266	0.433534	-0.298338	-1.827834
	(0.14435)	(0.11675)	(0.33430)	(1.21341)
	[-0.90244]	[3,71342]	[-0.89241]	[-1.50637]
LNL (-2)	0.161211	0.456065	06600104	2.121427
	(0.14386)	(0.11635)	(0.33317)	(1,20930)
	[1.12061]	[3,91967]	[1.80117]	[1.75426]
LNK (-1)	-0.051489	-0.041397	0.074383	-0.229607
	(0.02761)	(0.02233)	(0.06395)	(0.23212)
	[-1.86463]	[-1.85360]	[1.16313]	[-0.98917]
LNK (-2)	0.022204	0.013180	0.024785	-0.453738
	(0.02852)	(0.02307)	(0.06606)	(0.23978)
	[0.77841]	[0.57130]	[0.37517]	[-1.89229]
PMA (-1)	-0.012312	-0.001554	-0,019626	0.507280
	(0.00723)	(0.00585)	(0.01675)	(0.06079)
	[-1.70247]	[-0.26566]	[-1.17182]	[8,344483]
PMA (-2)	0.006278	-0.007656	0.002142	0.157649
	(0.00709)	(0.00573)	(0.01641)	(0.05958)
	[0.88580]	[-1.33559]	[0.13051]	[2,64611]
C	3.228027	1.908498	3,570399	37.90562
	(0.93601)	(0.75704)	(2.16776)	(7.86819)
	[3,44871]	[2.52101]	[1.64705]	[4.81758]
R-squared	0.747493	0.752700	0.375599	0.432178
Adj. R-squared	0.740253	0.745609	0.357695	0.415896
Sum sq. resids	196.4784	128.5254	1053,840	13883.65
SE equation	0.839180	0.678723	1,943503	7.054231
F-statistics	103,2401	106,1483	20.97854	26.54391
Log likelihood	-353.5876	-292,4702	-595.4561	-966.7272
Akaike AIC	2.517969	2.093543	4.197612	6.775884
Schwarz SC	2,632437	2.208010	4.312080	6.890351
Mean dependent	22,83768	10.38884	21,10991	83.63892
SD dependent	1.646569	1.345680	2.425016	9.230065

TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 6914 - 6924

Determinant residual covariance (dof adj.)	24,40964
Determinant residual covariance	21.49851
Log likelihood	-2076,407
Akaike information criterion	14,66949
Schwarz criterion	15.12736
Number of coefficients	36

Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.



January - February 2020
ISSN: 0193 - 4120 Page No. 6914 - 6924

V DISCUSSION

VAR Structural Model VAR, documents important changes in adjusting short-term output. VAR estimation results, in the production column, labor and capital in the short run at lag 1, show a negative coefficient and at lag 2 a positive coefficient value. This situation shows in the long run the influence of externalities FDI on the production of the food and beverage industry sub-sector. The effect of FDI externalities requires a process of learning and adaptation to both human resources and technology [30-34].

VAR Impulse Response Function

VAR Impulse Response value due to the shock of a variable against other variables in the VAR system. Estimation of the impulse response function is carried out to examine the surprise response of the innovation variable to other variables. Estimation of embroidering the system of assumptions of each innovation variable is not correlated with each other so that the trace of the effect of a shock can be direct. Image impulse response will show the response of a variable due to the shock of other variables up to several periods after the shock occurs. If the impulse response picture shows that the movement is getting closer to the point of balance (convergence) or return to the previous balance means the response of a variable due to a longer shock will disappear so that the shock does not leave a permanent influence on the variable.

From the picture we can see the response that tends to be divergent is the good FDI response to the value of industrial output, the amount of labor and capital in the food and beverage manufacturing sector. This shows the existence of FDI will provide externalities to the quality of labor and capital in the manufacturing industry, especially food and drinks. The food and beverage manufacturing industry is largely a Multi-NationalCorporation company, bringing in technical innovation, improving the skills of the workforce so that it can absorb change and improve technology, which will ultimately increase productivity. Increased productivity is also due to better managerial skills. Increased productivity can be done by increasing efficiency and increasing production scale.

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