ECONOMIC COST OF ELECTRIC POWER INTERRUPTION ON SMALL AND MEDIUM ENTERPRISES BUSINESS IN THE CASE OF HADIYA ZONE SOUTHERN ETHIOPIA.

MSc .THESIS

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A THESIS SUBMITTED TO THE DEPARTMENT ECONOMICS COLLEGE OF BUSINESS AND ECONOMICS, SCHOOL OF GRADUATE STUDIES WOLKITE UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN DEVELOPMENTAL ECONOMICS.

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"Who [am] I, O Lord GOD? And what [is] my house that thou hast brought me hitherto? ". 2nd Samuel 7:18. First and foremost, let me praise and honor the almighty God for the opportunity and capacity he gave unto me realize my objective.

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Solomon Daniel

June, 2012

ADVISORS' APPROVAL SHEET

SCHOOL OF GRADUATE STUDIES WOLKITE UNIVERSITY ADVISORS' APPROVAL SHEET (Submission Sheet-1)

This is to certify that the thesis entitled "ECONOMIC COST OF ELECTRIC POWER INTERRUPTION ON SMALL AND MEDIUM ENTERPRISES BUSINESS IN THE CASE OF HADIYA ZONE" submitted in partial fulfillment of the requirements for the degree of Master's with specialization in Development Economics, the Graduate Program of the Department/School of Business and Economics, and has been carried out by Solomon Daniel Id. No. GSE/077/2010/, under my/our supervision. Therefore I/we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

SOLOMON FISEHA  _____

Name of major advisor Signature Date

_____ _____ _____

Name of co-advisor Signature Date

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Abbreviations and acronym

SME: Small and medium enterprises

EEPCO: Ethiopian electric power corporation

USA: United States of American

UNIDO: The United Nations Industrial Development Organization

GDP: Gross domestic product

ICT: Information Communication Technology

MSME: Micro small and medium enterprises

WBES: World Bank enterprises survey

KWH: Kilowatt hours

HTFED: Hosanna town finance and economy development office

CM: Choice of model

MLM: Multiple logit models

IID: Independently and identical distribution

WTP: Willingness to pay

Abstract

In most developing countries electricity supply is highly not sustainable. The primary objective of this study is to analyze the economic cost of the electric power interruption on the SME business in a case of Hadiya zone, Ethiopia. These estimates rely on a cross sectional data collected from Respondents through questioners and face-to-face interviews. Using a conditional logit and the binary logistic regression models, to be associated with consumers' willingness to pay for improve power interruption. The study findings show that Family size and size of enterprise have no statistical significant and negative marginal effect of willingness to pay electricity improvement. In addition, Maintained cost of alternative sources, distance of manufacturing area to sale/services and satisfactions level with electricity service is insignificant effects for choosing of willingness to pay additional cost to avoid electricity interruption. also, the results reveals that power interruption variables (measured using frequency of power interruption in a per days and monthly electricity expenditure) have a positive and significant effect on the estimated willingness to pay or causes for economic costs on small and medium enterprise, but Alternative source of power supply equipment has negative and significant at 5% level of significance effects on willing to pay for improved services. One strong outcome of the study is that the power interruption in study area has imposed significant additional costs on the services/business sector in SMEs. The bulk of these additional costs relate to the enterprises' acquisition of very expensive alternative power source to cushion them against the even larger losses arising from frequent and long power fluctuations. Therefore, the paper suggests that there is need for the Ethiopia or regional government to come up with ways of improving energy generation and supply, as well as proper maintenance of electricity infrastructure in the study area.

Keywords: Electric Power interruption, Economic cost, Willingness to pay, Conditional logit and Binary logistic regression models.

CHAPTER ONE

1. Introduction

1.1.Back ground of study

Sustainable Electric power supply is the major moving force for all economic sector sustainability in today's competitive world. It is therefore important that an access to reliable power source is essential for the success of any business which in turn leads to consumer satisfaction, high productivity, profitability and overall economic growth. Small and medium enterprises contribute significantly to the economic development of many developing and developed countries in the area of job or employment creation and revenue generation by using reliable electric power supply (Gbeve Prosper Kwabla, 2015)

As much as air and water, human being requires electric power energy for existence now days, modern and renewable energy such as Sustainable electricity can stimulate economic growth. That will have beneficial spillover effects on households living in poverty and helps to insure environmental sustainability (Issahaku & Nkegbe, 2013)

The importance of electricity to economic development of any nation cannot be overemphasized (MusiliuOseni, 2013). Access to Sustainable electricity supply increases the productivity and welfare of society. To business enterprises, electricity serves as an indispensable input. Apart from its necessity for running many industrial machines, its contributions to the productivity of human capital are enormous. Virtually all business activities, especially industrial units, require constant and effective flow of electricity. Given the forgoing, it suffices to say that poor electricity supply or lack of quality and effective electricity service delivery is a depression to economic growth. It restricts economic as the socioeconomic welfare of the people.

Poor electricity supply affects business activities in many ways. First, it affects SME productivities as in many cases other inputs may be futile when there is no electricity to power them. The use of Information Communication Technology for different purposes requires an effective and efficient flow of electricity. Addition to this is huge injury to materials and equipment's that a power interruption of long duration that occurs during production process may cause in some businesses; an interruption of about 40 minutes will cause molten ore in electronically heated ovens to harden. (MusiliuOseni, 2013). This may consequently damage the ranges, destroys there sources and also results in huge restart costs. More so, an interruption of few minutes at an emergency unit of a specialist hospital may result in loss

of many lives. Second, many small and medium enterprises rely on the use of the Internet to communicate their customers (e.g. emails), to advertise their products, and for electronic payments, which can only be efficient if there is effective electricity supply. Lastly, many raw materials and some finished products require constant flow of electricity for their storage, and any power nicks would result in huge business loss; this may have considerable effects on people whose livelihoods depend on the business (OECD/ IEA, (2010).

Poor electricity supply has proved to be the major constraint to the business sector in the world. Electric power interruption follows so many economic losses in Africa and has contributed to the low productivity and poor competitiveness of the manufacturing sector in the continent. Between 2006 and 2010, more than 50% of the Sub-Sahara African businesses identified electricity as a major constraint to their businesses compared to just 27.8% which face transportation as the most critical problem (World Bank, 2012).

In Ethiopia like other developing countries, electricity service is limited not only by its access but also its quality in terms of its reliability is questionable. In this country, on average, electricity interruption occurs three times per day lasting for one to two hours (EEPCO, 2014). These frequent and longer interruption have direct and indirect costs. The direct cost includes; replacement cost (cost on damaged equipment and materials such as TV, Radio, divider, electric bulb and electric wire),cost on other alternative energy sources such as fuel wood, charcoal, kerosene, candles, increase workload on woman's and children's. The indirect cost includes reduce productivity, health problem such as respiratory disease, leisure time costs, climate change (which includes increase in average temperature, or a change in rainfall patterns) (Commore and ETO, 2006).

According to Simon off et al. (2005), there are many factors that may cause electricity interruption: Crime, equipment failure, fire, Human error, operational error, natural disaster, weather, capacity shortage. However, for many developing countries including Ethiopia, energy shortage leading to load shedding and equipment failure, which is the number one factor for interruption, causes and natural disaster, is also cause power interruption in Ethiopia (EEPCO, 2013). Improving access and quality of electricity service can enhance sustainable economic development and the wellbeing of the society while at the same time generating more revenue to the government that can help further development of the energy sector. However, policy makers need information on revenues that can be generated from customers once improvements are carried out since this is an important part of project evaluation.

The lack of secure and Sustainable electrical power is a constraint to doing business in developing countries. Industrial firms in developing countries adopt different strategies to cope with deficiency in electricity supply. Power interruption are disturb firms productivity negatively increasing firm cost by 15% from 2011 to 2015 World Bank enterprise survey data indicated that .this effect varied negatively with output levels suggesting that power interruption is particular costly for small firms (Lamessa ,2018). Electricity interruption frequencies, the duration of the interruptions and/or load curtailment have been known to cause a lot of difficulties for specific industries particularly those that use electric power as energy a sources. The electricity interruptions or fluctuations have had varying effects on businesses including but not limited to instantaneous damage to semi-finished goods, associated costs incurred in repairing equipment's and losses accrued from delayed or cancelled orders.

1.2. Statement of the problem

Electricity plays a great role in the modern economy. Still now purely having access to power is not enough especially in developing countries like Ethiopia. The reliability of supply is also vital. In Ethiopia, the number of interruption (both technical and non-technical) is very high compared to that of developed countries. EEPCO (2014) reported that the number of interruption experienced by all customers in all sectors in Ethiopia averages 1080 hours per year (equivalent to 45 days per year) , Whilst in developed countries like Netherlands and USA the average interruption for low voltage consumers is 26 and 106 minutes per year, respectively (Bloemhof et al.,2001).

Certain studies have been undertaken to analyze electric power consumption for economic growth. There is a direct relationship between energy consumption and economic growth, which is known as the growth hypothesis. This hypothesis states that a country's economic growth depends on energy consumption in the economy (Ogundipe et al.,20014).Economic growth not only depends in electric power supply there are different types of alternatives that used to economic growth natural gas, petroleum etc. Most studies focus only the importance of electric power consumption for economic growth Abundant evidence of the indispensable importance of access to a Sustainable supply of electricity for economic growth (Andersen and Dalgaard, 2013; Dinkelman, 2011; Lipscomb et al., 2013).

Electricity has become a vital part of the modern societies. Thanks to using electrical equipment in almost every aspect of the life (Sinan et al., 2015).Same times scholars specially those who wrote different kinds of journals, research and booklets around the importance of electric power consumption

for economic growth but seeing things only by positive side is not good identifying its negative impact is very essential. Deferent studies suggest that electric power interruption is the most factors for economic cost. Unreliable or epileptic power supply also posited that the poor performance of electricity supply in the state is the significance factor influencing against the performance of SMEs.

Many SMEs may have decreased due to the unreliable or epileptic power supply. In fact, there is an observed gloom by some will be entrepreneurs as to how long will they use backup energy and the probability of making an encouraging profit and Withstanding competitive pressure in their business environment.(Musiliu et al., 2013). Same studies deals about economic cost of electric power interruption on manufacturing areas (Fredrik et al., 2018). But still yet have not considered economic cost of electric power interruption on services sectors in Ethiopia specifically in Hadiya zone. Total loss of economic cost duo to electric power interruption is very important because government and other concern body rise to make good police and regulation in Ethiopia otherwise we don't know our total economic cost in each and every frequent electric power interruption problem.

The major issues for the researchers to make research on this area is most of the time electric power interruption problem influences on economic growth is not yet conceder even if in the servant or employers of Ethiopian electric power corporation. So the researcher to analysis and estimate economic cost/loss in same sectors specially small and medium enterprises in services sectors in Hadiya zone , because it is believed that there is no way those SMEs could have been contributing to the economy (in terms of poverty and unemployment reduction) without reference to the adequate and reliable power supply.

1.3.Research question

1. How electric power interruption affect income/sales volume of small and medium enterprise.

2. How the power fluctuations affect the expenditure patterns of SMEs

3. What are the other related factors to economic cost of small and medium enterprises.

4. Is there an alternative power source, if any what is impact on the competitiveness and productivity of SMEs?

1.4.Objectives of study

1.4.1. General objective the study

The general objective of this paper is to analyze the economic cost of the electric power interruption on the SME business in a case of Hadiya zone.

1.4.2. Specific objective of study

The specific objectives these studies are:

- ✓ To estimate economic cost of electric power interruption and its effect on income/sales volume of small and medium enterprise.
- ✓ To examine the effect of power fluctuations on the expenditure patterns of SMEs.
- ✓ To investigate the other related factors to economic cost of small and medium enterprises.
- ✓ To determine the cost of alternative sources of power interruption and its impact on the competitiveness of SMEs

1.5.Scope of the study

The scope of the study is delimited to Hadiya zone economic cost of electric power interruption and it focuses on a specific sector of service, trades and industrial sector. The research questions only in specific area and not to include other variables in the study like nation of the small and medium enterprise business. As the survey conducted was only restricted to Hadiya zone.

1.6. **Significance of the study**

The results of this study is therefore provide significant role in various aspects. it is important to reduce unnecessary cost by identifying the problem of electric power interruption, estimating the percentage

of how much electric power interruption influences on economic growth and to will be recommend for government to take responsibility and to make policy because due to electric power interruption so many small and medium enterprise exposed to economic cost or loss. Not only small and medium enterprises all economic agents will be affect negatively duo to electric power interruption in the level our country Ethiopia. Therefore after this thesis done it is very essential for all economic agents because it create awareness around there economic cost duo to electric power interruption and motivate them for searching other power option.

1.7. Limitation and Scope of the Study

The scope of the study is delimited to Hadiya zone SMEs focuses on a specific sector of service, trades and industrial sector. The research questions only in specific area and not to include other variables in the study like nation of the small and medium enterprise business. As the survey conducted was only restricted to Hadiya zone. This paper has also the following limitations: distance from urban area to rural due to data collection, less convenient respondent awareness and COVID 19 problems. Besides, there is scarcity of reliable and timely data in the study area for research purpose in general, the available information, gathered as per the need of the organizing institute, especially for econometric modeling. In addition, the study is also limited by financial resources to investigate the issue of large enterprise economy in a wider scope.

1.8. Organization of this paper

The whole paper is organized in to five chapters. The first chapter is dealing with introduction of the study, statement of the problem, research question, objective of the study, and significance of the study, scope and limitation of study and the organization of the paper itself. In chapter two, theoretical, empirical issues and conceptual frame work of study are discussed. Chapter three contains the methodological aspect of the study which includes: Description of the study area, Research Design, Population of the Study, Sampling Techniques, Sample Size and Sampling Procedure, Sources and Types of data, Methods of Data Collection, Techniques of Data Analysis, Model Specification and Description of Study Variables are discussed in detail. Chapter four deals about results and discussions including both the descriptive and result of empirical analysis and interpretation of the findings. Finally, chapter five presents the conclusions and Discussion with possible policy implications of based on empirical findings of the study. At the end, study followed by references and appendixes.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. THEORETICAL REVIEW

From the beginning of 1980s many countries reorganized their power sector putting aside non-competitive, dominant and regulated model. Along with this radical change came the emphasis on the significance of electric power reliability and therefore its economic worth. The authorities, the utilities and surely the costumers are asking for continuous electric supply with a certain level of power quality. Electricity power supply is one of the important components for development and in reducing poverty, which is one of Millennium Development Goals of Ethiopia.

Analysis of the relationship between the energy sector and economic development has been ongoing though in revealing measures since the middle of the 19th century. However, the interest in the relationship was later fuelled by the energy crisis of 1970s that saw the increase of the study of energy costs of the production process and subsequent effects on industry and the economy as a whole (Jiang et al.,2011). Many years later (in the 21st century), energy still holds a decisive significance for economic activity in that economic growth is determined by the energy resource of the country (Velasquez and Pichler, 2010).

2.1.1. Role of Electricity in Business

There is a symbiotic relationship between electricity and business. Energy supplies have a significant impact on economic activities (Velasquez and Pichler, 2010). This is because it is used for varied purposes ranging from production, storage, powering of office equipment and product display. Consequently, the use of electricity serves as input for production. This makes electricity an essential commodity for all industry types- manufacturing, service and distribution. Various sectors of the economy such as manufacturing and transport use enormous amounts of electricity (Haanes et al., 2011) for operation processes including storage, production. It is a critical resource needed to make products. In this respect, electricity as a “transformed unity” serves as a commodity. Consequently, suppliers of electricity have a strong influence on the buying organization’s ability to gain a competitive advantage and provide solutions to their clients.

This is because operators of Small and medium enterprise (MEs) have a high dependency on electricity as a standardized input, without it they cannot produce to satisfy their customers. This dependency on suppliers therefore explains the value of electricity to SME operations along two routes namely: supply risk and reliability of supply (Haanes et al., 2011)

2.1.2. Supply Risk

The supply risk route is a critical factor along the perception of electricity as a resource for the operation of SMEs (Halldorsson and Svedberg, 2013) In a report by UNIDO (2009), it was revealed that, in spite of the abundant resources Africa is endowed with, it still struggles with supply challenges in electricity. According to the UNIDO (2009) finding, only 26% of households have electricity making Africa the lowest in electricity penetration in all the continents. UNIDO (2009) reported that, an estimate of 547 million people in Africa lack access to electricity. Many reasons have been put forward by researchers and practitioners as the causes of such a predicament. For instance Mkhwanazi (2003) and Olumuyiwa and Mnse, (2008) have catalogued the following as the causes of poor access to electricity in Africa:

- ✓ Poor performance, resulting in poor quality of supply and service and an inability to meet growing electricity demand.
- ✓ Insufficient managerial and technical skills to do the job.
- ✓ Inability of the African country's government to fund expansion or refurbishment, or to attract private sector investment into the power sector.
- ✓ Lack of maintenance of the existing facilities due to inadequate finance/technical leading to reliability problems.
- ✓ Inappropriate tariffs, often resulting from political interference, with tariffs below marginal costs.
- ✓ Poor governance or unstable governments due to regional and ethnic conflicts Poor economic status of African states especially south of the Sahara.

- ✓ Inadequate revenue collection mechanisms, and therefore credit unworthy businesses
- ✓ Inadequate rainfall which causes power rationing.

All these have culminated in poor supply of electricity with its attendant effects on the operations and performance of SME.

2.1.3. Reliability

Reliability of electricity supply is another route that is closely linked to the supply risk route. Reliability was catalogued as a dimension of service quality in the work of Parasail man et al., (1988). It was then defined as the degree to which the retail service provides what was promised and when it was promised (Dabholkar et al., 1996). Electricity service providers have since measured system performance using reliability as an index (that is the proportion of uninterrupted customer hours provided per year out of a total number of customer hours provided per year) (Dabholkar et al., 1996). The deteriorating level of quality of electricity supply has since received a lot of researchers' attention.

In Africa in general and Ethiopia in particular, there are problems with the quantum of electricity supplied. The problems have been compounded with interruption in the supply of power which tends to affect business operations negatively. The New York Times in (2001) surmised that some business especially ICT-related businesses have suffered significant losses resulting from vulnerable electricity supply.

Electricity interruption frequencies, the duration of the interruptions and/or load limitation have been known to cause a lot of difficulties for specific industries particularly those that use electricity as a resource. The electricity interruptions or fluctuations have had varying effects on businesses including but not limited to instantaneous damage to semi-finished goods, associated costs incurred in repairing equipment's and losses accrued from delayed or cancelled orders.

2.1.4. Economic cost of electric power interruption

Two types of interruptions have been identified. They are planned interruptions and unplanned interruptions.

- Planned interruptions have a mitigating effect on business operations because potential damage to semi-finished goods or materials can be minimized through the switch to alternative sources of electrical power such as generators and solar panels. Cost incurred due to delayed or cancelled orders or equipment repairs can also be avoided because production and delivery schedules can be adjusted ahead of time. However, the costs of alternate power sources such as power generators, as well as expenditure on overtime pay to staff and outsourcing service cannot be avoided (Wang, 2002).

- Unplanned interruptions, however, have unmitigated and sometimes unforeseeable effects on business operations. Often, there are damages that tend to affect product quality, semi-finished goods and costs incurred in repairing, and in delays in the delivery of orders. The cancelations in delivery are borne by businesses and that increases the operation and maintenance costs (Lai, Yik and Jones, 2008).

The electric power clients could be divided into client sectors of industrial, service (or commercial), residential, etc. regarding their power consumption characteristics. To make better estimations and to reach sector specific results, this paper focuses on estimating the costs of power interruption for the service sector customers only. Before going through detailed analysis, understanding the nature of the power interruptions is obligatory. The interruptions could roughly be grouped into three types. Momentary interruptions, as the name calls, are the ones that last for a very short time, typically some seconds, or even less than one second. Sporadic interruptions, on the other hand, are caused by severe weather conditions such as floods, hurricanes or thunder storms. These types of interruptions pose great dangers for all the parties that benefit from the electric power system since they tend to last longer durations and they end up with quite high economic damages in the power infrastructure. The last type is the chronic interruptions. There are many factors that might end up with chronic interruptions.

Insufficient power generation, faults in the power system due to aging or lack of maintenance, the faults resulted from power system operation or overloading of the system are of some examples that end up with an unwanted and unexpected interruption.

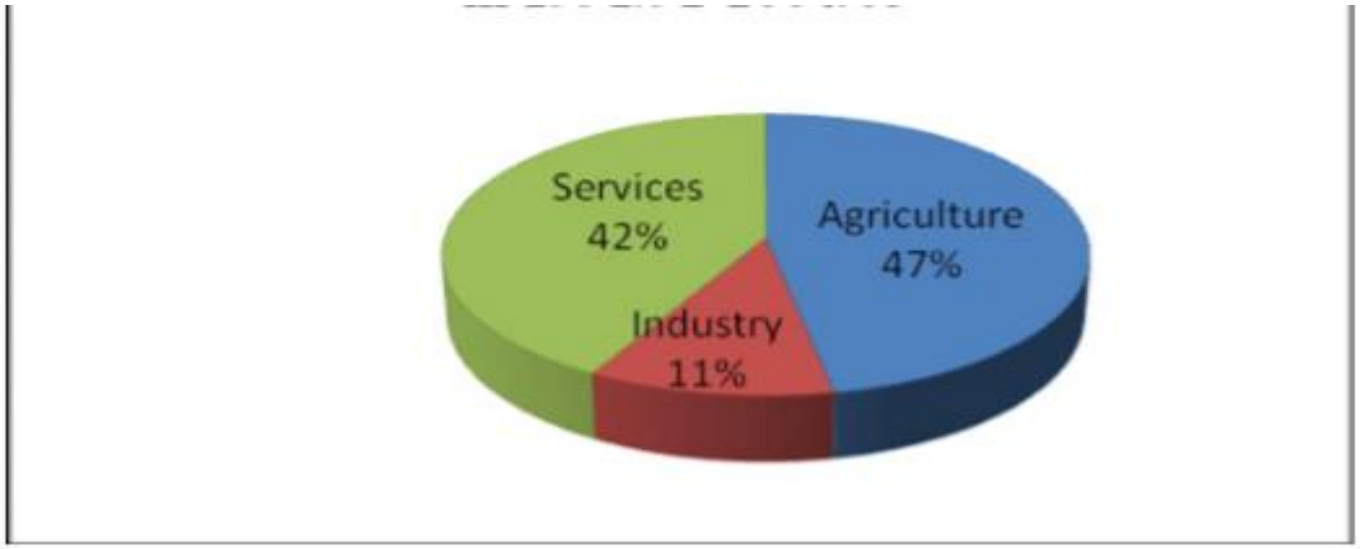
The duration of these interruptions might be from minutes to hours depending on the severity of the fault that occurred. Since the frequency of these interruptions is much higher than the others, in this paper, the researcher focused only on the chronic interruptions and sought for a methodology to come up with credible and sound estimates about the economic consequences of these events.

To fully understand the results of the interruptions, the impacts caused by these events must be analyzed and classified thoroughly. In the case study report of the 1977 New York blackout by the US Department of Energy the impacts of interruptions were grouped into two main categories: direct and indirect impacts.

The direct impacts include the direct effects of power interruption that cause economic losses such as sales loss, lost manufacturing, interruption of services, suspension of transportation, spoiled materials, damages on the electric equipment and on electronic data, other damages and accidents resulted from interruptions or, worst of all, injuries and deaths. The analysis of these events is relatively easy when they are compared to the indirect impacts. The indirect effects of power outages compose of arsons, looting, public disorder and crimes due to blackouts, possible sharp increases in the insurance rates, property losses, overtime payments, cancellation of social activities, lost tax revenues, the costs for recovering from looting and so on. When these indirect impacts are checked, it is obvious that the effects of some of those can only be seen after a considerable amount of time passes after the interruption. These long time effects make the analysis of the indirect impacts rather a challenging and a difficult task (BusaniMoyo (2011)

It further smacks of incompetence given that micro, small, and medium enterprises are the largest businesses in Ethiopia which accounts over 98% of all business firms and out of this figure the small firms represent around 65% of all businesses in the country (Aregash, 2005). This translates into an enormous potential to contribute to economic development and improve the living standard of the people with a corresponding potential to grow faster than larger contributions. Unfortunately the industrial sectors including SMEs did not grow as fast as service and agricultural sector; as a result it's potential to contribute for economic development is near to the ground and is not even partially utilized. In addition, currently the service sector contribution is surpassing the agricultural sector. This is because of that the industrial sector which provides advanced technology to agricultural sector is not developed in first place. Especially SMEs that can be used as a means for the development of large-scale firms did not get a favorable business environment (Eshetu and Mammo, 2009).

Chart 2.1.composition of real GDP in 1991/92-2004/5



Source: Ministry of Finance and Economic Development of Ethiopia (2005)

In terms of contribution to total output, it is evident from Figure 1 that the industrial sector's contribution is very low relative to other sectors such as agricultural and service sector. During the above stated period the industrial sector contributes only 11% to the national GDP and creates 22% of total employment at that year. The manufacturing sub sector contributes about 7% including SMEs. It is therefore telling that creating a functional business environment for the sector will accelerate the growth of the national economy.

This above mentioned figure indicates same thing which is the contribution of industry sector is low why because in the case of Ethiopia basic development infrastructure like electricity, pure water accessibility and road contraction still yet not full filled. Even if in Ethiopia only 44% population used electric power supply it is also its own problem like interruption.

In Calderon and Servén (2003), we present a similar empirical analysis with a focus on Latin America. Using GMM estimates of a Cobb-Douglas production technology obtained from a large cross-country panel data set, we find positive and significant output contributions of three types of infrastructure assets – telecommunications, transport and power. The estimated marginal productivity of these assets significantly exceeds that of non-infrastructure capital.

On the basis of those estimates, we conjecture that a major portion of the per-capita output gap that opened between Latin America and East Asia over the 1980s and 1990s can be traced to the slowdown in Latin America's infrastructure accumulation in those years. In contrast with the relatively large literature on the output contribution of infrastructure, studies of the impact of infrastructure on long-term growth are much less abundant. In a study of the growth impact of government spending, Easterly and Rebelo (1993) find that public expenditure on transport and communications significantly raises growth. Also, Sanchez-Robles (1998) find that summary measures of physical infrastructure are positively and significantly related to growth in GDP per capita. Easterly (2001) reports that a measure of telephone density contributes are significantly to explain the growth performance of developing countries over the last two decades.

Loayza, Fajnzylber and Calderon (2003) find that the same telecommunications indicator is robustly related to growth in a large panel data set including both industrial and developing countries. To our knowledge, López (2003) is the only paper assessing the contribution of infrastructure to both growth and income distribution, again using telephone density as the infrastructure indicator. In a panel framework and controlling for possible reverse causation, he finds that infrastructure both raises growth and reduces income inequality. A few papers go beyond measures of infrastructure spending and infrastructure stocks and consider the issue of infrastructure efficiency.

Hulten (1996) finds that differences in the effective use of infrastructure resources explain one-quarter of the growth differential between Africa and East Asia, and more than 40 percent of the growth differential between low- and high-growth countries. Esfahan and Ramirez (2002) report significant growth effects of infrastructure in a large panel data set in which the contribution of infrastructure is affected by institutional factors.

2.2. EMPIRICAL LITERATURE

According to Schurr and Netschert (1978), the connection between electricity and productivity was primarily investigated in the breakthrough period of the electrical motor from the 1890s to the 1920s. They noticed that, not only was there a general productivity surge in the 1920s, but this was accompanied by a steep increase in energy productivity, which they conjectured was related to the electrification of industry. Devine (1983) connected the general productivity growth with the energy productivity growth. He explicitly explained the productivity effects that arose from electrification of industry when steam and water-powered prime movers were substituted with electric motors that first

drove groups of machines and later individual machines. Not only did this mean that energy was saved because of reduced losses in the transmission of power within the industrial factories; it also improved the working conditions, the control of machines, and enabled the gradual expansion of plants. Together, this improved the productivity of labor and capital.

On Africa, Estache et al. (2005) made one of the first attempts to conduct a more systematic, quantitative assessment of the importance of Sub-Saharan Africa's infrastructure. They found that electricity, water, roads, and telecommunications are crucial factors in promoting growth. Esfahani and Ramirez (2003) estimated that Sub-Saharan Africa's poor growth performance is, in part, related to under investments in electricity and telecommunications infrastructure. Estache et al. (2005) also estimate that if Africa had enjoyed Korea's quantity and quality of infrastructure, it would have raised its annual growth in per capita income by about one percent.

Hulten (1996) found that differences in the effective use of infrastructure resources explain one-quarter of the growth differential between Africa and East Asia and more than 40 percent of the growth differential between low and high growth countries.

There are a number of studies that have been done on Nigeria looking at electricity supply and industrialization and growth. For instance, Udah (2010), using bounds test, found the long run and error correction model showed that the index of industrial development, electricity supply, technology and capital employed are important determinants of economic development. Iwayemi (1988) argued for importance of the energy sector in the socio-economic development of Nigeria. He submitted that strong demand and increased supply would stimulate increased income and higher living standards.

Oke (2006) attributed the non-competitiveness of Nigeria's export goods to poor infrastructure, especially electricity supply, which drives the running cost of firms. Ndebbio (2006) argued that electricity supply drives the industrialization process. He submitted that one important indicator, whether a country is industrialized or not, is the megawatt of electricity consumed. He further argued that a country's electricity consumption per-capita in kilowatt hours (KWH) is proportional to the state of industrialization of that country. Ekpo (2009) elaborated on the folly of running a generator economy and its adverse effects on investment. He strongly argued that for Nigeria to jump start and accelerate the pace of economic growth and development, the country should fix its power supply problem. In his paper, Aigbokan (1999) argued that fixing the energy sector is tantamount to shifting the production possibility curve of the country's economy.

Adenikinju (2005) provided a strong argument to support the importance of energy supply. The poor nature of electricity supply in Nigeria, he argued, has imposed significant cost on the industrial sector of the economy. This result corroborates the survey of the Manufacturers Association of Nigeria (MAN, 2005). In that survey, MAN indicated that the costs of generating power constitute about 36 percent of production. All these studies used time series analysis and electricity production and consumption as power infrastructure indicator variables while, in this study, we go down to firm level data and use infrastructure reliability indicators (number of days and hours without power), which is a big departure from the standard approach

In another study conducted in Indonesia, it was revealed that among the many barriers to SME development supply and price of reliable electricity was mentioned by 62% of the 180 respondents as being a major barrier to SME development (Tambunan, 2009). In the same research report, high production capacity deficiency, limitation in sales and high labor costs accounted for 21%, 36% and 18% respectively. In another study in Indonesia, it was found that SME sector account for 99% of businesses in Indonesia making them the most significant contributor to Indonesia's economic development (Irjayanti et al., 2013). Other studies by Wang (2002) on outage costs and strategy analysis of the hi-tech industries revealed that production process spans weeks and sometimes months in planning and execution. A slight variation in the load of supply can therefore render the objects they produce obsolete. Wang (2002) further revealed that a power interruption lasting between 1 and 4 seconds can result in a loss of more than US$ 3 to 10 million of damage to their properties.

Power interruption are disturb firms productivity negatively increasing firm cost by 15% from 2011 to 2015 World Bank enterprise survey data indicated that .this effect varied negatively with output levels suggesting that power interruption is particular costly for small firms (*Lamessa, 2018)*

2.2.1. Effect of Reliable Electricity Supply on SME Operations

The most significant effect vulnerable supply of electricity has on small business' operations is cost. Cost is a variable input in the measurement of profit. Profit is only realizable where cost of production is less than revenue. As a fixed cost therefore, SMEs' access to sufficient and affordable supply of electricity is therefore a crucial determinant of profitability and growth. Low levels of infrastructural development and poor services can drive up firms direct and indirect costs and bias their technological choices away from energy intensive ones which in turn increase the overall cost relative to competitors in other regions. SMEs suffer operation and maintenance costs arising out of power fluctuations (Lai et

al., 2008). Haanes et al., (2011) identified "reduced costs due to energy efficiencies" as the second highest possible source of sustainability next to improved brand reputation. In other words, the higher the frequency and Longer the duration of interruptions, the greater the cost incurred by small businesses and vice versa and lesser or greater their ability to sustain their business interests.

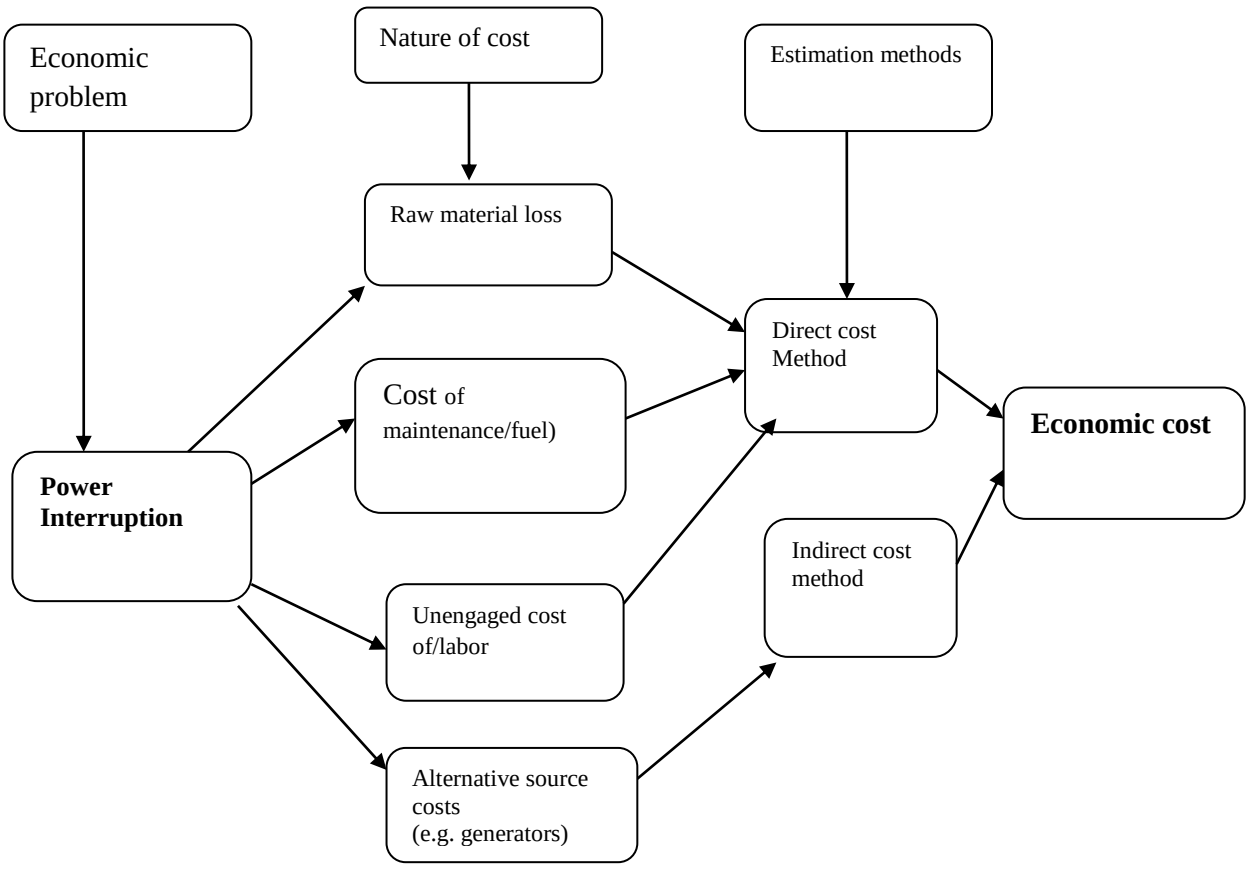
Velasquez and Pichler (2010) also reiterated that sufficient and affordable supply of energy (in this case, electricity) has had a decisive significance for economic activities and economic growth can or may be restricted by resource energy. Since a country's economic growth is a composite of economic activities of small and medium enterprises, the less cost they have to tolerate, the better a country's chance at harnessing their input towards greater levels of gross domestic product and growth. Okpara (2011) consents that; SMEs can contribute immensely towards economic growth and poverty reduction. Another effect of power fluctuations on businesses is related to their level of competitiveness.

Arinaitwe (2006) has revealed from his research that the rate at which SMEs fail in developing countries is higher than in the developed world. Irjayanti and Azis (2012) in their research found that as a result of the free market system, Indonesian SMEs were fighting stiff competition from foreign products and firms who have the ability to produce better quality products. In their research, they found that high cost of energy accounted for 62% of respondents' identification of barrier factors against Indonesia SMEs.

2.3. Conceptual framework for power interruptions estimation

This research focused to estimate the economic costs of electric power interruption in SMEs hadiya zone. Figure 1 illustrates the different steps followed in estimating the economic costs of power interruption in SMEs. The Figure illustrates that to estimate the economic costs of power Economic problem, consideration must be taken of the effect of power Interruption on economic costs, the estimation method used to quantify the costs, and the affected sectors of the economy.

Figure 2.1: Frame Work for assessing economic cost of electric power interruption.



Source: Author's own representation from theoretical and empirical literature reviewed

A number of scholars have identified different types of costs of power interruption, which include raw -material costs, production costs, unengaged labor costs and restart costs (Goldberg, 2015; Hachimenum, 2015; Sena, 2015). These costs are a direct result of a power interruption. To be clear, unreliable power may motivate customers to invest in back up equipment (Goldberg, 2015). To identify strategies for improving supply service the study complements the Direct and Indirect Cost Method with the stated preference method (SP) for willingness to pay for improved electricity supply in order to identify factors associated with customer's willingness to pay.

CHAPTER THREE

3. METHODOLOGY

This chapter deals with the description of the study area research design, population of the study, sampling techniques, sample size and sampling procedure, sources and types of data, methods of data collection, data collection instruments, techniques of data analysis, model specification and description of study variables, validity and reliability test, analysis of reliability test, and finally ethical considerations of the study all would be included.

3.1. Description of the study area

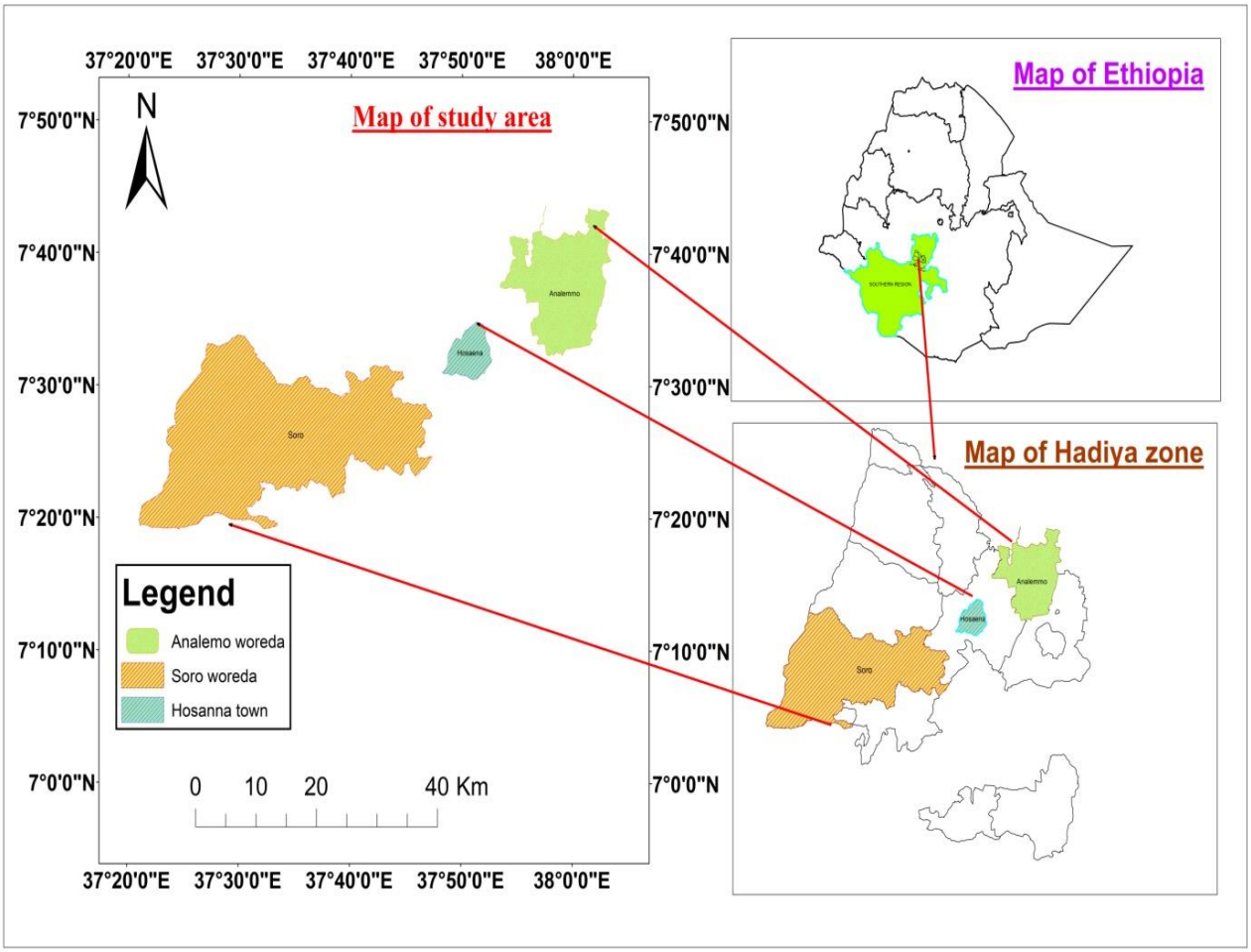
In SNNPR Hadya zone is situated roughly at the margin of the Great Ethiopian rift valley at the western fringe in the northwestern part of the Region. In the northwest, it shares common boundaries with Oromia region and Yem Special Wereda. The zone neighbors in east and northeast are Halaba Special Wereda and Silte zone and Kembata-Tembaro zone at its immediate south. But Wolaita zone at the near far is the neighbor of detached two weredas namely Misrak and Mirab Badewacho. At the southeast beyond Bilate River, inland boundary of Hadya zone is Oromiya region. It is located in the northern part of the Region. Geographically, Hadiya zone is located at 7º3'19" - 7º56'1"north latitudes and 37º23'14" - 38º52'13"east longitudes. Hadiya zone has three agro- ecological zones sharing, Dega (23.7%) Weyn adega(64.7) and Kolla (11.6%). The annual average temperature of the zone is 22.02^{o} Celsius and the mean annual rainfall is 1260 mm. (Atlas of the world, 2009; CSA, 2007).

Its capital, Hossana, is 236 kilo-meters South of Addis Ababa and 168 kilo meters west of Hawassa town, capital of SNNPRS. In Hadiya Zone, there are thirteen woreda and two town administration. These are Lemo, Soro,Mirab Soro, Badawacho, Misha, Shashogo, Duna, Gibe, Mirab Badawacho, misrak badawacho, Gombora, Amaka , Siraro, and Anlemo woredas and Hosana Town and shone Town administrations. Total population of Hadiya Zoneis 1,711,091. Based on the Hadiya Zone Finance and Economy Development, (2019). Among these only two woreda town and Hosanna town will selected for this study.

Hosanna Town has an area of 64km2. It is divided in to three sub-cities, eight kebeles and 160 localities (Menders). And also there were 694 small and medium enterprises found those who are organized by small and medium enterprise group by engaging on services sectors. The town has only

one energy sources which were hydro. The main problem of small and medium enterprises is electric power interruption which exposed to economic costs or loses. The total population of the Soro Woreda, 253653 Anlemo woreda 92,371 and hosanna town's is 117231. Out of this, the number of SMEs in the Soro town Gimbichu, Anlemotown Fonko and Hosanna townsis 794. The SME in each Town were, 648 inHosanna Town, 57 in Anlemo town, and 89 in Gimbichu Town.

Figure 3.1: Map of the Study Area



Source: - ETHIO-GIS

3.2. Research Design

The research design method was used cross- sectional research design. According to (Saunders et al., 2009) cross sectional survey design is a type of survey design which will be employed to collect necessary data at one point in time from particular set of population. Descriptive and inferential types of statistics would be used for the analysis of this study. And, also both qualitative and quantitative types of data would be used. Additionally, qualitative data collection would be carried out to triangulate/support the quantitative analysis of the data which was electric power interruption focus inquiry. A purposive sampling technique would be used to select sample SME. The sampling procedures used two stage sampling. First appropriate woreda was selected purposively from the town, followed by sample SME selection. The selection of respondents from sample Woreda and town administration SME based on simple random sampling while the selection of town was based on purposive sampling techniques. The reasons for the selection of these two woreda towns and hosanna town administration are: Firstly, topographic condition and dense population SME. Secondly, potential and specific activities of SME. Therefore, three towns SME were purposively selected to sampling design.

3.3.Population of the Study

The main objective of this study was analysis the impact of electric power interruption on SMEs economic benefits in Hadiya zone. The researcher would be focused on the selected three woreda/Towns such as Anlemo, Gimbichu woreda/town and Hosanna Town SME population. The total number of SMEs within three woreda/town had 794 formed the population for the study.

3.4. Sampling Techniques, Sample Size and Sampling Procedure

3.4.1. Sample size Determination and technique

Due to limited time and resources, including all Woreda's of the town and all SMEs in this study would be considered as difficult in effecting the intended in-depth study within the time frame available for fieldwork. In Hadiya Zone, there are thirteen woreda and two town administration. Among these only two woreda town and Hosanna town would selected for this study. Based on the Hadiya Zone Finance and Economy Development (2019). Total population of Hadiya Zoneis 1,711,091. The total population of the Soro Woreda, 253,653 Anlemo woreda 92,371 and hosanna

town's is 117231. Out of this, the number of SMEs in the Soro town Gimbichu, Anlemotown Fonko and Hosanna towns is 794. The target population in each Town SME were, 648 in Hosanna Town, 57 in Anlemo town, and 89 in Gimbichu Town. To select appropriate sample probability sampling technique would be applied. From total 794 SME, simple random sampling would be used to draw representative sample of the study.

3.4.2. Sample size

The size of the sample was one of the most important decisions in the planning of the survey. Therefore, to determine the sample size variability, confidence level and margin of error was considered the simple size determined by using the following formula (Yamane,1967).

$$n = \frac{N}{1+Ne^2}$$

Where, n = required sample of size study.

N= total number of Targeted Small and medium enterprise

e = margin of error

The total sample size obtained for the study based on the given information as follow: N= 794 total SME size of sampled Town's. At confidence level was 95%, and then margin of error is (e) is 0.05.Total sample size of the study (n)

Targeted SME size (N) =794

Margin of error is (e) = 0.05

$$\mathbf{n = \frac{N}{1 + N(e^2)}} \boldsymbol{n = \frac{794}{1 + 794(0.05^2)}} \boldsymbol{n = \frac{794}{2.985}} \boldsymbol{n = 265}$$

Therefore, in order to determine the Proportional allocation of total sample in each town the following formula had been applied / suggested.

$$\boldsymbol{n_i = \frac{n \times N_i}{N}}$$

Where, n_i = required Sample sizes of each town's (sample of i^{the} towns)

Ni =the number of SME in each selected Town (SME in i^{the} town)

Table 3.1 : Proportional allocation of sample small and medium enterprise by town

No_	Sample Town	Total Number of enterprise in selected town	Sample size	Method of selection
1	Hosanna town	648	$\boldsymbol{n_1 = \frac{265\times648}{794} = 216}$	Simple Random sampling method
2	Anlemo town	57	$\boldsymbol{n_2 = \frac{265\times57}{794}}$ =19	
3	Gimbichu town	89	$\boldsymbol{n_3 = \frac{265\times89}{794} = 29}$	
	Total	794	265	

Source, our survey,2020

3.5.Sources and Types of data

3.5.1. Primary Data

The primary data was collected through questionnaires. A structured questionnaire would be prepared and organized into different sections according to the following topics: personal background, behavior and economic drop duo to electric power interruption.

- The first section of the questionnaire would ask the respondents personal background, questions regarding their gender, age, marital status, income, and education background and business type.
- The second section of the questionnaire would be prepared to obtain information on the relationship with the economic cost. The respondents would ask the length of time that small and medium enterprise have been with their electric power interruption. Finally, the questionnaire would cover respondents to rate the relative importance of electric power contribution for economic development. Because the questionnaire was interviewer-administered, all 265 were retrieved signifying a success rate of 100%. Stata version14 was used to analyses the data. Associations between the power outages and various profitability ratios were examined.

3.5.2. Secondary Data

The secondary data source would be collected from different published and unpublished material like journals, articles, text book, organization manuals, reports and other secondary source which supports the study area was included.

3.6. **Methods of Data Collection**

The form of questionnaires give to informant and structure may affect customers' answer, so to collect accurate data it is highly important to think out exactly what questionnaires would be given to informant. In order to collect accurate and appropriate data from customers, questionnaires were needed to prepare and organize in relation of logit regression model which consist of numbers of questions. A total of 265 Questionnaires for each small and medium enterprises would be distributed which was assigned equally. Out of the distributed questionnaires the returned questionnaires would be carefully checked, and those with excessive missing data would be discarded.

3.7.Data Collection Instruments

In order to answer the research basic questions, the researcher was employed various data collection methods. Initially to gather information from the participant closed ended questionnaires with five point liker scale were used and open ended questionnaires also deployed for the study. The reason for using the liker scale was that enable certain arithmetical operations to perform the data that would be collected from respondents. Open ended questionnaire would be used to triangulate/support the data would be collected by closed ended. Beside this, the researcher was reviewed some document which was relevant to the study.

3.8.Techniques of Data Analysis

The collected data would be analyzed by using descriptive and inferential statistics. Descriptive statistics method would applied to analyze quantitative data where data was score by calculating the tables, graphs, percentages. In inferential statistics the econometrics model of conditional logit and Binary logistic regression model were used. This would be done by using STATA version 14 computer software.

3.9. Model Specification

An econometric model consists of a dependent variable, also called the left-hand-side variable, and independent variable(s), also called explanatory or right-hand-side variable(s) and an error terms, or to be more precise stochastic disturbance terms, which stand for unobservable random variables not explicitly included in the model. The error term may also reflect randomness in human behavior or measurement errors, and has certain assumed properties such as a mean, variance and covariance. The estimated coefficients indicate the effect of a change in the independent variables on the dependent variable (Green, 2003). The model specifications applied for this Choice of Experimental study was the conditional logit model and the binary logistic regression models.

3.9.1. The conditional logit model

Conditional Logit Model was closely related to the better-known MLM model, but it derives from different behavioral assumptions and was estimated in different form. The CLM model was appropriate whenever it was reasonable to assume that individual choices among available alternatives were a function of the relevant characteristics of those alternatives, rather than the characteristics of the individual. Like MLG model, the CLG model were based on the independently and identically distributed assumption .I.e. error terms follow an extreme value distribution and were independent across alternative. Generally, if the researcher interest was to analyze the effect of characteristics of alternatives on SME choices, he/she may used CLG.

The natural model formulation would be

$$prob\left(yi = \frac{j}{xi1}., xi2, \dots, xij\right)$$

$$prb\left(yi = \frac{j}{xi}\right) = pij = \frac{expxij\beta}{\sum_i^j expxij\beta}$$

In accordance with the convention in the literature, we let j =1, 2... J for a total of J alternatives.

The model is otherwise essentially the same as the multinomial logit. In this model, the coefficients are not directly tied to the marginal effects. The marginal effects for continuous variables can be obtained by differentiating the above equation with respect to a particular xm to obtain

$$\frac{\partial pij}{\partial xim} = [pij(1(j = m) - pim)]\beta, m = 1 \dots j$$

It is clear that through its presence in pij and pim, every attribute set xm affects all the probabilities. Hensher (1991) suggests that one might prefer to report elasticity's of the probabilities. The effect of attribute k of choice m on pij would be

$$\frac{\partial lnpj}{\partial xmk} = xmk[(1(j = m) - pim)]\beta k$$

Because there is no ambiguity about the scale of the probability itself, whether one should report the derivatives or the elasticity's was largely a matter of taste.

Several analysts recommend the mixed logit model or the Random parameter logit (RPL) for discrete choice modeling applications. The RPL model can overcome the limitations noted above, particularly random tastes variation (Train, 2003). Moreover, the RPL model provides a flexible, theoretical, and conceptual econometric model that can estimate any random cost model (McFadden and Train, 2000). It also provides superior insights into choice performance and welfare estimates (Sillano and de Ortúzar, 2005; Scarpa et al., 2008; Hynes et al., 2008). For these reasons, the RPL model would be used in this thesis and was discussed further in the following section.

3.9.2. Binary Logistic Regression

A binary logistic regression was used to capture the net effect of the different possible factors on the choice of willingness to pay for improved electricity supply. There were two categories which formed the binary outcome of willing to Pay (WTP) coded as 1, or not willing to Pay (NWTP) coded as 0. Odds ratio were used to interpret the associations between the outcome variables and independent variables.

The probability of a enterprise being willing to pay for improved power could be written as follows:

$$Pi = \frac{E(\gamma = 1)}{\text{Xi}} = (\frac{1}{1 + e^{-(\beta o + \beta i Xi)}})$$

Where, $\beta 0 + \beta i\ Xi$ to be *zi* then the formula could be broken down as follows;

$$\text{Prob(WTP)} = \left(\frac{1}{1 + e^{-zi}}\right) = \frac{1}{1} + \left(\frac{1}{e^{-zi}}\right) = 1 + e^{-zi}$$

$$\text{Prob(WTP)} = \ln 1 + \ln e^{-zi} = 0 + zi$$

Were, $Zi = \beta o + \beta 1X1 + \beta 2X2 + \beta 3X3 + - - - + \beta nXn$

Which implies a linear combination of correlates, X*i* with *i* ranging from 1 to n and the βi (*i* = 1 to n) represents the coefficients for the correlates. The value of *Zi*ranges from $-\infty$ *to* $+\infty$ and therefore, P*i* ranges between 0 and 1. Given that P*i*is the probability of WTP then 1- P*i* becomes the probability of not WTP.

For empirical estimation, the logistic regression model was specified as follows:

$$Zi = \beta o + \beta 1X1 + \beta 2X2 + \beta 3X3 + - - - + \beta nXn + Ui$$

Where,

Zi=willingness to pay or not/ economic costs

X1 = Frequency power off per day

X2 = Duration interruption (day time)

X3 = alternative power source of Equipment

X4 = Size enterprise

X5 = Maintenance Cost of alternative source

X6 = Average Monthly Income enterprise

X7 = Satisfaction with Electricity Service

X8 = Monthly Electricity Expenditure

X9 = Perception of enterprises

X10= education level of enterprise

X11=family size of entrprise

Ui = Random Error Term

3.10. Cost of Power interruption

3.10.1. Direct Cost

The Direct Cost Method was an approach where a customer was directly asked on the economic losses that resulted from power interruptions (Kufeoglu, 2015). This method reduces the biases that resulted from quantifying the costs of power outages using total output losses only. When using the Direct Cost approach, the loss of raw material, damage to appliances, loss of manpower, restart and indirect costs are included in the total cost estimation.

In order to obtain accurate and reliable results, the approach requires the researcher to reach out to a large number of customers in order to mitigate the effect of non-responses (Amadi and Okafor, 2015). Quantification of the direct costs of power outages for SMEs were done based on estimations made by respondents on material destruction damage and maintenance (cost of damage to enterprise appliances, and cost of replacement or maintaining damaged appliances) and additional costs.

3.10.2. Indirect Cost

The Indirect Cost Method was an approach where a customer was asked on the costs incurred due to mitigating the impact of power interruption. For indirect costs, the alternative energy source cost was annualised by dividing the initial capital cost by the expected life (in years) of the generator, taking off depreciation for each year using the prevailing reducing balance method at 10% per annum. Other costs such as maintenance costs, annual fuel costs were added to the annualised initial capital cost to come up with a total indirect cost. The total cost for power interruption was obtained by summing the direct and indirect (alternative source) costs.

3.11. Validity and Reliability Test

Validity test:-Validity refers to the extent to which an instrument measures what is supposed to measure. Data need not only to be reliable but also true and accurate. If a measurement is valid, it is also reliable. The content of validity of the data collection instrument would be determined through discussing the research instrument with the research experts in the university. The valuable comments, corrections, suggestions would be given by the research experts assisted in the validation of the

instrument. The content of the responses would be given by the respondents would be checked against the study objectives. Evidence of content relevance, representativeness and relevance to the research variables would also be checked for testing validity (Joppa, G. 2000).

3.12. Definition of variables

Frequency of interruption per day:-Enterprises who have many incidents of electricity power outages are expected to be more likely to be willing to pay for improved

Electricity service in order for the daily frequency of power interruption they experience can be reduced.

Duration of interruption (day time):- As with the frequency of power interruption, enterprises that have longer durations of electricity power outages are expected to be more likely to be willing to pay for improved electricity service in order for the duration of power interruption they experience can be reduced.

Maintenance cost of alternative source:-As the frequency of power interruption increases, the more times that alternative source equipment has to be used. This results in a higher chance of having to maintain the equipment due to its constant use and therefore expenses increase in the process. To avoid this, enterprise with alternative source equipment are expected to be more willing to pay for improved electricity service.

Size of enterprise:-Enterprise with larger sizes will have more people benefiting from the use of electricity for varying uses. As such, the absence of improved electricity will cost enterprises greatly and thus such an enterprise will be willing to pay more for improved electricity. On the other hand, a enterprise with large numbers is likely to incur huge enterprise expenditures especially if many of them are unemployed and dependent on the enterprise. Such a enterprise may not be willing to pay any higher for improved electricity supply as this will increase their expenditure (Adjei-Mantey, 2013).

Alternative source equipment:-enterprises who invest in alternative source equipment are those who can afford it and also those who really require reliable electricity. As a result, they are expected to be willing to pay more to have uninterrupted power supply as the use of back-up equipment is more expensive compared to using electricity as stated by Foster &Steinbucks (2008)

Average monthly income:- It is expected that enterprise who are willing to pay for improved electricity service are those who have a higher income compared to those who have a lower income, hence as income rises, the more likely that a household will be willing to pay for improved electricity service.

Satisfaction with electricity service:- It is expected that enterprise who are willing to pay for improved electricity service are those who have a higher income compared to those who have a lower income, hence as income rises, the more likely that a enterprise will be willing to pay for improved electricity service.

Perception of power interruption on business:-Enterprises who perceive the current price of electricity to be high are expected to not to be willing to pay for improved electricity service compared to those who perceive the price to be satisfactory or too low.

Monthly electricity expenditure:-Households who already pay a high amount for electricity may not be willing to pay any higher because they consider the amount that they pay to be already high while households who pay lower amounts may be willing to increase the amount they pay for improved electricity. On the other hand, other households who pay a high amount for electricity do it because they really require electricity for their household needs. Such people may be willing to pay even higher in order to obtain reliable service at all times while those households who pay a lower amount because they barely use electricity may not be willing to pay any higher to improve the service because they hardly used it.

CHAPTER FOUR

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Outcome of Data Analysis Using Descriptive Statistics

4.1.1. Descriptive Statistics

Comparison between male and female respondents, male was represented by (160)60.4% and female by 105(39.6%). By age distribution, respondents that categorized between 29 to 45 years old contributed the most with 95(35.8%), 69(26.0%) respondents were age group 18 to 29 years old, 55(20.8%) respondents participate in a SMEs were within age group 45 to 60 years old. So, most respondents within a age group of 29 to 45 years old and productive age groups. Out of 265 respondents 160 (60.4%) are male and 105 (39.6%) are female small and medium enterprise heads. From this as table 4.1 majority of them, about 48.7 percent were single, 43.4 % were married and 7.9 % were others. Besides this, most of the single and married respondents have an interest to create business if electricity is provided to them. When we consider the family size of the enterprise, the average number of family size is two up to five in a given or under 180(67.9%) enterprise , family size member 5 to 10 lead with in enterprise 73 27.5%) member of family. With regard to education variable, the diploma level of education for the sampled enterprise was 88(33.2%), degree and above was 58(21.9%) and remains was secondary, primary and no formal education level educated enterprise in this study. See in a table 4.1. Summarizes the marital status, age, education level and family size of respondents as shown below.

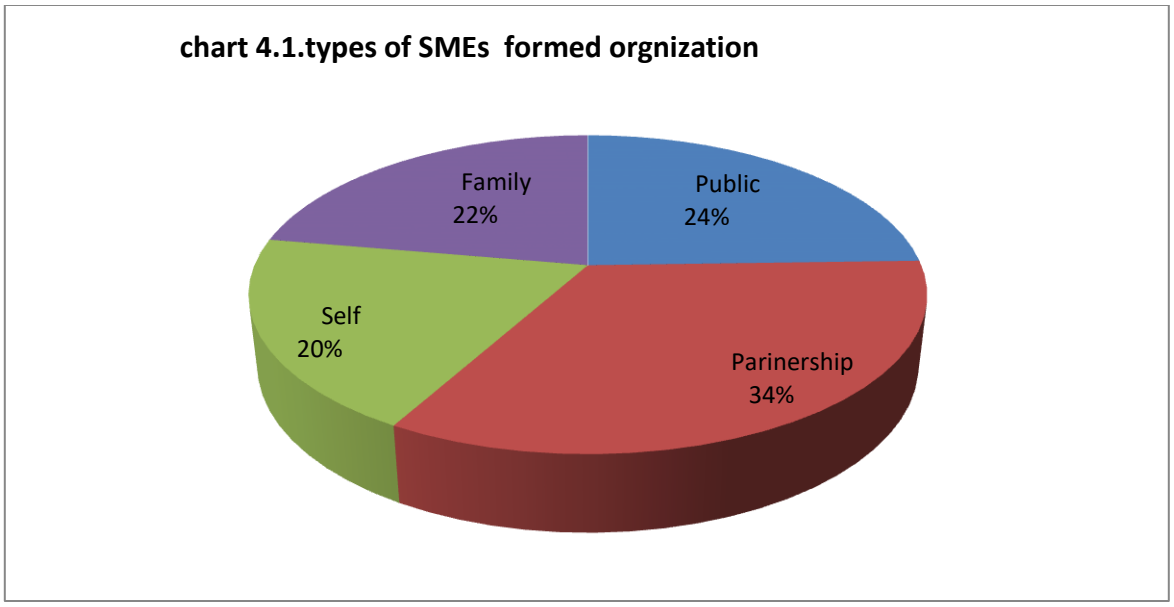
Table 4.1. Demographic statistics of respondents

Sex			Marital status			Age			Education level			Family size		
Type	**Freq**	**%**	**Group**	**Frequency**	**Percent**	**Group**	**Frequency**	**Percent**	**Group**	**Frequency**	**Percent**	**group**	**Frequency**	**Percent**
Male	160	60.4	Married	115	43.4	<18	19	7.2	**No formal edu.**	22	8.3	2-5	180	67.9
Female	105	39.6	Single	129	48.7	18-29	69	26.0	**Primary**	42	15.8	5-10	73	27.5
			Divorced	8	3.0	29-45	95	35.8	**Secondary**	55	20.8	>10	12	4.5
			Window	13	4.9	45-60	55	20.8	**Diploma**	88	33.2	Total	265	10510 0.0
						>60	27	10.2	**Degree**	58	21.9			
Total	**265**	**100**	**Total**	**265**	**100.0**	**Total**	**265**	**100.0**	**Total**	**265**	**100.0**			

Source: Survey data, 2020.

4.1.2. Types of SMEs Organization

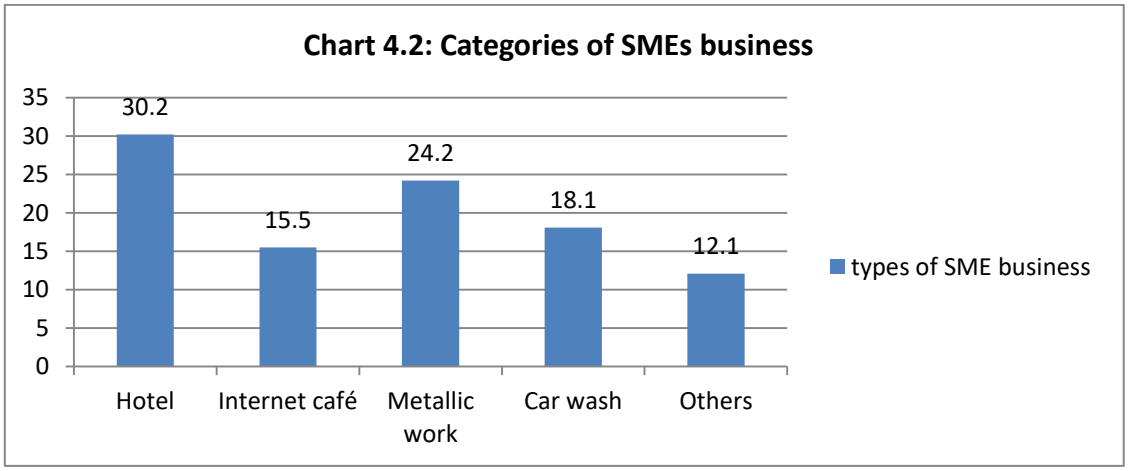
SMEs were classified into three categories namely, micro, small and medium enterprises. The Small and Medium Enterprises (SMEs) surveyed cut across the various sectors of the Ethiopian economy. Different groups or team formed structure of SME organizations. It appears the rapid economic growth in the last few years has increased the job creation capacity of SMEs hence the increasing number of larger SMEs. In chart 4.1 bellow, it could be observed that the bulk of the respondent SME organization is listed. Public or governmental organization accounted for 65 out of 265 sample, representing 26 percent. There was 89 out of 265 and 34 percent of partnership organizations. Whiles Out of265 respondents, 52(20%) operate self-business. The remaining 59(22%) of the respondents were registered as family owned businesses as can be seen from chart below.



Source: Survey data, 2020.

4.1.3. Categories / Types of SMEs Businesses

Inthe chart 4.2 below, it could be seen that, out of a total of 265 respondents received, most of the SME firms are dominated in hotel business sector, representing 80(30.2%) of the total responses. The Metallic work sector accounts for 64(24.2%), whilesThe internet cafe services sector accounted for 41(15.5%).The Car wash service sector records 48(18.1%), Others service sector records 32(12.1%) respectively



Source: Survey data, 2020.

Table 4.2: Number of years SMEs are in Operation

Number of Years	Frequency	Percentage
0-5	50	18.9
5-10	147	55.5
10-15	51	19.2
15 and above	17	6.4
Total	265	100.0

Source: survey data, 2020

From the results in Table 4.2, it could be observed that the number of years SMEs surveyed were in operation has been analyzed. The result above indicates that 50(18.9%) of the total respondents have been in operation for just zero up to five year. Also 147(55.5%) of the total respondents haven been in operations from five to ten years. Whiles 51(19.2%) of the total respondents claimed they were in business about ten to fifty years and finally 17(6.4%) claimed they have been in business from fifty years and above. From the above analysis, it could be seen that greater proportion of themes sampled indicates that they have been in operation for five to ten years. Majority of the respondents increase experience operation which include high production capacity and cost minimizations are increased.

Table4.3: Frequency Distribution of Average Monthly Sales income of Respondent SME firms

Amount (by birr)	Frequency	Percentages (%)
Less than 10,000	13	4.9
10000 –15000	95	35.8
15000–20000	73	27.5
20000–25000	66	24.9
Greater than 25000	18	6.8
Total	265	100.0

Source: Survey data, 2020.

From Table above 4.3 above, which represents the average monthly sales income of the 265 SMEs sampled, 13(4.9%) of the respondents recorded an average monthly sales income below the 10,000ETB threshold. Also 95(35.8%) of the respondents whose average monthly sales were slightly within the 10,000ETB to 15,000ETB threshold and 73(27.5%) fell within the 15,000 to 20,000 and 66(24.9%) respondents recorded a monthly sales of greater than 25,000.00ETB.This result represents SME firms mostly from the hotel and restaurant business, internet cafe services and metallic work sector of the economy. Majority of the respondents experience power fluctuations which include high production capacity deficiency, limitation in sales and high labor cost (Irjayanti and Azis, 2013) and damage to their properties (Wang, 2002). In terms of service delivery to customers when power was inconsistent, the average sales reduced because of productivity decreased and costs increased.

4.1.4. Effects Electric power interruption on economic cost/Businesses

Damage to sort able products was due to high power interruption in day time which seems to be a bigger problem than during night time. Due to the interruption of power systems, cost of material like additional and unexpected costs for energy was increased. as a problem from sampled SMEs 265 out of 42(15.8%) of the respondents raw material cost, 12(5.3 %) of additional electricity tariff cost, 84(31.7%) of respondents labor cost expense, 97(36.3%) of respondents additional fuel cost were increased and SMEs to increase customer satisfaction and to increase their production, due to electric power interruption.

This percentage would most likely in a developed country as security systems such as alarms may stop working and it describes the relationship between the duration of an outage electricity and the perceived negative effect on business.

Figure 4.4: Effect of electric power interruption and duration on cost of production

Effects of electric power interruption			Duration of electric power interruption		
Cost of production	Frequency	Percentage (%)	Period interruption	Frequency	Percentages (%)
Increase in raw materials costs	42	15.8	Night time	30	11.3
Increase in electricity tariffs	14	5.3	Day time	167	63.0
Increase in the cost fuel	97	36.6	Both night and day	68	25.7
Increase in labor expenditure	84	31.7	Total	265	100.0
Others costs	28	10.6			
Total	265	100.0			

Source: Survey data, 2020.

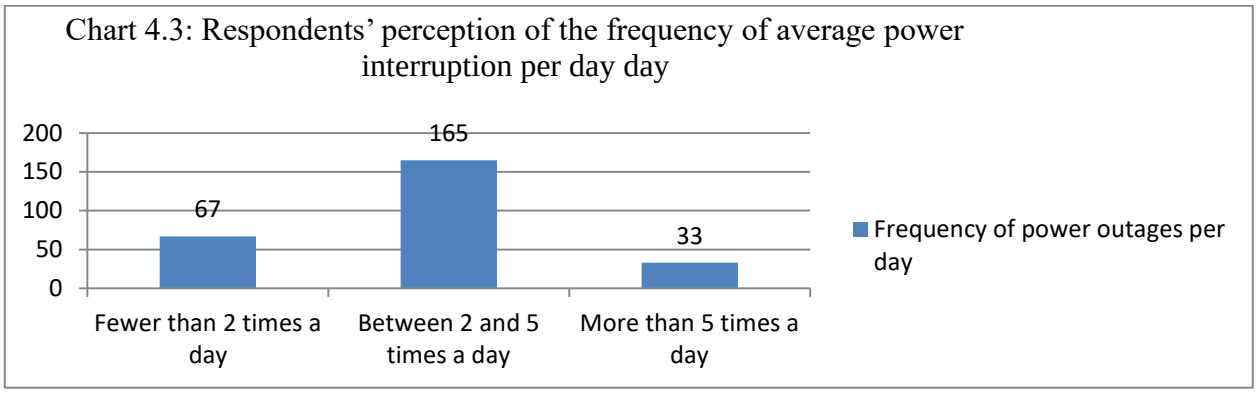
4.1.5. The frequency of average electric monthly payments and power interruption per day and its effects on Businesses of SMEs

The poor reliability of publicly supplied power has imposed a lot of costs on service sectors in the country. As a result of power outages firms lost an average of between 2and 5 working times in a per day. i.e., 165(62.3%) of respondents shutdown their business per day because of power interruption. Also, about 67(25.3%) of the firms reported having to shut down production at less than once time per day. On the average, 33(12.5%) firms experience electric power interruption recoded greater than five times in a par day. If these outages occur during the working period of the firms, then the potential losses would be so much and thus firms would need a form of insurance.

Table 4.5: Average cost or expense of Electricity consumption per month was as bellow table.

Electricity expense per month in birr (ETB)	Frequency	**Percentage of Average cost of electricity per month**
<100	60	22.6
100-500	137	51.7
>500	68	25.7
Total	265	100.0

Source: Survey data,2020.



Source: Survey data, 2020.

Finally, the average cost for publicly provided electricity is presented in Table 4.5. While electricity accounted for about 60 (22.6%) of total respondents Payment for electricity was bellow 100ETB per month. Also, 137(51.7%) of respondents monthly payment of 100-500 birr for electricity consumption to supply services. While as 68(25.7%) of SMEs pay electricity consumption expense or operating cost per month.

4.1.6. Other Sources of Energy and Its Cost and the competitiveness of SMEs

This study is aimed at finding out the effect of the electric power interruption on economic cost of SMEs in the Hadiya zone. Majority of the SMEs surveyed revealed that most of the small and medium enterprises relied on electric power supply from the national grid or electricity power for their daily operations. However, the table below indicates that apart from electricity, a variety of other sources of energy are used by SME businesses to power their operations. For most SMEs, power outage does not mean stop page in production as their ability to produce and sell brings income for self-sustenance.

Therefore, the need for alternative sources of energy becomes more apparent. The study explored the proportions (in %) of the various sources of energy and the perception of respondents on the cost of such alternative energy sources. Also of interest was the generators and solar purchase costs incurred on alternate source of power.

From Table 4.6: below, it could be seen that 106(40%) out of the total of 265 SMEs were used generator constitutes the largest proportion of the alternative sources of power though necessary to keep their businesses running and it was generally very expensive and coasty; Also 103(38.9 %) of the respondents claimed they use solar energy to their operations which is relatively cheaper. whiles 56(21.1%) out of the total of 265 SMEs surveyed indicates that they use others types of energy. above indicate that the use of Generator and solar energy source increasing cost of energy particularly operation and maintenance cost to be expensive. Thus interruption of electric power has forced SMES businesses to spend additional funds to procure another's energy source for the effective and efficient running and survival of their businesses and increasing their cost of operations and thereby lowering profits.

Table 4.6: Sources of Energy used by SMEs

others Energy Sources	Other energy sources		Purchase Cost of other source			Fuel and maintenance costs		
	Frequency	Percent (%)	Cost by birr	Frequency	Percentages (%)	Cost by birr	Frequency	Percentages (%)
Generators	106	40.0	Greater than 10000	106	40	>600	108	48.7
Solar Energy	103	38.9	5000-10000	103	38.9	300-600	147	55.5
Others type of energy	56	21.1	Up to 5000	103	38.9	up to 300	10	3.8
TOTAL	265	100.0	Total	265	100.0	Total	265	100.0

Source: Surveyed data 2020**.**

Table 4.7: effect of electric power interruption on small and medium enterprise business

No	Statement	Level of impact				
		Strongly Agree	Agree	Neutral/Non Response	Disagree	Strongly disagree
1	Electric power interruption to a decrease in our profit margin	58 (30.5%)	76(40%)	35(18.4%)	20(10.5%)	1(0.5%)
2	We will reduce sells and production of goods and services if we had irregular power supply.	94(49.5%)	63(33.2%)	25(12.2%)	7(3.7%)	1(0.5%)
3	Our business will make less profit if we had irregular & unreliable power supply.	123(64.1%)	44(23.2%)	15(7.9%)	7(3.7%)	1(0.5%)

Source: Surveyed data 2020**.**

From the above table 4.7, it could be observed that 76(40%) of the respondents are of the opinion that electric power interruption has led to the decrease in their profit margin. Whiles 123(64.1%) strongly agree that they would have made less profit if they had regular and reliable power supply.

From the table 4.7 above, it can also been observed that 94(49.5%) of the respondents strongly agree that their businesses would have decrease sells and production if they had irregular and unreliable power supply.

4.2. Econometric model Analysis and discussion

In this survey, choice set includes two alternatives including statuesque option so a conditional logit regression and binary logistic regression model have been examined though it is the latter model. Conditional logit regression model offers a better fit and is preferred for capturing the taste preferences amongst individuals. Also the binary Logistic regression model to identify factors associated with willingness to pay for improved electricity supply.

4.2.1. The Conditional Logit Model Results

Table 4.8 shows the results of the conditional logit model, which indicates that, the attributes such as Frequency power off per day, Time duration/time of day and Cost of alternative source is significant at 5% level of significance. The mean coefficients of the attributes such time duration of interruption (day time interruption) and cost of alternative source is positive effect on economic cost and significant at 5% level of significant. i.e., day time power interruption main cause of economic cost of SMEs. So, the policy maker could opt to take action only in districts where reliability is not already too low. However, even in districts in the worst situations (i.e., with the lowest power quality or interruption without planed period and power off at necessary time for enterprise) the policy maker should still prioritize the enhancement of reliability. In contrast, Large Frequency of power off interruption per day at day times have a significant negative impact on enterprises with an economic costs. Day time's power interruption largely affect income or economy of enterprise.

In addition, the mean coefficients of the attributes such Frequency power off per day is negatives and 5% level of significant effect economic cost. Respondents preferred fewer outages as indicated by the negative and significant signs for frequency. The positive coefficient of time of interruption (days) shows that the respondents do not prefers the interruption that occurs during the day time. For the Cost of alternative source, this coefficient is positive, because the electric power interruption of selecting an increase in service reliability decreases and addition cost increased with higher in alternative source cost payments. Moreover, the base case scenarios for each of these two attributes are simulated where the ratio of each attribute mean to the cost coefficient yields the implicit economic cost estimates.

Table 4.8.The Conditional logit model out put

```
Conditional (fixed-effects) logistic regression

                                        Number of obs     =        265
                                        LR chi2(3)        =     188.15
                                        Prob > chi2       =     0.0000
Log likelihood = -59.215182             Pseudo R2         =     0.6137

------------------------------------------------------------------------------
         wtp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
frequencyofi~y |   6.753299   .8871791     7.61   0.000      5.01446    8.492138
durationofin~e |   -.238628   .4156427    -0.57   0.566    -1.053273    .5760168
alternativeso~y |  -1.710791   .4367438    -3.92   0.000    -2.566793   -.8547887
------------------------------------------------------------------------------
```

Conditional(fixed effects) logistic regression				
	Coefficient	Std.err	z- value	P-value
duration of interruption day time	0.8117173	0.3521661	2.30	0.021
Frequency power off per day	-1.200642	0.4511172	-2.66	0.008
Alternative source cost	5.182814	0.8118771	6.38	0.000
Pseudo ρ2	0.4758			
Log likely hood	-87.012168			
NOobs.	265			

Source: Own survey, 2020

4.2.2. Binary Logistic Regression Model Results

To investigate the factors that influenced willingness to pay for improved electricity supply or to reduce effect of electric power interruption, responses from the survey were subjected to a binary logistic model. To begin with, a likelihood ratio or Wald test and Hosmer and Lemeshow test were used to check if the binary model is a good fit to the data provided. The result of the binary logit model is given below.

The test statistics to evaluate the validity and significance of the model parameters are the likelihood ratio or Wald test (for overall joint test). The hypothesis that all coefficients are simultaneously equal to zero in the binary logit model was tested using chi-$\chi 2$ statistics. The tabulated wald $\chi 2$ statistics at 5% significance level for each model using degrees of freedom equal to the number of attributes/coefficients to be estimated, in this case, eleven is 54.79; leading to rejection of the null

hypothesis. Furthermore, just using the probability of chi2 value reported in Table 4.9, we could reject the null hypothesis mentioned bellow. This indicates that the model is efficient for explaining the variation in willingness to pay for electricity service connection.

Table 4.9: Factors Associated with SMEs' Willingness to Pay for Improved Electricity Service (stata result)

```
Logistic regression                             Number of obs     =        265
                                                Wald chi2(11)     =      54.79
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -61.984041               Pseudo R2         =     0.6289

------------------------------------------------------------------------------
                             |               Robust
                         wtp |      Coef.   Std. Err.      z    P>|z|
-----------------------------+------------------------------------------------
                educenterprises |   .1648704   .1570573     1.05   0.294
                     familysize |   .1199171   .5586876     0.21   0.830
                sizeofenterprise |   .3515304   .4322846     0.81   0.416
           averagemonthlyincome |   .1865419   .2057973     0.91   0.365
   monthlyelectricityexpenditure |   2.213188   .8790733     2.52   0.012
   durationofinterruptiondaytime |  -.5278257   .3899937    -1.35   0.176
   frequencyofinterruptionperday |   5.140454   1.667824     3.08   0.002
  alternativesourceofpowersupply |  -2.267236   .7301566    -3.11   0.002
maintenancecostofalternativesour |  -.0091004   .2446613    -0.04   0.970
satisfactionwithelectricityservi |   .0262484   .2590399     0.10   0.919
distancefrommanufacturingareatos |   .0309643   .2711426     0.11   0.909
                           _cons |  -3.368123   1.021931    -3.30   0.001
------------------------------------------------------------------------------
```

Table 4.9: Factors Associated with SMEs' Willingness to Pay for Improved Electricity Service

Factors of WTP	**Coefficient**	Std.err	z-value	**P>|Z|**	Odds Ratio
education level	**1.648704**	0.1570572	1.05	**0.294**	1.17924
family size,	0.1709326	0.5394741	0.32	0.751	1.12740
size of enterprise	0.3574303	0.4321306	0.83	0.408	1.42124
average monthly income	0.1878027	0.2019969	0.93	0.353	1.20507
monthly electricity expenditure,	2.221138**	0.8775282	2.53	0.011	9.14482
duration of interruption day time	-0.554188	0.3943516	-1.41	0.160	0.58988
frequency of power interruption in a per day	5.117073***	1.682806	3.19	0.001	170.793
alternative of source power supply equipment	-2.260665***	0.714431	-3.16	0.002	0.10359
the maintenance cost of alternative source	-0.13577	0.2483292	-0.05	0.956	0.99094
satisfaction with electricity services	-0.0054855	0.2659901	-0.02	0.984	1.02659
distance manufacturing area to sales /services	0.0193689	0.2689168	0.07	0.943	1.03144
Constant	-2.89428***	0.801634	-3.61	0.000	0.03445
Wald chi2 (11)		54.79			
Prob>chi^2		0.0000			
Pseudo R^2		0.62689			
Log pseudolikelihood		-61.984			
Hosmer and Lemeshow		18.34			

Source: Authors' Estimation, 2020. *Notes:* *Significant at 10%, **Significant at 5%, ***Significant at 1%

From the results, the family size, size of enterprise, the average monthly income, the monthly electricity expenditure, the duration of interruption day time, the frequency of power interruption in a per day, alternative of source power supply equipment, the maintenance cost of alternative source equipment, the satisfaction with electricity services and distance manufacturing area to sales /services were found be factors associated with willingness to pay for improved electricity supply.

The family size, size of enterprise, the average monthly income, the monthly electricity expenditure, the frequency of power interruption in a per day and distance manufacturing area to sales /services

have a positive relationship with the enterprise's willingness to pay for improved service whilst the duration of interruption day time, the alternative of source power supply equipment, the maintenance cost of alternative source equipment and the satisfaction with electricity services have a negative relationships because it is expense and reduce the cash income of enterprise but it used to sack of lack of adequate electricity as seen in Table 4.9.

Specifically, the results mean that as the frequency of power interruption in a per day experienced by the enterprise increase, the more likely that an enterprise will be willing to pay for improved electricity service and the coefficient or odds of this happening are 5.117 times greater than enterprises who experience lower incidents of power interruptions. Also, the frequency of power interruption in a per days positively and 170.793 times marginal effect on economic cost at 5% level of significant

Moreover, enterprises who invest in the alternative of source power supply equipment are those who can afford it and who really require reliable electricity and thus would be willing to pay more to have uninterrupted power supply as the use of the alternative of source power supply equipment is more expensive compared to using electricity as stated by Foster & Stein bucks (2008).

As the enterprises' the alternative of source power supply equipment decreases, the more likely that they will be willing to pay for interrupted electricity supply increased. The alternative of source power supply equipment has experienced by the enterprise increase one unit, willingness to pay of enterprise decreased by 2.26 at 5% level of significant, when things remain constant.

On the other hand, the marginal effect coefficient of the alternative source of power supply equipment has negative significant influences on the enterprises' willingness to pay for electricity service connection in all models. This result is also in line with the economic theory particularly the law of demand, which implies that the higher the money amount the respondents were additional expense/costs to pay, the less likely they would agree to pay for electricity service. This is because of the fact that if consumers/enterprise do not afford they would not have willingness to pay for an expensive services compared to the cheaper one. This result coincides with the findings of Abdullah and Jeanty (2011)which states that alternative source of power supply equipment has negative and significant (at 5% significance level) influences on households demand for electricity services connection.

The monthly electricity expenditure has positive role to willing to pay for improved services, enterprise will be willing to pay for improved other electricity service and monthly electricity expenditure/costs are positive marginal effect and significant at 5% level of significance. With the observed values in the sample, a one percentage point higher monthly electricity expenditure/costs causes a 2.22 percentage point fewer connected willingness to pay of enterprise for secure power interruption.

This result provides evidence that an unreliable electrical service acts as an obstacle to subscriptions production or effects of economic costs and that the impact of low reliability could be greater than that of enterprise not willing to pay for alternative power sources.

The result of the empirical model indicates that the enterprises willingness to pay alone is not sufficient to recover the cost of electricity connection.

According to the ErGEthio research Group (2012) the average cost of grid line electricity service connection for enterprises within 1 km radius of grid line transformation is estimated to be approximately around 5000 birr.

CHAPTER five

5. Conclusion and policy Recommendation

5.1. Conclusions

The descriptive analysis and the econometric results reported in the paper. Descriptive variables such as sex of respondents, marital status of respondents, education level of respondents, business types of enterprise, family size and etc., have analyzed by tables, graphs and charts. Also in Econometric models were applied. This paper contributes to this issue by estimating the cost of power interruption for small, and medium-sized enterprises located in Hadiya Zone, SNNPR, and Ethiopia. To this end, we conducted a Binary Logistic model and conditional logit model were applied.

Econometric model result shows that education level of enterprise, family size, size of enterprise, average monthly income and distance manufacturing area to sales/services are positive marginal effects of cost of power interruption in SMEs, but not statistically significant for cost of electric power interruption. Also alternative source of power supply of equipment, maintenance cost of alternative source and satisfaction with electricity service are negative marginal effects of cost of power interruption and not statistically significant. In contrast, monthly electricity expenditure, frequency of power interaction in day a time and Duration of interruption in day time are positive marginal effects of cost of power interruption in SMEs at 5% level of significant.

In many developing countries, enterprises are suffering from power interruption that are both frequent times and of long duration of day times, which makes it difficult to plan and undertake production activities and it causes of additional costs of SMEs. Thus, understanding the cost for SMEs associated with an unreliable electricity supply is important especially for policy makers who plan investment in the energy sector.

The SMEs' expenditures on equipment to cope with interruptions, such as alternative source generators, might be limited because of the credit market imperfection, raising the need to complement revealed preference approaches with stated preference. The bulk of these costs come in the form of acquisition of very expensive backup or alternative source power. However, the decision to acquire an alternative source is actually a rational decision on the part of the SMEs in order to insure it from larger losses arising from frequent and long power fluctuations.

The continuation of the existing state of power interruption will no doubt continue to have a negative impact on the attempt by the government to diversify the production and SMEs will be loss and unnecessary cost.

The study identifies frequency of power interruption in per day, perception of current price of electricity, maintenance cost of alternative energy equipment as having a role in enterprises' willingness to pay for improved supply.

- ✓ The monthly electricity expenditure has positive role to- willing to pay for improved services, enterprises will be willing to pay for improved other electricity service and monthly electricity expenditure/costs are positive marginal effect and significant at 5% level of significance.
- ✓ The marginal effect coefficient of estimated frequency of power interruption in a per day has positive sign and significant effects on enterprise' willingness to pay for all types of electricity products
- ✓ Alternative source of power supply equipment has negative and significant at 5% level of significance effects on willing to pay for improved services.

In generally, it is clear that the challenges experienced by the electricity sector have resulted in many consequences which include the loss of raw material, output loss, and damage to equipment, material destruction, and purchase costs, fuel cost, idle productive time of unengaged workers, enterprise welfare loss and high costs of investing in alternative equipment to secure power interruption.

Notably, the impact of the power interruptions varies from business types. Amongst hotel service, and internet café, etc., areas are mostly impacted by power interruption. If not addressed, the problems with the electricity sector will severely undermine the government's effort to improve the development of the country. In essence, the benefits of increased access to the electricity grid will not be realized if the power is unreliable.

5.2. Policy Recommendations

The study sought to quantify the economic costs of power interruptions on the service/business sector in a bid to provide possible policy solutions to curb electricity unreliability. The country should fast track the comprehensive nationwide energy resource assessment in order to inform investment decisions.

Set up customer compensation schemes whereby a customer is compensated for facing a prolonged power interruption than the certain acceptable period(this could be determined by the regulatory authority) in order to increase standards of service for electricity customers. Expedite the implementation of a tariff differentiation strategy between low income and high income groups.

Economic progress, enterprise services or manufacturing development and other energy consumption policies cause increase productivity and increase economic costs. With increase in increasing product cost, the sources of alternative energy are also increasing that give enterprise an opportunity to choose more preferable energy sources or to choose willingness to pay alternative costs. Therefore, the paying alternative costs to secure electric power interruption by alternative energy source like generators, solar energy are uses to increase productivity or Increasing per capita income increases.

Furthermore, as the results of our analysis have shown, small-scale operators are more heavily affected by the infrastructure failures. In many instances they are unable to finance the cost of backup necessary to mitigate the negative impact of frequent outages.

Hence, they have to bear the full burden of electricity failures. Small-scale operators that could afford to back up their operations have to spend a significant proportion of their investment outlay on this.

The nation’s power transmission and distribution infrastructures should be urgently upgraded. The number of power generating stations should be increased also to meet the ever increasing demand for electricity while the power stations should be rehabilitated and the weak transmission lines replaced in order to further strengthen the network.

Ethiopia should diversify into alternative energy sources such as solar, wind, biofuels, and traditional biomass. Government should encourage investment in generation capacity expansion and strengthening of the sector infrastructure facilities to ensure efficient delivery of electricity to the consumers. Estimating the value of alternative source of electricity service connection in the Ethiopia by considering different products and payments options is of paramount significance for an optimal investment decision by both SMEs and institutions involved in a country electrification program. In Ethiopia at this time and in the future, sources of electricity generation could be diversified based on the country's economic needs.

REFFERENCES

Abdullah, S., Jeanty, P.W., 2011. Willingness to pay for renewable energy: evidence from a contingent valuation survey in Kenya. Renew. Sustain. Energy Rev. 15 (6), 2974–2983.

Abdullah, S., Mariel, P. (2010) Choice experiment study on the willingness to pay to improve electricity services, Energy Policy.38(8), 4570–4581.

Bloomberg New Energy Finance, Ethiopian Electric Power Corporation, Ministry of Water, Irrigation and energy, Ethiopian Sugar Corporation.

BusaniMoyo(2011) Do Power Cuts Affect Productivity? A Case Study Of Nigerian Manufacturing Firms International Business & Economics Research Journal – October 2012 Volume 11, Number 10

Doe Frederick, Asamoah Emmanuel Selase(2014) :The Effect of Electric Power Fluctuations on the Profitability and Competitiveness of SMEs: A Study of SMEs within the Accra Business District of Ghana Journal of Competitiveness Vol. 6, Issue 3, pp. 32-48, September 2014

Energy Sector Management Assistance Programmed (ESMAP).Energy services for the world'poor.Washington,DC:WorldBank.Availablefrom:http://www.worldbank.org/html/fpd/esmap/energy report2000/front.pdf; 2000 [accessed on 23.07.08].

ErGEthio research Group, 2012. Solar energy vision for Ethiopia: opportunities for creating a photovoltaic industry in Ethiopia, international solar energy institute. Freiburg Addis Ababa.

Ethiopian Electric Power Corporation (EEPCO). (2014/15) Electricity Supply and Demand Plan. Addis Ababa, Ethiopia. Ethiopian Electric Power Corporations, 'Facts in Brief 2015.'

Foster, V., &Steinbuks, J. (2008). Paying the price for unreliable power supplies: In-house generation of electricity by firms in Africa. Paying the price for unreliable power supplies: In-house generation of electricity by firms in Africa

Fredrik Carlsson, EyoualDemeke, Peter Martinsson, and TewodrosTesemma (2018) Department of Economics Cost of Power Outages for Manufacturing Firms in Ethiopia: A Stated Preference Study

Goldberg, A. (2015). The Economic Imoact of Load Shedding: The Case of South African retailers. University of Pretoria.

Gollagari Ramakrishna (2015): Energy Consumption and Economic Growth: The Ethiopian ExperienceJournal of Economic and Financial Modelling: Vol.2 No.2 , pp35-47 Article ·

Hachimenum, A. (2015). Impact of Power Outages on Developing Countries: Evidence from Rural Households in Niger Delta, Nigeria. *Journal of EnergyTechnologies and Policy*, 27-38.

HAGOS, YaredHaftay(2012): small and meduim enterprise in Ethiopia: the challenges and prospects

Kaseke, N. (2014). Comparative Cost Assessment Of Electricity Outages And Generation Expansion In Zimbabwe. *International Journal of AdvancedResearch in Management and Social Sciences*, 2278-6236.

Lamessa Tariku Abdisa (2018): Power Outages, Its Economic Cost and Firm Performance: Evidence From Ethiopia February

Lay, J., Ondraczek, J., Stoever, J., 2013. Renewables in the energy transition: evidence on solar home systems and lighting fuel choice in Kenya. Energy Econ. 40, 350–359.

MOFED (Ministry of Finance and Economic Development). (2010b) the Growth and Transformation Program (GTP) 2010-2015, Volume II: Policy Matrix. Addis Ababa: MOFED.

National Centre for Research Methods. (2011). Using Statistical Regression Methods in Education Research-The SPSS Logistic Regression Output. Retrieved from http://www.restore.ac.uk/srme/www/fac/soc/wie/researchnew/srme/modules/mod4/12

Jadresic, A., 2000. Subsidies for Rural Electrification in Chile. Energy and Development Report 2000.

OECD/ IEA. (2010) Energy Poverty: How to Make Modern Energy Access Universal? Special earl excerpt of the World Energy Outlook 2010 for the UN General Assembly78 PagMillenniumDevelopmentGoals.Retrievedfrom:http://www.worldenergyoutlook.org/media/weowebsite/2010/weo2010

P. J. Balducci J. M. Roop L. A. Schienbein J. G. DeSteese M. R. Weimar (2002). Electrical Power Interruption Cost Estimates for Individual Industries, Sectors, and U.S. Economy.

Sinanm Kufeoglu (2015) economic impacts of electric power outages and evaluation of customer.

TadeleBayu Genet (2020) does energy matter for economic growth in Ethiopia

ToleshiWakjiraAdugna (2016): households' willingness to pay for reliable electricity services in kuyuworeda, ethiopia: an application of choice experiment method.

Zarnikau, J., 2003. Consumer demand for 'green power'and energy efficiency. Energy Pol. 31 (15), 1661–1672.

Appendix 1.

WOLKITE UNIVERSITY

SCHOOL OF GRADUATE STUDIES

MSC PROGRAMIN DEVELOPMENT Economics

SURVEY QUESTIONNAIRE

QUESTIONNAIRES FOR SME THOS WHO USE ELECTRIC POWER IN THE SEREVICES SECTOR

SELF-INTRODUCTION

My name is……and I came from Wolkite University and I am on the way of doing my MSc thesis on economic cost of electric power interruption on small and medium enterprises business in the case of Hadiya zone .So, I want to collect survey data related to electric power interruption .

Dear respondent,

Your participation in the survey is voluntary. Your participation and opinions is important for the success of this study. You have been randomly selected for this independent survey. The results can be provides recommendations for governmental interventions in SME operations and for development of appropriate policy frameworks for the nation's energy sector, as well as minimizing alternative power cost. Your answers to this questionnaire will be completely confidential.

Anybody who can represent the head of your small and medium enterprises can complete this survey. Please answer the questionnaire on behalf of all members of your SME members. There is no right or wrong answers-we are interested in your opinions. Your answer will be strictly confidential. We anticipated that it would take no more than 10 minutes to complete the questionnaire. Consent to participate in this study is implied by completing the questionnaire.

Thank you!

Part I: General SOCIO ECONOMIC CHARACTERISTICS of the small and medium enterprises

1. *Sex* of the enterprises head: a. Male b. Female
2. *Age* in years on average _____ a. less than 18 years b. 18-29 Years c. 30-45 Years d. 46-60 years e. above 60 years
3. What is your *marital status*? a. Married b. Single c. Divorced d. Widow
4. Educational Level of enterprises head:

A. No formal education B. Elementary school

C. Secondary school D. Technical College =3 E. University degree=4

5. *Family size*: _____in numbers. 0=2-5 , 1= 5-10 , 2=above 10
6. On the average how much do you spend in this family in a month? ----------

0= less than 1000birr, 1=1000-1,500 birr, 2=1,500- 2000birr, 3=2,000-2500birr,4=above 2500 birr

7. How many individuals are in these enterprises? .....
   0=>10, 1= 10-20, 2=<20
8. What is the total enterprises monthly income? I.e. The sum of incomes of all persons who are working in this enterprises in a month …….birr

0= less than 1000birr, 1=1000-1500birr, 2=1500-2000 birr, 3=2500-3000birr, 4=greater than 3000

9. What is the type of your organization? (Please tick as appropriate)

A. Public (government)=0 B. Partnership=1

C. Self-employed =2 D. Family Owned business=3 F. Other (specify) =4

10. In which type of business your enterprises doing----------?

A. Hotel=0 B. internet house=1 C. metallic work =2 D. car wash =3, E. Others =4

11. Do you have other jobs you do besides your main occupation? A. yes B. No

If yes, what are they? ----------

12. For how long has your organization been in business (Please tick as appropriate)

a) Less than a year (1year) =0

b) Between 1 and 5 years =1

c) Between 6 and 10 years =2 D) 10 years and above =3

13. Are you willing to engage in the business in the feature?

A. Yes =1 B. No=0 C. Not sure=2

14. Have you employed qualified professionals in managerial positions in your organization?

A. Yes =1 B. No = 0

15. If your answer for question number 15 is yes, what are their qualifications ?

a) Senior High School Certificate =0

b) Higher National Diploma Certificate =1

c) First Degree and above =2

16. Does your organization have an initial business plan? A. Yes =1 B. No=0

Part II: Economic cost to Pay For avoid interruption of Electricity power Services

We will now ask some questions regarding your enterprise's willingness to pay to avoid power outages. The following questions relate to the negative effect of electric power interruption on the daily operations of Small and Medium Enterprises. The following characteristics and the levels each characteristic may take will define your electricity service:

1. How much do your enterprises currently pay birr every month for electricity received from the electricity company----------?
   0=less than 100 birr , 1= 100-500, 2= grater than 500 birr
2. What do you think about the impact of electric power interruption on your business------?
   A. very positive=0 B. positive =1 C. negative =2 D. very negative=3
3. How does the electric power interruption affect your cost of production?

   a) Increase in raw materials =0

   b) Increase in electricity tariffs =1

   c) Increase in the cost fuel =2

   d) Increase in labour expenditure =3

   e) Other (please specify)=4

4. When is an unplanned interruption of uncertain duration most disruptive for your enterprises?
   A. Day time =1 B. Night time=0 C. Both equally disruptive=2 D. None=3
5. How many times the power does go off in a day?

   a) Once in the day =0 c) greater than Three times in a day=2

   b) Twice in the day=1

6. What do you think to improve electric power interruption ?
   A. willingness to pay for improved electricity supply
   B. not willingness to pay for improved electricity supply
7. Do your organization uses any alternative source of power supply for your operations when national grid is off? A. Yes =1 B. No =1

8. Which type of alternative source of power supply does your company uses?

    a) Generators =1

    b) Solar Panels =2 c) Other (please specify) =0

9. How much does the alternative source of power average cost your organization to acquire with -in a month in birr? ----------

    a) Less than 5,000.00=0

    b) 5,000.00-10,000.00=1

    c) 10,000.00- 15,000.00=2

    d) Greater than 15,000 =3

10. Apart from electricity, how much does your organization spend on fuel to keep the generator running for your operations when the national grid is off in birr month day in average?

    a) up to 300.00 =0

    b) 300.00 - 600.00=1

    c) 600.00 – 1000.00 =2

    d) Greater than 1000.00=3

11. How much does it cost your organization to do maintenance of your alternative source of power supply in month average in birr? ----------

    a) up to 300.00 =0 b) 300.00 - 600.00=1 c) 600.00 – 1000.00 =2 d) Greater than 1000.00=3

12. Have your organization lay-off some of your employees? A. Yes =1, B. No=0
13. In general, the power supply provided by electric power company is A. Very good B. Good =1 C. Fair =2 D. Poor =3 E. Very poor =0

14. Do you electric power interruption decreases your annual services sale volume?

A. yes B. no

15. What is the Distance in KM from manufacturing area to sale center/market? _____

0 = less than 10 K.M, 1= 10-20 K.M, 2= 20-30K.M, 3=30- 50km, 4=greater than 50km

Part III: The following table indicate impact rate of electric power interruption and other related factors on small and medium enterprises business. Please put a „√"mark for each statement by using the following scale ranging from "1= strongly agree (SA) to 5= strongly disagree (SD)" based on their degree of impacts

1=strongly agree (SA), 2=Agree (A), 3= neutral (N), 4= disagree (D), 5= strongly disagree (SD)

No	**Factors for economic cost of small and medium enterprise business**	**Level of impact**				
		1	**2**	**3**	**4**	**5**
1	Electric power interruption to a decrease in our profit margin					
2	We will reduce sells and production of goods and services if we had irregular power supply.					
3	Our business will make less profit if we had irregular & unreliable power supply.					
4	Distance to the services sale center					
5	Lack of Access to credit services					

apendex 2. Conditionallogit model

```
Conditional (fixed-effects) logistic regression

                                                Number of obs     =        265
                                                LR chi2(3)        =     188.15
                                                Prob > chi2       =     0.0000
Log likelihood = -59.215182                     Pseudo R2         =     0.6137
```

wtp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
frequencyofinterruptionperday	6.753299	.8871791	7.61	0.000	5.01446	8.492138
durationofinterruptiondaytime	-.238628	.4156427	-0.57	0.566	-1.053273	.5760168
alternativesourceofpowersupply	-1.710791	.4367438	-3.92	0.000	-2.566793	-.8547887

Apendex 3.Binorylogir regression out put

```
Logistic regression                             Number of obs     =        265
                                                Wald chi2(11)     =      54.79
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -61.984041               Pseudo R2         =     0.6289
```

wtp	Coef.	Robust Std. Err.	z	P>|z|
educenterprises	.1648704	.1570573	1.05	0.294
familysize	.1199171	.5586876	0.21	0.830
sizeofenterprise	.3515304	.4322846	0.81	0.416
averagemonthlyincome	.1865419	.2057973	0.91	0.365
monthlyelectricityexpenditure	2.213188	.8790733	2.52	0.012
durationofinterruptiondaytime	-.5278257	.3899937	-1.35	0.176
frequencyofinterruptionperday	5.140454	1.667824	3.08	0.002
alternativesourceofpowersupply	-2.267236	.7301566	-3.11	0.002
maintenancecostofalternativesour	-.0091004	.2446613	-0.04	0.970
satisfactionwithelectricityservi	.0262484	.2590399	0.10	0.919
distancefrommanufacturingareatos	.0309643	.2711426	0.11	0.909
_cons	-3.368123	1.021931	-3.30	0.001

```
Logistic regression                             Number of obs     =        265
                                                Wald chi2(11)     =      54.79
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -61.984041               Pseudo R2         =     0.6289
```

wtp	Odds Ratio	Robust Std. Err.	z	P>|z|
educenterprises	1.17924	.1852083	1.05	0.294
familysize	1.127403	.6298663	0.21	0.830
sizeofenterprise	1.421241	.6143806	0.81	0.416
averagemonthlyincome	1.205075	.2480012	0.91	0.365
monthlyelectricityexpenditure	9.144826	8.038972	2.52	0.012
durationofinterruptiondaytime	.5898862	.2300519	-1.35	0.176
frequencyofinterruptionperday	170.7933	284.8531	3.08	0.002
alternativesourceofpowersupply	.1035981	.0756428	-3.11	0.002
maintenancecostofalternativesour	.9909409	.2424449	-0.04	0.970
satisfactionwithelectricityservi	1.026596	.2659293	0.10	0.919
distancefrommanufacturingareatos	1.031449	.2796697	0.11	0.909
_cons	.0344542	.0352099	-3.30	0.001

apendx 4.goodness fit

```
. estat gof, all group(10) outsample table
```

Logistic model for wtp, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.0467	2	0.7	25	26.3	27
2	0.0826	0	1.7	26	24.3	26
3	0.4844	4	7.0	23	20.0	27
4	0.8496	19	17.1	7	8.9	26
5	0.9068	25	23.9	2	3.1	27
6	0.9352	25	23.9	1	2.1	26
7	0.9840	27	26.0	0	1.0	27
8	0.9922	24	25.7	2	0.3	26
9	0.9991	27	26.9	0	0.1	27
10	1.0000	26	26.0	0	0.0	26

```
      number of observations =       265
            number of groups =        10
    Hosmer-Lemeshow chi2(10) =        18.34
                Prob > chi2 =         0.0495
```