Two Different Approaches of Estimating Production Factor Demand: Evidence from Indonesian Large and Medium Enterprises

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Keywords

System Equation, Firm Behavior, Factor demand, Production, Manufacturing Industry.

Abstract

This study measures the elasticity of production factors of manufacturing companies in Indonesia by applying a demand model for production inputs. Using survey data of large and medium-sized companies in Indonesia from 1995-2015 annually collected and published by Bada Pusat Statistik (BPS), this study calculates the elasticity of demand for factors of production which are labor, capital, energy, and materials through two approaches: first, the transcendental logarithm equations applying unrestricted, homotheticity, and adjustment cost model, and second, a system of equations. The purpose of using these two methods is to compare the estimation results of both and whether the two models produce consistent conclusions. The first approach has been frequently used in previous studies while the second approach, system demand, is proposed in this study. This study uses the variation in the group of industries as a proxy for the market price of inputs. The results show that there is heterogeneity in terms of the magnitude and nature of the cross-price elasticity between production inputs for both complementary and substitute inputs. Although different in magnitude and nature, all show sensitivity between price levels and demand for production inputs and interactions between production factors. The implication of this is that companies rationalize their demand for production factors to respond to price changes. Meanwhile, the own price elasticity is negative for all production inputs and there are positive effect adjustment costs that must be borne by firms in expanding production inputs.

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1. Introduction

The manufacturing sector is the engine of growth in many countries, especially those classified as developing nations, where manufacturing contributes to higher income (Helper *et al*, 2012), technological accumulation, and human capital utilization as well as an economic institution (Su and Yao, 2016). Demand for the inputs of production has an important role in investigating policy impact on industrial performance, especially in relation to the price of inputs. Industry performance is influenced by the situation in the input or output market. However, uncertainty in either market has an impact on the company's production decisions. In the case of certainty, an increase in input prices causes firms to reduce their use of that input. To ensure this result in the uncertainty case, we need a well-behaved production function. Furthermore, the effects of uncertainty on the demand for other inputs are unpredictable (Batra and Ullah, 1974). Research has examined how output price uncertainty affects a competitive firm's supply and factor demands under the presumption that all decisions are made prior to the price being observed (Hartman, 1976). However, the demand for high-risk inputs falls in response to increased financial risk, while on the other hand, non-risky inputs respond in reacting to technological progresses (Alghalith, 2005). Sources of input risk may come from price input fluctuation, either from exogenous shocks or government intervention such as minimum wage policy, capital cost adjustment, positive and or negative tax of input prices, or international market shocks, especially in countries where industrial products are mostly exported and inputs are imported. The influence of uncertainty both in general terms and in policy poses a risk to companies, especially in developing countries, which remain highly dependent on the industrial sector as a source of growth. The transition of the economic structure from the traditional to the modern sector is the hope for the majority of the workforce to get a greater share of income.

In line with each nation's degree of industrialization and economic policy, manufacturing sectors in Muslim-majority nations have developed in a variety of ways. For example, 36.8 percent of Malaysia's gross domestic product (GDP) comes from manufacturing, with the electronics and electrical sector playing a significant role (Department of Statistics Malaysia). Furthermore, it has been demonstrated that financing from Islamic banks improves industrial production (Bougatef, Nakhli, & Mnari, 2020). Bangladesh's apparel exports to the US market reached $2.98 billion, a significant 29.33% year-on-year growth (Hossain, 2025) and employs over five million people, (FICCI, January 9, 2025) primarily women, is the foundation of the country's export economy. Pakistan, too, depends on the textile sector, which accounts for around 8.5 percent of its GDP (Nasir *et al*., 2025), although it faces difficulties due to energy crises and a decline in its ability to compete globally. Meanwhile in Morocco, the country has advanced quickly in the automotive and aerospace industries, producing 700,000 vehicles a year and becoming a significant exporter to Europe (Vorotnikov, 2024). This sector creates a large number of jobs, including for women, and accounts for 22 percent of the country's GDP (Sharki, 2024). In Egypt, the steel, textile, and chemical sectors all make significant contributions to the country's highly diverse manufacturing economy. According to Egypt's Ready-Made Garments Export Council, the industry's exports rose by 18% in 2024, reaching $2.84 billion from $2.41 billion in 2023 (State Information Service, 2024). In addition, Egypt's chemical sector exports reached around $6.5 billion by the end of September 2024, with plastics making up 29% of the total, or about $2.6 billion, according to the Export Council for Chemical Industries (DailyNews Egypt, 2024).

Nevertheless, productivity is a problem for all Organization of Islamic Cooperation member nations, as evidenced by the declining total factor productivity index (Rusdiana & Ningsih, 2024). This is primarily brought on by technical and technological inefficiencies. Additionally, the manufacturing sectors in Muslim-majority nations have enormous potential to expand through innovation, efficiency gains, and industrial diversification despite structural and competitive obstacles.

Indonesia is the world's largest Muslim-majority country, with around 15 percent of the nation's total labor force work in the manufacturing sector. Unfortunately, Indonesia's manufacturing sector growth has not show improvement since the economic crisis in 1998, with the global financial crisis in 2008 and the COVID-19 pandemic worsening manufacturing conditions in the country. Indonesia's manufacturing sector grew at an average rate of 11.13 percent between 1976 and 1997, before the Asian financial crisis. In contrast, average growth declined to just 3.57 percent between 1998 and 2020 (World Development Indicators, World Bank, 2024). Tariff and non-tariff policies have been designed for improvement, but the sector's performance still failed to meet expectations.

Pursuing economic development through industrialization will probably continue to represent an important path for developing countries because they can take advantage of their development situation compared to those countries that have already experienced rapid industrialization with a disproportionately large share of manufacturing activities and may soon reach an advanced position of industrialization (Haraguchi *et al*., 2016). By estimating the demand for inputs in the manufacturing sector, we can look deeper into how the policy addressed affects the production decision-making of the manufacturing firms.

This paper estimates the input demand of Indonesia's manufacturing sector at the firm level. We identify jhow sensitive the demand of each component of production factors is to firm demand, and how substitution among factors is identified. The research uses data from Indonesia's large and medium enterprises survey from 1995 to 2014 published by the Central Statistics Agency (Badan Pusat Statistik, BPS). The firms covered by the survey are manufacturing companies, with more than 20,000 firms responding every year. We estimate the demand function of input including, raw materials, electricity, fossil energy, labor, and machinery, employing both single and system equation techniques. This study contributes to sectoral knowledge because there are no existing references on factor demand for Indonesia's manufacturing industry, even though this is information is important for analysts and policy makers, especially with regards to components which directly affect input prices, such as minimum wage policies, energy prices, and industrial raw materials. Second, this study contributes by discussing methods for calculating the elasticity of demand for factors of production which generally use the transcendental logarithm model and the budget share model of decreasing translog production models. In this study, there is a modification in the budget share model by adopting a unit value model approach that developed by Deaton (1988) to be applied to the case of industrial manufacturing companies. Deaton's model was originally used for demand systems by considering the problem of measuring unit prices in estimating demand systems through examining the quality correction in the spatial variation of the unit value being measured. This study assumes that variations within the same industry cluster reflect differences in value construction, especially in competitive markets, challenging the classical view that industries are homogeneous except in size (Porter, 1979). This paper is structured as follows. Section 2 presents a literature review of previous studies both theoretical and empirical studies. Section 3 discusses the data and the empirical methods used in this study. The data section provides an overview of data sources and observations, while the methodological section explains the estimation strategy used, including issues related to the choice of estimation technique used. Section 4 describes the estimation findings from the model developed in the previous section including the interpretation and calculation of the elasticity of demand for production factors. Section 5 provides a summary of the findings of this study.

2. Literature Review

Input demand is derived from production optimization. Most existing literature explains derived demand function for factors of production try to directly model this least-cost expansion path; that is, using a comparative statics model with constant returns to scale and perfect competition assumptions (Mohr, 1980). In the demand for factors of production, there are several elements must to be considered by a company in determining how much input is used in production. Above all, price is the key factor of input demand; the higher the price, the smaller number of inputs bought. However, since the inputs used in the production process are not singular in nature, the price of other inputs also determines the input demand. In other words, complementarity, substitutability, and independence of inputs influence the combination of inputs in production. Another determinant factor of input demand is output price. If output price increases, and all other factors remain the same, producers expand their production; subsequently, producers increase the input demand (Rasmussen, 2011). The response of firms depends on how quickly firms adjust production factor demand.

At the empirical level, there are multiple studies which identify the production factor demand. Binswanger (1974), Yotopoulos *et al*. (1976), and Kamruzzaman *et al*. (2021) provided empirical studies on factor demand and substitution elasticities among inputs in agriculture sector using derived demand function from translog cost production model. Another study of input demand in agriculture came from Higgins (1986), who used translog profit function to estimate the input demand of Irish farms. Gyapong and Brempong (1988) applied production function approach in estimating demand for police production input (civilian and capital input) and found that both inputs were complementary. Le (2019) used enterprises survey data to investigate the input demand of manufacturing companies by employing translog production function derived into system input demand function with focus on four input demands: capital, labor, energy, and intermediate materials. Allen's (1938) relative substitution elasticity and price elasticities of input resulted in consistent expected sign and magnitude, while Kim (2021) explored dynamic production demand input using panel manufacturing surveys from Japan. Kim revealed that factor demand rises when its own price rises in the short run, implying that factor prices have largely determined factor adjustment in the past due to depressed factor adjustment. However, factor demand ultimately reverts to its normal downward slope. As factor adjustment is accomplished, the curve will flatten out in the long run. In the economy, labour and capital are substitutes. In the short run, they are competitors, but in the long run, they become complementary elements.

Existing factor demand models majority fall into two types of models: static and dynamic. The first type of model is static, in which substitution among several factors is consistently accounted for without imposing a priori constraints on the production structure. Such models use functional forms with flexibility to represent the underlying technology. The models impose strict constraints on the technology's dynamic behavior, with the assumption of either full or partial static equilibrium, which consistently accounts for substitution among several factors without imposing a priori constraints on the production structure. Dynamic models may identify why some inputs are not adjusted at the period in responding a new equilibrium of prices (Asche & Salvanes, 1997). Dynamic models of factor demand function is becoming popular recently, both theoretically and empirically, in estimating the model of production input demand. Smolny (1997) provided a theoretical explanation of dynamic model of factor demand with rationing of the firms in the competitive markets under disequilibrium markets. The dynamic model of factor demand generates a wealth of important information about production structure, and productivity growth sources, the effect of technological changes, and impact of policy instruments and expectations on output supply, input demand, the technical change directions, growth of productivity. It is possible to measure not only the components of traditional productivity, but also the firm’s labor and capital decisions at the same time (Nadiri & Prucha, 2001).

Some empirical studies employ dynamic factor demand models. Mcquinn (2003) used the dynamic factor demand model for the macro level economy of Ireland, while Friesen, Capalbo, and Denny (1992), Thijssen (1994), and Daigneault and Sohngen (2008) applied the dynamic factor demand models for forest and agricultural commodities. On the other hand, Papagni (1990) and Lundgren and Sjoestroem (1999) used the models to estimate the factor demand in the manufacturing firms but had a different conclusion about the adjustment cost of factor demand, while Papagni found the adjustment cost whereas Lundgren and Sjoestroem did not find strong evidence the adjustment cost, especially for capital input. Hamermesh and Pfann (1996) argued that there are at least three reasons why firms slowly adjusted of a single input in any studies using microeconomic data. First, there is a time lag between making output decisions and when those decisions result in actual production, simply due to the time required for implementation. The time required to build productive structures is just as consistently observed in microeconomic data as adjustment costs are. Long and discrete lags exist to be near consistent with the markets for most capital equipment, and the concept appears to be distorted. The second possibility is that the pattern under observation resulted in the process of demand response shocks; we are not able to properly specify expectations about those shocks in the model. The behavior of firms which we observe may be influenced by a combination of shocks and the formation of expectations, so we have a problem that we cannot ignore without an accurate comparison of product and input demand at the firm level. Third, it is important to assume adjustment costs as a modeling device. They are not the only explanation for the observed behavior, but they represent more advanced forms.

3. Methodology

3.1. Data

This study uses firm-level data from large and medium enterprises who completed yearly surveys from Indonesia's Central Statistics Agency (BPS). The Annual Large-Medium Industry Survey is conducted as a census of all large and medium-sized industrial companies listed in the BPS Industrial Company Directory. A firm is categorized as medium or large depending on the number of workers, where 22 to 99 active workers designates a medium enterprise and 100 or more workers is categorized as a large enterprise. The information collected during the survey includes location, both domestic and imported inputs (workers, raw materials, energy consumption as such fuel, electricity, and gas), domestic and exported sales, ownership of capital share, other expenses (building rents, taxes, interest payment), and asset values.

This study uses firm-level data covering the 1995-2015 period. Data related to input prices is obtained in two ways, namely using unit price data obtained by dividing expenditures for each input for each unit. Inputs calculated by this method include labor wages (PL), fuel (PF), electricity (PE), and capital prices calculated using interest rates (lending rates). This calculated capital includes expenses for rent, purchase of buildings, vehicles, and machinery, and land. The second way uses aggregate data, especially for raw materials. The price of raw materials used in this study is proxied by the Wholesale Price Index (WPI). Specifically for energy, because there are eight types of fuel including lubricants (gasoline, diesel, kerosene, coal, coal briquettes, gas, liquid petroleum gas, and lubricants) which use different units, the energy price is calculated using the weighted average energy price. The descriptive statistics of variables are summarized in the Table 1.

Table 1 Descriptive Statistics of Variables

Variable	Obs	Mean	Std. dev.	Min	Max
Total Cost	453,289	3.99E+07	4.21E+08	0	8.10E+10
Share of Labor	453,268	0.255594	0.2299	0	1
Share of Energy	453,268	0.03748	0.0783	0	1
Share of Electricity	453,268	0.0404	0.0924	0	1
Share of Capital	453,268	0.00937	0.0488	0	1
Share of Materials	453,268	0.6571	0.2688	0	1
Price of Labor	453,289	12692.17	43393.02	0	1.13E+07
Price of Energy	407,708	3.8532	2.700.904	0	10663.61
Price of Electricity	453,289	19.5833	3544.308	0	1485838
Price of Capital	453,289	16.3822	4.9506	116.575	32.1542
Price of Materials	453,309	81.7123	32.2706	3.1106	143.9522
Dummy Central Government Ownership	453,309	1.3158	11.1835	0	100
Dummy of Local Government Ownership	453,309	7.7648	26.5252	0	100
Dummy of Private Ownership	453,309	84.0581	35.6456	0	100
Dummy Java Island	453,309	0.8716	0.3344	0	1
Tax Spending	451,838	1227949	1.06E+08	0	2.61E+10
Dummy Export	453,309	0.0897	0.2857	0	1

3.2. The Empirical Method

The standard method to estimate demand for factors of production is using derived demand of production function. We follow Papagni (1990) in terms of estimating the elasticity of short-term price elasticity of demand for production factors; Pyndick and Rotenberg (1980) as the calculation base of long-term price of elasticity; and Binswanger (1974) for the symmetric estimation of the cost function. We assume that a firm produces single output Y using n variable inputs $V_{tn} = (v_{t1}, v_{t2},\dots v_{tm})$ at prices $W_t = (w_{t1}, w_{t2}\dots w_{tn})$ and there are m quasi-fixed production factors, which are capital (K) and labor (L). The number of variable inputs may be changed without postponement, while the quasi-fixed factors need adjustment cost. The production function of firm can be written as follows (Equation 1):

$$Y_{it} = F(V, K, L) \text{ ......(1)}$$

Where C is the capital input. Therefore the adjustment cost for capital input can be defined as $\Delta Ct = W_{Ct} - WC_{t-1}$, and t is time. The difference between variable and quasi-fixed inputs categorizes the function (1). Variable I in equation 1 implicitly shows the adjustment cost because of changes in capital stocks; when labor is assumed to be a quasi-fixed input, then there are two quasi fixed inputs. This assumption may be true because capital needs process and administration cost, application of bank credits, and purchasing capital takes time. In addition, labor can also be a quasi-fixed input since there is a cost to adjust labor needs in the production function such as searching, matching, and training (on and off the job training), , so that the adjustment cost for labor input follow difference equation as: $\Delta WL_t = WL_t - WL_{t-1}$. The estimated cost of production function follows trans-logarithm function (Equation 2):

$$LnTC_{it} = \alpha_0 + \alpha_1 lnY_{it} + \sum_{k=1}^{5} \beta_k lnW_{it} + \frac{1}{2}\alpha_2 lnY_{it}^2 + \frac{1}{2}\sum_{j=}^{4} \sum_{k}^{5} \beta_{jk} lnWjlnWk_{it}$$

$$+\sum_{k=1}^{5} \varphi kllnYlnW_k + \delta_1 \Delta W_{Cit} + \delta_2 \Delta W_{Lit} + \delta_3 \Delta W_{CLit} + \sum_{j=}^{4} \gamma_m X_{it} + \mu_{it} \quad \text{......(2)}$$

Where TC is total cost, Y is the total output, W is price of inputs, X is a set of firm characteristics, and μ_{it} is error disturbance. The demand functions for the variable factors of fuel energy, electricity, and raw materials are obtained using Shephard's lemma and the restricted cost function (Equation 2) as the following five equations (where α is the share cost of each input, the variables of characteristics of the firm are still included in the models (Equation 3):

$$S_{jit} = \gamma 0 + \sum_{j=1}^{5} W_{jit} + \sum_{m=1}^{6} \gamma_m X_{it} + \varepsilon_{it} \quad \text{......(3)}$$

where S is the budget share of the company's expenditure on input j and the Allen Partial Elasticity of Substitution (APES) calculation can be derived as follows (Equation 4):

$$\sigma_{ij}^{A} = (\beta_{ij} + S_t S_j) / S_t S_j$$
$$\sigma_{it}^{A} = (\beta_{ii} + S_i (S_j - 1) S_{it}^2 \quad \text{......(4)}$$

Estimation can be done either with a single equation (equation 2) or with a system of equations such as equation 3 for all inputs. The assumption used in the APES calculation is that the budget share is assumed to be constant throughout the observation period. From the APES calculation, we can calculate own and cross price elasticity with the following formula (Equation 5)

$$\eta_{ij} = \sigma_{ij}^{A} S_j$$
$$\eta_{it} = \sigma_{it}^{A} S_t \text{ ......(5)}$$

Systemic estimation as in equation 3 can be done even though it contains weaknesses in the calculation of input unit prices. This weakness was revealed by Deaton (1988), so we propose using Deaton's unit price model. Deaton explains that there are differences in quality and variation in a certain area. In this study, we consider that the regional distribution of the quality of goods used in this study is relevant for a variety of industrial sectors. One industrial sector can have similarities in production structure or costs. We also use the unit price model developed by Deaton (1998) to address the problem of measuring input prices such as energy, labor, and electricity as measured by unit prices, namely the ratio between input expenditure divided by the number of inputs per unit. Deaton (1988) argues that the mix of unit values by quality impacts is not the only issue, and it might not even be the most important one, that prevents the use of unit values to signify costs. Errors in measuring lead to additional issues. Since unit values are computed by dividing expenditures by quantities, measurement errors in either will not only result in inaccurate measurements of the unit value but are also likely to produce an unintended negative connection between quantity and unit value. The empirical model of Deaton Unit Value Model with spatial variations can be written as follows (equation 6):

$$S_{kit} = \tau_0 + \tau_1 TC_{it} + \sum_{m=1}^{6} \gamma_m X_{it} + fc + u_{1,i,t} \text{ ......(6)}$$

$$ln(W_{kit}) = b_0 + b_1 TC_{it} + \sum_{m=1}^{6} \gamma_m X_{it} + f_c + u_{2,i,t} \text{ ......(7)}$$

Where S is the budget share input, k is the input k, i is the entity of the firm, and t as time, TC is the total budget (total cost), z is the characteristics of the company, W is the measured unit value, and fc is the fixed effect of group A, in which the estimation of both models is considered as the first step of the Deaton model with spatial variations. Instead of using spatial variation as in the Deaton model, we estimate for firms in this industry the fc as the industry group identified in the five digit International Standard Industrial Classification (ISIC) code as a cluster as the primary sampling unit. The second step is the estimation of the following Equation 8:

$$S_{kit} = \emptyset_0 + \widehat{\phi_1 ln(W_{it})} + u3 \text{ ....(8)}$$

It should be noted that the estimation at this second stage is not the usual least squares. Indeed, Deaton (1988) uses the correlation between the first-stage residuals to estimate the seriousness of the problem in measuring error. The calculation of demand elasticity based on this approach is technically explained by Araar and Verme (2016) and Araar *et al* (2018). By providing alternative calculations through both the production function estimation method and derived demand with a unit price model that considers input quality and price variations within clusters can provide a more comprehensive picture.

A single equation, equation 2, or system of equations approach, equation 6-8, can be used to estimate the translog cost production function (2). The cost shares of all inputs (C, L, E, EL, and M) will be estimated using a system of equations approach. Since this study investigates the adjustment cost and price elasticities (both own-price and cross-price elasticities among the input factors), both models must be estimated. Due to the singularity of the covariance matrix of four equations (the cost shares of all inputs adding up to one), one equation must be canceled out prior to estimation. However, the Deaton model offers an alternative estimation approach used in this study to estimate budget share equations for all production inputs.

4. Results and Discussion

4.1. Translog Model Estimation

The total data resulting from building longitudinal data around is unbalanced panel data with a total of 453,306 observations and the estimation results of the equation 2 model leave 240,000-270,000 observations or 50-60 percent of the total data collected. Equation 2 is estimated using several models, including unrestricted, homotheticity, and non-adjustment cost. Several alternative estimation models used in this study follow those used by Pindyck and Rotemberg (1983) and Gyapong and Gyimah-Brempong (1988) for the transcendental model. Homotheticity assumption uses restriction $\alpha_1 = \rho\ (1 - \beta_E - \beta_{EL} - \beta_L - \beta_C - \beta_M)$, $\varphi_{YE} = -\rho(\beta_{EE} + \beta_{EC} + \beta_{EEL} + \beta_{EL} + \beta_{EM})$, $\varphi_{YEL} = -\rho\ (\beta_{ELEL} + \beta_{ELL} + \beta_{ELC} + \beta_{EL} + \beta_{ELM})$, $\varphi_{YL} = -\rho\ (\beta_{LL} + \beta_{LC} + \beta_{ELL} + \beta_{EL} + \beta_{LM})$,

$\varphi_{YC} = -\rho\beta_{CC} + \beta_{LC} + \beta_{EC} + \beta_{CM} + \beta_{ELC}$), the restriction shows that if the output of 1 percent increases, the total cost will increase by ρ. On the other hand, parameter estimation of the production function model needs to consider endogeneity issues. This was conveyed in studies including those by Kumbhakar (1989), Felipe *et al* (2021), and Sampi *et al* (2021). In addition, Karakaplan (2017) and Karakaplan and Kutlu (2017) explain that in stochastic frontier models, endogeneity issues can occur for a few main reasons: first, there is a correlation between the two-sided error term and the cost frontier determinants. In particular, the causes of the inefficiency might lead to this association between the two-sided error term and the inefficiency term. In a stochastic frontier model, endogeneity will result in contradictory parameter estimations, therefore it will need to be carefully addressed. Second, they also explained that using the conventional maximum likelihood method will produce inconsistent parameters.

Table 4.1 Estimation Results of Translog Model (Driscoll and Kraay Standard Error)

Variables	Unrestricted	Homotheticity	Non-Adjustment Cost
α_1	1.409***		1.407***
	-0.0188		-0.0163
β_E	-0.231***	-0.487**	-0.122**
	-0.0581	-0.19	-0.0493
β_{EL}	-0.266***	-1.031***	-0.268***
	-0.0474	-0.166	-0.0406
β_L	-0.184***	-1.299***	-0.176***
	-0.0509	-0.126	-0.043
β_C	1.897***	-7.729***	1.584***
	-0.379	-1.197	-0.306
β_M	1.007***	-0.135	0.661***
	-0.207	-0.638	-0.157
α_2	-0.0203***		-0.0212***
	-0.000355		-0.000353
β_{EE}	-0.00116	0.0499***	-0.00180*
	-0.001	-0.00481	-0.000963
β_{ELEL}	-0.00130*	-0.0410***	-0.00124*
	-0.000734	-0.00314	-0.000708
β_{LL}	-0.0192***	0.0825***	-0.0197***
	-0.00112	-0.00253	-0.00106

β_{CC}	-0.0988**	0.964***	-0.0891**
	-0.0418	-0.136	-0.037
β_{MM}	-0.0876***	0.134***	-0.0648***
	-0.0121	-0.0379	-0.00985
φ_{YE}	-0.000558		-0.000732
	-0.00122		-0.00119
φ_{YEL}	-0.00881***		-0.00885***
	-0.00142		-0.00137
φ_{YL}	0.0342***		0.0368***
	-0.000997		-0.000994
φ_{YC}	0.00571		0.00928**
	-0.00463		-0.00435
φ_{YM}	0.00106		0.000511
	-0.00228		-0.00199
β_{EEL}	0.00788***	0.175***	0.00665**
	-0.00284	-0.0107	-0.00275
β_{EL}	-0.00975***	-0.0413***	-0.0106***
	-0.00283	-0.00781	-0.00272
β_{EC}	0.0391***	0.395***	0.0191
	-0.013	-0.0458	-0.0119
β_{EM}	0.0452***	-0.0663***	0.0355***
	-0.0067	-0.0222	-0.00563
β_{ELL}	0.00188***	-0.00173***	0.00176***
	-0.000173	-0.000548	-0.000164
β_{ELC}	0.0215***	0.0469***	0.0202***
	-0.0026	-0.00934	-0.0024
β_{ELM}	0.0157**	0.220***	0.0210***
	-0.00722	-0.0246	-0.00616
β_{LC}	-0.0763***	0.321***	-0.0866***
	-0.0128	-0.0326	-0.0119
β_{LM}	0.0264***	-0.101***	0.0237***
	-0.00614	-0.0146	-0.00503
β_{CM}	-0.154***	0.0844	-0.0857**
	-0.0456	-0.141	-0.0358

δ_C	7.33e-10**	2.77e-09***	
	2.90E-10	7.31E-10	
δ_L	2.46e-10**	2.67E-10	
	1.24E-10	6.71E-10	
δ_{CL}	0	0	
	0	0	
$\gamma_{Central}$	-0.000804***	-0.00330***	-0.000662***
	-0.000156	-0.000383	-0.000148
γ_{Local}	0.000841***	-0.00757***	0.000880***
	-7.79E-05	-0.000219	-7.58E-05
$\gamma_{Private}$	0.00144***	-0.00890***	0.00144***
	-6.52E-05	-0.000172	-6.33E-05
γ_{Java}	-0.0171***	0.0990***	-0.0141***
	-0.00343	-0.0102	-0.0032
γ_{Tax}	-0.0242***	0.394***	-0.0237***
	-0.000598	-0.0014	-0.000574
γ_{Export}	-0.0355***	0.598***	-0.0374***
	-0.00409	-0.0113	-0.00387
Constant	-8.275***	23.71***	-7.141***
	-0.935	-2.871	-0.71
Two Digits ISIC Fixed Effect	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes
Observations	245,317	245,317	276,301
R-squared	0.944	0.528	0.943

Standard errors in parentheses

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

Table 4.1 provides a summary of the estimation results of the four models: unrestricted, homotheticity, non-adjustment cost, and CRTS. Model estimation is carried out with a fixed effect by including the variable time effect and two digits ISIC. The use of the fixed effect model also considers the results of the Hausman specification test. The results of parameter estimation show that there is consistency in significance, but the non-adjustment cost and unrestricted models are closer in terms of the coefficient results. This is possible because there are no constraints in the variable parameters in both models compared to the homotheticity constrained model. Model selection based on Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) showed that the unrestricted and nonadjusted models had a lower value than the homotheticity model. The estimation results use Driscoll and Kraay (1998) for the fixed effect model and were developed by Hoechle (2007) for unbalanced panel data which is intended to overcome the problem of heteroskedasticity and autocorrelation in the model. In addition, we conduct a Wald test to see whether an additional fixed effect for the dummy variable year and two digits ISIC sector needs to be added to the model and the results of this post-test can be seen in table 4.2 where the results are significant at the 1 percent level, which means that the dummy variable year and two digits ISIC number need to be included in the estimation model. The estimation results of the adjustment cost variable are positive and significant at the 5 percent level for capital and labor variables, which can be interpreted as increasing and convex. Even so, the adjustment cost interaction between labor and capital is very small.

Table 4.2 Post Estimation Results Fixed Effect Regression

Tests	Unrestricted	Homotheticity	Non-Adjustment Cost
Hausman	540.69***	896.42***	449.33***
Join F-Test Time Fixed Effect	65.08***	139.75***	96.87***
Join F-Test Two Digits ISIC Fixed Effect	8.69***	14.12***	15.57***
Group Wise Heterogeneity	7.63***	6.80***	3.1***
Wooldridge Autocorrelation Test	530.898***	1939.205***	707.525***
AIC	206924.9	418425.8	210064.7
BIC	207732.9	418435.8	210074.7

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

Based on the model estimation results in Table 4.1, the Allen Price Elasticity of Substitution (APES) and Own and Cross elasticity are calculated and summarized in table 4.3. From this table, we can see that all own price elasticities are negative, which means they are in accordance with the demand function, while for cross price elasticity, there are those which show positive and negative values. The negative value indicates that the two inputs are complementary, while if the value is positive, it means that the two inputs are substitutes.

Table 4.3 Allen Price Elasticity of Substitution

	APES				
	Energy	Electricity	Labor	Capital	Material
Energy	-0.001	-0.445	-0.846	-1.246	1.455
Electricity		-0.83	-0.233	0.257	0.243
Labor			-0.961	0.742	-0.815

Capital				-2.372	0.772
Material					-0.984
Own and Cross Price Elasticity					
	Energy	Electricity	Labor	Capital	Material
Energy	-0.003	-0.017	-0.216	-1.167	0.949
Electricity		-0.332	-0.932	0.240	0.009
Labor			-0.245	0.695	-0.208
Capital				-2.223	0.922
Material					-0.647

From the calculation of the input elasticity value, capital is the most elastic input compared to other inputs with a value of -2.223, which means that for every 1 percent increase in the price of capital, there is a decrease in the demand for capital by 2.223 percent. The most inelastic input is energy of -0.001. Therefore, it can be said that manufacturing companies are remain very dependent on conventional energy. The elasticity calculation assumes symmetry in the model so for elasticity under the diagonal it is not calculated because it is assumed to be the same as its elasticity above the diagonal.

4.2. System Equation Model Estimation (Deaton Unit Value Model)

The estimated model equations 6 (clustered price equation) and 7 (budget share equation) can be seen in table 4.4. The estimated price and budget share variables are significantly influenced by the total cost and characteristic variables. However, there is heterogeneity in the parameters for all variables both in terms of magnitude and expected sign. Fixed effect year and two digits ISIC are also included in the estimation of each clustered price and budget share equation. In contrast to the strategy of estimating the budget share equation from the derived factor input demand from the translog model (as discussed in the literature study), in this unit value model, estimation is carried out with several stages described in the previous section. In addition, estimation of the effect of the unit value input on the budget share is carried out by considering the estimated residuals from the estimation stages of equations 6 and 7 to reduce the impact of measurement error.

Table 4.4 Estimation Results of Cluster Fixed and Budged Share Regression

Cluster fixed effect regression(s)					
Variables	Price of Labor	Price of Energy	Price of Electricity	Price of Capital	Price of Materials
Total Cost	0.395***	0.173***	0.183***	-0.655***	0.0474***
Firm Size	-0.405***	-0.223***	-0.190***	0.844***	-0.0591***
Tax	0.0372***	0.0047***	0.0070***	-0.0397***	0.0012***
Foreign	0.0026***	0.0079***	0.0068***	-0.0092***	0.0022***

Domestic	0.0021***	0.0084***	0.0073***	-0.0111***	0.0025***
D Export	-0.061***	-0.0542***	-0.181***	0.394***	-0.0151***
Java	-0.0800***	-0.117***	-0.0728***	0.348***	-0.0385***
Constant	4.237***	-1.552***	-2.838***	22.95***	3.626***
Two Digits ISIC Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	331,678	291,727	295,265	331,799	331,799
R-squared	0.65	0.648	0.631	0.47	0.844

Budget shares regression(s)					
Variables	Share of Labor	Share of Energy	Share of Electricity	Share of Capital	Share of Materials
Total Cost	-0.112***	-0.0046***	-0.0033***	-0.0011***	0.121***
Firm Size	0.112***	0.00325***	0.000338	-0.000123	-0.116***
Tax	0.00114***	0.00210***	0.00321***	0.0009***	-0.0073***
Foreign	0.000668***	0.00009***	-0.000015	0.0001***	-0.0008***
Domestic	0.000391***	0.0001***	0.00001*	-0.000002	-0.0005***
D Export	-0.0080***	-0.007***	-0.0098***	-0.0013***	0.0262***
Java	-0.0186***	-0.0079***	0.0054***	-0.0018***	0.0230***
Constant	1.383***	0.0710***	0.0549***	0.0171***	-0.526***
Two Digits ISIC Fixed Effect	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	331,799	331,799	331,799	331,799	331,799
R-squared	0.495	0.131	0.187	0.04	0.441

Standard errors are not reported by the package
*** p<0.01, ** p<0.05, * p<0.1

Based on the estimation results of the budget share and clustered price equations, the results of calculating the elasticity of the input factor can be categorized into two assumptions in the model: quality correction and symmetry restriction (table 4.5). Estimating the Deaton model for demand for production factors uses the assumption that clusters are companies that have the same five -digit ISIC. The estimation results show that the own price elasticity is all negative for all combinations of assumptions used. This shows the consistency of the theory from the estimation results of the own price elasticity of each production input. As the primary sampling unit of five digits ISIC, we argue that the use of industry classification standards up to five digits is more representative of the behavior between companies with the same classification compared to companies that are in the same location (as identified in survey data). Companies with the same five digit ISIC code will have a greater similarity in production and cost structure, so the use of variations in one industry group provides an overview of input market prices, compared to companies in different industrial groups butthe same location.

Table 4.5 Own and Cross Price Elasticity

Price elasticities: without quality correction | without symmetry restricted estimators					
	Labor	Energy	Electricity	Capital	Materials
Labor	-0.251	-0.059	0	-0.024	0.069
Energy	0.428	-1.109	0	0.026	0.108
Electricity	0.857	-1.244	-0.993	-0.208	0.651
Capital	1.976	-1.227	0	-1.099	0.294
Materials	-0.475	0.113	0	0.011	-0.994
Price elasticities: without quality correction | with symmetry restricted estimators					
	Labor	Energy	Electricity	Capital	Materials
Labor	-0.07	0.199	0	0.009	-0.427
Energy	1.274	-1.957	0	-0.041	0.531
Electricity	-0.091	-0.004	-0.993	0	0.173
Capital	0.164	-0.166	0	-1.004	0.571
Materials	-0.319	0.015	0	0.005	-0.992
Price elasticities: with quality correction | without symmetry restricted estimators					
	Labor	Energy	Electricity	Capital	Materials
Labor	-0.275	-0.065	0	-0.026	0.076
Energy	0.428	-1.110	0	0.026	0.108
Electricity	0.858	-1.245	-0.993	-0.208	0.651
Capital	1.964	-1.220	0	-1.092	0.292
Materials	-0.043	0.01	0	0.001	-0.09
Price elasticities: with quality correction | with symmetry restricted estimators					
	Labor	Energy	Electricity	Capital	Materials
Labor	-0.076	0.218	0	0.01	-0.468
Energy	1.275	-1.959	0	-0.041	0.532
Electricity	-0.091	-0.004	-0.993	0	0.174
Capital	0.163	-0.165	0	-0.998	0.568
Materials	-0.029	0.001	0	0	-0.09

The model estimation output provided by the WELCOM version 2.1, as developed by Arrar *et al* (2018), provides the regression results of equations 6 and 7 but does not explicitly provide the estimation results of equation 8. Instead, it provides the results of elasticity calculations, taking into account the assumption of symmetry and quality correction. The assumption of quality correction in this model illustrates that an increase in input prices will not only change the quantity demanded but also the quality of the inputs demanded by the company. For example, workers with certain qualities are preferred over standard quality workers in terms of experience, education, and skills. There is a difference in the magnitude of the calculation of elasticity between the assumption of symmetry and quality correction. Energy and capital are the most elastic inputs while labor is the most inelastic input. In addition, there is a clear difference between the calculation results from the calculation system approach and the translog model. Some inputs have a cross price elasticity of 0, such as electricity, which means that electricity input cannot be replaced with other inputs.

Some of the consequences caused by heterogeneity in price elasticity include, first, the occurrence of misallocation of company resources due to elasticity, which means that companies have different responses to each input and in conditions where the information owned by the company is not always symmetrical, the consequence is misallocation of resources (Lai and Kumbhakar, 2025). Second, the risk of distortion at the level of company competition. If a company gets a certain raw material subsidy so that it gets a cheaper price, it can have an impact on the level of competition which is getting lower because some companies get better access and at the end of this process, the consumers are the ones who are harmed (Weinberger, 2015). Third, the occurrence of agglomeration can be stronger towards cheaper areas and different input price elasticity between companies causes companies with the same scale of responsiveness to price changes to tend to form production agglomerations (Blaum, *et al*, 2018). The policy implication of this condition is that heterogeneity in input price elasticity can be avoided by opening up wide access to information for industry players because with easy and accurate access to information for industry players, the response to changes in input prices will be relatively the same for each individual player because the reaction of each player, even though at one time it is different, will move convergently to equalize.

5. Conclusion

This study measures the elasticity of demand for medium and large industrial production factors in Indonesia. This study contributes not only to the application of the methods and results of calculating elasticity in industrial policymaking in Indonesia (especially policies that directly affect industrial input prices) but also contributes to the discussion of scientific literature regarding the application of methods in calculating elasticity of demand for production factors. To the best of the author's knowledge, there has been no similar research in Indonesia nor any discussion regarding the application of Deaton’s unit value approach . Based on the estimation results, it can be seen that there is heterogeneity between the elasticity with the production function estimation method and the unit value model method in the system of equations scheme.

Future studies for large and medium industries would be useful, but it would also be interesting to measure the elasticity for micro and small industries, which are far more numerous and absorb more labor, so that policies that affect input prices can have an impact on the industrial sector in general. The development of a dynamic approach in modeling the system of equations for the unit value approach with spatial and industrial variations would be valuable develop in econometric discussions, not only for the system of equations in the application of dynamic product demand in the case of households but also for factors of production.

REFERENCES

Araar, Abdelkrim,. and Verme, P. (2016). *Prices and welfare, Policy Research Working Paper Series 7566, The World Bank*, http://hdl.handle.net/10986/23897

Araar, Abdelkrim, Malasquez, Eduardo , Olivieri, Sergio, and Carlos Rodriguez-Castelan. (2018). Introducing WELCOM: A Tool to Simulate the Welfare Impacts of Competition Version, *Working Paper*, http://dasp.ecn.ulaval.ca/webwel/manual/User_Manual_V2.1.pdf

Allen, R.G.D., (1938). Mathematical Analysis for Economists. Macmillan, London

Alghalith, Moawia. (2005). Input demand with cost uncertainty, *International Economic Journal, Vol 19*, No 1, pp.115-123, https://doi.org/10.1080/1351161042000320425

Asche, Frank, and Salvanes, Kjell G. (1997). Dynamic Factor Demand Systems and the Adjustment Speed towards Equilibrium, *The Canadian Journal of Economics, Vol 2*, Part 2, pp. S576-S581, http://www.jstor.org/stable/136111

Batra, Raveendra N. and Aman Ul1ah. (1974). Competitive Firm and the Theory of Input Demand under Price Uncertainty, *Journal of Political Economy, Vol. 82*, No. 3 (May - Jun., 1974), pp. 537-548, https://doi.org/10.1086/260211

Binswanger, Hans P. (1974). A Cost Function Approach to the Measurement of Elasticities of Factor Demand and Elasticities of Substitution, *American Journal of Agricultural Economics Vol. 56*, No. 2 pp. 377-386, https://doi.org/10.2307/1238771

Blaum, Joaquin, Claire Lelarge, and Michael Peters. 2018. The Gains from Input Trade with Heterogeneous Importers." *American Economic Journal: Macroeconomics 10* (4): 77–127, https://www.aeaweb.org/articles?id=10.1257/mac.20160426

Bougatef, Khemaies; Nakhli, Mohamed Sahbi; Mnari, Othman (2020) : The nexus between Islamic banking and industrial production: empirical evidence from Malaysia, *ISRA International Journal of Islamic Finance, ISSN 2289-4365, Emerald, Bingley, Vol. 12*, Iss. 1, pp. 103-114, https://doi.org/10.1108/IJIF-05-2018-0052

Daigneault, Adam, and Sohngen, Brent. (2008). Estimating Welfare Effects from Supply Shocks with Dynamic Factor Demand Models, National Center for Environmental Economics (NCEE) *Working Paper Series* No 08-03, February 2008. https://www.epa.gov/sites/default/files/2014-12/documents/estimating_welfare_effects.pdf

DailyNews Egypt.(2024). C*hemical exports increase to $6.5bn in 9M 2024*, https://www.dailynewsegypt.com/2024/11/24/chemical-exports-increase-to-6-5bn-in-9m-2024/#:~:text=The%20Chemical%20and%20Fertilizer%20

Export,capabilities%2C%20and%20supportive%20government%20policies.

Deaton, A.(1988). Quality, Quantity, and Spatial Variation of Price, *The American Economic Review, Vol. 78*, No. 3 (Jun., 1988), pp. 418-430, http://www.jstor.org/stable/1809142

Driscoll, J., and A. C. Kraay. (1998). Consistent covariance matrix estimation with spatially dependent data. *Review of Economics and Statistics, Vol 80*, No 4, pp: 549–560, https://www.jstor.org/stable/2646837

Felipe, J, McCombie, J, Mehta, A, and Bajaro, D.F. (2021). Production Function Estimation: Biased Coefficients and Endogenous Regressors, or a Case of Collective Amnesia?, *Levy Economics Institute Working Paper* No 994. https://www.levyinstitute.org/pubs/wp_994.pdf

FICCI.(2025). Ready-Made Garment and Textile Sector: The Change Maker of Bangladeh Economy, *FICCI Monthly Bulletin 9 January 2025*, https://www.ficci.org.bd/ficci-stories/ready-made-garment-textile-sector-the-change-maker-of-bangladesh-economy

Friesen, J, Capalbo, S, and Denny, M. (1992). Dynamic factor demand equations in U.S. and Canadian agriculture, *Agricultural Economics, Vol 6*, No 3, pp. 251-266, doi: 10.1111/j.1574-0862.1992.tb00182.x, **https://doi.org/10.1111/j.1574-0862.1992.tb00182.x**

Gyapong, Anthony O, and Brempong, Kwabena, Gyimah. (1988). Factor Substitution, Price Elasticity of Factor Demand and Returns to Scale in Police Production: Evidence from Michigan, *Southern Economic Journal Vol.54 Vol.4*, pp.863-878, doi:10.2307/1059522

Gyimah-Brempong, K. (1987). Elasticity of Factor Substitution in Police Agencies: Evidence from Florida. *Journal of Business & Economic Statistics, 5*(2), 257–265. https://doi.org/10.2307/1391906

Hamermesh, Daniel S. and Pfann, Gerard A. (1996). Adjustment Costs in Factor Demand, *Journal of Economic Literature, Vol. 34*, No. 3, pp. 1264-1292, https://www.jstor.org/stable/2729502

Haraguchi, Nobuya; Cheng, Charles Fang Chin; Smeets, Eveline.(2017). The Importance of Manufacturing in Economic Development: Has This Changed?. *World Development, 93*(), 293–315. https://doi.org/10.1016/j.worlddev.2016.12.013

Hartman, Richard.(1976). Factor Demand with Output Price Uncertainty, *The American Economic Review, Vol. 66*, No. 4, pp. 675-681, http://www.jstor.org/stable/1806710

Helper, Susan, Krueger, Timothy, and Howard Wial. (2012). Why Does Manufacturing

Matter? Which Manufacturing Matters? A Policy Framework, Brookings Paper, *Metropolitan Policy Program*. https://www.brookings.edu/wp content/uploads/2016/06/0222_manufacturing_helper_krueger_wial.pdf

Higgins, James.(1986) Input Demand and Output Supply on Irish farms— A Micro-economic Approach, *European Review of Agricultural Economics, Volume 13*, Issue 4, Pages 477–493, https://doi.org/10.1093/erae/13.4.477

Hoechle, Daniel (2007). Robust Standard Errors for Panel Regressions with Cross-sectional Dependence, *The Stata Journal, Vol 7*, No 3, pp: 281–312, https://journals.sagepub.com/doi/pdf/10.1177/1536867X0700700301

Hossain, R. (2025). Bangladesh gains bigger share in US apparel market as China loses ground, sees 29% export growth in Jan-Apr, *The Business Standard*, https://www.tbsnews.net/economy/rmg/bangladesh-gains-bigger-share-us-apparel-market-china-loses-ground-sees-29-export-growth

Kamruzzaman, Islam Shamima, and Rena, Jaber Md.(2021). Financial and Factor Demand analysis of broiler production in Bangladesh, *Heliyon, Vol 7* No e07152, https://doi.org/10.1016/j.heliyon.2021.e07152

Karakaplan, Mustafa U. (2017). Fitting Endogenous Stochastic Frontier Models in Stata, *The Stata Journal, Volume: 17*, Issue: 1, pp.39-55, https://doi.org/10.1177%2F1536867X1701700103

Karakaplan, Mustafa U. and Levent Kutlu.(2017). *Endogeneity in Panel Stochastic Frontier models: An Application to the Japanese Cotton Spinning Industry*, http://dx.doi.org/10.1080/00036846.2017.1363861

Kim, Sangho. (2021). Dynamic Factor Demand in the Japanese Manufacturing Industry, *Journal of Asian Business and Economic Studies, Vol 28*, Issue 1, pp: 20-30, http://dx.doi.org/10.1108/JABES-12-2019-0123

Kumbhakar, S. C. (1989). Modelling Technical and Allocative Inefficiency in a Translog Production Function, *Economics Letters, Volume 31*, Issue 2, pp.119–123, https://doi.org/10.1016/0165-1765(89)90183-3

Lai, H., & Kumbhakar, S. C. (2025). Input misallocation and productivity dynamics. *Macroeconomic Dynamics, 29*, https://doi.org/10.1017/S1365100525000033

Le, Phu Viet. (2019). Energy Demand and Factor Substitution in Vietnam: Evidence from Two Recent Enterprise Surveys, *Journal of Economic Structures Vol 8*, No 35, https://doi.org/10.1186/s40008-019-0168-9

Lewbel, A. (1989). Identification and Estimation of Equivalence Scales under Weak Separability. *The Review of Economic Studies, Vol.56*, No 2, pp: 311-316, https://doi.org/10.2307/2297464

Lundgren, Tommy, and Sjöström, Magnus. (1999). A Dynamic Factor Demand Model for the Swedish Pulp Industry: An Euler Equation Approach, *Journal of Forest Economics, Vol 5*, No 1, pp. 45-67, https://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-4001

McQuinn, Kieran, (2005). Dynamic Factor Demands in a Changing Economy - An Irish Application, *The Economic and Social Review, Economic and Social Studies, vol. 36*(2), pages 109-126, http://hdl.handle.net/2262/60048

Menon, Martina, Perali, Federico, and Tommasi, Nicola. (2017). Estimation of Unit Values in Household Expenditure Surveys Without Quantity Information, *The Stata Journal, Vol 17*, No 1, pp.222-239, https://journals.sagepub.com/doi/pdf/10.1177/1536867X1701700112

Mohr, Mike.(1980). The Long-Term Structure of Production, Factor Demand, and Factor Productivity in U.S. Manufacturing Industries. In *Kendrick J.W & Vaccara B.N, (Ed) New Developments in Productivity Measurement*, pp(137-238), University of Chicago Press, http://www.nber.org/books/kend80-1

Nadiri, M. Ishaq, and Prucha, Ingmar.(2001). Dynamic Factor Demand Models and Productivity Analysis, Chapter of the NBER Book, New Developments in Productivity Analysis, *University of Chicago Press*, http://www.nber.org/chapters/c10125

Nasir, S, Ali, M, Irshad, M, Abdullah, Wazir, S, and Islam M. (2025). Critical Evaluation of Textile Industry of Pakistan and Way Forward , *Khyber Journal of Public Policy, Spring 2025, Volume: 4*, Issue:1 (Special), https://nipapeshawar.gov.pk/KJPPM/PDF/CIP/RG-9.pdf?ref=finshots.in#:~:text=The%20textile%20industry%20plays%20a,and%208.5%25%20to%20its%20GDP.

Papagni, Erasmo.(1990). Dynamic Factor Demands and Market Structure Under Rational Expectations: Some Estimates for the Italian Manufacturing System, *Applied Economics, Vol 22*, No 10, pp.1377-1387, https://doi.org/10.1080/00036849000000108

Pindyck, Robert S. and Rotemberg, Julio J. (1983). Dynamic Factor Demands under Rational Expectations, *The Scandinavian Journal of Economics, Vol. 85*, No. 2, pp: 223-238, : http://www.jstor.org/stable/3439480

Porter, M. E. (1979). The Structure Within Industries and Companies' Performance. *The Review of Economics and Statistics, Vol 61*, No 2, pp: 214–227, https://doi.org/10.2307/1924589

Rasmussen, Svend.(2011). P*roduction Economics, Springer-Verlag Berlin Heidelberg*, https://link.springer.com/book/10.1007/978-3-642-14610-7

Rusydiana, A. S., & Ningsih, R. R. (2024). Productivity growth in OIC countries: SDGs perspective. *Islamic Economics Methodology, 3*(2). https://doi.org/10.58968/iem.v3i2.561

Parteka, A., Wolszczak-Derlacz, J. Dynamics of productivity in higher education: cross-european evidence based on bootstrapped Malmquist indices. *J Prod Anal 40*, 67–82 (2013). https://doi.org/10.1007/s11123-012-0320-0

Sampi, J, Jooste, C, and Vostroknutova, E. (2021). Identification Properties for Estimating the Impact of Regulation on Markups and Productivity, *World Bank Policy Research Working Paper*, No 9523, http://hdl.handle.net/10986/35070

Sharki, M. (2024). Morocco's thriving auto industry braces for challenges ahead, Al Majalla, June 3, 2024, https://en.majalla.com/node/318396/business-economy/morocco%E2%80%99s-thriving-auto-industry-braces-challenges-ahead

Smolny, W. (1997). Dynamic Factor Demand in a Rationing Model. *Applied Economics, Vol 29*, Issue 8, pp: 1091–1101, https://doi.org/10.1080/000368497326480

State Information Service. (2025). Garment Export Council: 18% increase in exports, recording $2.84 billion in 2024. *State Information Service*. https://www.sis.gov.eg/Story/204500/Garment-Export-Council-18%25-increase-in-exports%2C-recording-%242.84-billion-in-2024?lang=en-us#:~:text=Egypt's%20Ready%2DMade%20Garments%20Expo-rt,Export%20Council%2C%20headed%20by%20Eng.

Su, Dan. and Y. Yao. (2016). Manufacturing as the Key Engine of Economic Growth for Middle-Income Economies. *ADBI Working Paper 573*. Tokyo: Asian Development Bank Institute. Available: http://www.adb.org/publications/manufacturing-key-engine-economic-growth-middle-income-economies/

Thijssen, Geert, (1994). Supply Response and Dynamic Factor Demand of Dutch Dairy Farms, European Review of Agricultural Economics, Foundation for the *European Review of Agricultural Economics, vol. 21*, No2, pages 241-258, https://doi.org/10.1093/erae/21.2.241

Vorotnikov, V. (2024). Leaps and bounds across the strait: How Morocco has become the new hub driving exports to Europe, *Automotive Logistics, 31* October 2024, https://www.automotivelogistics.media/finished-vehicle-logistics/morocco-becomes-largest-vehicle-exporter-to-eu/46307.article

Weinberger, A. (2015). Markups and misallocation with trade and heterogeneous firms *(Globalization and Monetary Policy Institute Working Paper No. 251)*. Federal Reserve Bank of Dallas. https://www.dallasfed.org/-/media/documents/research/international/wpapers/2015/0251.pdf

Yassar, Mahmut, Raciborski, Rafal, and Poi, Brian.(2008). Production function estimation in Stata using the Olley and Pakes method, T*he Stata Journal, Vol 8*, No 2, pp.221-231, https://journals.sagepub.com/doi/pdf/10.1177/1536867X0800800204

Yotopoulos, Pan A. , Lau, Lawrence J. ,and Wuu-Long Lin. (1976). Microeconomic Output Supply and Factor Demand Functions in the Agriculture of the Province of Taiwan, *American Journal of Agricultural Economics, Vol. 58*, No. 2 (May, 1976), pp. 333-340, https://doi.org/10.2307/1238990