DEMAND FOR ELECTRICITY IN INDONESIA
THE CASE OF QUANTITY DEMANDED FOR ELECTRICITY IN PT PLN (PERSERO) 1982-2002

A THESIS

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ABSTRACT

Muhammad Reza Arifani (2004), "Demand For Electricity In Indonesia The Case of Quantity Demanded For Electricity In PT PLN (PERSERO) 1982-2002". Economics Faculty, Economics Department, International Program, Universitas Islam Indonesia, Yogyakarta.

More advances in the community social welfare creates more demand in a certain product. Nowadays, every body uses electronic tools to make their life become easier. Therefore, electricity becomes the commodity that is needed by many sectors. Every people need electricity in their daily life because in this modern era, most activities need electricity. Because the electricity is very useful in every activity, it would create a demand for electricity. Electricity in Indonesia was provided by PT PLN as the only state-owned company that has the authorities in electricity business over the country. Based on the PLN data, the quantity demand for electricity in Indonesia is increasing from time to time. It reflects that electricity is needed more and more by the Indonesia citizen. Nowadays, the condition of demand for electricity in Indonesia is high, thus PT PLN as the supplier of electricity cannot cover all of the demand. PT PLN can only cover about 60% from the total demand of electricity.

This research was conducted in order to know the demand for electricity in Indonesia and to identify the factors that influencing to the quantity demand for electricity in Indonesia. The research only deals with the demand of electricity in PT PLN because most of the demand of electricity in Indonesia comes from PT PLN and the other demand electricity is shared with so many private companies, therefore it is difficult to collect the accurate data. This research was using time series data from 1982 to 2002. The research used per capita income and per capita demand in measuring the quantity demand for electricity.

This research summarizes the determination of the quantity demand for electricity per capita on PT PLN (PERSERO); they are Indonesian Gross Domestic Product per capita, Prices of Oil, and the amount of PT PLN customer. The coefficient determination R-square is 0.996247. Here, the price of oil is the dominant factor influencing the quantity demand for electricity per capita in PT PLN. Therefore, the price of oil variable is needed to get more attention. PT PLN should have more consideration in determining the electricity prices respect to the price of oil because if PLN does not do so, it will lose some of their potential demand for electricity.

ABSTRAK

Muhammad Reza Arifani (2004), "Demand For Electricity In Indonesia The Case Of Quantity Demanded For Electricity In PT PLN (PERSERO) 1982-2002". Fakultas Economi, Jurusan Ilmu Ekonomi Studi Pembangunan, Program International. Universitas Islam Indonesia, Yogyakarta.

Perkembangan gaya hidup masyarakat yang semakin meningkat menciptakan permintaan yang meningkat terhadap suatu produk tertentu. situasi yang terjadi sekarang ini adalah setiap orang menggunakan alat-alat elektronik untuk memudahkan mereka dalam kehidupan sehari-hari. Sehingga ini membuat listrik menjadi comoditas utama yang dibutuhkan diberbagai bidang. Setiap orang membutuhkan listrik dikehidupan sehari-hari dikarenakan diera moderen seperti sekarang ini listrik sangat dibutuhkan disetiap kegiatan. Karena sangat dibutuhkan maka terjadi permintaan terhadap listrik. Listrik di Indonesia disediakan oleh PT PLN sebagai satu-satunya perusahaan negara yang diberikan wewenang khusus untuk menangani bisnis listrik dinegara ini. Berdasarkan data dari PLN permintaan listrik dari waktu ke waktu cenderung meningkat, ini mencerminkan bahwa listrik makin dibutuhkan oleh setiap warga negara Indonesia. Kondisi yang terjadi sekarang ini adalah jumlah permintaan listrik di Indonesia sudah cukup tinggi sehingga membuat PT PLN tidak dapat memenuhi semua permintaan akan listrik. PT PLN hanya dapat memenuhi sebanyak 60% dari keseluruhan permintaan listik yang ada.

Penelitian ini dilaksanakan untuk mengetahui permintaan listrik di Indonesia dan untuk mengetahui faktor-faktor apa saja yang mempengaruhi jumlah permintaan listrik di Indonesia. Penelitian ini hanya mencangkup permintaan listrik di PT PLN saja dikarenakan hampir semua permintaan listrik di Indonesia datangnya dari PT PLN. Dan permintaan-permintaan listrik yang lain itu datangnya dari berbagai perusahaan-perusahaan swasta , sehingga sangatlah susah untuk mendapatkan suatu data yang akurat. Penelitian ini menggunakan data deret waktu dari tahun 1982 hingga 2002. Penelitian ini juga menggunakan pendapatan per kapita dan permintaan per kapita untuk mendapatkan jumlah permintaan listrik.

Kesimpulan dari pada penelitian ini adalah faktor-faktor yang mempengaruhi permintaan listrik per kapita di PT PLN adalah Indonesia Gross Domestic Product, harga minyak dan jumlah pelanggan PT PLN itu sendiri. Dari regressi total didapat R-kuadrat = 0.996247. Disini juga dinyatakan bahwa harga minyak adalah faktor yang dominan yang mempengaruhi jumlah permintaan listrik per kapita di PT PLN.

Oleh karena itu variable harga minyak perlu mendapat perhatian lebih. PT PLN harus lebih memperhatikan dalam memberikan harga listrik mengingat akan harga minyak sehingga PT PLN tidak akan kehilangan permintaan listrik yang potensial.

CHAPTER I

INTRODUCTION

1.1. Background of the Study

If we talk about electricity, it is about the commodity needed by many sector. Every people need electricity in their daily life because in this modern era, most activities activity needs electricity. In the form of economic, electricity was needed in the term of production, consumption and distribution activity.

Electricity in Indonesia was began on the 19th century when some of Dutch companies established power unit for their own supplier which later on developed its core business into a public supply of electricity. In October 1945, President Soekarno inaugurated the National Electricity and Gas Corporation. In January 1965, two state-owned companies were established. The National Electricity Company ran the electricity supply and the National Gas Company catered for the demand for gas. In 1972, the Indonesia government declared the status of this National Electricity Company as the state-owned Public Electricity Company (Perusahaan Umum Listrik Negara). With a Government declaration number 17 issued in 1990, this company was appointed to hold the authority for electricity business. In 1992, the government offered the opportunities for the private sector to participate in the electricity business. In line with policy in June

1998	26,433,489	7.8
1999	27,524,552	4.13
2000	28,595,405	3.89
2001	29,827,728	4.31
2002	30,586,479	3.47

Source: Statistik PLN 2001

So based on the costumer data in PT PLN, the quantity demanded for electricity in Indonesia is always increasing from time to time. It reflects that electricity is needed more and more by the Indonesian citizen. The changing of percentage on the third row shows the number of change of the total costumer from time to time. It shows various numbers and instability. If we look in 1997 to 1998, it shows a significant drop to the total costumer because during that time Indonesia experienced monetary crisis.

Despite of the monetary crisis, the increasing number of costumer using electricity in Indonesia on PT PLN (PERSERO) means the growth for electricity demand is estimated to be 10 – 11 % per year this is an indication that electricity market is tremendously potential.

Nowadays, the demand of electricity in Indonesia is high, so that PT PLN as the supplier of electricity cannot cover all of the demand. According to the data, PT PLN can only cover about 60% from the total demand of electricity. This condition happens because PLN doesn't have the capability to produce electricity, so the remaining 40% demand for electricity gone to the private company, for example most of the Multinational companies that

run their business in Indonesia like PT Freeport in Papua, PT Exxon in Aceh, PT Caltex in Borneo provide their own electricity. Also the demand for electricity in the area surrounding the factory is provided by the company it's self. This is an example why PT PLN had lost their opportunities in providing electricity. However PT PLN doesn't give up and let the remaining 40 % demand for electricity gone to the private company. PT PLN use investment strategies to try to cover the remaining demand. Because PLN have the right from the government to provide electricity, PLN have the first authorities to decide how much the demand they want to cover. PLN use private investment to invest their capital in PT PLN so that PLN can build some more generators to increase their supply of electricity and can meet the demand that PLN has to cover. The purpose of this strategy is that some day PT PLN can cover all the demand of electricity throughout Indonesia.

It is interesting to know why it happens and what factors influence the quantity demand of electricity in Indonesia that makes state company like PT PLN (PERSERO) cannot cover all the demand of electricity in Indonesia. The research only deal with the demand of electricity in PT PLN because most of the demand of electricity in Indonesia comes from PT PLN and the other demand for electricity is shared with so many private companies, therefore it is difficult to collect the accurate data. Hopefully from the quantity demand of the electricity analysis, we might know what factor that influence the most to the quantity demand of electricity in

Indonesia by PT PLN (PERSERO). This research will limited to the year of 1982 to 2002.

1.2. Problem Formulation

Based on the study background and the significant of analysis on factors influencing the quantity demand for electricity per capita in PT PLN (PERSERO) Indonesia, the writer formulates the following problems:

1. What are the factors affecting the quantity demand for electricity per capita in Indonesia?
2. What are the effects Indonesian Gross Domestic Product per capita have on the quantity of demand for electricity per capita in PT PLN?
3. What are the effects of oil price upon the quantity of demand for electricity per capita in PT PLN?
4. What are the effects of the amount of customer upon the quantity of demand for electricity per capita in PT PLN?
5. What are the factors that influence dominantly to the quantity of demand for electricity per capita in Indonesia that provided by PT PLN?

1.3. Problem Limitation

The studies will focus on the demand of electricity in Indonesia provided by PT PLN (PERSERO). The reason is because PT PLN (PERSERO) is the only provider of electricity in Indonesia that has legal authority by the Indonesia government to supply, distribute and sell the electricity. PLN controls a large portion of the electricity supply such as, its generation, transmission and distribution. However it does not imply that PLN has a pure monopoly over the industry. PLN provide 80 % from the total of electricity used in Indonesia, the remaining 20 % is comes from the private company like Freeport. They provide their own electricity with their own generator and also supply the electricity in the area surrounding the company. Usually the other electricity provider like multinational company such as Exxon, Caltex, Freeport and other, they only provide electricity for the internal use and industrial purpose. So the other supply of electricity beside PLN are relatively small and scattered in isolated location (usually in other island outside java), making difficult to draw any general conclusion.

According to the difficulties to observe the demand for electricity by those companies, we only focuses on the demand for electricity produced by PT PLN (PERSERO) and still get general picture of the whole demand over the country.

1.4. Research Objectives

1. To examine the factors that affecting the quantity demanded of electricity per capita in Indonesia from the PT PLN (PERSERO) in the year 1982 – 2002.
2. To explore and measure factors that influence dominantly to the quantity demand of electricity in Indonesia.

1.5. Research Contribution

1. Company

   Hopefully the research can give useful benefits for PT PLN management, mainly concerning to the demand of electricity in Indonesia. The research might also be able to give some supporting data for PT PLN (PERSERO) about the quantity demand of electricity in Indonesia so that PT PLN can cover all the demand for electricity in Indonesia.

2. Writer

   The research can give so many positive contributions for the writer, mainly concerning to the demand where in this case it deals with the demand of electricity in Indonesia that provide by PLN. The research is also to practice writer's ability in systematical analytic thought.

3. Other Parties

   The research might also give contribution for other parties who want to make similar report. It can be a reference for them in making their report.

1.6. Definition of Terms

Demand for electricity means demand from Indonesia people for electricity that comes to PT PLN as the company in Indonesia that provide the electricity. The demand of electricity included people that already use the electricity. The demand of electricity data base on the PT PLN data about PT PLN customer, its cover all of PT PLN customer including household sector, industrial sector, business sector, and other. Where the demand for electricity each individual assume to be unequal.

CHAPTER II

REVIEW OF RELATED LITERATURE

2.1. Literature Review

2.1.1. Faried Wijaya Mansure (1986)

The former researcher that already research about electricity condition in Indonesia was done by *Faried Wijaya Mansure* (1986), his research entitles *Electricity Pricing and Investment under government policy constraints: the case of the Java Indonesia Interconnected supply system*. This research purpose is to review and analyze PLN pricing and investment under the government policy constraint. Its covers mostly in the period that begin in the late 1970's up to 1986 because in all of this period a non economic distributional objective dominates the price setting policy. The research study tries to analyze the industries optimization under such constraint. The mythology applied basically analytical and empirical simple a general overview of the industry and its relation with government role and policy is explored and the hypothesis is that electricity power has been almost always under priced due to general distributional objective. The similarities with the former research are related to the electricity in PT PLN. The different with this former research are this research is analyzing the factor that affecting to the quantity demand for electricity in Indonesia on the PT PLN.

2.1.2. Amarullah M (1983)

Another research that studies about electricity in Indonesia is done by *Amarullah, M.* (1983). His research's title is *Pricing of electricity in Indonesia.* The subject of this research is on the Energy Planning & Policy; electric power prices; electric power rate, rate structure ; Indonesia electric power; Mathematical models ; And power demand. The objectives of this study are 1) to establish a sound theoretical basis for the determinants of electricity demand in Indonesia, 2) to measure the welfare losses of existing electricity pricing, and 3) to suggest a method of reducing these welfare losses. An econometric model for electricity demand is estimated using pooled time-series of fifteen regions in Indonesia covering the period 1970-1979. The short run price elasticity for both residential and industrial/business sectors are found to be inelastic, while the long run price elasticity for these sectors is found to be quite elastic with a value of -.61 for the residential sector and of -1.1 for the industrial/business sector. Income elasticity is .8 in the short run and around 1.00 for the long run. The exposure variable that captures the accessibility of electricity has long run elasticity of 1.00 for the residential sector and less than 1.00 for the industrial/business sector. Due to distributional considerations, the 1980`s electricity rate was set below its efficient level, and has created a welfare loss of Rp.8273.23 million per month. This accounts for 36.03% of the

monthly electricity revenue. A rebate mechanism is recommended in this study, which provides a way to mitigate conflicting aspects of efficiency and equity.

2.1.3. Article from *listrik watch journal* (February – March 2004)

An article written in *Listrik Watch Journal* on February – March 2004 talk about the demand of electricity in India. The article describes the situation of electricity in India. The problem is almost similar to the problem of electricity in Indonesia, where the demand of electricity in India is bigger to the supply of the electricity itself. In India, the total population is about 1 million people it places India country as the second biggest population in the world. Based from this total population makes the demand for electricity in India is huge the India states electricity company can not cover all the demand for electricity, the second reason is in India there also not enough resource as the fuel of the electricity. But India managed to deal with this problem. India government managed to develop renewable resource thru India Ministry of non-Conventional Energy Sources. This department set the national policy and regulation that not limited to the development and research about the renewable resource for electricity. For example India developed Biogas plant technology and wind power technology to produce energy for electricity. India also develops Solar Photovoltaic energy. Because of

the development of technology in renewable resource it attracts many private investors to invest in India. According to the data total private investors reach 82% from the total investment of 250 million rupee or similar to 46,23 trillion rupiah with 1 rupee = 184,918 rupiah, and the total capacity around 4 Giga Watt.

1994, the status of this company was changed into a state-owned Limited Company.

Based on the brief history of electricity in Indonesia, it can tell that most of electricity in Indonesia was provided by PT PLN (PERSERO), so the research will based on the PT PLN.

Based on its use, the electricity was needed in many sectors such as household, transportation, industrial, commercial, and business sector according to the data of PT PLN costumer. Because the electricity is very useful in every activity, it would create a demand for electricity. The demand for electricity is measured in quantity. Based on the economic theory, if a commodity is useful, it means that this commodity has more value, and then it would create more demand for this commodity. It can be seen from the increasing quantity of demand for this commodity from time to time. The example same as the quantity demanded for electricity in Indonesia.

Table 1.1
Consumer data in PT PLN (PERSERO)

Year	Total Costumer	Percentage Change
1992	14,543,907	11.56
1993	15,157,409	12.39
1994	16,936,613	11.74
1995	19,471,647	14.97
1996	21,980,325	12.88
1997	24,640,587	12.10

CHAPTER III

THEORITICAL BACKGROUND AND HYPOTHESIS

3.1. Theoretical Background

3.1.1. Quantity Demand Theory

Demands are determined by quantity demanded of product, are the total amount of any particular goods and services that an economy's consumers wish to purchase in some time period. It is important to notice three things about this concept: (Richard G. Lipsey(1996: 63))

First, quantity demanded is a *desire* quantity. It is the amount that consumers wish to purchase that the price of the other product is assumed to be constant.

Second, *effective demand.* Are the amounts that people are willing to buy, given the price they must pay for the product.

Third, quantity demand refers to a continuous *flow* of purchase. The amount of some product that all costumers wish to buy in a given time period is influence by the following important variable (Richard G. Lipsey (1996: 65)):

1. Product's own price

   A basic economic hypothesis is that the price of a product and the quantity that will demand are related negatively, while other thing is equal. That is, the lower the price, the higher

the quantity demanded, and the higher the price, the lower the quantity demanded. (Alfred Marshall (1842-1924)) this fundamental concept is called "Law of Demand." On the case of demand for electricity related to the prices of electricity is when the prices of electricity is increasing the quantity demand for electricity will decreasing.

2. Average Consumer Income

If consumers receive more income on average, they can be expected to purchase more of most products even though product prices remain the same. In the case of demand for electricity related to the income is when the National income or GDP is increasing the quantity demand for electricity will also increasing.

3. Other Price

It means other product prices or substitutes, A rise in the prices of substitute for a product its will make the quantity demanded for the product increase. It will make the demand curve shift to the right. In this case the price of gasoline is the substitution product for the electricity, when the price of gasoline is increasing the quantity demand for electricity is increasing or otherwise.

4. Taste

Tastes have an effect on people's desire to purchase. A change in the taste maybe long-lasting or short- lasting, a change in the tastes in favor of a product shift the demand curve to the right. In the case of demand for electricity we don't talk about the taste because every person have different taste and electricity is a commodity that needed by every individual.

5. Population

An increase in population will shift the demand curves for most products to the right, indicating that more will be bought at each price. It means that the increase of the population will increase the quantity demand for electricity because more people need more electricity in their daily lives.

Other economist, Gregory Mankiw (2001: 67) determines that quantity demand is *the amount of good that buyers are willing and able to purchase*. According to him the quantity of every individual demand are determine by,

1. Price, if the price of good is increasing the quantity of demand will decreasing.
2. Income, if the income is increasing the quantity demand is also increasing but this theory is happen on the normal

goods, and for the inferior goods increasing to the income will lend to the decreasing to the quantity demand for that goods.

3. Prices of related goods, means that substitution and complement goods, substitution if two goods for which an increasing in the price of one leads to an increasing in the demand for the other. And complement if two goods for which an increasing in the prices of one leads to a decreasing in the demand for the other. In the case of electricity and gasoline is if the price of gasoline is increasing the demand for electricity is increasing so electricity and gasoline related to the substitution goods.
4. Taste, economists normally do not try to explain people's taste because tastes are based on historical and psychological forces that are beyond the realm of economists.
5. Expectation, expectation of every individual will affect to the quantity of demand in the future.

3.1.2. Elasticity of Demand

The laws of demand and supply predict the direction of changes in price and quantity in response to various shifts in demand and supply. However, it is usually not enough to know merely whether the

quantity and price each rise or fall; it is also important to know *how much the change*. This is what the concept of *elasticity* does.

Elasticity is a term in economics to denote the responsiveness of one variable to change another, for example the elasticity of X with respect to the Y means the percentage of change in X for every 1 percent change in Y. In the term of demanding one good, the elasticity of demand will be showed by the percentage change price as the independent variable (X) and percentage change in quantity demand of good as the dependent variable (Y).

In economic there are several concept of elasticity (Gregory Mankiw, 2001: 75),

1. *Price elasticity of demand*, a measure of how much the quantity demanded of a good responds to a change in price to that good, computed as the percentage change in quantity demanded divided by the percentage change in prices.

   Prices elasticity of demand = $\frac{\%\text{ change in quantity of demanded}}{\%\text{ change in price}}$

2. *Income elasticity of demand*, a measure of how much the quantity demanded of a good responds to a change in costumers income, computed as the percentage change in quantity demanded divided by the percentage change in income.

Income elasticity of demand = $\frac{\%\text{ change in quantity demanded}}{\%\text{ change in income}}$

For most goods, increasing in income can lead to increasing in the demand this happen on the *normal goods*. Goods for which consumption decreasing in response to a rise in income has negative income elastic ties and is called *inferior goods*. Even among normal goods, income elastic ties vary substantially in size. Necessities such as food and clothing, tend to have small elastic ties because consumer regardless of how low their incomes, choose to buy some of these goods. Luxuries, such as caviar and furs, tend to have large income elastic ties because consumer feels that they can do without these goods altogether if their income is too low. (Gregory Mankiw, 104). In the case of demand for electricity the electricity is the normal goods cause if people income is increasing the consumption of electronic tools also can increase so they demand more electricity.

3. *Cross-price elasticity of demand*, measure of how much the quantity demanded of one goods responds to a change in the price of another good, computed as the percentage change in quantity demanded of the first good divided by the percentage change in the price of the second good.

Cross-prices elasticity of demand = $\frac{\%\text{ change in quantity demanded of good 1}}{\%\text{ change in the price of good 2}}$

Whether the cross prices elasticity is a positive or negative number depends on whether the two goods are substitute or complements. Substitution goods if increasing in one prices makes the demand for another prices is increasing it had positive cross price elasticity and complement goods if prices of one good increasing the demand for another goods is decreasing it had negative cross price elasticity.

If the result are higher (>) than 1 means that elastic

Less (<) than 1 means that inelastic

Equal (=) than 1 means that Unitary

3.1.3. The Theory of Consumer Choice

Examine the trade off that people face in their role as costumer. When a costumer buys more of one goods, he can afford less of other goods. When he spends more time enjoying leisure and less time working, he has lower income and can afford less consumption. So these theories examine how consumer facing these tradeoffs makes decision and they respond to change in their environment.

The Consumer Budget Constraint, the budget constraint shows the various bundles of goods that the consumer can afford for a given income.

Indifference curve, a curve that shows consumption bundles that give the consumer the same level of satisfaction. Four properties of indifference curve:

- Higher indifference curve are preferred to lower ones.
- Indifference curve are downward sloping.
- Indifference curve do not cross.
- Indifference curve are bowed inward, means the slope are marginal rate of substitution.

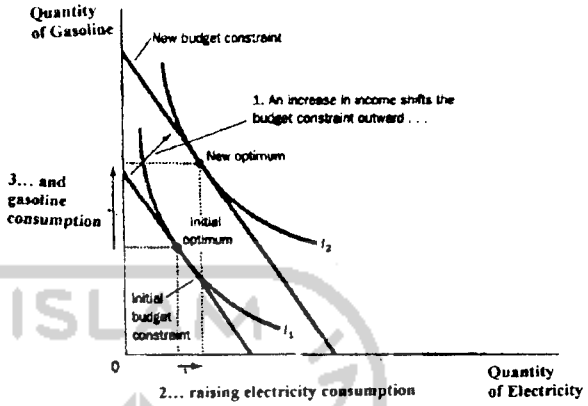
Marginal rate of substitution, is the rate at which a consumer is willing to trade one good for another.

The Consumer Optimal Choices, The consumer choose the point on his budget constraint that lies on the highest indifferent curve. At this point, called optimum, the marginal rate of substitution equals the relative prices of two goods.

3.1.3.1. The effect of income on the Consumer's Choices

An increase on the consumer income raises the budget constraint shift to the right. If both goods are *normal goods*, the consumer responds to increasing in income by buying more of both of them. In this case the writer use electricity and gasoline as the example, graphical example show the

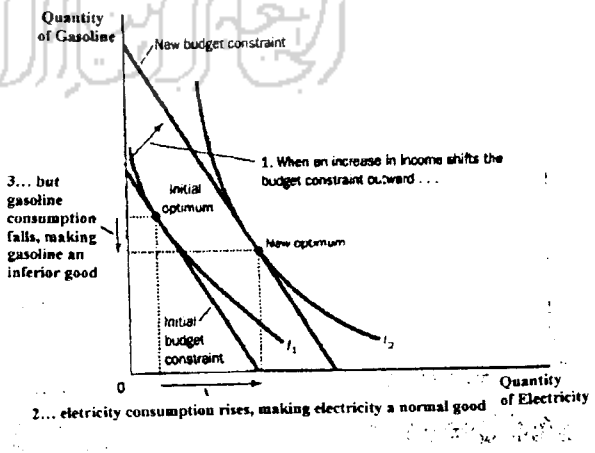
consumer buys more electricity and more gasoline when their income is increasing. In **Graph 3.1**



Normal good, a good for which an increasing in income raises the quantity demanded.

If the good are *Inferior good*, a good for which an increasing in income reduces the quantity demanded. The graph is like in the below.

Graph 3.2

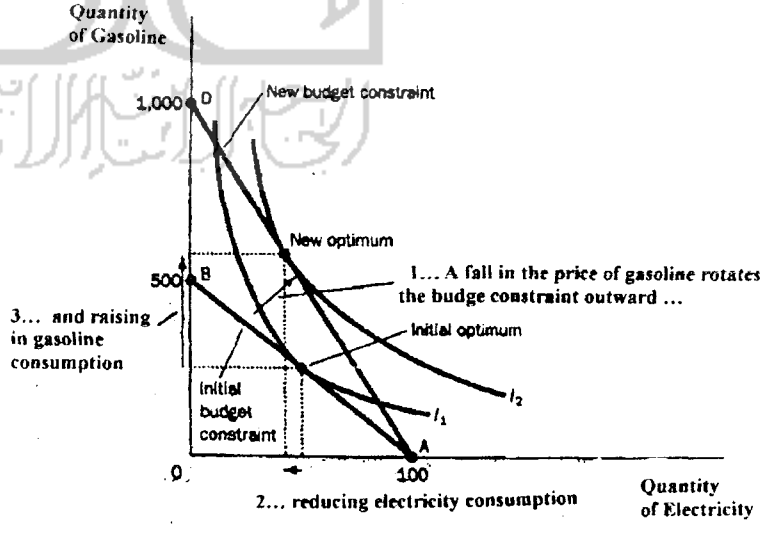


In this graph gasoline is the inferior good, when the consumer's income increases and the budget constraint shift outward; the consumer buys more electricity but less gasoline.

3.1.3.2. The effect of price on Consumer's Choices

When the prices of one good falls in this case the prices of gasoline, the consumer's budget constraint shift outward and change the slope. The consumer moves from initial optimum to the new optimum, which changes his purchase of both gasoline and electricity. In this case, the quantity of gasoline consumed rises, and the quantity of electricity consumed falls.

Graph 3.3



3.1.3.3. Income and Substitution Effect

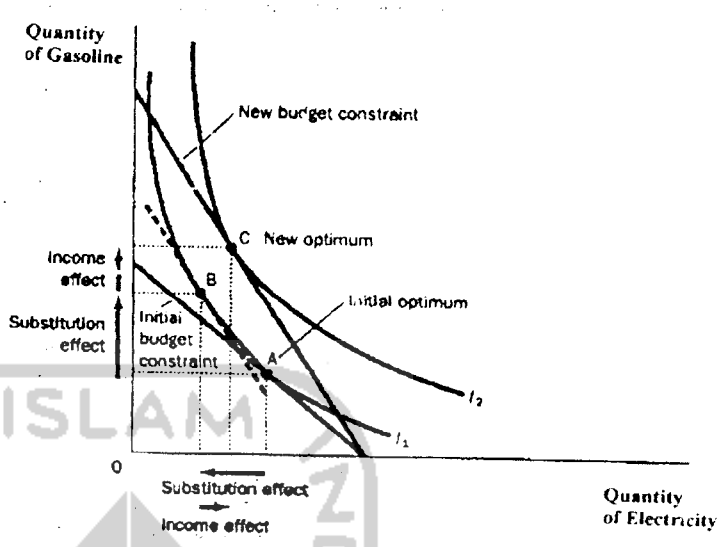
The impact of a change in the price of a good on consumption can be decomposed into two effects: an income affect and substitution effect. We use the example of electricity and gasoline. The situation maybe like this:

- "Great news! Now that price of gasoline is cheaper, my income has greater purchasing power. I am, in effect, richer than I was. Because I am richer, I can buy both more gasoline and electricity. (this is the income effect)
- "Now that the price of gasoline has fallen, I get more pints of gasoline for every electricity that I give up. Because electricity is now relatively more expensive, I should buy less electricity and more gasoline. (This is the substitution effect).

Income effect is the change in the consumption that result when a price is change moves the consumer to a higher or lower indifferent curve.

Substitution effect is the change in consumption that results when a price change moves the consumer along a given indifference curve to a point with a new marginal rate of substitution.

Graph 3.4



The effect of a change in price can be broken down into an income effect and substitution effect. The substitution *effect* is the movement along an indifferent curve to a point with in different marginal rate of substitution, is show here as the change from point A to point B along indifferent curve I_1. The income *effect* the shift to a higher indifference curve, is show here as the change from point B indifference curve I_1 to point C on indifference curve I_2.

3.2. Hypothesis Formalization

This hypothesis defined as a right and temporarily argument to the behavior of model that it used and tested with the statistical test and econometric test. This hypothesis will be tested with the variable independent regression analysis that affects the demand of electricity in Indonesia on PT PLN (PERSERO). The hypotheses that are to be taste are:

1. The GDP of Indonesia individually has positive effect to the quantity of demand for electricity in Indonesia.
2. Price of oil in Indonesia individually has positive effect on the quantity of demand for electricity in Indonesia.
3. Number of PT PLN customer individually has positive effect on the quantity of demand for electricity in Indonesia
4. All the factor GDP, prices of gasoline, and number of customer is assume to be affecting the quantity demanded for electricity in Indonesia.

CHAPTER IV

RESEARCH METHOD

4.1. Research Method

The research method used in this research was quantitative analysis. The quantitative analysis is a characteristic of variables where the mark stated on the numerical form. The characteristics of the measurement variable make the mark being placed in an interval.

The writer also used literature study. Literature study is meant to get theory to help in solving the problem in the research by learning the literatures and books related to the analysis and problems of research.

4.2. Research Subject

This research concentrates on the demand for electricity in Indonesia. The case study of quantity demand for electricity in PT PLN (PERSERO) became the subject in this thesis

4.3. Research Setting

The study of this thesis takes place on Economics Faculty of Islamic University of Indonesia, PT PLN (PERSERO) head office Jl Trunojoyo 135 Kebayoran Baru, Jakarta and also in BPS (Badan Pusat Statistik) Yogyakarta. The writer does the research through literature and data analysis

that available on the library and reference room in economics faculty of Islamic University of Indonesia and also from PT PLN office at Jakarta.

4.4. Research Variables

Based on the data used in this research, the variables in this thesis are categorized into two variables; dependent variable and independent variables. Both variables are described as follows:

4.4.1. Dependent variable

The dependent variable in this research is the Quantity demand for electricity per capita in Indonesia (Q).

4.4.2. Independent variable

The independent variables in this research consist of four variables, they are:

4.4.2.1 The Indonesian GDP per capita (GDP).

4.4.2.2 The Price of oil (Po).

4.4.2.3 The Number of PT PLN customer (Customer).

4.5. Types and Sources of Data

4.5.1. Data Source

- Primary Data

Data that obtain straightly from the authorization that comes from interview with the PT PLN officer or whom it may concern and employee.

➢ Secondary Data

Secondary data is the data taken from the literatures related to the research topic.

4.5.2. Data Needed

➢ General Data

- The Quantity demand for electricity in Indonesia
- Indonesia population
- Indonesia GDP
- Indonesia price of oil
- Number of PT PLN customer

4.5.3. Population

Population is the whole or individual unit becoming the suggestion or the research subject, which the characteristics will be supposed. In this research, the population is all of Indonesian citizen.

4.5.4. Sampling method

In this research, the researcher prefers to use selected sampling method, which means the researcher will choose several units from the population independently. The sample will be the customers at PT PLN (PERSERO) who use electricity. The method of sample collection for this research will collect accurate data from PT PLN (PERSERO):

Based on the data of PT PLN customer that already use electricity, according to PLN, the costumer who use electricity is divided into four groups: residential, industrial, business and social.

4.6. Method of Data Compilation

The writer uses method of data compilation to obtain the prices of electricity and oil in Indonesia because the prices of both commodities, the electricity and the oil, have different prices for different use and function.

In this research the writer do not include the prices of electricity in the regression model because prices of electricity is determine by the company together with central government as the supplier, not from the market it self. Based on the research, the prices of electricity and prices of oil get multicorrelation it means that prices of oil and prices of electricity have strong correlations. The reason not to include prices of electricity and only based on the prices of oil as the substitution goods because whenever the prices of oil is increasing as the result of decreasing in subsidies to the oil prices, the government also increase TDL (Tarif Dasar Listrik) in Indonesia so makes the prices of electricity in PT PLN increasing. From this analysis we can see that prices of oil and prices of electricity have a strong relationship.

Other reason not to include prices of electricity because nowadays electricity just likes necessities goods whenever the price is increasing the

demand for electricity relatively not change. The research only based on the prices of oil as the substitution goods.

For the price of oil, because there is various kind of oil, so the price is also different. This oil its self can be divided into engine oil and diesel oil. Engine oil such as premium, petramax and petramax plus are sold in the market with different prices. And diesel oil is the only solar that is sold in the market and had different prices with engine oil. The writer will use the prices of solar as the price of oil in the analysis, the reason because the substitution goods for electricity is using generator. Solar used as the energy to run the generator that produce electricity. Many household and industries used generator as the replacement of electricity. The frequencies of using this alternative resource of electricity depend on the prices of electricity from PLN itself. So if the prices of electricity increase the demand of diesel oil (solar) also increasing.

4.7. Technique of Data Analysis

This research uses multiple regression model, in which involves the use of more than one independent variable to predict a dependent variable (Hanke and Rietsch, 1995:255). Meanwhile, in determining the parameter of α, the method being used is Ordinary Least Square (OLS). By using this method, it is expected that the Best Linear Unbiased Estimator (BLUE) will be get by the writer. Basically, the content of this method is normal determination through minimization of error square.

Function of Quantity demand for electricity per capita in Indonesia can be formed as follows:

$$Q = f\{GDP, Po, Customer\}$$

Where:

Q : Quantity Demand for electricity per capita in Indonesia (GWh).

GDP : The Value of Indonesia's Gross Domestic Products per capita (in Rupiah).

Po : The Price of oil (Rp/litter).

Customer: The amount of PT PLN customer (people)

Writer uses linear regression model in this research in the form of the following econometric model:

$Q = \beta_0 + \beta_1 GDP + \beta_2 Po + \beta_3 Customer + u$

Where;

β_0 : Constant

$\beta_{1,\ldots,}\beta_4$: Regression coefficient of each variable.

Q : The Quantity demanded for electricity per capita in Indonesia (GWh)

GDP : The Indonesia's Gross Domestic Products per capita (Rupiah)

Po : Prices of oil (Rupiah/litter)

Customer: Amount of PT PLN Customer

u : disturbance error

The writer also applies statistical test which include testing about individual partial regression coefficient and testing the overall significance of

the sample regression. Beside this statistical test, writer also analyzes the R^2, classical assumptions that cover: multicollinearity, autocorrelation, and heterocedasticity.

4.7.1 T – test

This test is used to detect the correlation between dependent variable and independent variables individually. In this research, the writer uses one tail test since this research has a strong theoretical expectation.

The following hypothesis will be examined individually:

H_0: $\beta_i = 0$: means that the independent variable individually does not impact on dependent variables.

H_i: $\beta_i > 0$: means that the independent variable individually has positive impacts on dependent variables.

The decision will be made with the parameter (α) 5% based on the following rules:

a. When the value of computed t < t table value, the decision is accept H0. In this case the independent variable individually does not impact the dependent variable significantly.

b. When the value of computed t > t table value, the decision is reject H0. In this case the independent variable individually impacts the dependent variable significantly.

4.7.2 F – test

This test is used to detect the correlation between dependent variable and independent variables jointly. The testing of F test is the same as the testing for t test. Hypothesis is formulated as follows:

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$: hence the independent variables do not affect the dependent variable jointly.

H_1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$: hence the independent variables affect the dependent variable together.

4.7.3 Goodness of Fit (R^2)

It is an important property of R^2 that a non decreasing function of the number of explanatory variables or independent variables presents in the model; as the number of independent variables increase. R^2 almost invariably increases and never decreases. R^2 is used to detect how far the independent variable influences the dependent variable in the model (Gujarati, 1995: 207). R^2 is being a measure of the goodness of fit of a sample least squares linear regression in a body of data. The number of R^2 is between 0 – 1. The closer the number of R^2 to 1 the better the model explain about relationship between dependent variable and independent variables.

4.7.4 Classical Assumption

Basically this test is used to know whether the model in this research is a valid model or not. We can say the model is a valid model if there is no correlation, autocorrelation, and heterocedasticity in the model.

4.7.4.1 Multicollinearity

Multicollinearity means the existence of a perfect or exact linear relationship among some or all explanatory variables of a regression model (Gujarati, 1995: 320). The consequences of multicollinearity are as follows: if there is perfect collinearity between the X's, their regressions coefficients are in determine and their standard errors are not defined. If collinearity is high but not perfect, estimation of regression coefficients is possible but their standard errors tend to be large. As a result, the population values of coefficients cannot be estimated precisely. However, if the objective is to estimate linear combination of these coefficients, the *estimable function.* this can be done even in the presence of perfect multicollinearity (Gujarati, 1995: 345).

To detect multicollinearity, we can use the correlation method as the best one. The multicollinearity is predicted happens when R^2 is high, say in excess of 0.8. If R^2 is high,

the F test in most cases will reject the hypothesis that the partial slope coefficients are simultaneously equal to zero.

4.7.4.2. Autocorrelation

The term autocorrelation may be defined as correlation between members of series of observations ordered in time (as in time series data) or space (as in cross-sectional data) (Gujarati, 1995: 400). If there is autocorrelation in the model, it will raise the value of residual and the impact is the number of t-test, f-test and R^2 will decline.

The tool of analysis is used to detect autocorrelation is using LM test (Lagrange Multiplier Test). This test uses the level of degree (χ^2) in which the expressing that there is no autocorrelation, with the guidance if χ^2 statistic bigger than the value of χ^2 table, hence H_0 denied and also on the contrary.

4.7.4.3. Heteroscedasticity

An important assumption of heteroscedasticity shows the conditional of X increasing as Y increasing. Here the variances of X are not the same. The writer used White Test that provided by the Eviews 3.0 program to detect heterocedasticity.

The White Model is:

$$E^2 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \delta_1 X_1^2 + \delta_2 X_2^2 + \delta_3 X_3^2 + \delta_4 X_1 X_2 + \delta_5 X_1 X_3 + \delta_6 X_2 X_3 + \varepsilon \quad (4.7.4.3.a)$$

That is, the squared residual from the original regression are regressed on the original X variable, there squared values, and the cross product of the regressors.

Under the null hypothesis that there is no heteroscedasticity, it ca be shown that sample size (n) times the R^2 obtained from the auxiliary regression asymptotically follows the chi-square distribution with df equal to the number of independent variables (excluding the constant term) in the auxiliary regression. That is,

$$n.R^2 \underset{asy}{\sim} X^2 \text{ df} \quad (4.7.4.3.b)$$

If the chi-square value obtained in (4.7.4.3.b) exceeds the critical chi-squared value at the chosen level of significance, the conclusion is that there is heteroscedasticity. If it does not exceed the critical chi-square value, there is no heteroscedasticity, which is to say that in the auxiliary regression (5.7.4.3.a), $\alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 0$.

4.7.4.4. Specification error test

A commonly used general set of tests for mis-specification, which are not based directly on an examination of residual, are the RESET tests (regression error specification test) based on the work of Ramsey (1969).

In the RESET test such proxies are based on the predicted value of Y, obtained from the OLS estimation. We first estimate.

$$Y = \beta + \beta_2 X_2 \qquad (4.7.4.4.a)$$

Ramsey suggests the use of various powers of the Ys retained from (4.7.4.4.a) as proxies for X_3, that is Y^2, Y^3 etc. Thus to carry out the RESET test, we next estimate equation such as.

$$Y = \beta_1 + \beta_2 X_2 + \delta_1 Y^2 + \delta_2 Y^3 + \varepsilon \qquad (4.7.4.4.b)$$

The significant of the δ coefficient on the proxy variable can then be tested using standard F test for additional explanatory variables. If only one proxy, Y^2, is included then the significance of its coefficient may be assessed by the normal t-test.

If one or more of the δ coefficient in (4.7.4.4.b) prove to be significantly different from zero then this is evidence of omitted variable error. Note, though, that, since the Y variables could be acting as proxies for more than one

omitted variable, the test can be regarded as a general one for the omission of one or more relevant variable.

The RESET test of this subsection can be regarded as a test of general mis-specification. When we apply it, the null hypothesis is that of a correct specification but we have no definite alternative hypothesis in mind. Rejection of the null hypothesis merely indicates that the equation has been mis-specification in some way or other.

CHAPTER V

GENERAL DESCRIPTION OF PLN

5.1. PT PLN (PERSERO) in brief

The history of PT PLN dates back to the end of 19th Century when some of Dutch companies established some power unit for their own supply. which later on developed its core business into public supply of electricity.

In October 1945, Indonesian first president, Soekarno, inaugurate the National Electricity and Gas Corporation. At the time being, the generation capacity was only 157.5 MW.

In January 1965, two state-own companies were established. The National Electricity Company that ran the electricity supply and the National Gas Company catered for the demand for gas. The installed Capacity was around 300 MW.

In 1972, the Indonesian government declared the status of this Electricity Company as the State-owned Public Electricity Company (Perusahaan Listrik Negara). With a Government Declare number 17 issued in 1990, this company was appointed to hold the authority for electricity business.

In 1992, the government offered the opportunities for the private sector to participate in the electricity business. In line with this policy, in June 1994, the status of this company changes into a State-Owned Limited Company (PERSERO).

5.1.1. PLN corporate legal basis

1. PLN Statuses 1998.
2. Government Decree No 23, 1994 on the transfer of the status from the State-owned Public company to State Owned Limited Company.
3. Government Decree No 12, 1998 on State Owned Limited Company.
4. Government Decree No 50, 1998 on the change of the reins of authorities.
5. Government Decree No 64, 2001 on transferring the reins of authority of State-Owned Limited Company from the Minister of Finance to the State Minister for State-Owned Enterprises.

5.2. PT PLN (PERSERO) Vision & Mission

The mission and vision of PT PLN Persero are:

1. To become a world class company with suitable growth, a prominent and a reliable company.
2. To conduct electricity business with orientation on customer, employee and owners satisfaction and to remain environmentally friendly.
3. To promote electricity as the means to improve the quality of living and to boost the economic growth.

5.3. PT PLN (PERSERO) Organizational Development

The operational coverage of PLN is very large, spreading across the entire nation with more than 13.000 islands.

In order to overcome the obstacle in management, to simply the procedure and to speed up the decision making, it is necessary to decentralize managerial authority.

During its growth, PT PLN (PERSERO) has established 4 subsidiaries. As the State-owned Limited Company, the subsidiaries are expected to be able to make more maneuvers, for instance, to establish a joint venture company, offers shares in the Stock Exchange, issues Obligation or other business venture.

5.3.1. PLN Subsidiaries:

- PT Indonesia Power with business in Electricity Power Generation and other related business established on October 3rd, 1995 under the name of PT PJB and changed its title into PT Indonesia Power in September 1st, 2000.
- PT Pembangkit Jawa Bali (PT PJB) with business in Electricity Generation and other related business. Established on October 1995 under the name of PT PJB II and change its title into PT PJB on September 22, 2000.

- PT pelayanan Listrik Nasional Batam (PT PLN Batam) with business in Electric Power supply for public in Batam Island region, established on October 3rd, 2000.
- PT Indonesia Comnets Plus (PT ICON+) with business in Telecommunication, established on October 3rd, 2000.

In additional to these activities, to anticipate a regional autonomy policy, PLN has also established Strategic Business Units in regard to regions, a similar entity with wider managerial autonomy.

5.3.2. PLN Supporting Units:

- PT PLN (PERSERO) Jasa Pendidikan dan Latihan (PLN Jasdik)

  PLN educational and training center has conducted various educational activities and training in fields such as technical, management, finance, and general administration in 10 location spread out in many region in Indonesia and prepared to serve for the needs of education and training within PLN or outside PLN.
- PT PLN (PERSERO) Jasa Enjiniring (PLN Jaseng)

  PLN engineering Service has several experts knowledgeable in various fields of technology who have wide experience working with International Consultants.
- PT PLN (PERSERO) Unit Bisnis Jasa Teknik Kelistrikan (PLN Jastek)

The research and development unit business provides support in standardization, calibration as well as test for electrical appliances and other instruments.

The Low Voltage Laboratory has been accredited nationally by KAN-BSN and internationally by Raad voor Acreditatie (RvA – the Netherlands)

The Medium & High Voltage Laboratory as well as the Calibration Laboratory has received the national accreditation form KAN-BSN and international accreditation from RvA – the Netherlands is currently on the assessment process.

- PT PLN (PERSERO) Unit Bisnis Jasa dan Produksi (PLN-JP)

  The Service and Production Business Unit of PLN give supports in field of Production, Construction and Repair Services, particularly in the electricity sector. PLN – JP is a consolidation of 4 Production Unit and 2 Sub-Production Units spread all over Java.

5.4. PT PLN (PERSERO) Human Resources

PLN currently employs 50.310 staff across the country with 7.4 % of them are having graduated and post graduate. In order to improve individual skill and competence as required by the constantly developing technology, the company conduct various educational and training activities though in-house training, universities, and other local and overseas institutional. Table 5.1 and table 5.2 below show the number of employee that work in PT PLN according their major field of study and group of employee in PT PLN (PERSERO).

Table 5.1, *source 50 year PLN dedication book*

Jurusan	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	1994
Sarjana	**509**	**591**	**667**	**779**	**913**	**1.095**	**1.466**	**1.716**	**2.003**	**2.116**	**2.188**	**2.304**	**2.376**	**2.552**	**2.712**	**3.164**	**3.669**	**3.961**
Teknik																		
Listrik	227	268	289	338	404	483	605	718	859	904	932	959	946	1.011	1.021	1.214	1.351	1.453
Mesin	101	120	147	163	191	211	292	292	340	359	374	383	404	422	435	513	594	646
Sipil	42	55	69	83	110	139	201	241	267	263	263	291	290	298	310	318	330	345
Lain-lain	19	21	25	26	26	32	60	85	82	85	86	58	56	58	67	115	159	197
Bukan Teknik																		
Ekonomi	46	43	46	62	66	95	128	177	219	241	243	275	297	338	389	448	544	616
Hukum	21	25	25	30	28	45	55	72	83	100	104	120	131	140	152	169	206	211
Administrasi	45	46	48	60	51	69	72	76	90	100	112	147	165	192	235	280	339	343
Lain-lain	8	13	18	17	37	21	53	55	63	64	74	71	87	93	103	107	146	150
Sarjana Muda	**639**	**696**	**767**	**870**	**1.029**	**1.140**	**1.466**	**1.704**	**1.985**	**2.070**	**2.092**	**2.119**	**2.235**	**2.294**	**2.376**	**2.551**	**2.717**	**2.750**
Teknik																		
Listrik	265	282	294	340	401	433	537	637	718	745	761	758	841	872	889	970	1.070	1.101
Mesin	107	121	148	160	197	221	261	307	351	349	354	374	388	377	388	412	460	482
Sipil	38	41	51	56	68	91	135	159	189	197	196	192	197	196	202	202	203	171
Lain-lain	11	15	21	18	23	25	41	50	48	46	51	52	52	52	58	67	62	63
Bukan Teknik																		
Ekonomi	69	72	80	99	76	129	182	217	283	299	304	314	313	336	386	426	431	449
Hukum	29	27	33	42	50	47	61	66	71	65	61	50	46	54	44	49	51	42
Administrasi	79	85	75	90	99	130	145	142	160	190	169	200	200	197	198	203	210	211
Lain-lain	41	53	65	65	115	64	104	126	165	179	96	179	198	210	211	225	230	231

Table 5.2, show the worker in PT PLN based on there group of employee.

Tahun Anggaran	Golongan				Calon Pegawai	Tenaga Harian	Jumlah
	I	II	III	IV			
1969							18.100
1970							18.282
1971							20.083
1972							21.100
1973							21.530
1974							19.509
1974/75							20.308
1975/76							21.299
1976/77							25.015
1977/78	10.490	6.389	845	150	600	9.315	27.789
1978/79	10.703	7.349	940	160	474	9.719	28.385
1979/80	10.663	7.342	1.013	171	764	10.177	30.130
1980/81	10.631	8.231	1.187	182	682	12.038	32.951
1981/82	10.481	9.886	1.337	181	1.240	12.666	35.791
1982/83	10.729	11.445	1.640	193	1.718	14.237	39.962
1983/84	10.854	12.751	1.934	196	3.048	16.126	44.909
1984/85	11.736	14.208	2.274	202	4.231	17.045	49.696
1985/86	12.496	17.016	2.629	206	4.475	14.468	51.290
1986/87	12.776	19.287	2.956	200	2.204	14.148	51.571
1987/88	12.487	20.815	3.161	220	1.566	12.954	51.203
1988/89	12.080	21.686	3.321	236	2.136	11.778	51.237
1989/90	11.446	23.339	3.595	263	2.537	10.673	51.853
1990/91	11.307	25.632	3.827	261	3.827	7.958	52.812
1991/92	10.932	27.089	3.759	414	4.559	7.129	53.882
1992/93	11.008	29.805	4.061	420	4.909	5.534	55.737
1993/94	9.731	33.292	4.319	521	5.898	4.145	57.906
1994	9.525	35.694	4.632	583	4.353	3.209	57.996

Source: 50 year PLN dedication

From the table 5.1 and table 5.2 it can be seen that the number of worker in PT PLN (PERSERO) is increasing each year, this is because each year PT PLN have to do different job in providing electricity and each year the task is more difficult.

In order to maintain PT PLN human resources well PT PLN (PERSERO) work together with several University in the country and also outside the country. The cooperation is in the form of education and short course program for S2 in foreign country. Table 5.3 show the University that work together with PT PLN (PERSERO).

Table 5.3, *Universities* that had work together with PT PLN

University of Westminster	3 Hoxton Street London N 1 6 HG
University of Dundee	Dundee, DDI 4 HN Scotland Telp. (01382) 223181
University of Sheffield	United Kingdom Flat 7, 36 Oakholme Road Sheffield S10
University of Leeds	3 DF - UK Woodhouse Lane Leeds LS 2 9 JT United Kingdom
University of Wollongong	Telp. (0532) 332207 Hortfields Avenue Wollongong, NSW 2609 Australia
University of Melbourne	Parville, Victoria 3052 Australia Tepl. 61. 3. 3447839
University of New South Wales	Sydney NSW 2063 Australia
University of Tasmania	GPO BOX 252 C Hobart Tasmania 7001 Australia
Edith Cowan University Perth	
Universitas Indonesia	
Institute Teknologi Bandung	
Institute Teknologi Surabaya	
Universitas Gajah Mada	
Universitas Diponegoro	
Universitas Syahkuala	
Universitas Hasanudin	
Universitas Sumatera Utara	

Source: 50 year PLN dedication

5.5. PT PLN (PERSERO) Business Activities

5.5.1. Generation

At the end of 2000 the installed capacity of PLN has reached 20,762 MW, coming from all generation units across Indonesia.

The generation capacity respectively is given below:

- Hydro Power Plants : 3.015 MW
- Oil-fired Diesel Power Plants : 2.550 MW
- Steam Power Plants : 6.770 MW
- Gas Turbine Power Plant : 1.203 MW
- Combined Cycle Gas Turbine Power Plants : 6.873 MW
- Geothermal Power Plants : 360 MW

5.5.2. Financing

PT PLN financing sector is comes from many sectors

1. Foreign aid, this aid comes from multilateral source such as: World Bank, Asian Development Bank. And Bilateral source such as: KfW-German, France, Austria, and Japan. And also from Export Credit.
2. Grant, commonly this help in form of training to the employee, scholarship, etc.
3. Domestic fund, this domestic fund comes from the entire fund in Rupiah that help PT PLN to finis all PT PLN project beside foreign aid.

4. APBN (Anggaran Pendapatan Belanja Negara).
5. Government Saving.
6. APLN (Anggaran PLN), from 1982/83 PT PLN have to provide its own source of fund.
7. Obligation, since year 1992/1993 PT PLN had already issue an obligation to the society to finance their project.
8. Banking sector means that PT PLN must loan fund from the banking sector.

Table 5.4, show how much funds that PT PLN get from Valas, APBN and APLN.

Tahun	Valas	APBN	APLN	APBN+APLN	Total	Total Repelita
1969/70	1.039.847	3.987.100		3.987.100	5.026.947	
1970/71	2.511.954	7.098.189		7.098.189	9.610.143	
1971/72	11.127.545	8.756.874		8.756.874	19.884.419	
1972/73	6.571.848	13.870.873		13.870.873	20.442.721	
1973/74	9.498.765	15.563.735		15.563.735	25.062.500	80.026.730
1974/75	39.470.272	44.879.882		44.879.882	84.350.154	
1975/76	78.953.763	45.934.965		45.934.965	124.888.728	
1976/77	113.966.750	57.904.588		57.904.588	171.871.338	
1977/78	110.050.560	64.609.574		64.609.574	174.660.134	
1978/79	90.953.343	65.197.758		65.197.758	156.151.101	711.921.455
1979/80	208.477.410	72.739.368		72.739.368	281.216.778	
1980/81	323.838.704	111.429.773		111.429.773	435.268.477	
1981/82	313.218.787	151.582.833		151.582.833	464.801.620	
1982/83	580.650.582	182.873.847	183.424.445	366.298.292	946.948.874	
1983/84	540.093.742	149.778.121	74.368.224	224.146.345	764.240.087	2.892.475.836
1984/85	636.141.000	182.094.017	181.030.123	363.124.140	999.265.140	
1985/86	877.992.000	199.319.215	76.293.000	275.612.215	1.153.604.215	
1986/87	767.725.000	96.297.437	316.525.011	412.822.448	1.180.547.448	
1987/88	1.270.454.000	187.377.000	577.068.000	764.445.000	2.034.899.000	
1988/89	1.157.831.000	638.812.868	127.046.793	765.859.661	1.923.690.661	7.292.006.464
1989/90	685.037.508	405.747.471	465.189.000	870.936.471	1.555.973.979	
1990/91	671.635.305	522.541.956	607.950.772	1.130.492.728	1.802.128.033	
1991/92	1.785.766.580	618.169.869	786.463.000	1.404.632.869	3.190.399.449	
1992/93	2.934.717.000	725.803.233	1.616.745.000	2.342.548.233	5.277.265.233	
1993/94	2.540.951.580	818.439.497	2.089.778.000	2.908.217.497	5.449.169.077	17.274.935.771

Source: 50 year PLN dedication book

Table 5.5, show number of PLN project that had help from foreign country.

Source from: *50 year PLN dedication book*

Tahun kontrak	Proyek	Negara Donor	Bantuan (juta US$ eq)
1957	PLTA Jatiluhur	Perancis	9,7
	PLTD Tersebar	Amerika Serikat	7
1958	PLTA Timo	Cekoslovakia	0,45
1959	PLTA Jatiluhur	Perancis	6,9
1960	PLTA Jatiluhur	Perancis	5,5
	PLTA Jatiluhur	Perancis	15
	PLTU Tanjung Priok	Jerman	7,7
	PLTD Tersebar	Cekoslovakia	1,85
	PLTD Kebayoran	Jerman	1,6
	PLTU Tanjung Perak	Amerika Serikat	14,35
1961	PLTU Tanjung Priok	Jerman	4
1962	PLTA Jatiluhur	Perancis	5,5
1963	PLTA Jatiluhur	Perancis	23
	PLTA Jatiluhur	Perancis	10,2
	Transmisi Jawa Barat	Hungaria	0,7
	PLTU Tello (Ujung Pandang)	Yugoslavia	9,95
	PLTU Keramasan (Palembang)	Yugoslavia	9
1964	PLTA Jatiluhur	Perancis	0,8
	PLTA Jatiluhur	Perancis	3,2
	PLTA Jatiluhur	Perancis	6,3
	PLTU Tg. Priok	Jerman	1,1
	Transmisi Jawa Barat	Perancis	1,2
	PLTD Tersebar	Cekoslvakia	0,2
1965	PLTA Jatiluhur	Perancis	5
	Transmisi Jawa Barat	Perancis	2,2
	Transmisi Jawa Barat	Perancis	2,2
	PLTG Medan, Palembang, Semarang	Jerman	4
	Transmisi Jawa Timur	Yugoslavia	2,5
1966	PLTA Jatiluhur	Perancis	6,05
	Transmisi Jawa Timur	Yugoslavia	1,5
1968	Transmisi Jawa Barat	Perancis	2,1
	PLTA Asahan	Rusia	2,7
		Total	173,45

Sumber : Tenaga Listrik, Profil dan Anatomi Hasil Pembangunan Dua Puluh Lima Tahun Bambang Pumomo - PT Gramedia Pustaka Utama 1994

5.6. PT PLN (PERSERO) Transmission and Distribution

For Java-Bali PLN has an Interconnected Transmission System of 500 kV and 150 kV, while for outside Java-Bali the System used is the separated transmission system 150 kV and 70 kV. The transmission and distribution line show in the table 5.6 below.

Table 5.6, Transmission and Distribution line

YEAR	Transmission Line (kms)	Distribution line Medium voltage (kms)	Distribution line Lower voltage (kms)	Distribution pos MVA
1969	-	-		-
1970	-	-		-
1971	-	-		-
1972	-	-		-
1973	1101	6349	17265	924
1974	-	-	-	-
1975	-	-	-	-
1976	-	-	-	-
1977	-	-	-	-
1978	6582	14715	28448	2839
1979	6731	16975	32028	3181
1980	8020	18788	36571	3736
1981	8740	20315	39703	4183
1982	9608	22602	43724	4726
1983	10641	27627	50673	5649
1984	11416	31876	54914	6360
1985	12320	37438	64936	7166
1986	13774	42821	74101	8145
1987	14505	55602	92637	9915
1988	14983	63455	103694	10720
1989	15426	70666	114225	12285
1990	16563	77346	120919	13108
1991	18509	84776	126919	13609
1992	18874	101037	141138	14737
1993	18997	106506	160935	15266
1994	19514	116804	177258	16937

Source:50 year PLN dedication book

5.7. PT PLN (PERSERO) Production

Electricity in Indonesia mostly comes from PT PLN but not all of it. PT PLN also does not produce total of electricity. Some of electricity in PLN comes from private company. It means PT PLN buy electricity form private electricity company in Indonesia. Example of the private electricity companies are:

- NV.EMTO (Electricity Maatschappij Timor en Omstreken).
- S.W. YOUNGE (Electricity Maatschappij S.W.Younge), in Tanjung Pinang.
- NV. MEPB to provide electricity in Prapat, Balige, Sidikalang, and Penuh River Celebes Island.
- NV. MEPB (Maatschappij tot Exploitatie van Plaatslijke Bedrijiven) provide electricity in Celebes Island and outside Makasar.

Table 5.7 below shows how much electricity that is produced by PT PLN and how much electricity that PT PLN must buy in providing electricity in Indonesia.

Table 5.7, PLN Own Production and PLN buy electricity

YEAR	Own Production GWh	Buying Electricity GWh
1969	1429	486
1970	1626	525
1971	1756	677
1972	1997	566
1973	2369	637
1974	2631	714
1975	2989	781
1976	3428	700
1977	4055	685

1978	4910	813
1979	6201	804
1980	7502	918
1981	8606	1532
1982	10571	1275
1983	12111	1281
1984	13622	1155
1985	15838	1061
1986	18202	1253
1987	21559	747
1988	24940	683
1989	28739	836
1990	34012	856
1991	37894	843
1992	40900	1058
1993	45469	1250
1994	50066	1412

Source:50 year PLN dedication book

5.8. PT PLN (PERSERO) Supervisory and Control system

The operation of the integrated electrical power system in the island of Java and Bali supervised and controlled by a Load Dispatch Center (LDC) located in Gandul, Southern Jakarta. The Java-Bali LDC in Gandul is conducting energy management and supervising 500 kV system. Switching operation of the 150 kV system is mainly managed by the second hierarchy which is called Area Control Centers (ACC). There are 4 Area Control Centers located at Jakarta & Banten Region, West Java Region, Central Java & Yogyakarta Region and East Java & Bali Region.

5.9. Horizon of Opportunities

The current electrification ratio in Indonesia is 52% with energy consumption of 375 kWh/capita. The growth for electricity demand is estimated to be 10-11% per year, an indication that electricity market is tremendously potential. To increase the electrification ratio and meet the demand for supply in the coming 10 year, an investment of US$ 28.5 billion is needed for additional generating capacity of up to 24,500 MW and additional Transmission lines of 11,600 kms. Up to 2003 there will be this investment opportunities amounting to US$ 3,73 billion for new Generator and Transmission, whereas for Distribution Lines with an additional connection to 2–3 million potential customers per year, an investment of US$ 3 billion is needed.

CHAPTER VI

RESEARCH FINDINGS AND DISCUSSION

6.1. Research Description

The research aims to analyze factors affecting the quantity demand for electricity in PT PLN (PERSERO). This research used quantity demand for electricity per capita in order to have a better in measure in average person demand. The factors that affect the quantity demand for electricity per capita in PT PLN that are examined in this research consist of Indonesian gross domestic product per capita, prices of oil and number of PT PLN customer.

The type of data being observed and examined in this research is time series data. The data used in this research annually are the data from 1982 until 2002. It cover the total value of quantity demand for electricity per capita in PT PLN (Q) measure in Giga Watt hours, Indonesian gross domestic product per capita (GDP) measure in million rupiah, prices of oil (P_Oil) measure in rupiah/litter and number of PT PLN customer (CUSTOMER) measure in people.

The data used in this research can be seen in the table 6.1 below:

Table 6.1
Research Data

obs	Q	GDP	P_OIL	CUSTOMER
1982	59.47321	80537.77	85	3802518
1983	63.91211	471065.5	145	4406077
1984	69.05798	488552.1	220	5133231
1985	77.76284	520732	242	5953293
1986	88.57398	539602.3	200	6965579
1987	99.28138	549496	200	8203349
1988	113.8668	569147.4	200	9275938
1989	130.8209	599091.8	200	10316945
1990	154.6355	686875.7	245	11463738
1991	169.1474	704839.9	300	12396716
1992	184.4585	1622127	300	13486556
1993	201.9493	1709303	380	15157409
1994	219.3681	1806627	380	16936613
1995	249.1798	1922326	380	19471647
1996	294.7249	2145358	380	21980325
1997	328.4384	2212583	380	24640587
1998	325.088	1873233	600	26433489
1999	351.684	1870298	650	27524552
2000	384.5939	1933623	800	28595405
2001	404.5973	1970412	1600	29827728
2002	410.7986	2011978	1980	30586479

Note

Q = Demand for electricity per capita (Gwh)

GDP = Indonesian GDP per capita (Million Rupiah)

P_oil = Price of Oil (Rupiah/litter)

Customer = Amount of PT PLN customer (people)

6.1.1. Choosing Regression Model

The reason of choosing the linear model in this research is because linear model gives a better estimation result than the log linear model. Beside that the writer also runs the MWD ((McKinnon, White, Davidson, (1983)) Test to choose the best model for this research. The MWD test suggests regressing in linear model was the best ways. After getting the result of estimation, the decision to choose the best model is shown by the value of Z in which provided through MWD test. In MWD test shows that the probability of Z value on the linear model shows statistically insignificant its means that we reject the null hypothesis that says rejected the linear model. The result of MWD test can be look on the appendix page.

6.2. Research Findings

6.2.1. Regression Result Analysis

The first step to analyze the data is by regress the data with the assistance of the supported computer package that competent and representative with the research. The writer uses Eviews 3.0 computer program in order to make the data estimation easier. Beside that Eviews 3.0 computer program helped the writer in avoiding the computation error.

The result of regression by using Eviews 3.0 program is as follows:

Dependent
Variable: Q
Method: Least Squares
Date: 07/19/04 Time: 21:08
Sample:
1982 2002
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.817533	3.695447	0.49183	0.6291
GDP	6.80E-06	6.42E-06	1.058896	0.3045
P_OIL	0.014646	0.006546	2.237513	0.0389
CUSTOMER	1.21E-05	6.53E-07	18.52438	0

R-squared	0.996247	Mean dependent var	208.6387
Adjusted R-squared	0.995585	S.D. dependent var	121.2636
S.E. of regression	8.05739	Akaike info criterion	7.1807
Sum squared resid	1103.666	Schwarz criterion	7.379656
Log likelihood	-71.3974	F-statistic	1504.347
Durbin-Watson stat	1.538435	Prob(F-statistic)	0

This result is using linear model.

Based on the result of regression, the regression models for quantity demand for electricity per capita (Q), Indonesian GDP per capita (GDP), prices of oil (P_oil), and number of customer (CUSTOMER), the writer gets the estimation equation for the quantity demand for electricity per capita in PT PLN, that is:

$$Q = 1.817533 + 0.0000068\ GDP + 0.014646\ P\_OIL + 0.0000121\ CUSTOMER + u$$

Where:

Q	= Demand for electricity per capita (Gwh)
GDP	= Indonesian GDP per capita (Million Rupiah)
P_oil	= Prices of Oil (Rupiah/litter)
Customer	= The amount of PT PLN customer (people)

6.2.2. Statistical Result Analysis

6.2.2.1. Constant or Intercept

The constant value is 1.817533 indicate that the average level of Demand for electricity in Indonesia on PT PLN is 1.817533 when other variable is zero. The sign is positive, means that the demand for electricity in Indonesia tends to increase, keep other variables constant.

6.2.2.2. T Test

The t test is done to test the independent variables individually by t statistic. From the regression result gathered the value of computed t value for each independent variable in which will be compared to the value of t table. The way to find the value of t table is:

t table = t α df (n-k)

α : the level of significance

df : degree of freedom

n : the number of data

k : the number of parameter

This research estimates the t table with α 0.05 and df (21-4) that is 17. From the table found that the value of t table is 1.740.

If the value of t-statistic or computed t value > t table value; the independent variables impact the dependent variable significantly. Likewise, if the computed t value < t table value; means that the independent variables are not significant impact on the dependent variable.

From the regression result, the computed t value for each independent variables found and shown in the following table 6.2:

Table 6.2
The Comparison Value of t-statistic and t-table

Variable	t-statistic	A	t-table	Result
GDP	1.058896	5%	1.740	Insignificant
P_OIL	2.237513	5%	1.740	Significant
Customer	18.52438	5%	1.740	Significant

6.2.2.2.1. T – Test of Indonesian GDP per capita (GDP)

H_0 : $\beta_1 > 0$

H_i : $\beta_1 < 0$

The value of computed value is 1.058896

The value of t table with α 5% and df 21 is 1.740.

Since the value of computed t value is smaller than the t table, so the H_a is rejected or H_0 is accepted statistically. It means that the Indonesian GDP per capita does not impact the demand for electricity per capita in Indonesia significantly.

6.2.2.2.2. T – Test of Prices of Oil (P_OIL)

H_0 : $\beta_1 > 0$

H_i : $\beta_1 < 0$

The value of computed t value is 2.237513

The value of t table with α 5% and df 21 is 1.740

Since the value of computed t value is bigger than the t table, so the H_o is rejected or H_a is accepted statistically. It means that the prices of oil have a positive affect on the demand of electricity per capita in Indonesia significantly.

6.2.2.2.3. T – Test of Number of Customer (Customer)

H_0 : $\beta_1 > 0$

H_i : $\beta_1 < 0$

The value of computed t value is 18.52438

The value of t table with α 5% and df 25 is 1.740

Since the value of computed t value is bigger than the t table, so the Ho is rejected statistically. It

means that the number of customer have a positive affect on the demand for electricity per capita in Indonesia significantly.

6.2.2.3. F Test

This test is used to detect the correlation between dependent variable and independent variables jointly. The testing of F test is the same as the testing for t test. Hypothesis is formulated as follows:

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$: hence the independent variables do not affect the dependent variable jointly.

H_1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$: hence the independent variables affect the dependent variable together.

The decision will be made with the parameter (α) 5% based on the following rules:

a. When the value of computed F < F table value, the decision is accept H_0. In this case the independent variables jointly do not impact on dependent variable significantly.

b. When the value of computed F > F table value, the decision is reject H_0. In this case the independent variables jointly impacts on dependent variable significantly.

The way to run the F test is similar to t test in which comparing the value of computed value and table value. First thing to do is looking for the value of F table in the statistical table. The way to find the F table is by getting the degree of freedom for numerator (k-1) and degree of freedom for denominator (n-k)

With the level of α 5%, degree of freedom for numerator 3 (4-1) and the degree of freedom for denominator 17 (21-4), found that the value of F table for $F_{(3:17),}$ is 3.20. Meanwhile the value of computed F value from the regression result is 1504.347. Since the value of computed F value is much greater than the value of F table, it can be concluded that the independent variables impact on the dependent variable jointly. In other words, Indonesian Gross Domestic Product, Prices of Oil, and Number of customer were impact jointly and significantly on the demand for electricity per capita on PT PLN in Indonesia.

6.2.3. Goodness of Fit (R^2)

From the regression run by writer, resulted the value of coefficient determination (R^2) 0.996247. This value shows a high measure for independent variables to explain its impact on dependent variable in the model. It means that the variation of the dependent

variable can be explained by the independent variables about 99.6247%, while the rest 0.3753 % are explained by factors outside the model.

6.2.4. Classical-Assumption Test

6.2.4.1. Multicollinearity

In this research, the detection of multicollinearity is done by watching and comparing the correlation among independent variables shown in the following table 6.3.

Table 6.3
Multicollinearity Test

	GDP	P_OIL	CUSTOMER
GDP	1	0.576172	0.905557
P_OIL	0.576172	1	0.766598
CUSTOMER	0.905557	0.766598	1

From the table above, it is clearly shown that the values of correlation among independent variables are relatively high. The correlation method states that when the correlation is r <0.99 it can be said that there is no multicollinearity in the model. So based on the correlation matrix writer conclude that the model of this research does not involve multicollinearity.

6.2.4.2. Autocorrelation

The tool of analysis is used to detect autocorrelation in this research is using LM (Lagrange Multiplier) test. The result of LM test shown below:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.736245	Probability	0.403537
Obs*R-squared	0.923812	Probability	0.336476

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 07/20/04 Time: 08:48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.19092	3.731093	-0.051171	0.9598
GDP	-2.11E-06	6.92E-06	-0.304083	0.765
P_OIL	-0.0031	0.007523	-0.412396	0.6855
CUSTOMER	2.68E-07	7.28E-07	0.368126	0.7176
RESID(-1)	0.242957	0.283151	0.858047	0.4035

R-squared	0.043991	Mean dependent var	-3.27E-14
Adjusted R-squared	-0.19501	S.D. dependent var	7.428546
S.E. of regression	8.120632	Akaike info criterion	7.23095
Sum squared resid	1055.115	Schwarz criterion	7.479646
Log likelihood	-70.925	F-statistic	0.184061
Durbin-Watson stat	1.712459	Prob(F-statistic)	0.943299

The guidance of decision which shows whether there is an autocorrelation or not in the model is by watching and comparing the value of χ^2 computed (Obs*R-square) and χ^2 table. When the value of χ^2 computed is greater than χ^2 table with α 5%,

so the hypothesis that stated there is no autocorrelation in the model is rejected, and the contrary.

From the LM test found that the value of χ^2 computed (Obs*R-square) is 0.923812 in which smaller than the value of χ^2 Table; in other words; there is no autocorrelation in the model because the value of χ^2 computed is smaller than the value of χ^2 table 6.4.

Table 6.4
The Comparison Value of χ^2 computed and χ^2 table

χ^2 computed	χ^2 table	Decision
0.923812	3.84146	No Autocorrelation

6.2.4.3. Heterocedasticity

An important assumption of heterocedasticity shows the conditional of X increasing as Y increasing. Here the variances of X are not the same. The writer using white test that provide by the eviews 3.0 program to detect heterocedasticity.

The white model is:

$$E^2 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \delta_1 X_1^2 + \delta_2 X_2^2 + \delta_3 X_3^2 + \delta_4 X_1 X_2 + \delta_5 X_1 X_3 + \delta_6 X_2 X_3 + \varepsilon$$

The result as follow

White Heteroskedasticity Test:

F-statistic	1.226478	Probability	0.368633
Obs*R-squared	10.51825	Probability	0.31018

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 07/20/04 Time: 08:39
Sample: 1982 2002
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	73.28449	102.6766	0.713741	0.4903
GDP	-0.00026	0.000351	-0.724876	0.4837
GDP^2	-2.73E-10	4.77E-10	-0.572392	0.5786
GDP*P_OIL	1.74E-06	1.38E-06	1.266804	0.2314
GDP*CUSTOMER	2.14E-11	6.62E-11	0.323574	0.7523
P_OIL	-0.4746	1.025871	-0.462634	0.6526
P_OIL^2	5.99E-05	0.000285	0.210032	0.8375
P_OIL*CUSTOMER	-1.08E-07	1.01E-07	-1.074597	0.3056
CUSTOMER	2.23E-05	2.29E-05	0.97084	0.3525
CUSTOMER^2	-1.44E-13	3.26E-12	-0.04412	0.9656

R-squared	0.500869	Mean dependent var	52.55552
Adjusted R-squared	0.092489	S.D. dependent var	70.45926
S.E. of regression	67.12186	Akaike info criterion	11.55665
Sum squared resid	49558.78	Schwarz criterion	12.05404
Log likelihood	-111.345	F-statistic	1.226478
Durbin-Watson stat	2.825586	Prob(F-statistic)	0.368633

The guidance of decision which shows whether there is heterocedasticity or not in the model is by watching and comparing the value of χ^2 computed (Obs*R-square) or by times $n.R^2$ and the chi-square distribution with 9 df. The 5% critical chi-square value for 9 df is 16.91990. When the value of χ^2

computed is greater than critical chi-square with α 5%, so the hypothesis that stated there is no heterocedasticity in the model is rejected, and the contrary.

From the White test found that the value of χ^2 computed (Obs*R-square) is 10.51825 or $n.R^2$ = 21 x 0.500869 = 10.518249 in which smaller than the value of χ^2 table (critical chi-square) with df = 9 and α= 5% is 16.91990; in other words; there is no heterocedasticity in the model because the value of χ^2 computed is smaller than the value of χ^2 table 6.5.

Table 6.5
The Comparison Value of χ^2 computed and χ^2 table

X^2 computed	χ^2 table	Decision
10.51825	16.9190	No Heterocedasticity

6.2.4.4. Specification error test

The writer using RESET (regression error specification test) based on the work of Ramsey (1969). This test is general set of test for mis-specification, which are not based directly on an examination of residuals. In this test we have to make assumption that the null hypothesis is the correct specification that is linear model. The result that provide by the Eviews 3.0 computer program as follow:

Ramsey RESET Test:

F-statistic	0.42281	Probability	0.524766
Log likelihood ratio	0.547733	Probability	0.459246

Test Equation:
Dependent Variable: Q
Method: Least Squares
Date: 08/10/04 Time: 18:29
Sample: 1982 2002
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.42888	9.413158	0.789202	0.4415
GDP	8.74E-06	7.19E-06	1.216877	0.2413
P_OIL	0.010211	0.009532	1.071232	0.3
CUSTOMER	1.11E-05	1.69E-06	6.568864	0
FITTED^2	0.000174	0.000268	0.650239	0.5248

R-squared	0.996344	Mean dependent var	208.6387
Adjusted R-squared	0.99543	S.D. dependent var	121.2636
S.E. of regression	8.197758	Akaike info criterion	7.249855
Sum squared resid	1075.252	Schwarz criterion	7.498551
Log likelihood	-71.1235	F-statistic	1090.059
Durbin-Watson stat	1.496148	Prob(F-statistic)	0

The guidance of decision which shows whether there is a mis-specification or not in the model is by watching and comparing the value of computed F-statistic and the F-table. When the computed F value is less than the F table means we accept the null hypothesis that there is no mis-specification in this model.

With the level of α 5%, degree of freedom for numerator 3 (4-1) and the degree of freedom for denominator 17 (21-4),

found that the value of F table for $F_{(3:17),}$ is 3.20. And the computed F value is 0.42281 in which smaller than F-table 3.20; in other words; we accept the null hypothesis there is no mis-specification in this model.

Table 6.6
The Comparison computed F value and F-table

F computed	F table	Decision
0.42281	3.20	No mis-specification

6.3. Research Discussion

The discussion in this part is meant to have a deep and advance discussion related to the model.

6.3.1. Gross Domestic Product

GDP or gross domestic product is the total value of a country's output. It is the market value of all final goods and services produces within a given period of time by factors of production located within a country. (Karl E. Case, 2002).

In this research GDP is one variable that affecting to the demand for electricity, cause GDP represent income, it is says from the method of calculating GDP, there are two method of calculating GDP, first expenditure approach, second income approach in this approach including all the income such as wages, rents, interest and profit.(Karl E. Case,2002)

In this research data the writer used Per capita GDP. It means a country's GDP is divided by it population. The reason of using per capita GDP is a better measure of well-being for the average person than is the total GDP

Previously, the writer made hypothesis of relationship between per capita gross domestic product and per capita demand for electricity on PT PLN Indonesia is positive. It means that an increase of per capita gross domestic product will increase to the per capita demand for electricity.

According to statistical test, the coefficient value of per capita gross domestic product variable is 0.0000068. This value represents that when per capita GDP increase by 1 Rupiah, the demand for electricity per capita will also increase by 0.0000068 GWh holding all variable assume to be constant. It agrees with the previous hypothesis in this research about the positive relationship between both variables gross domestic product and the demand for electricity.

GDP represents the welfare of community in a country. The higher the number of a country's GDP the richer the community in that country. GDP can also present the county production based on its definition, where increasing a production can increase the GDP, the relationship with the demand for electricity is when the production is increase the demand for electricity also increase this is happen because in modern era the major input factor of production is electricity, many

industrial tools need electricity in order to be more faster and efficient in production. Another reason that might tell that increasing GDP can increase demand for electricity is according to consumption theory if customer have more income or money they tend to spent more on the consumption (Lipsey, 1996), based on this definition, in this modern era where every tools in our daily life is using electricity and PLN have the monopoly authorities to do that so, the demand for electricity in PLN also increase.

Meanwhile the insignificant number of T-test 1.058896 below the T-table, the effect of GDP per capita on the demand for electricity per capita the reason is because of electricity right now is just like necessities good that needed to our daily activity so when ever their income is increasing or decreasing people are still willingly to pay to purchase this commodity.

6.3.2. Prices of Oil

The other variable that affecting quantity demand for electricity per capita is prices of oil. In this research the prices of oil its self is the prices of diesel oil or call "solar" in Indonesia. The purpose of using these prices of oil is as the substitution goods for electricity.

The hypothesis for this variable is prices of oil impact on the quantity demand for electricity per capita positively. It means that an increase on the prices of oil will increase to the quantity demand for

electricity per capita. In other words, both variable prices of oil and quantity demand for electricity per capita has a positive relationship.

The statistical test supports hypothesis correctly. The resulted coefficient from regression for prices of oil variable is 0.014646. The value shows the impact of prices of oil on the quantity demand for electricity per capita in Indonesia. When the price of oil is increase by 1 rupiah/litter, the quantity demand for electricity per capita is also increase by 0.014646 GWh. This statistical result is fit with the previous hypothesis that stated a positive relationship between prices of oil and quantity demand for electricity per capita in Indonesia.

The statistical result show probability and t-statistic number that significant at 0.0389 and 2.237513, its means that when the prices of oil is increasing the customer tend to decreasing their volume of using oil and shifting to using more electricity immediately its would create an increasing to the quantity demand for electricity.

The statistical significant result for the prices of oil that shows the positive impact to the quantity demand for electricity in PLN can be supported by some reason. The significant number show customer immediately change from using oil to electricity it is because the concept of efficiency, in economics term concept of efficiency is to minimize the cost and maximizing the return or profit. In Indonesia many industries when they start doing their business commonly they already prepare their source of energy power ones they build their own generator and

second they also demand electricity from PT PLN. This situation happen because the electricity that produce from PT PLN sometimes does not good enough, according to the research, electricity in Indonesia that comes form PLN sometimes got cut off suddenly or sometimes the energy power goes down or drop suddenly, this can make the production process not running well it can make the production became decreasing or may be stopped, the businesses or industries sector doesn't want that happen. So this is makes the industries build their own generator as the other source of energy. The relation between electricity from PT PLN and prices of oil is relatively high, in Indonesia the prices of oil also monopolized by the state company that call PT PERTAMINA, is the state company that deal with producing, distributing and selling the oil in the country. This is make the prices for both goods got monopolized by the supplier. Because of that right now many industries sector commonly using both sources of energy that comes from electricity and also comes from generator together, it means, the industries using both goods at the same time, the industries as the consumer use a combination for using both goods electricity and oil, in economics term this situation can be represent on indifferent curve. The volume of using both sources is depended on the concept of efficiency and the Theory of Consumer Choice. (Gregory Mankiw, 2001), Examine the trade off that people face in their role as consumer. When a consumer buys more of one goods, he can afford less of other goods. When he spends more time enjoying

leisure and less time working, he has lower income and can afford less consumption. These theories examine how consumer facing these tradeoffs makes decision and they respond to change in their environment. Consumer will choice the commodity that according to them more efficient. So when ever the prices of oil is increasing at the same times the consumer will decreasing their volume of using oil and shifting to use electricity form PLN, this is make the quantity demand for electricity is increasing.

The writer used industrial sector because according to the data from PT PLN, the volume of energy that had been sold most of it had sold to the industrial sector. It can be seen from the table 6.7 below.

Table 6.7

Energy sold (GWh)

Customer	End REPELITA 1 (1973/74)	End REPELITA 2 (1978/79)	End REPELITA 3 (1983/84)	End REPELITA 4 (1988/89)	End REPELITA 5 (1993/94)	End REPELITA 6 (.1998.)	Year 2001
Household	1077.3	1962.2	4219.5	7274.63	13140.74	24865.45	33339.78
Industry	596	1443.4	3435.9	9052.24	19560.98	27995.54	35593.25
Business	220.9	430.9	1002.5	1740.14	3774.97	8655.96	11395.35
Other	320.8	450.4	1269.8	1925.83	2485.34	3744.46	4192
Total	2215	4286.9	9999.7	19992.84	38962 03	65261.41	84520.38

source: PLN statistic 2001

The table shows that from REPELITA 4 in the year 1988/89 the number of energy sold to the industrial sector became the highest, and to the year of 1998 the number of energy sold to the industrial sector became increasing more sharply, and if we look on the

prices of oil in that year, the prices of oil increasing almost two times from 280 to 600 rupiah/litter or increasing 214.29 %. The situation also happen in the year 2001 where the number of energy sold in the industrial sector increasing a lot, in that time the prices of oil increasing from 600 to 1600 rupiah/litter or increasing 266.67%, although the prices of electricity is also increasing from year to year the percentage of change in prices of oil is still higher that percentage change in prices of electricity. This analysis is to provide stronger statistical hypothesis to the price of oil as the substitution goods for electricity.

6.3.3. Customer

Customer is one variable that most definitely affecting the quantity demand for electricity in PLN. In this case the customers are the total of PT PLN customer that is using electricity from PT PLN. In this research the customers are mention by people so that every individual have different demand for electricity.

The hypothesis for customer made by writer is a positive relationship between number of customers and the quantity demand for electricity per capita in PLN. It means that when the number of PT PLN customer increases, the quantity demand for electricity per capita in PT PLN also increases.

The hypothesis is corrected and supported by the value of coefficient for the number of customer variable as much 0.000021. It

means that when the number of customer increases by 1 person the quantity demand for electricity per capita in PT PLN will also increase by 0.000021 GWh.

Actually the statistical test, clearly explain the logical thinking behind the hypothesis. The more the number of customer who using the electricity form PT PLN the higher the quantity demand for electricity per capita in PT PLN.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

From the examination and discussion of the previous chapter, several conclusions and recommendations are outlined as follow.

7.1. Conclusions

1. This research summarizes the determination of the quantity demand for electricity per capita on PT PLN (PERSERO); they are Indonesian Gross Domestic Product per capita, Prices of Oil, and the number of PT PLN customer.
2. Based on the research, the coefficient of determination R-squared is 0.996247. It means that about 99.66247% of variation in quantity demand for electricity per capita in PT PLN can be explained by variation in the explanatory variables. They are Indonesia Gross Domestic Product per capita, Prices of Oil and the amount of PT PLN customers. Meanwhile, the rest is around 0.33753% that explains the outside factors of this model.
3. According to the regression result, F test value of this research is greater than F table value; means that those independent variables (GDP per capita, Prices of Oil and Number of Customer) affect the quantity demand for electricity per capita in PT PLN in jointly.
4. The t test for Indonesian Gross Domestic Product per capita is statistically expresses that the relationship between Indonesian gross

domestic product per capita and the quantity demand for electricity in PT PLN is positive. It is proved with the coefficient value of Indonesia gross domestic product per capita variable 0.0000068. This coefficient value means that the increase of the gross domestic product per capita in Indonesia, as much as 1 Rupiah, will increase the quantity demand for electricity per capita on PT PLN by 0.0000068 GWh and other variables are assumed to be constant. The insignificant effect of the Indonesia gross domestic product per capita is caused electricity is a necessities commodities needed by every one or a basic need in this modern era. So whenever the income is increasing or decreasing, people still have willingness to purchase this commodity. This makes the gross domestic product per capita variable in the model become insignificant.

5. The t test for Prices of oil as the substitution goods explained by the coefficient value for prices of oil variable is as much as 0.014646. It means that when the prices of oil increases by 1 Rupiah/litter, the quantity demand for electricity per capita in PT PLN also increases by 0.014646 GWh while other variables are assumed to be constant. The prices of oil impacts to the quantity demand for electricity per capita in PT PLN are significant. Price of oil as the variable in this research affects the quantity of demand for electricity dominantly. It is the reason why, according to the PLN data in term of energy sold in PT PLN on the table 6.7, the most of the energy sold go to the industrial sector where

industrial sector is also using a lot of oil as the other source of energy beside electricity from PT PLN.

6. The t test for the amount of PT PLN customer by the coefficient value for customer variable is as much as 0.0000121. It means that when the amount of customer increases by 1 person, the quantity demand for electricity per capita in PT PLN also increases by 0.000021 GWh where it is assumed that other variable is constant. The number of PT PLN customer impacts the quantity demand for electricity per capita significantly.
7. There are no multicollinearity, autocorrelation, heterocedasticity and mis-specification in the model of this research. It means that all independent variables (GDP, P_OIL and CUSTOMER) affect dependent variable quantity demand for electricity per capita (Q) significantly.

7.2. Implication

1. Based on the analysis in term of income per capita variable, it shows that the result is positive (+) insignificant to the quantity demand for electricity. This is because of electricity is necessities good in this modern era, so whenever the income is increasing they will buy more electricity from the PLN. This is a good sign for PT PLN as the only provider of electricity in Indonesia. Therefore, PT PLN should consider more the increasing of income because it may increase the quantity demand for electricity. PT PLN also has to give more attention to their customer in order not to make them disappointed by increasing the company performance.
2. According to the analysis result price of oil, price of oil has a positive significant effect to the quantity demand for electricity in PT PLN. It means that oil is a substitution good for electricity and the significant point show that whenever the price of oil decreases, people will shift their demand from electricity to oil immediately. Based on that PT PLN should consider more in determining the electricity prices because if it doesn't, PT PLN will lose some of their potential demand for electricity.

BIBLIOGRAPHY

Abdulkadir, Ariono. (2000). Pedoman Hitungan Dampak Kenaikan Harga BBM & TDL Tahun 2000. Indonesia: KADIN Indonesia & KLUB BIMASENA.

Blanchard, Olivier (1997). Macroeconomics, 2nd ed., Massachusetts Institute of Tecnology, USA : Prentice-Hall, Inc.

Case, Karl E., and Fair, Ray C. (2002). Principles of Economics, 6th ed., USA: Prentice-Hall, Inc.

Dirjen LPE (2002). PT PLN (PERSERO) In Brief. Enclosure Paper, No 2769/04.1/2002 October 21, 2002.

Gujarati, Damodar N. (1995). Basic Econometrics, 3rd edition., Singapore: McGraw-Hill.

Hyman, David N. (1996). Microeconomics, 4th ed., North Carolina State University, USA : Irwin/McGraw-Hill.

Lipsey, Richard G., and Paul N. Courant. (1996). Economics, 11th ed., New York, USA: HarperCollins Publisher Inc.

Mankiw, Gregory. (2001). Principle of Microeconomics, 2nd ed., Harvard University, USA : Harcourt College Publishers.

Oxford University. (1995). Oxford Advance Learner's Dictionary. Britain. Oxford University press.

Presiden Republik Indonesia. (2002). Undang-Undang Republik Indonesia No nor 20 Tentang Ketenagalistrikan. Indonesia: Dewan Pimpinan Serikat Pekerja PT PLN (PERSERO).

PT PLN (PERSERO). (2000). Panduan Penjelasan Tarif Dasar Listrik 2000. Indonesia: PT PLN (PERSERO).

PT PLN (PERSERO). (1997). 50 Tahun Pengabdian PLN. Indonesia: PT PLN (PERSERO).

PT PLN Statistics. (2001). Catalogue In Publication (2002), No 31.621.3 , PT PLN (PERSERO)

Samuelson, Paul A., and Nordhaus, Willliam D. (1995). Economics, 15th ed., USA: Mc Graw Hill.

Tim Redaksi. (2004). Pengembangan Energi Terbarukan. Listrik Watch Journal. Vol. 6 Year II Edition, February – March 2004, pp 27-28.

APPENDIX

RESEARCH DATA

obs Year	Quantity demand Per capita (GWh)	GDP Per capita MillionRupiah	P_OIL Rupiah/litter	CUSTOMER People
1982	59.47321	80537.77	85	3802518
1983	63.91211	471065.5	145	4406077
1984	69.05798	488552.1	220	5133231
1985	77.76284	520732	242	5953293
1986	88.57398	539602.3	200	6965579
1987	99.28138	549496	200	8203349
1988	113.8668	569147.4	200	9275938
1989	130.8209	599091.8	200	10316945
1990	154.6355	686875.7	245	11463738
1991	169.1474	704839.9	300	12396716
1992	184.4585	1622127	300	13486556
1993	201.9493	1709303	380	15157409
1994	219.3681	1806627	380	16936613
1995	249.1798	1922326	380	19471647
1996	294.7249	2145358	380	21980325
1997	328.4384	2212583	380	24640587
1998	325.088	1873233	600	26433489
1999	351.684	1870298	650	27524552
2000	384.5939	1933623	800	28595405
2001	404.5973	1970412	1600	29827728
2002	410.7986	2011978	1980	30586479

MWD TEST

Dependent Variable:
Q
Method: Least Squares
Date: 08/10/04 Time: 17:52
Sample: 1982 2002
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.06752	4.53332	-0.235482	0.8168
GDP	1.66E-05	1.10E-05	1.503168	0.1523
P_OIL	0.018628	0.00747	2.493697	0.024
CUSTOMER	1.14E-05	9.33E-07	12.17945	0
Z1	-120.004	110.3615	-1.087374	0.293

R-squared	0.996506	Mean dependent var	208.6387
Adjusted R-squared	0.995632	S.D. dependent var	121.2636
S.E. of regression	8.014513	Akaike info criterion	7.204642
Sum squared resid	1027.719	Schwarz criterion	7.453338
Log likelihood	-70.6487	F-statistic	1140.66
Durbin-Watson stat	1.612438	Prob(F-statistic)	0

Dependent Variable: LOG_Q
Method: Least Squares
Date: 08/10/04 Time: 17:52
Sample: 1982
2002
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.851	0.424245	-25.57712	0
LOG_GDP	-0.11727	0.041358	-2.83539	0.0119
LOG_P_OIL	0.008742	0.030161	0.289842	0.7757
LOG_CUSTOMER	1.071942	0.054782	19.56747	0
Z2	-0.01006	0.003959	-2.541242	0.0218

R-squared	0.995645	Mean dependent var	5.153758
Adjusted R-squared	0.994556	S.D. dependent var	0.654168
S.E. of regression	0.048267	Akaike info criterion	-3.01989
Sum squared resid	0.037275	Schwarz criterion	-2.77119
Log likelihood	36.70884	F-statistic	914.4414
Durbin-Watson stat	0.901535	Prob(F-statistic)	0

MULTICOLLINEARITY

CORRELATION MATRIX

	GDP	P_OIL	CUSTOMER
GDP	1	0.576172	0.905557
P_OIL	0.576172	1	0.766598
CUSTOMER	0.905557	0.766598	1

AUTOCORRELATION

LAGRANGE MULTIPLIER TEST

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.736245	Probability	0.403537
Obs*R-squared	0.923812	Probability	0.336476

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 07/20/04 Time: 08:48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.19092	3.731093	-0.051171	0.9598
GDP	-2.11E-06	6.92E-06	-0.304083	0.765
P_OIL	-0.0031	0.007523	-0.412396	0.6855
CUSTOMER	2.68E-07	7.28E-07	0.368126	0.7176
RESID(-1)	0.242957	0.283151	0.858047	0.4035

R-squared	0.043991	Mean dependent var	-3.27E-14
Adjusted R-squared	-0.19501	S.D. dependent var	7.428546
S.E. of regression	8.120632	Akaike info criterion	7.23095
Sum squared resid	1055.115	Schwarz criterion	7.479646
Log likelihood	-70.925	F-statistic	0.184061
Durbin-Watson stat	1.712459	Prob(F-statistic)	0.943299

SPECIFICATION ERROR TEST

RAMSEY RESET TEST

Ramsey RESET Test:

F-statistic	0.42281	Probability	0.524766
Log likelihood ratio	0.547733	Probability	0.459246

Test Equation:
Dependent Variable: Q
Method: Least Squares
Date: 08/10/04 Time: 18:29
Sample: 1982 2002
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Variable	Coefficient	Std. Error	t-Statistic	Prob.
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GDP	8.74E-06	7.19E-06	1.216877	0.2413
P_OIL	0.010211	0.009532	1.071232	0.3
CUSTOMER	1.11E-05	1.69E-06	6.568864	0
FITTED^2	0.000174	0.000268	0.650239	0.5248

R-squared	0.996344	Mean dependent var	208.6387
Adjusted R-squared	0.99543	S.D. dependent var	121.2636
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Sum squared resid	1075.252	Schwarz criterion	7.498551
Log likelihood	-71.1235	F-statistic	1090.059
Durbin-Watson stat	1.496148	Prob(F-statistic)	0