DOES PUBLIC CAPITAL EXPENDITURES AND INFRASTRUCTURE INFLUENCES THE GROSS DOMESTIC REGIONAL PRODUCT OF INDONESIAN MANUFACTURING INDUSTRIES ?

(A STUDY ON INDONESIAN PROVINCES)

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Does Public Capital Expenditure and Infrastructure Influences the Gross Domestic Regional Product of Indonesian Manufacturing Industries ? (Study on Indonesian Provinces)

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ABSTRACT

This research empirically examines the relationship between public capital expenditures and road and electricity infrastructure on the output of manufacturing industry during 2013-2017 using Cobb-Douglas production function as its theoretical framework. The dependent variable used in this study adopts the panel data of 34 Indonesian provinces on real Gross Domestic Regional Product based on production. The independent variables used in this study are public capital expenditure, length of road, and electricity sales to represent infrastructure. The number of employed labor force in 34 Indonesian provinces is used as the control variable. This study finds that public capital expenditure, length of road, electricity sales, and employment have a positive and significant effect on the real Gross Domestic Regional Product of manufacturing industry.

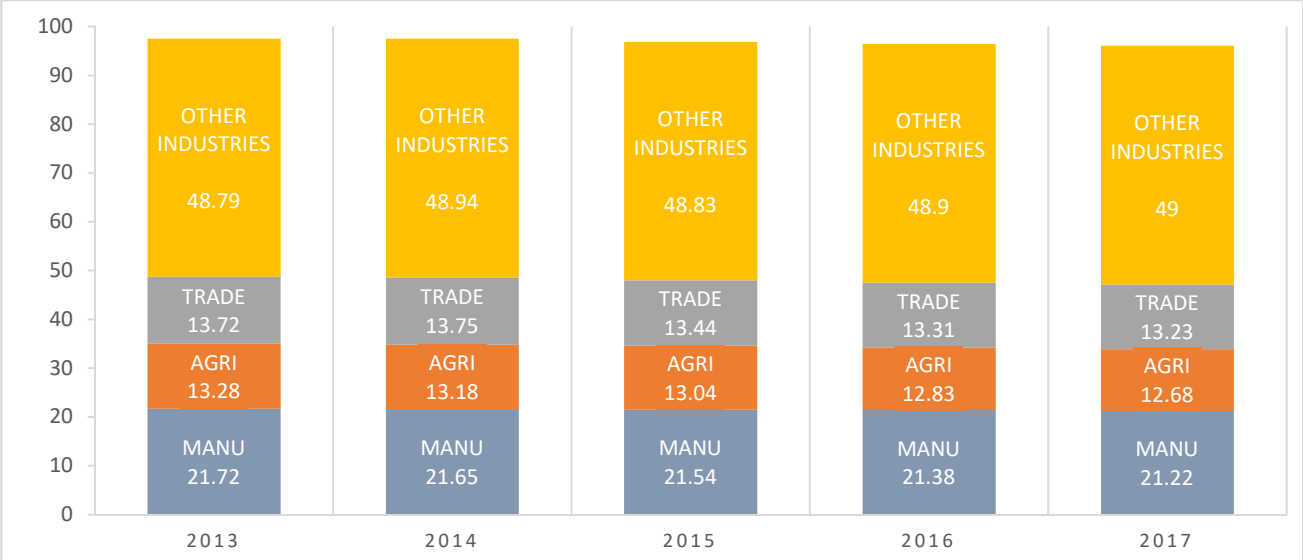
KEYWORDS: *public capital expenditure, manufacturing industry, infrastructure development, Cobb-Douglas production function, regional budget allocation*

1. INTRODUCTION

Manufacturing Industry in Indonesia still dominate and contributes the most to the national GDP in 2017 with 20.16% contribution to the national GDP and a growth of 4.27%. In a presentation at the Indonesia Industrial Summit 2018 Darmin Nasution, the Coordinating Ministry for Economic Affairs said that the government had to push for an improvement in the industrial sector because from 2013 to 2017 the industrial sector growth stagnates around 4% every year. To support this notion, state government are obliged to provide services and infrastructural facilities which will stimulate investment and output a productive capacity of the manufacturing industry to the economy (Adebayo, Adebusuyi, & Ishola, 2014). These infrastructural facilities then may produces multiplier effect on the economy as a whole, especially the contribution from manufacturing sector where it had a big role in supporting the economic growth and also state's development (Loto, 2012).

Manufacturing industry is an important foundation and big contributor to the country's economy as a whole. It acts as an engine of growth for some low and middle income countries especially to middle income developing countries with big human capital like Indonesia (Szirmai & Verspagen, 2015). This argument then later supported because in 2019 Indonesia was classified by the World Bank (2019) as lower-middle-income country. With a low-medium national per-capita income. From that survey, it could be seen clearly that Indonesia generates most of its income from manufacture and agriculture (See: Figure 1.1). This condition fits perfectly with Fourastié's (1949) Progression of Distribution on the Three-Sector Hypothesis, where Indonesia is still at a stage where its economy still focuses on secondary sector. This particular secondary sector, according to Fourastié (1949) is where manufacturing and agriculture sectors are still dominant.

Figure 1.1 – Share of GDP on Indonesian Industries From 2013 - 2017



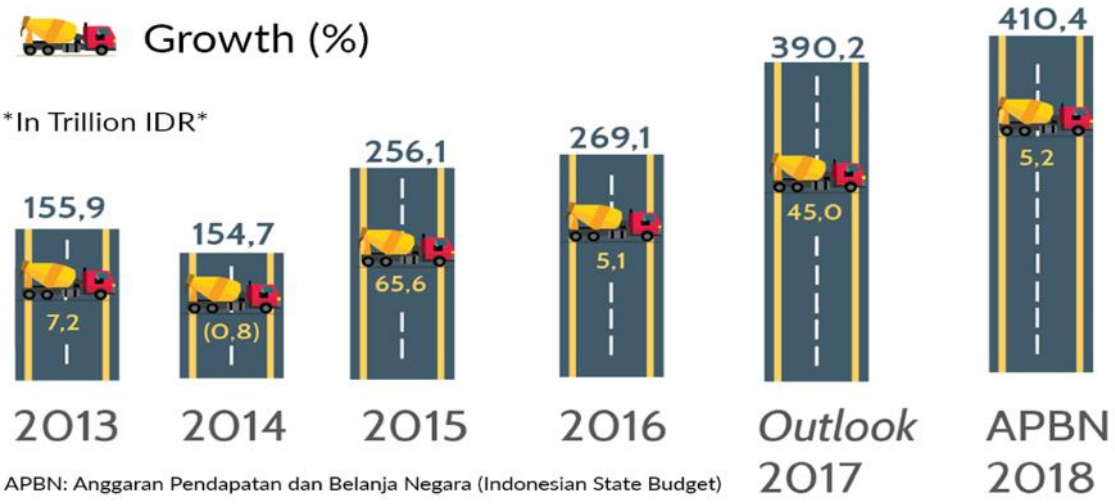
Source: Raw Data Acquired From Badan Pusat Statistik (2018) – Processed by Author

The phenomenon of economic activity shift was rooted from the classic works by Fisher (1939), Clark (1940), and Fourastié (1949), the so-called three-sector hypothesis in an economic model. This model divides the economy into three activities or sectors; they are extraction of raw materials (primary), manufacturing (secondary), and services (tertiary). In his book The Conditions of Economic Progress, Clark (1940) argued that consumer demand will shift to services because the demand for manufactured goods will be saturated, and labor will subsequently move to the service sector. Similar to Clark (1940) and Fisher (1939), Fourastié (1949) argued that, in the process of economic development, employment will first shift from agriculture to manufacture and then to services.

From the three sector hypothesis, it is concluded that there are significant relationships between primary, secondary, and tertiary sectors. Subramaniam & Reed (2009), concluded in their research that there are linkages between those three sectors. That linkage is called industrial linkage, and it plays an important role in economic development. In an early literature by (Hirschman, 1958), it is proved that the linkage is essential for economic development. And this Industrial linkage can be broadly defined as the contacts and flow of information and/or material between two or more industrial sectors or firms (He & Zhu, 2017). Commonly, Industrial linkage is used in industrial and economic geography to portray interfirm interdependence. In an early literature by Hirschman (1958), it is proved that forward and backward industrial linkages are essential to economic development and able to propel economic growth.

This means that all industries in a country are interconnected and affecting each other. It is believed that an increase in a certain industry will induce another increase in other industries. Linkages across industrial sectors are proven by economists to be existent, but all of those industries are not just linked together without any access to each other. To have linkages among industries, sufficient physical public infrastructures are required to connect them all. In general, physical public infrastructure is believed to be one of the foundations for a country's economic development. Ample networks of roads, power generating facilities, and communications are essential for the improvement of private sector's productivity, decreasing the costs for businesses in private sector's production factors (Rioja, 2004). Infrastructural projects started by the government are crucial for igniting economic development in a region. Without infrastructure, private sector cannot be expected to invest and open their business in those underdeveloped regions (Singh, Batra, & Singh, 2007).

Figure 1.2 – Infrastructure Budget Growth From 2013-2018



Source: Informasi APBN 2018 (Kementrian Keuangan Republik Indonesia, 2018)

The reason of why this research was conducted rooted from Figure 1.2 above. The exponential growth as shown in Figure 1.2 was caused by President Joko Widodo's revision on 2015 state budget to support his infrastructure program, as one of his presidential campaign promises. The increase in infrastructure budget is considered important because the poor infrastructure has impeded Indonesia's economic growth (Widoyoko, 2016). Goal of the revision was to increase the budget for infrastructural development and optimize government expenditures and also easing the overall government budget from the burden of massive fuel subsidy (Humas Setkab, 2015; Lelyemin, 2014). This method of state budget easing had also been researched by Dartanto (2013) for its viability, in his research he suggested that the government should alter the fuel subsidies for investments in infrastructure or human capital in order to promote economic growth. This fund alteration were then used on 2015 to fund infrastructural projects via government expenditures, we could see this happening from looking at the budget for infrastructure increased to 65.6% from 2014 to 2015.

2. THEORETICAL FRAMEWORK

2.1 Economic Growth and Gross Domestic Regional Product

To measure economic growth, Gross Domestic Regional Product (GDRP) based on constant price (Real GDRP) is often used. The use of constant price GDRP eliminates the effect of price changes because it uses the fixed price of a base year to calculate the yearly gross domestic regional product (Setiawati, 2017). There are three conceptual approaches in measuring GDRP: the first approach is measuring expenditure, the second is measuring production, and the third is measuring income (Bank Indonesia, 2018). According to Indonesian Statistics Agency (2019) or BPS, the Gross Domestic Regional Product (GDRP) measured from the production stand point is the total of gross value added which occurs in all economic sectors in a region. The aforementioned added value is acquired from the process of combining production factors and raw materials in the production processes, calculated by deducting cost from production output. Based on the data from BPS, there are 17 categories from which Indonesian industrial constant price GDRP or industrial real GDRP is based on but from all 17 categories, only manufacturing industry is used in this research.

2.2 Public Capital Expenditures

According to BPS (2017) in their book entitled *Financial Statistics of Provincial Government*, capital expenditures are expenses used for purchasing or procuring durable goods with tangible fixed asset or capital where the value worth more than a year. Saragih (2003) argued that if the capital expenditures of a regional government are larger than its regular expenditures, the regional economy of that particular region will increase. Hakim (2014) specifically argued that an increase in capital expenditures of land, capital expenditures of equipment and machinery, and other capital expenditures have a positive effect on economic growth.

2.3 Physical Public Infrastructure

A general consensus has been achieved around the idea that basic infrastructure facilities are important features related to economic performance (Torrisi, 2009). Infrastructure is the foundation on which production factors interact to produce output (Jimenez, 1994). Jimenez (1994) divided infrastructure into two, human and physical infrastructure. Solid and tangible infrastructure is classified into physical infrastructure, and human infrastructure is classified into health, education, and nutrition. This research will only use physical public infrastructure to see whether or not this particular kind of infrastructural development really affect the output of manufacturing industry.

2.4 Employment

Employment represents citizens included in the labor force and are currently contributing to the economy by working and producing economic output. The definition of labor force as defined by BPS (2019) is citizens aged 15 and above who are working or not working, or currently have a job but not working. This research uses the data on employed or working citizens with the age of 15 and above who are working during the past one week, measured from the number of working citizens included in the labor force.

2.5 Cobb-Douglas Production Function

Production function in economics is related to physical output created by a process of converting physical inputs or production factors. It is a mathematical function that relates the maximum amount of output that can be obtained from a given number of inputs, generally capital and labor (Shekhat, 2015). Production function which only uses capital and labor as parts of the production function equation is commonly known as neo-classical growth model (Prasetyo & Firdaus, 2009). Because the model is unrealistic in nature, this research will use a growth model based on the Cobb-Douglas production function, which includes technology in its equation.

The equation developed by Cobb & Douglas (1976), is often used in literatures regarding production and economic growth. The function is a mathematical model to represent total output as a log linear function (Costa, Lopes, & de Pinho Matos, 2015). The equation as described by Costa et al. (2015) and (Prasetyo & Firdaus, 2009) is as follows.

$$P = A^{g\,t}\, K_t^{\alpha} L_t^{\beta}$$

A is technology, g is technological growth per t period, P is total output of manufacture, K is fixed capital, and L is the total number of workers. This model assumes that the market is perfectly competitive with an elastic price factor and full employment rate. This model is a simplification of the real economy, while the variable of private investment which can affect technological growth is not modelled because it is beyond the scope of this research. In this research technology, i.e. electricity, is also imbued within the capital variable K.

2.6 Industrial Linkage

The concept of industrial linkage is widely used in industrial and economic geography to portray interdependence between sectors of firms (He & Zhu, 2017). Hirschman (1958) argued that industrial linkage is still a powerful sustainer of industrial agglomerations, and thus have fundamental impacts on firms' location. The interactions between linkage partners represent one of the routes through which the economic multiplier operates to further enhance some initial changes in the economy through its interdependencies with others. Industrial linkage itself is broadly defined as contacts and flows of information and/or materials between two or more industrial sectors or firms (He & Zhu, 2017).

There are multiple dimensions of linkages, but only side-stream linkage is the one used in this research because it involves economic links created to support infrastructure (power, logistics, communications, and water), agriculture, and skills and technology development (Extractives Hub, 2019; He & Zhu, 2017). The linkages between infrastructure and economic growth are multiple and complex because not only does it affect production and consumption directly, but it also creates many direct and indirect externalities, and it involves large flows of expenditures thereby creating additional employment (Srinivasu & Srinivasa Rao, 2013).

2.7 Previous Research

Relationship between government expenditures specifically in public capital expenditures and economic growth has already been studied by a series of theoretical and empirical studies of Barro (1990), Barro & Sala-i-Martin (1992), and Devarajan, Swaroop, & Zou (1996). In his research on government spending, Barro (1990) found that government revenues from taxes are spent for public services in a way that all producer will be equally benefitted. In his research framework, Barro (1988) concluded that the economic growth rate and saving rate initially rise with the ratio of productive government expenditures to GNP, but each rate eventually reaches a peak and subsequently declines. These foundational research by Barro (1988), (1990), (1991) and Barro & Sala-i-Martin (1992) was a development from Solow's (1956) growth model, where public investment is not related to long-run economic growth in neo-classical perspective.

A similar study on public capital expenditures and industrial growth was also done by Adebayo et al. (2014). They found that a significant relationship between industrial growth and components of government expenditures exists. Ademola (2012) also found that there is a significant relationship that exists between government expenditures in manufacturing sector and economic growth. Emmanuel & Oladiran (2015) also found that in Nigeria capital expenditures have a positive relationship with manufacturing sector's output. The same conclusion was drawn by Mesagan & Ezeji (2016), who found that growth of government capital expenditures and growth of government expenditures on education positively and significantly enhances the added value of manufacture. This is a sign that government expenditures do affect the many aspect of industries, especially manufacturing industry.

A study that becomes the ground work of this research is the research of Ramadhian (2018). He studied the effect of road infrastructure, water, electricity, and the number of workers on the GDRP of regencies/cities in East Java. Ramadhian (2018) found that road infrastructure, water, electricity and the number of workers have a positive and significant relationship with the GDRP of regencies/cities in East Java. Similar with Ramadhian (2018), Prasetyo & Firdaus (2009) also echoed the same regarding the effect of infrastructure on economic growth. They found that economic growth is influenced by infrastructure, such as the provision of electricity, paved roads, and clean water. In addition, Prasetyo & Firdaus (2009) also found that production activities in Indonesia are still categorized as labor intensive.

Regarding the Indonesian public capital expenditures, the ground work for this research of including public capital expenditures as a variable to represents capital is the research of Hakim (2014). Through his research, Hakim (2014) aims to test the effect of each category of public capital expenditures on economic growth in cities and regencies in Java and Bali. He found that the increase on public capital expenditures on land, equipment and machinery, and other public capital expenditures has a positive effect on economic growth. Hakim (2014) used cross-section weighted fixed effect model. (Rauf, 2017), using fixed effect model as the best model of his research, also found that public capital expenditures as a whole partially give a positive and significant effect on economic growth. Besides Ramadhian (2018), Hartono (2012) also conducted his research by including employment alongside with public capital expenditure. Hartono (2012) found that both public capital expenditures and employment have a positive and significant relationship.

3. RESEARCH METHODOLOGY

This research is classified as a basic research aiming to understand an interesting phenomenon for the researcher (Sekaran & Bougie, 2016, p. 7). As a basic research, this research uses quantitative approach to know better about the effect of Public Capital Expenditures and Infrastructure on the Regional GDP of Indonesian Manufacturing Industry. The goal of quantitative research is to determine the relationship between independent variables and dependent variables within a population (Babbie, 2010). This quantitative research uses panel data, which combines cross-sectional data of 34 Indonesian provinces with the five-year time series data spanning from 2013 to 2017.

3.1 Population and Sample

This research consists of multiple sets of data population. The first population is Gross Domestic Regional Product, the second population is capital expenditure, the third is length of road, the fourth is electricity sales, and the last is the number of employments. But, the population is often very large, maybe largely infinite in size. Thus, to keep this research focused and able to accurately analyze the variables, samples are needed to be taken from the population. According to Keller (2016) and Sekaran & Bougie (2016), sample is a sub-group of data drawn from the studied population. The sampling method of this research is classified as judgement sampling, meaning that the sample was chosen on the basis of the individual's ability to provide the type of special information needed by the researcher (Sekaran & Bougie, 2016, p. 393). The sample selection criteria for every variable selected for the research are as follows:

1. Among the many sub categories of Gross Domestic Regional Product (GDRP), manufacturing industry was selected. Real GDRP was chosen instead of the nominal GDRP to ensure that the research can properly analyze the effect of each independent variable on this particular variable.
2. The year of 2010 was selected as the base year for the GDRP to maintain a constant base price in order to minimize the effect of price volatility throughout the 5 years (2013-2017) of GDRP data.
3. GDRP based on industry was selected as the dependent variable of this research because this type of GDRP uses industrial output or value added as the economic capacity parameter of a particular industry in a province. This suits well with the grand theory of Cobb-Douglas production function used in this research.
4. The capital expenditures must have already been realized. Therefore, instead of capital expenditures "budget", realized provincial capital expenditure was chosen as the sample of this research because it produces the output desired by the capital expenditures "budget".
5. This research only considers roads built under the responsibility of the provincial government as the sample of this research because the capital expenditures used to build and maintain those roads came from the province's capital expenditure.
6. This research only uses regional electricity sales recorded by the State's Electricity Company (PLN) as the sample of this research.

7. From several types of consumer as classified by PLN, this study only uses sales of electricity to industrial consumer as the sample of this research because the research focuses only on manufacturing industry.
8. Number of Employment is measured from the number of working citizens. In this matter the working citizens are those included in the labor force. Labor force is defined by BPS (2019) as citizens with the age of 15 and above who are working or not working, or currently have a job but not working.
9. This study only uses citizens who are included in the labor force and are employed and working during the past week at the time of the survey as the research sample.
10. The sample was taken from a survey which was done every February in each year.

3.2 Data Types and Collection Technique

This research uses panel data analysis, varied from previous empirical research by Ademola (2012) and Emmanuel & Oladiran (2015), which uses time series analysis. In this study, the researcher attempts to analyze the effect of manufacturing industry's GDRP of each Indonesian province as the dependent variable on each independent variable studied in this research. Hence, panel data analysis method is considered the best for analyzing variables used in this research.

The data was sourced from multiple annual statistical reports provided by related government agencies such as BPS and Ministry of Energy and Mineral Resources. The first data is the GDRP of each province from the websites of all 34 provincial offices of BPS. The data of capital expenditures was also taken from the provincial government financial statistics of 2013-2016 published by the head office of BPS. A similar report covering the year of 2014-2017 was also used. The data for road length was taken from the annual transportation statistics published by head office of BPS, using the year of 2013-2017. The data of electricity sales to industrial consumers was taken from multiple electricity statistics reports published by the head office of BPS and the Ministry of Energy and Mineral Resources of Indonesia from 2013 to 2017. The last data is working citizens or employed labor force, specifically the Labor Force Statistics, from 2013 to 2017, taken from BPS's website.

3.3 Research Variables

The dependent variable used in this research is the GDRP of Manufacturing Industry in 34 provinces in Indonesia. And for the independent variable, this research uses: Public Capital Expenditure, Length of Road, and Sales of Electricity. The data of each province's GDRP was originally denoted in million, billion, and trillion Indonesian Rupiah. In order to normalize and uniform the data, the researcher decided to standardize the notation into billion Indonesian Rupiah. Provincial public capital expenditures was uniformly denoted to billion Indonesian Rupiah. The length of road was denoted in kilometers, and the total of any kind of road conditions is used. Electricity sales was denoted in Gigawatt-hours (GWh) of electricity sold to industrial customers. The number of labor force with the age of 15 years and above employed during the past week at the time of the survey is used as the control variable.

3.4 Model Specification

This paper adapts the quantitative research model used by (Ramadhian, 2018), where he used the variables of length of road, electricity consumption, water consumption, and labor. This research bases its inclusion of public capital expenditures as a variable on the preliminary research made by Devarajan, Swaroop, & Zou (1996) and Emmanuel & Oladiran (2015), who used manufacturing output as the dependent variable and public capital expenditures as one of the independent variables. Based on the previously mentioned reasoning, the model of this study is expressed mathematically as:

$$LI \quad _{it} = \beta_0 + \beta_1 X_1 L \quad _{it} + \beta_2 X_2 \; L \quad _{it} + \beta_3 X_2 \; L \quad _{it} + \beta_3 X_3 L \quad _{it} + \varepsilon_{it}$$

Where:

LNGDRPMI	= Real GDRP of Manufacturing Industry
LNPCEXP	= Public Capital Expenditure
LNROAD	= Length of Road
LNELECTRIC	= Sales of Electricity
LNEMPLOY	= Number of People Employed
β	= Regression Coefficient
i	= Provinces
t	= Time Period
ε	= Error Term

All of the variables used in this research are transformed using a type of logarithmic transformation called Natural Logarithm, frequently denoted as "ln". This transformation method uses natural log function which are predominantly used in economics and business literatures, even in mathematics, physics, and other sciences (Duke University, 2019). The data transformation was decided because the data used in this research is characterized as an interval scale, not to mention its function for normalizing data and avoiding autocorrelation (Gujarati, 2004; Keene, 1995). Gujarati (2004), in his book entitled *Basic Econometrics,* mentioned that there are at least three analysis techniques that can used in quantitative studies that use panel data, including this research. Those techniques will be explained further in the next sub-chapter.

4. RESEARCH FINDINGS AND DISCUSSION

Provinces of Indonesia are the main focus of this research. During the research period, Indonesia is divided into 34 provinces. Each province is an administrative region headed by a Governor and Vice Governor who are elected every 5 years. They have their own autonomy to govern the province and manage their own Regional Expenditures and Budget Plan / Anggaran Pengeluaran dan Belanja Daerah (APBD) together with the regional People's Representative / Dewan Perwakilan Rakyat Daerah (DPRD). These provincial government administer cities, led by mayors, and regencies, led by regents (Undang-Undang Republik Indonesia, 2014).

After the fall of President Soeharto and his centralized development program, Indonesia overhauled its administrative system, changing it into a decentralized administration, giving Indonesian regions autonomy to manage themselves. This overhaul was then legalized through Law Number 22 of 1999 on Regional government, updated by Law Number 23 of 2014 on regional government. A decentralized regional autonomy means that each region in Indonesian has its own authority in any aspects of governance, such as administration, law, infrastructure development, budget and spending, including exploration, exploitation, and conservation of sea resources other than oil and gas. All of which must be under the consent of the central government (Undang-Undang Republik Indonesia, 2014).

4.1 Data Description

Provinces that are chosen as the object of this research are those that has been established during 2013 to 2017 because North Kalimantan province was only established into a province in 2012, which then administratively separated from East Kalimantan. For the GDRD used in this research, it was based on real GDRP, known as GDRP based on constant price, with 2010 as the base year. Industrial GDRP was chosen as the main object of this research, and the industry being used is manufacturing industry.

The public capital expenditures used in this research are the realized capital expenditure. This decision was made due to the fact that only do realized capital expenditures produce output as desired by the budgeted capital expenditure. Roads built and maintained under the responsibility of provincial governments were chosen as a sample of this research. This was due to the fact that capital expenditures used to build and maintain those roads came from the province's capital expenditures budgeted in the APBD. Electricity sales used in this research are regional electricity sales as recorded by the State Electricity Company (PLN). From various types of consumer as classified by the PLN, only Industrial type was chosen as the variable of this research due to the fact that the research focuses only on manufacturing industry. The number of employed people, also known as working citizens, is used as a control variable in this research. This is relevant with the Cobb-Douglas production function equation, which includes labor as one of the variables in production. The number of working citizens used in this research are included in the labor force, defined by the BPS (2019) as citizens aged 15 and above who are working or not working, or currently have a job but not working.

4.2 Model Selection and Classical Assumption Test

The approaches of analyzing the panel data can be categorized into either Common Effect Model (CEM), Fixed Effect Model (FEM), or Random Effect Model (REM). The model used in this research was tested further to determine the best approach for the data interpretation. Chow test is used to determine the better model between common effect and fixed effect. Hausman test follows to decide the better model between fixed effect and random effect. After further analysis on model selection between CEM, FEM, or REM it was decided that the best model chosen was fixed effect model. Because the result from Hausman test had a Cross-section Chi-square probability is valued at 0.0000, which is less than the α (alpha) significance at 5%, or 0.05 in decimal and even at 1%, or 0.01 in decimal. Thus the fixed effect model was chosen.

From the model selection process classical assumption test are needed. It is known as Classical Linear Regression Model or Gauss-Markov Classical Assumption. Te classical assumption then were continued to be worked and perfected by Baltagi (2013) and Gujarati (2004). The first classical assumption test is to test for residual normality. And from the test, Jarque-Bera probability value, which is 0.996137. This means that the data residuals is normally distributed at 5% α significance, or 0.05 in decimal, the value is more than the 5% α, mathematically expressed as p value > 0.05 (Gujarati, 2004). Therefore, it can confidently be concluded that in 95% confidence the error terms within the OLS regression residuals are normally distributed. For the multicollinearity test, it is confirmed that all of the variables are free from multicollinearity because all of the VIF value are lesser than 5. For the Heteroscedasticity test with a null hypothesis of homoscedasticity, the likelihood ratio for the heteroscedasticity test is 0.0000, which means that it is significant at 5% α significance, or 0.05 in decimal and the model's null hypothesis is accepted, thus making the model homoscedastic.

For the Autocorrelation testing, it was found that the common effect model encounter an autocorrelation condition because of the low Durbin-Watson value, lower than the permitted level on which made the model autocorrelated. This autocorrelation problem in fixed effect model also happens in the research of Hakim (2014), in which he studied about the correlation of various types of public capital expenditures and GDRP. He then solved the problem by adding cross-section weights to the fixed effect model. To solve this issue, the researcher replicated Hakim (2014) solution by adding cross-section weights to the fixed effect model. This weights then increased the Durbin-Watson value and produced a better model overall. Even though according to the argument of Baltagi (2013) in Torres-Reyna (2007) a test for autocorrelation within a model is not needed in a micro panel research. In a case of this research, the time-series data span is 5 years covering the cross-section data of 34 provinces, perfectly matching the criteria for a micro panel data, thus eliminating the need for any autocorrelation test altogether. Therefore, a positive autocorrelation occurring within a macro panel data actually can be ignored.

Table 4.1
Weighted Cross-Section
Fixed Effect Regression Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	-3.628084	1.153288	-3.145862	0.0021
LNPCEXP *	0.063701	0.010910	5.838739	0.0000
LNROAD *	0.089532	0.019545	4.580887	0.0000
LNELECTRIC **	0.035496	0.015015	2.364005	0.0196
LNEMPLOY *	0.829709	0.084292	9.843307	0.0000

R-squared	0.999660	Dependent Variable = GDRPMI
Adjusted R-squared	0.999563	* Significance at α 0.01
F-statistic	10265.61	** Significance at α 0.05
Prob(F-statistic)	0.000000	

Source: Processed by Author using Eviews 10

From the table 4.1 it could be seen that the F-statistic probability result is 0.00 or lesser than the significance level of 0.05 thus it could be concluded that the weighted cross-section fixed effect regression method had a simultaneous significant relationship between the independent variable to the GDRPMI dependent variable. For the partial significance in each independent variable of this research T-test was done and produced test result on every independent variable as follows:

H_1 **: Regional Public Capital Expenditures *(X_1)* has a positive and significant effect on the Gross Domestic Regional Product of Manufacturing Industry.**

The first hypothesis as represented by the LNPCEXP is considered as positive and significant at α 1%. This can be seen from the probability value of LNPCEXP of **0.0021** and a positive coefficient value at **0.063701**. Thus the H_1 is accepted because an increase in public capital expenditure would give a positive and significant effect to the manufacturing industry GDRP.

H_2 **: Length of Road under the Responsibility of the Provincial Government *($X_{2\,1}$)* has a positive and significant effect on the Gross Domestic Regional Product of Manufacturing Industry.**

The second hypothesis as represented by the LNROAD is considered as positive and significant at α 1%. This can be seen from the probability value of LNROAD of **0.0000** and a positive coefficient value at **0.089532**. Thus the H_2 is accepted because an increase in provincial road length would give a positive and significant effect to the manufacturing industry GDRP.

H_3 **: Industrial electricity sales *($X_{2\,2}$)* has a positive and significant effect on the Gross Domestic Regional Product of Manufacturing Industry.**

The third hypothesis as represented by the LNELECTRIC is considered as positive and significant at α 5%. This can be seen from the probability value of LNROAD of **0.0196** and a positive coefficient value at **0.035496**. Thus the H_2 is accepted because an increase in electricity sales would give a positive and significant effect to the manufacturing industry GDRP.

H_4 **: Number of employments *(X_3)* has a positive and significant effect on the Gross Domestic Regional Product of Manufacturing Industry.**

The fourth hypothesis as represented by the LNEMPLOY is considered as positive and significant at α 1%. This can be seen from the probability value of LNROAD of **0.0000** and a positive coefficient value at **0.829709**. Thus the H_2 is accepted because an increase in employment would give a positive and significant effect to the manufacturing industry GDRP.

4.3 Discussions

Referring to the previous T – test result in relation with the hypothesis of this research, all of the hypotheses are declared appropriate in explaining the phenomenon. Based on the result of this research, it is clear that government policy of increasing expenditures for infrastructure development is done well. The expansionary policy of the Indonesian government from allocating more budget to infrastructure via public capital expenditure has proven to be true as well. It could be seen that the provincial government had done a fair job in allocating public capital expenditures to the right sector at the right time. Capital expenditures made allocated by the provincial government directly affect the manufacturing industry's output, which causes a considerable increase in manufacturing industry's GDRP.

Currently, There are 7 provinces that had a heavy reliance in manufacturing industry, meaning that this industry contributes more than 25% to their regional GDRP. Those provinces are: Riau, Riau Islands, Banten, West Java, Central Java, East Java, and West Papua. The other provinces also had a quite big GDRP share from the manufacturing industry. This industry contributes from 10% to 25% in GDRP of these 15 provinces, including central Sulawesi that had a significant growth in share of manufacturing industry from 2013 to 2017. The other 12 provinces, on which those have lesser than 10% manufacturing industry share still have a quite significant contribution, albeit small. The small amount of contribution from the 12 provinces did not impede the model's ability to explain the phenomenon. Thus an increase of 0.06 points in manufacturing GDRP for every 1% increase in public capital expenditure would affect the manufacturing industry as second biggest contributor to all of the GDRP of Indonesian provinces.

Coefficient value of LNROAD showed that for every 1% increase of road length correlates to an increase of 0.09 points in manufacturing industry's GDRP, *ceteris paribus*. As described by the low coefficient displayed from the LNROAD variable, it could be concluded that manufacturing industries and still cannot connect well enough trough infrastructure provided by the provincial government. This statement is rooted from the fact that LNROAD with LNGDRPMI have a low coefficient value. It's also proved empirically from this research that roads made with public capital expenditure did not to produce quite a significant amount of output from 1% increase of road length.

This is a clear mark that Indonesian provincial governments haven't done a well enough job in allocating the regional public capital expenditures and putting them into a good use. To overcome this problem, future fund allocation on road construction and development made from the public capital expenditures fund should aim towards connecting more industrial areas, especially manufacturing industries. It's because, from the empirical study done in this research, an increase in road length from 2013 to 2017 did not show that much of an effect towards manufacturing industry GDRP.

From the previously mentioned topic regarding electricity sales, it was concluded that an increase in electricity sales made by the state electricity company to industrial customers will increase manufacturing industry's GDRP. This result is an empirical evidence of the Indonesian government success in the mission of building powerplants and electrical network. The effort has paid off properly and it is reflected by the fact that electricity sales made by the state electricity company does contribute to the increase of manufacturing industry's GDRP. Even though the contribution is not that huge and its effectiveness still needs some improvements starting from improving the electricity grid and network in Industrial area.

But if we look again, electricity sales had the lowest level of coefficient value out of all other independent variable. This is not without cause, the Indonesian manufacturing industry still puts a heavy reliance on labor intensive work. Operation of electricity consuming robots and machines with narrow intelligence is not that commonly employed in Indonesia as well. The current cost of labor far outmatched

the capital intensive cost of acquisition, operating and maintaining such machinery. Empirical evidence made by this study showed that electricity is the least effective in increasing manufacturing industry GDRP even though it had a significant and positive relationship. Out of all independent variable, the topmost effective variable is LNEMPLOY, so an increase in electricity sales and also supply capacity from building new powerplant won't affect the manufacturing industry GDRP greater than the increase of labor employment.

Contrary from the electricity sales variable, employment had the highest coefficient value out of all other independent variables. If this result is compared with the previous discussion on electricity sales, the low degree of relationship between it and manufacturing industry's GDRP is a clear sign that Indonesia has not fully embraced industrial automation because the automation needs high power generation capability and capable electricity network. A plausible cause of the weak level of relationship between electricity sales to industries and manufacturing GDRP is that the infrastructure supporting for such level of automation is still not available yet. Combined with the fact that labor cost in Indonesia is really cheap. It is not that economically viable to convert into automation because the labor cost in Indonesia is still far lower than the cost of technology acquisition and development for the machinery to support full industrial automation.

Even though conversion to a more effective and automated manufacturing industry would output more goods and higher electricity consumption, it still requires huge capital investment by the industry. The manufacturing industry practitioners will surely choose the cheaper option if needed be, this is why human labor is still king in Indonesia. Plus, the goal of the current Indonesian government is to absorb more of its working age citizens into employment by empowering Indonesian manufacturing industries. Cheap labor is the current Indonesian competitive advantage and by enabling this naturally labor intensive industry, Indonesian government aims to expand the nation's manufacturing prowess, thus making it produce more output and are able to more recruit more worker.

This advantageous situation will not stay long as technological progress in Artificial Intelligence and Robotics goes exponentially. Development in robots with Artificial Narrow Intelligence and human operated machinery has proven to be a cause job loss in the manufacturing sector during the 20th century and past years If in the future, cost of acquisition of hi-tech machinery surpasses the cost of labor, the current advantage of low cost Indonesian labors would eventually be nullified. Low cost of acquisition and operation of machines with Artificial Narrow Intelligence and Artificial General Intelligence powered by the mighty muscles of "economics of scale" will overpower any cheap human labor.

5. CONCLUSIONS

5.1 Main Conclusions

Based on the problem formulation, theoretical analysis, model creation, and statistical testing, the following conclusions are drawn.

1. This study finds that both public capital expenditure and infrastructure as represented by length of road, sales of electricity, and employment have a positive and significant effect on the Gross Domestic Regional Product of manufacturing industry.
2. The increase in regional infrastructure budget reflects the increase in Gross Domestic Regional Product of manufacturing industry, based on the fact that both public capital infrastructure and the two variables that represent infrastructure as a whole are significant to the Gross Domestic Regional Product of manufacturing industry.
3. Infrastructure sufficiency reflects the increase of the Gross Domestic Regional Product of manufacturing industry. This is supported by the fact that both length of road and electricity sales that represent infrastructure sufficiency provided by the government are significant to the Gross Domestic Regional Product of manufacturing industry.

4. Industrial automation, which is represented by electricity sales to industrial customers, is far outmatched by the effect of employment. In this case, employment is still the driving force of Gross Domestic Regional Product increase because of its high degree of relationship.
5. Provinces such as: Riau, Riau Islands, Banten, West Java, Central Java, East Java, and West Papua would benefit the most from this study, given the huge contribution made by the manufacturing industry to the region's Gross Domestic Regional Product.

5.2 Author's Recommendations

Referring to the previously mentioned main conclusions, the following recommendations are given to prospective agencies and to the reader.

1. Cobb-Douglas production function theory is a viable theory to be used in literature which aims to see whether or not the combination of capital and labor really has a significant effect on production output.
2. Because this research uses secondary data in analyzing the phenomenon, there are several points which were left blank because of data unavailability. This makes the model an unbalanced in its panel data. The BPS and Indonesian Ministry of Energy and Mineral Resources should update the data in their website and reports to support future researchers in acquiring better and accurate data.
3. This research only focuses on manufacturing industry, which contributes more than 21% to the national GDP during the time frame of this research. Future studies are suggested to use other relevant sectors, such as service sector considering that during the time of this research Indonesia is on a slow transition into service industry.
4. There are rooms for improvement in public capital expenditures allocation. Policy makers in Indonesia, especially those in provincial governments such as Governor and the regional house of representative, should use an infrastructure-focused budget allocation to increase the manufacturing industry's output if that is the main goal of the provincial government.
5. Policy makers in: Riau, Riau Islands, Banten, West Java, Central Java, East Java, and West Papua province should improve the public capital expenditure absorption in road development and also improve the employment rate to manufacturing industries. This is because those 7 provinces had a big portion of its GDRP coming from manufacturing.
6. Future fund allocation on road construction, development, and maintenance made from the public capital expenditures fund should aim towards connecting more industrial areas, especially manufacturing industries. Regional government should also increase its public capital expenditure budget in constructing more roads connecting manufacturing industry with other industries and its customers.
7. The Indonesian government should start to improve on electricity network and power generation infrastructure to enable manufacturing industry practitioners in expanding its production lines with automated machinery. This would stimulate higher yield in production output and also manufacturing industry GDRP.
8. Current competitive advantage that Indonesia had in labor cost will not stay long as technological progress in Artificial Intelligence and Robotics increases exponentially. In the future, cost of acquisition of hi-tech machinery will surpasses the cost of labor, the current advantage of low cost Indonesian labors would eventually be nullified. Indonesian government should push more on solving this issue because manufacturing industry had a second highest in automation potential and manufacturing industry is the top biggest labor employer in Indonesia. Job loss in this sector would be catastrophic if not handled correctly. Future research regarding this issue would be highly appreciated.

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