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EAST JAVA MANUFACTURING SECTOR GROWTH DYNAMICS: NEED MORE PHYSICAL CAPITAL OR QUALITY OF LABOR?

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ABSTRACT

This paper identifies the dynamic pattern of East Java growth of manufacturing sector and addresses the basic questions of individual economic firms whether they would be better off if increasing physical capital or investment in human capital. To know which one of the two main inputs in industrial sector that is more needed than the other, the marginal productivity of each production factors must be identified. I estimate the models which accommodate the optimum input level by applying general method of moment (GMM) and panel instrumental variable (IV) techniques on some reduced form models. I find that on the demand function of labor and capital as the first step of IV or Two Stage Least Square (2SLS) show that the elasticity of both of them are inelastic and elasticity of labor demand is more sensitive than capital. In the production function as the second step, yields that the most productive production factors is labor so that investment in this factor production is beneficial for industrial growth in East Java. On the other side, the physical capital has not been reached the optimum level but the elasticity of capital in production is low. Hypothetically, the inelasticity of physical capital is because macroeconomic aspects which is monetary policy and expected economic situation. Considering these two arguments, quality of labor should be more concerned in the context of regional economy of East Java because capital aspect cannot be interfered at regional level at least for large capital scale.

Keywords: *Capital, Labor, Growth, General Method of Moment (GMM), Instrumental Variable (IV)*
JEL: C50, C33, C36, M51, L29, L60, O25, D22

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Introduction

In most modern economy, manufacturing has been known as one of the largest sectors in economy besides trade, services, finance, banking, transportation and communication. Indonesia, a country which has developing economy towards a modern society is highly depended on manufacturing performance. In addition, industries contribute to Indonesian economy about 24 percent which is the biggest sector. Kusnetzs (1973) proposed six characteristics of a modern economy and one of these are the rate of structural transformation is high. At the beginning 1990s, the change of the structure of Indonesian Economy had begun, the falling

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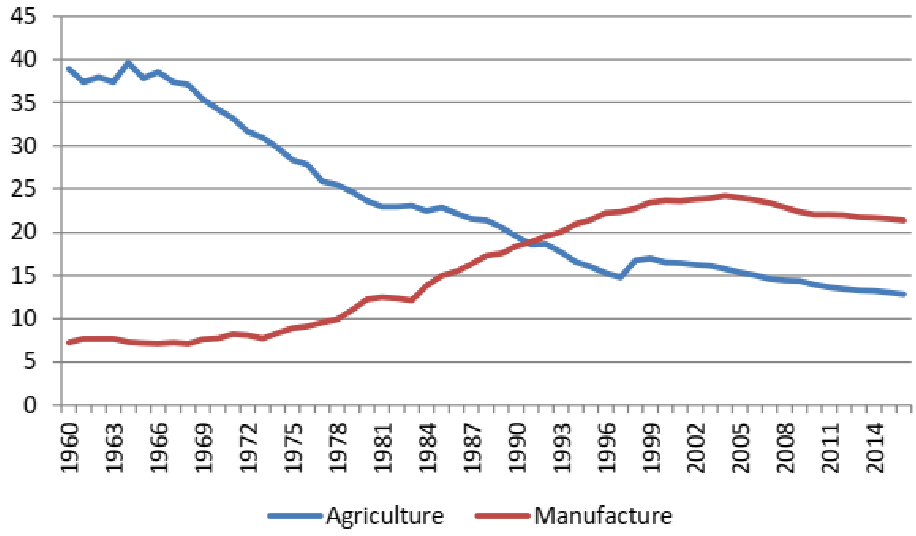
of traditional agricultural sector and on the other side rising manufacturing role even though there have been stagnated phase since the global economic crisis in 1998.



Source: World Development Indicator (2017)

Figure 1: Contributions of Manufacturing and Agriculture to Gross Domestic Product 1960-2016

Industries spread out across country but mostly in Java Island that in habited by more than 82 percent of total medium and large-scale enterprises. The industrial concentration in Java may be explained by some reasons. Firstly, because labor supply is abundant in Java, 56.9 percent of Indonesian population is living in Java even though Java has only 6.75 percent of Indonesia territorial area. Moreover, population is the main source of workers and a market of industrial output. Second, Infrastructures in Java are relatively well developed such as transportation seaports, international airports, and toll roads, banking and finance, and telecommunication networks. Third, theoretically, each location more encourages enterprises than others because it has more natural endowment and technological progress that is typically Ricardian model (Fedderke and Wollnik, 2007) and even without differences in endowment and technological progress among locations, business location decision is the strategy of pursuing economies of scale which so called New Trade Theory developed by Krugman (1979).

Among all Java regions, East Java is the main place for manufacturing enterprises. More than 800,000 business units of manufacturing and 6226 of them are large and medium scale in 2013 which is the highest number of firms compared to other provinces in Indonesia. Nevertheless, World Bank finds some development challenges of manufacturing in East Java: First, decreasing of labor-intensive manufacturing and on the contrary, the rise of capital intensive that change industrial labor markets equilibrium. Second, labor cost is one of issues of some firm relocation to outside East Java or overseas. Third, a limited number of products to be exported may constrain the potential growth of export base manufacturing firms. Fourth, the import dependence of production factors especially materials still dominate manufacturing inputs of East Java Industries. Those main problems of East Java manufacturing sector need to be resolved and bring the industry on its position before the crisis 1998 or even better.

This paper studies the production aspect of East Java manufacturing sector to find the optimum level of factors demand and investigates the effect of this optimum level to manufacturing decision on production input choice. This study tries to address the problems faced by industrial sectors in East Java that there is shifting from labor intensives to capital intensive production and relatively high labor cost. The shifting may be the rational decision of firms to response high labor cost so that the optimum decision of how many labor and capital should be used in production function would be necessary managerial decision. The gap between optimum level production factors and existing factors used as well as the abundance of these factors in East Java may represents how firms make decision in their production function and it reflects what makes East Java manufacturing sectors are being stagnated. Sengupta (2012) argue that study of the dynamics of industry growth is essential since: first is that the competition and its market equilibrium and basic behavior have faced fast technological development and international markets. The second point is that modern manufacturing and economy have experienced a dramatic change from large scale production to the application of advanced technologies, computerization, and concern on research and development.

The paper proceeds to the next parts as described as follows: the second part explores some theoretical considerations on how firms taking any decision on input combination choice to reach optimum level of production and provides and how industry growth based on their decision on input combination as well as some previous related studies. Part three examines the methodological issue containing econometric model building and estimation techniques and its challenges including the data management process, potential problems, and some strategies to deal with. Part four provides description of manufacturing performance in East Java and the results of estimation process and its problem of post estimation. Part five, would be concluding remarks and policy recommendation.

Literature Review

This part examines the theoretical foundation of this study and empirical evidence from related previous studies. The Theoretical section contain how firm decide how many outputs will produce and how many inputs will be used and how optimum level of production can be achieved through input combination derived by Sengupta (2012). This behavior brings manufacturing sector to the next level growth. Theoretical background of this study can be explained into three most important theories those are neoclassical model, competitive models with adjustment costs, and dynamic models with declining production cost.

In neoclassical model, production function consists of two input variables those are capital stock (K) and labor (L) with the assumption of constant return to scale, the model can be written as $Q = F(A,K,L)$ and each firm maximize the present value of their profit (π):

$$J = \int_0^\infty \exp(-rt)\,\pi(t)\,dt \tag{1}$$

Where π is the difference between total revenue and total cost which can be formulized as:

$$\pi(t) = P(t)\,Q - \omega L - qI \tag{2}$$

Q is the production function, P is the market clearing price, ω is the wage rate, q is the price of additional capital or investment, and I is gross investment. The decision on product expansion using capital changes depend on time derivation since the capital stock has cost of time usage that is depreciation which can be derived as follows:

$$\dot{K}(t) = \frac{dk}{dt} = 1 - \delta K \tag{3}$$

Where δ is the positive and constant depreciation rate lies on $0<\delta<1$, dot in K and µ shows time derivation and using Euler – Lagrange Equations with u is the Lagrange multiplier, the optimum level of firm decision can be written as:

$$u = u(t) = q(t)$$
$$\dot{u} = (r+\delta)u - pFk \quad (4)$$
$$w = pF_L \quad and \quad \dot{K} = I - \delta K$$

F_K and F_L is marginal product of capital and labor. There is additional assumption on this equation that enterprises know the next period price so that $p=p(t)$, labor price $w=w(t)$ and $q=q(t)$. In the equilibrium of steady state where $\dot{K}=0$ and $\dot{u}=0$ results in $Q^*=F(A, K^*, L^*)$ where the marginal product of capital and labor can be shown in the following equation:

$$F_L(A,K^*,L^*) = \frac{w}{p}$$
$$F_K(A,K^*,L^*) = \frac{(r+\delta)q}{p} \quad (5)$$

Where K^*, Q^*, and L^* are the targeted optimum level of capital, output, and labor. We can see from those two identical equation that the optimum level of marginal product of capital and labor is the ratio of their price with price of output where w is the price of labor and *(r+δ)* is the price of capital or rent for using capital. If one unit of capital is rented at c and the depreciation rate is δ so that the present value of rent of all the use of the capital can be derived:

$$\int_0^\infty c\exp(\delta t)\,dt = \frac{c}{r+\delta} \quad (6)$$

Until the equation 6, the demand for capital is determined of price of capital and the present value of marginal productivity of capital. The rationality of firms is that maximize their input combination to achieve the optimum level of production which is represented in the steady state equilibrium. All the above arguments of the firm decision under competitive markets, price is certainly known in the future, and firms work in constant return to scale, but if there a change in all or one of the assumptions, this will need some adjustment on the model and so the conclusions. This leads us to the next model which is competitive market with adjustment cost.

In the adjustment cost model with competitive markets, firms are assumed to change their cost in some period of time. Sengupta (2012) divided the adjustment cost model into two approaches which are flexible accelerator model and partial adjustment hypothesis. In the flexible accelerator model, the demanded stock of capital in the steady state equilibrium can be written as follow:

$$pF_K(A,K,L) = c_t \quad (7)$$

Applying the equation 7 to Cobb-Douglas production function, $Q=AK^aL^{1\ a}$ and assuming constant return to scale, the capital at the steady state equilibrium results in:

$$K^* = \frac{aQ}{c_t^{-\sigma}} \quad (8)$$

a is the share of capital which lies between 0 and 1 and σ is the substitution elasticity and K^* is the demanded. The adjustment cost can be modeled by putting lag structure so that there will be time adjustment cost in using capital:

$$K_t = \frac{uL}{vL}K^* \quad (9)$$

Where K_t is distributed lag of capital, uL and vL are polynomial lag operator of L and to simplify the symbol on the model, the notation of uL is changed into h and vL becomes $1\ (1\ h)\ L$ to accommodate the simpler way of lag structure that is geometric lag that can be derived as follows:

$$K_t - K_{t-1} = h\left(K_t^* - K_{t-1}\right) \quad (10)$$

In the equation 10, the left side shows the time difference of actual capital and on the right side shows the difference of optimum level in steady state with time lag with h is positive number $0<h<1$. In more intuitive way, the firm makes decision to adjust their demanded capital by considering changes in using labor on certain time during production in a lifetime period and optimum level of capital. However, during production period, h will not always be a constant value.

The second approach, partial adjustment model, generally uses convex cost function and it applies maximization of long-term profit function and the decision of production can be written as the followings:

$$\max J = E\sum_{t=1}^{\infty} r'\pi_t \quad (11)$$

While the short-term profit maximization at time t is:

$$\pi_t = p_t F\left(A, K, L_t\right) - C\left(I_t, K_t\right) \quad (12)$$

Where r is discount rate and C is the adjustment cost consisting of the additional capital stock on period t which is I_t and C is also assumed to be standard quadratic function as written as follows:

$$C(\bullet) = \frac{b}{2}\left(\frac{I_t}{K_t}\right)^2 K_t \quad (13)$$

By injecting conditional expectation on information that is needed to take the decision on period t and applying the Lagrangian to the equation can be modeled as follows:

$$L = \max\begin{Bmatrix} p_t F\left(A_t, K_t, L_t\right) - w_t L_t - C\left(I_t, K_t\right) - q_t I_t + rE_t V\left(K_{t+1}, h_{t+1}, q_{t+1}\right) \\ +E_t \lambda_{t+1}\left[(1-\delta)K_t + I_t - K_{t+1}\right] \end{Bmatrix} \quad (14)$$

The optimum value of the profit function is denoted by $V(.)$ and can be derived from equation 14 as follows:

$$V = \max\left\{p_t F\left(A_t, K_t, L_t\right) - w_t L_t - C\left(I_t, K_t\right) - q_t I_t + rE_t V\left(K_{t+1}, h_{t+1}, q_{t+1}\right)\right\} \quad (15)$$

$$Subject\ to\ K_{t+1} = (1-\delta)K_t + I_t$$

Where $h_t = (p_t, w_t, A_t)$ and q_t is the price of capital and λ_{t+1} is the Lagrange multiplier so that the optimum condition can be written as follows:

$$E_t\lambda_{t+1} = E_t\left[\sum_{j=1}^{\infty} r^j (1-\delta)^j \pi_K\left(K_{t+j}, h_{t+j}\right)\right] \quad (16a)$$

$$Where\ \pi_K(.) = \frac{\partial\pi}{\partial K} \quad (16b)$$

The implication of the derivation is:

$$q_t + C_I(I_t, K_t) = \sum_{j=1}^{\infty} r^j (1-\delta)^j E_t \pi_K (K_{t+j}, h_{t+j}) \tag{17a}$$

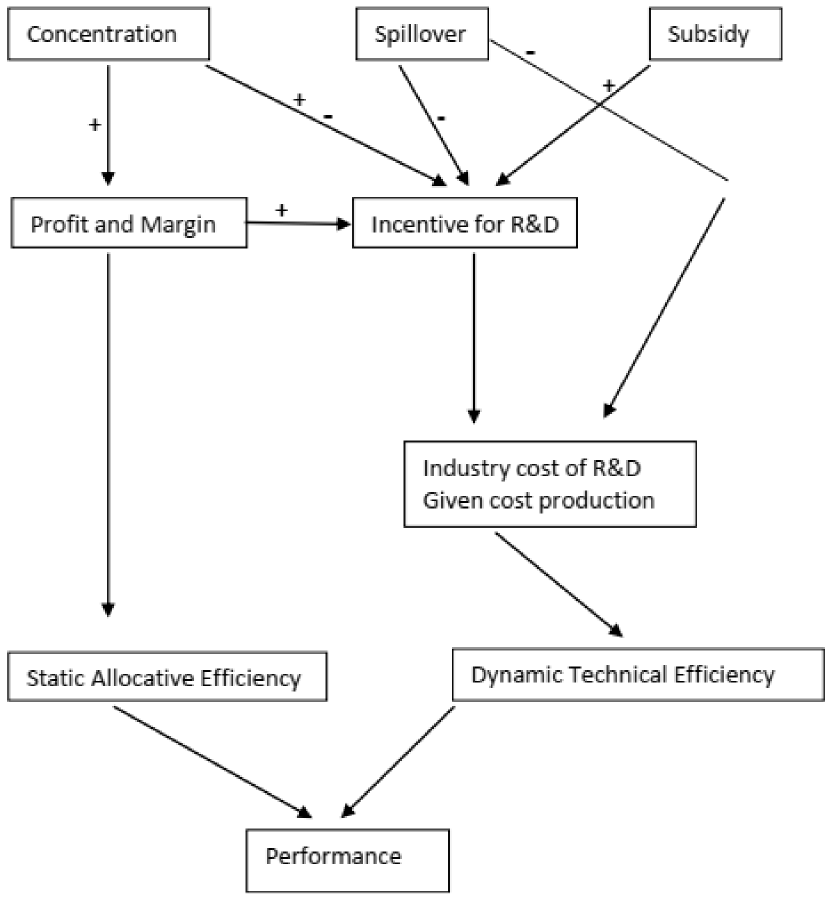
$$Where\ C_I(.) = \frac{\partial C(I_t, K_t)}{\partial I_t} \tag{17b}$$

There are some implications on the model with adjustment cost. First, the model shows the value of a capital. This value of capital equals to the expected discounted value of short-term profit depreciation so that the decision of firm expansion by investment depend on the expected value of profit that can be generated by a unit of capital. Second, the model also tells us that the decision of investment and firm expansion is based on forward looking because the optimum condition in equation 15 shows that the value of profit in short term depends on the value of expected number of capital and its price, and labor. Third, in terms of there is increasing returns the existence of high discount rate r in equation (17b) to be convergence and able reach the optimality condition. Some other views of what determine investment decision of industrial production, Kennan (1979) and Sengupta (2010) propose the rational expectation on optimum investment decision which examines optimum decision on investment when firm expectation is unobserved. On the other side, Miao (2005) provides theoretical model suggesting that firms make decision on financing, entry, and exit the industry depend on idiosyncratic technological shock.

The other theoretical foundation on firm decision on investment is the models with decreasing cost. The decreasing cost models arise from the comprehension of the role of technological progress especially information and communication technology. At empirical level, more than twenty years ago, Brynjolfsson and Hitt (1994) proved that computers had significant effect on firm output. In the last decade, computer and internet are growing very fast to any line of trade in e-commerce, online transaction either manufacturing products or services. Markets that can be much more easily to be accessed make firms should make quick adjustment in production as well and this leads managers, engineers, and workers to easily control the flow of materials, production quality, and the schedule of production as the demand of market changes (McConnel, 1996). As the consequence of high development of computer technology and internet cause firms more productive and in terms of their costs, it comes to the decreasing cost scheme.

The application of technological development has consequences of a certain cost namely R&D (Research and Development) cost. Spence (1984) developed model of dynamic cost reduction caused by R&D expenditure of industry.

Figure 2 summarizes the structural interaction among characteristics of industries and their effect on performance in some aspects. There are some ambiguous among those variables that is concentration and incentive on R&D, the effect of concentration on the incentive can be negative or positive. In endogenous growth theoretical framework, innovation is the most important of factor for growth and as its consequence, R&D is necessary. Schumpeterian says that the less competitive the markets the more incentives for firms to invest on R&D. They argue that R&D is costly so that the firms that can spend more money on R&D are large firms. On the other side, recent studies both theoretical and empirical studies show that more competitive markets lead to higher R&D for example Viscusi et all (2005) and Medvedev and Zemplinerova (2005). Syrneonidis (1996) provide discussion on both sides how firm size and market competition interaction. As the more interesting issue is that the effect of spillover on R&D incentive and cost which is negative. Cohen and Levin (1989) critically argue traditional view of negative effect of spillover on R&D incentive that R&D also has another role that is it increases a firm's absorptive capacity which is the power of firms to manage knowledge and adapt to their own environment. As a result, there will be spillover that can complement the firms R&D attempts and this can raise R&D equilibrium.



Sumber: Spence (1984)

Figure 2: R&D Market Structure

Research Method and Models

Data

This section focuses on empirical strategy on how to identify manufacturing sector behavior on deciding factor demand. This part is started to discuss about the data, its structure and sources, and continued by examining the econometric model. The data are enterprises survey held by Badan Pusat Statistik (BPS). The survey is conducted annually and the respondent is classified as medium and large firms. East Java contributes as the second position after West Java. This study takes 2008 until 2013 as the sample of study.

Since this study use panel data for all targeted firm in the survey so that ensuring the panel position of the micro level data is part of this data analysis. Most BPS survey is not designed as panel survey even though the identifier of respondents can be pooled for some periods. In this study, we select industrial firm located in East Java and filtering the identifier of firm that can be built into panel data structure. In the natural feature of survey at micro level data, the balance structure is very seldom found, the unbalanced panel data is the most common structure.

Table 1: Survey Distribution of Manufacturing

Year	National	East Java	Percentage Ea Java
2008	25694	6248	24,32
2009	24468	6183	25,27
2010	23345	6005	25,83
2011	23370	6228	26,91
2012	23592	6370	27
2013	23698	6226	26,27

Source: Micro Data Survey, BPS

There are 37,320 observations in the panel form of East Java manufacturing firms. One of the problems in unbalanced panel data is that deciding what should be done to the firm or identifier that only has one year time observation and how many years should be included as the minimum observation included in the estimation. As the solution for this, this study selects 3 years panel and removed observation that has less than 3 years. There is standard method to identify the optimum year of panel data in the unbalanced panel data. The result is shown as follows:

Table 2: East Java Manufacturing Distribution of Year included in The Analysis

3 Year Panel		5 Year Panel	
Year	**Freq.**	**Freq.**	**Percent**
2008	5,676	6,248	16.74
2009	5,767	6,183	16.57
2010	5,979	6,005	16.09
2011	6,182	6,288	16.85
2012	5,945	6,370	17.07
2013	5,611	6,226	16.68
Total	35,16	37,32	100.00

Source: Micro Survey Data, Large and Medium Enterprises, BPS

As far as I know, there are no studies concerning manufacturing sector in Indonesia trying to build panel at firm level. This part is tricky because the design of survey is not panel survey and the other challenge to build panel data of firm level study is that there some changes on questioner of the survey. For example, in labor part of the question, there is erasing question on education of labor after 2008 and this could serious problem on the building panel process. In addition, some firms are only surveyed once in the period of this study. This study contributes to the design of panel firm level study in the manufacturing sector. The World Bank conduct panel survey on enterprises in some countries in the world including Indonesia and the survey cover mostly manufacturing firms and the rest is services covering 1444 companies in 2015 and also designed as panel studies. The World Bank surveys only twice which are in 2009 and 2015. The sample is classified into three categories those are small, medium and large companies. This World Bank Data set is better in terms of questioner because covers not only quantitative and companies inside data but also qualitative perception of the firm and markets both input and output markets. Unfortunately, the option to almost all questions in the questioner is provided “do not know” or spontaneous that should not be provided especially for the quantitative information such as the number of input or output components. This situation may not appear if there is long period of survey and revisit survey to targeted respondents but this has serious consequences of the budget and related to this study, it will not satisfied observation on the variables included in the structural model. So that in this study, I choose the data set from BPS as the best choice.

Econometric Model

The specification models for empirical analysis are designed to identify the interaction of input and production and measuring the input marginal productivity so that the contribution of each production input shows the demand of inputs in the following production and as the production expansion plan. The model is developed based on Stochastic Frontier Approach (SFA) in production function or Stochastic Production Frontier Approach (SPFA) since there is SFA based on cost function called Stochastic Cost Frontier Approach (SCFA). Another popular technique of estimating efficiency based on production function is Data Envelopment Analysis (DEA) that use linear programming rather than econometric models. The mathematical form of interacting variables in the empirical analysis can be written as the followings:

$$Q = f(K, L, RM, Energy) \tag{18}$$

Where Q is the production output, K is the capital stock, L is production workers, and RM is the raw materials and Energy is energy used especially fossil fuel. The detail description of all variables included in the models is described in the appendix. In the econometrics form we can re written the model 18 into:

$$LQ_{it} = \beta_0 + \beta_1 LK_{it} + \lambda_1 RM_{it} + \lambda_2 Lenergy + v_{it} - \mu_{it} \tag{19}$$

The notation of variables with L represents logarithm form to take into account on exponential form of input and output in Cobb-Douglass production form. u_{it} is the random noise distributed under normality assumption and homoscedasticity $N(0,s^2)$ and m_{it} is positive technical efficiency and i and t is the entity of the firm and time order. The main issue of the stochastic frontier approach is the estimation techniques by which the parameters of the model are measured. The maximum likelihood estimation (MLE) and Corrected Ordinary Least Square (COLS) is the most common. The COLS method is not as complicated in terms of calculation as the ML method requiring maximization of the likelihood function (Coelli et al., 1998).

Recently, there are some discussions on the problem of endogeneity in SFA. The model 20 seems to indicate endogeneity problem especially on the interaction among capital labor, and production output. This endogenous relationship makes traditional approach of SFA model estimation results in inconsistent parameters (Karakaplan and Kutlu, 2017). The general common technique for dealing with endogeneity is the instrumental variable (IV) or two stage least square (2SLS) because ordinary procedure of estimating stochastic model assumes that inputs are exogenous (Amsler et al., 2014). The other technique to overcome endogeneity in SFA in the context maximum likelihood is the join distribution of the dependent variable and endogenous variable and seeking maximization of corresponding log likelihood (Karakaplan and Kutlu, 2017). The equation 20 provides three endogenous variables those are Q, K and L so that the endogeneity problem can be examined in the structural equation model (SEM) is also developed into transcendental logarithmic form as follows:

$$\begin{aligned} LQ_{it} = {} & \beta_0 + \beta_1 LK_{it} + \beta_2 LL_{it} + \beta_3 LRM_{it} + \beta_4 Lenergy + \tfrac{1}{2}\beta_5 LK_{it}^2 + \tfrac{1}{2}\beta_6 LL^2 \\ & + \tfrac{1}{2}\beta_7 RM^2 + \tfrac{1}{2}\beta_8 Lenergy_{it}^2 + \beta_9 LK.LL_{it} + \beta_{10} LK.RM_{it} + \beta_{11} LKenergy_{it} \\ & + \beta_{12} LL.RM_{it} + \beta_{13} LL.Lenergy_{it} + \beta_{14} RM.Lenergy_{it} + v_{it} - \mu_{it} \end{aligned} \tag{20}$$

So that we have two types of production function those are log linear model as written in model 20 and we also have trans log model in equation 21 and the model for estimating other two endogenous variables which are stock of capital and labor based on their demand function that are based on cost-minimizing framework as described below:

$$LL_{it} = \delta_0 + \delta_1 Lwages_{it} + \delta_2 pma_{it} + \delta_3 LQ_{it} + \varepsilon_{it} \tag{21}$$

$$LK_{it} = \alpha_0 + \alpha_1 L\,\mathrm{int}\,erest_{it} + \alpha_2 Taxrate_{it} + \alpha_3 LPcap_{it} + \alpha_4 LQ_{it} + \phi_{it} \tag{22}$$

Where wages is the log average of wages for workers, pma is the dummy variable indicating that 1 is status of firm is foreign investment, Lineterest is the log of firm expenditure on commercial bank interest rate, and Pcap is the log of average firm's spending on building and land. The derivation of labor and capital stock into the demand function because those variables are identified as the highly endogenous than raw material and energy. Raw and energy mostly determined by outside market and by government plan and policy.

The big issue that is currently growing related to SEM is the identification problem. In the context of SEM, normally every endogenous variable, there will a structural equation examining its conduct in the whole model. The equation system is completely built if the number of equations is as many as endogenous variables included in the modeling system (Baltagi, 2008). Ensuring there is no error correlation among the equations, the number of exogenous variables in the model or in the particular equation must be specified. A minimum requirement of variables both endogenous and exogenous in particular equation or in the model system brings us to the concept of order condition of identification. The requirement formula for order condition can be written as follows:

$$K - M \geq G - 1 \tag{23}$$

Where K is the number of variables included in the model both endogenous and exogenous, M is the number of variables in the particular equations; G is the number of endogenous variable or the number of equations. If the right hand side is exactly the same as the left hand side the order condition is exactly identified; if the right hand side is less than the left, the order condition is not satisfied or under identified; if the right hand side is more than the left, the order condition is over identified. Applying equation 23 to the equation 19, 20, 21 and 22 the results show that the number of variables included in the system is 10 when we assume the derivation of core variables such as square and multiplication or variable interaction are not considered and the number of endogenous variable is 3 those are LQ, LK, and LL but if we consider all variables in the production function in equation 20 the results is all models 21 and 22 are satisfied. The identification process for equation 19 is under identified or not satisfied but if we assume the true model of production is 20, then the production model is over identified, or it means satisfied. Why we are still in doubt if the model does not satisfied in order condition.

The order condition as described before is necessary but it may not be sufficient condition for identification problem. Even though the order condition is satisfied, the equation will not be identified if the sufficient condition is not satisfied. The sufficient condition of identification problem is called rank condition. In general, satisfaction in order condition cannot ensure satisfaction in rank condition because there could be some variables excluded from particular equation but exists in the model and they may not all be independent so it will not be one to one relationship between the structural parameters and reduced form parameters (Gujarati and Porter, 2009).

The problems may arise when we apply rank condition for identification of the structural model. Firstly, the identification theory that previously examined when the theoretical relationship among variables are linear both in parameters or variables but the problem is that many economic variables inter relationship are not linear and a priori restrictions so that order and rank conditions as previously identified cannot be applied in such relationship (Koutsoyiannis, 1977). Until now, the discussion regarding the identification of non-linear structural model is still running. In addition, the more growing ideas to deal with non-linearity in structural model mostly concerns on estimating coefficients on non-linear variable interaction. The other problem is that, in a big structural model involving many variables, the rank condition may be very complicated thing to do and it may be formidable (Gujarati and Porter, 2009). Another support for avoiding rank condition for identification in the big models comes from Harvey (1990) that mentioned the order condition is commonly sufficient for model identification and even though the rank condition must be considered, a failure to confirm and check the model result in a big problem.

Result and Discussions

The empirical strategy of this study provides some econometric model estimation to deal with some situation that changes the results. Generally, the method of estimating structural equation is 2SLS or IV and the first step of estimation is the demand function estimation of labor and capital stock. Since those two variables as examined in the econometric model section. In the first part of this section is firm's demand function estimation of labor and capital and followed by discussing about production function the next section. Demand for labor of industrial sector determined by its price, value of output produced by firm, dummy variables of status of the firm whether foreign investment or not. The individual effect of explanatory variable as theoretically predicted where average wages is negatively affect demand for labor, shown in appendix 2, output has positive sign and foreign investment has greatly contribute to demand for labor on average compared to other status. From all estimation results of labor demand function there is consistency both sign and probability of significance.

On the capital demand side, the estimation satisfies the theoretical foundation both the effect and probability. Price of capital has positive effect on demand, as shown in appendix 1, and since we categorize land, buildings, and machinery as the component of capital, would encourage firms to have an investment on this. We understand that property is one of most expensive investment in establishing business and its expected price is always highly growing that make possible for firms to make decision on physical investment. In addition, the effect of interest rate burden is negative on investment funded by credit from commercial bank. Even though the price of capital make interest on firms to invest but the financing of the decision is important to be considered. At the government side, tax spending ratio has negative contribution on the decision to manufacturing investment. If we compared the two endogenous inputs, capital and labor on all model estimation, capital has relatively more elastic than labor. The dynamic approach to demand (GMM, Bond and Arrelano) lead to similar performance in terms of parameter value but capital demand function results in worse estimator generating higher standard error (See Appendix 2A).

After estimating the demand function of labor and capital, we identified the predicted value of those two variables, LL and LK, and put it on the estimation of production function. It applies maximum likelihood (ML) estimation for stochastic frontier function (equation 19). However, there is assumption that must be applied in the estimation process in the SFA model with maximum likelihood that is assuming time invariant (ti) or time varying decay model (tvd). In the time invariant model, the value of truncated normal *iid* disturbance is assumed to be constant as written $u_{it} = u_i, u_i \overset{iid}{\cong} N^{+}(\mu, \sigma_\mu^2), v_{it} \cong N(0, \sigma_\mu^2)$ are not correlated and covariates in the model. On the other hand time varying decay model assume that $u_{it} = \exp\{-\eta(t - T_i)\}u_{it}$. Unfortunately, after more that hundreds iteration, tvd cannot be run properly because results in not concave iteration so that the process only have ti as the maximum likelihood estimation of SFA model with log linear form. As previously discussed in the section 3.2 that one of the common techniques to estimate SFA model is COLS besides likelihood function and in this case, I tried Praist Winsten with applied panel corrected standard error developed by Beck and Katz (1995) but the problem is the panel structure is unbalanced so that disturbance covariance matrix cannot be built using case wise inclusion. The second strategy for estimating production function is using transcendental logarithmic (trans log) function estimation for panel data. Nevertheless, the estimation trans log model does not generally require any certain technique and we can apply some methods for this step. As the basic and standard techniques to treat panel data, the trans log model is estimated using fixed and random effect and Hausman specification test to select the best fit model and there is also some estimation strategy as alternatives of the trans log model. The results are summarized in appendix 3 and 4 for the production function.

From the results of production function estimation, we see that all variables are consistent with theoretical foundation in terms of the sign of the coefficient. The frontier model yields raw material is not significant determinant of the production. On the other hand, trans log production function differently results in estimating input to output production. The trans log model less sensitive parameter than frontier log linear model. As the consequence of this there are at least two basic conclusions on the production stage of the manufacturing firms. First, since the total parameter is more than 1 in the frontier model, the production function is increasing return to scale meaning that additional input is responded by more additional output. On the contrary, trans log model also generate increasing return to scale of production function since the amount of parameter of input variables are more than 1. Second, the role of employee in the production function is highest and dominating at all estimation techniques both likelihood function and trans-logarithmic. In another words, labor is the most productive input in East Java manufacturing sector.

The other highlighted results are that the model of fixed effect is the better than random effect both in trans log with or without auto regression/AR (1) disturbance. The Hausman test specification test show that fixed is more preferred. Since fixed model performs similar to the ordinary least dummy with dummy variables, the problem may appear on classical assumption especially heteroscedasticity and serial correlation which are commonly disrupt the estimation. To deal with heteroscedasticity, robust standard error is attached in the estimation (Hoechle, 2007) and dealing with serial correlation by applying AR (1) disturbance (Baltagi and Wu, 1999). The results of applying robust and AR(1) disturbance in the model is better. The individual effect of variables has more significant effect because there is improvement in standard error of regression.

Based on the estimation results, there are some implications on industrial development in East Java. First, if we compared the elasticity of output to demand of labor and capital with production function, we could identify the firm's decision on shifting input combination on production function. Based on estimation results, all models yield increasing return to scale and marginal productivity of inputs both capital and labor are higher than input demand elasticity. On another words, firms total factor productivity is growing faster than demand, so that firms can have higher benefit by increasing their inputs. The next question is what inputs should be priorities to be invested by firms. The answer depends on which inputs that have higher productivity than others. As mentioned previously, that labor is the most productive inputs so that increasing the number of labors could have greater impact on production than other factors such as capital, raw material, and energy. Market structure and expected business return may have effect on this decision taken by firms in factor input demand as maximizing profit behavior. The scheme of firm's behavior on the production on every stage described in table 3.

Table 3: Firms Behavior on Production Function

Production Scale	Marginal Productivity (MP) and Output Demand Elasticity	Decision
Increasing Return	MP > Eo	Firm has benefit on this stage, but the firm has not taken to increase the production at competitive level.
	MP < Eo	As long as in increasing stage, firms still have gain opportunity even though the benefit of one additional input is lowering. The possibility to increase the quality of inputs may boost firm's productivity.
	MP = Eo	If this happen, firms should take the position because this is an optimum position in increasing stage.
Decreasing Return	MP > Eo	Firms face input total productivity that lower than its demand so that firms should take rationing the input demand
	MP < Eo	Firms should take rationing on larger portion of inputs
	MP = Eo	This position represent that firms should try to increase productivity of labor or other inputs
Constant Return	MP > Eo	Firms could rationing it input in the production
	MP < Eo	Some efforts to increase input's productivity should be taken.
	MP = Eo	Maintaining this position

Conclusion

This study aims to investigate the behavior of firms in East Java industrial sector especially in combining production factors. Some points on this study that should be noted are, firstly, labor as one of the main production factors has the largest impact on production represented by its marginal productivity which is the highest. It means that labor is the most productive production factors of manufacturing firms in East Java. Second, price of demand elasticity of capital is higher than labor so it means that the changes of capital price either it is financed by cash or credit (interest rate) will be responded by higher demand of capital. Third, the effect of output changes on input demand are dominated labor demand; it is rational because the most productive factor is labor.

Industrial growth in East Java dominated by worker intensive so that it is strategic decision to invest in human capital. World Bank enterprises panel survey in 2015 show that more than 72 percent of industrial workers in East Java have 12 years education. High productivity and high absorption in industrial labor markets generate high return in human capital investment. Market structure and expected business return can be argued as the important outside firm determining their behavior to maximizing profits. Concerning in labor quality development does not mean that we ignore the role of other factors, the abundant of labor with middle level of education constraints manufacturing firms to adjust their production with new technology because labor cannot be combined with such technology.

Business environment variables, tax, interest, energy and raw material also have significant effect on industrial development so that every change on these variables lead to changes in industrial growth in East Java. The stagnation phase of industrial sector in East Java needs some strategic and comprehensive policy to generate better industrial business environment. The maximizing profits behavior of firms by recruiting less labor than its marginal productivity show that there is one of the criteria of less competitive output markets.

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Appendix

Appendix 1: Capital Demand Function

Variables	Fixed Effect		Random Effect		Fixed Effect with AR(1) Disturbance		Random Effect with AR(1) Disturbance	
	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error
LQ	0.042126**	0.0175723	0.350291***	0..017808	0.189398***	0.0255171	0.5166446***	0..017676
Lpcap	0.026580	0.0202341	0.152828***	0..021587	0.100038***	0.0308336	0.1979124***	0.0221146
Linterest	-0.46905***	0.0186441	-.0.50605***	0.020751	-0.4487***	0.029475	-0.507519***	0.021822
Ltax	-0.20449***	0.0163338	-0.17437***	0.0181255	-0.23176***	0.0242452	-0.17633***	0.019209
Constant	1.199956***	0.2290606	7.26375***	0.239349	1.028152***	0.18543	4.739.913***	0.2353267
	Hausman Chi Score: 13816,48				Hausman Chi Score: 660,86			
Note: * Significant at 10 Percent, ** Significant at 5 Percent, *** Significant at 1 Percent								

Appendix 2: Labor Demand Function

Variables	Fixed Effect		Random Effect		Fixed Effect with AR(1) Disturbance		Random Effect with AR(1) Disturbance	
	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error
$Lwages$	-0,0353***	0.0019979	-0,03835***	.002065	-0.01714***	0.01793	-0,02446***	0,0018131
LQ	0,133404***	0.0016057	0.1758847***	.0014879	0.10304***	0.00171	0,15312***	0,0014427
Pma	0,128159***	0.0340137	0.2795756***	.0290596	0.12085***	0.03874	0,28873***	0,0277316
$\_cons$	2,2177***	0,286908	1,55203***	.0281255	2.51861	0.01694	1,783***	1,7826
	Hausman Chi Score: 4705				Hausman Chi Score:1109			
Note: * Significant at 10 Percent, ** Significant at 5 Percent, *** Significant at 1 Percent								

Appendix 2A: Capital and Labor Demand in GMM Framework (Bond and Arrelano)

Variables	Capital Demand		Variables	Labor Demand	
	Coef.	Std. Err.		Coef.	Std. Err.
LK			LL		
L1.	0.2384578	0.1459436	L1.	0.6621652***	0.0538852
LQ	0.0292732	0.0192936	LQ		
L1.	-0.0067194	0.022757	--.	0.0835337***	0.0025661
			L1.	-0.0432234***	0.0054336
lpcapita					
--.	-0.0194434	0.0231229	Lwages	-.0148784***	0.0025103
L1.	-0.0270136	0.0257122	pma	0.1674758***	0.0567612
L2.	0.0123278	0.0200099	_cons	0.8407412***	0.1365863
lbebanpajak					
--.	-0.4989414***	0.0216931			
L1.	0.1061166	0.0738875			
L2.	-0.036916*	0.0220365			
_cons	8.063951	1.611446			

Appendix 3: Frontier Function Estimation

Variables	Fixed Effect		Random Effect		Fixed Effect with AR(1) Disturbance		Random Effect with AR(1) Disturbance	
	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error
LRM	-0,0026	0.006224	-0,00206	0.004434	-0,028330**	0,0112043	-0,0019283	0,0045148
Lenergy	0,07197***	0,013506	0,05173***	0.006776	0,0487925**	0,0239136	0,0528376***	0,0068718
$L\hat{K}$	0,00036	0,014677	-0,01551**	0.007860	-0,113697***	0,0252047	-0,0151921*	0,0080031
$L\hat{L}$	7,2986***	0,061405	7,4258***	0.033271	6,8871***	0,1007042	7,41771***	0,0337818
_cons	-141,77***	0,310965	-1,425***	0.157261	-1,0044***	0,4254256	-1,42334***	0,1599914
	Hausman Chi Score: 7.97				Hausman Chi Score: 94.92			

Note: * Significant at 10 Percent, ** Significant at 5 Percent, *** Significant at 1 Percent

Appendix 4: Transcendental Logarithmic Production Function

Variables	Fixed Effect		Random Effect		Fixed Effect with AR(1) Disturbance		Random Effect with AR(1) Disturbance	
	Coef	Stand.Error	Coef	Stand.Error	Coef	Stand.Error	Coef	Stand.Error
$L\hat{K}$	-0.00497	0.1561795	-0.2046**	0.0898461	-0.4591598**	0.2243011	-0.2045997**	0.0898461
$L\hat{L}$	5.100545***	1.041	8.225926***	0.6306099	2.888794***	1.078154	8.225926***	0.6306099
$\boldsymbol{Lenergy}$	0.0522966	0.1398479	0.0240992	0.0869349	-0.0184752	0.1865932	0.0240992	0.0869349
$\boldsymbol{LRM}$	-0.059289	0.0805643	0.023022	0.0617758	-0.1035721	0.1036468	0.023022	0.0617758
$L\hat{K}^2$	0.0025166	0.0048928	0.0063597**	0.0028114	0.009471	0.0086689	0.0063597**	0.0028114
$L\hat{L}^2$	0.4038204***	0.1292138	-0.0145	0.0797076	0.6430815***	0.1488965	-0.0144995	0.0797076
$\boldsymbol{Lenergy^2}$	0.0041998	0.0038276	0.000196	0.0025412	0.0036895	0.0054406	0.000196	0.0025412
$\boldsymbol{LRM^2}$	0.0000121	0.0014588	0.0004838	0.0011105	-0.0009558	0.0021667	0.0004838	0.0011105
$L\hat{K}\ L\hat{L}^2$	-0.062263**	0.0281588	-0.021497	0.0184404	-0.0640277*	0.0375133	-0.02150	0.01844
$L\hat{K}\ \boldsymbol{Lenergy}$	0.0158596**	0.0066258	0.0091549**	0.0039351	0.02524***	0.0096056	0.0091549**	0.0039351
$L\hat{K}\ \boldsymbol{LRM}$	0.000318	0.0038919	-0.002092	0.002957	0.0052789	0.0049589	-0.0020923	0.002957
$L\hat{L}\ \boldsymbol{Lenergy}$	-0.064602**	0.0306689	-0.027277	0.020737	-0.0742952*	0.0410288	-0.0272769	0.020737
$L\hat{L}\ \boldsymbol{LRM}$	0.0176455	0.01688	-0.000169	0.0128032	0.0219745	0.0219303	-0.0001685	0.0128032
$\boldsymbol{Lenergy\ LRM}$	-0.001846	0.0035199	-0.000552	0.0025519	-0.0031036	0.0045549	-0.0005521	0.0025519
$\_cons$	-8.680922***	2.514175	-14.45656	1.583192	1.205361**	0.555900	-14.45656***	1.583192
		Hausman Chi Score: 7.97				Hausman Chi Score: 94.92		

Note: * Significant at 10 Percent, ** Significant at 5 Percent, *** Significant at 1 Percent

Appendix 5: Statistical Description of Core Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
LK	22994	1.372.042	2.372.916	.6931472	3.054.337
LQ	35160	1.574.431	2.973.732	7.766.417	2.975.925
Lwages	35159	9.253.649	1.273.517	.1419702	2.044.201
Lpcap	8289	-6.409.636	2.570.535	-1.749.478	-.265177
Lenergy	31784	1.088.158	2.265.234	0	1.926.256
LRM	35705	1.455.405	2.150.759	0	2.511.772
ltax	27162	8.429.363	2.967.142	.6931472	2.859.037
Predicted					
LL	35159	3.995.401	.3873566	30.685	5.942.742
Ltax	19976	-5.477.047	2.342.965	-1.768.363	8.048.799
LL	35160	3.995.498	1.128.863	2.484.907	1.062.133
pma	35160	.0315984	.1749309	0	1