UNIVERSITY OF CAPE COAST

POWER GENERATION AND PERFORMANCE OFMANUFACTURING COMPANIES LISTED ON THE GHANA STOCK EXCHANGE

BY

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DECLARATION

Candidate's declaration

I hereby declare that this dissertation is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere

Candidate's Signature………………………………

Date……………………………

Name: Michael Anum Odotei

Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature ……………………… Date……………………

Name: Ebenezer Dzinpa Effisah

ABSTRACT

Manufacturing companies employ electricity as a key resource input in their production mix. This has generally led to a situation where manufacturing companies subsist heavily on electricity for survival and continuity in business. Against this backdrop, the objective of this study was to examine the effect of power generation on the performance of manufacturing companies listed on the Ghana Stock Exchange.

A sample of seven firms was selected for the study using convenience sampling technique. Panel data covering the period 2008-2012 was adapted from the published financial statements of sampled firms. Data on power generation were time series data adapted from the Ghana Energy Commission spanning between the period 2008 and 2012. Multiple linear regression models were used to estimate the relationship between the variables in the study. The results of the study suggest that electricity supply has a significant positive impact on both profitability and efficiency. The effect of System Average Interruption Duration Indexon both profitability and efficiency were found to be negative. However, System Average Interruption Frequency Indexwas found to have an insignificant effect on both profitability and efficiency.

In respect of this, energy ministry should initiate prudent measures to improve electricity supply to ensure efficiency and profitability of manufacturing companies.In addition, manufacturing companies are to invest in other energy efficient technologies to ensure continuous electricity supply in the event of erratic supply of electricity from the national grid.

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I will like to express my sincere gratitude to my supervisor, Mr. Ebenezer DzinpaEffisah of the University of Cape Coast, Department of Accounting and Finance, and Mr. Benedict Afful Jnr. of the Economics Department, University of Cape Coastfor their professional guidance, advice, encouragement and goodwill with which they guided this work. I am really very grateful.

DEDICATION

To my wife and daughter,Mrs. Priscilla Odotei and Joan.

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CHAPTER ONE

INTRODUCTION

Introduction

This study looks at power generation and performance of manufacturing industries listed on the Ghana Stock Exchange. This part looks at the background of the study and the statement of the problem. The chapter further looked at the research objectives, questions and research hypotheses and proceeds to make a justification for the study and ends with limitations and delimitations of the study

Background of the study

Literature has it that infrastructure services (e.g. Electricity supply) isa major factor of economic development.Electricity supply interacts with the economy through multiple and complex processes. It represents an intermediate input to production, and thus changes in electricity supply quality and quantity significantly affect the profitability of production, and invariably the levels of income, output and profit (Adenikinju, 2005). Moreover, electricity supply services raise the productivity of other factors of production (Kessides, 1993). Electricity is a significant component of virtually any production process. As such, limited supply has the potential to, directly and/or indirectly; affect the economic activities of firms.

Ghana, since the establishment of Akosombo Hydroelectric Dam, has experienced several episodes of electricity supply challenges. The first of such experience was in 1983-1985 followed by 1998-2000 and then in the period 2006-2007 and the current power crisis which started in 2012 to 2015 as reported by Tano, (2015) on graphiconline.com. In between these periods there have been several power supply challenges which have lasted for shorter periods.

Failures in the electricity supply system have a negative impact on industries and compelthe industries to adapt any of these four options; decrease productivity, outsourcing, self-generation and energy efficiency technology (Fisher-Vanden, Mansur&Wang, 2014)

Low quality infrastructure has been identified as one of the potential contributors to the large productivity gap between developed and developing countries and one of the obvious examples of infrastructure failures is inadequate electricity generating plant (Allcott, Collard-Wexler & O'Connell, 2014). Electricity is intertwined with every aspect of day-to-day life. From our home to our business, health and recreation, electricity is crucial. The issue of electricity supply reliability is paramount. In addition to the inconvenience experienced by consumers during prolonged periods without electricity service, a power outage can literally mean the difference between life and death (Rouse & Kelly, 2011). Osborn andKawann (2001), defines electricity supply reliability as "*the ability of power system component to deliver electricity to all point of consumption, in the quantity and quality demanded by the consumer*".Dabholkar,Thorpe and Rentz, (1996) also defined electricity supply reliability as "*the degree to which the retail service provides what was promised and when it was promised*"

Rouse and Kelly (2011) explained that electricity was originally intended as a means of powering light bulbs. However, today, electricity is used for a wide variety of critical applications for which reliability is paramount. Industries of all types heavily depend on electricity supply for their operation

Making investment decision is critical to business activities as it relates to or affects the overall business objectives. The profitability level of a firm depends on how good or bad its investment decision is determined. While a good investment decision increases the profitability and enhances the financial viability of firms, poor choice of investment reduces the financial capability and sometimes causes firms to liquidate. Investment in fixed capital, often referred to as business fixed investment, has both the relative costs and expected benefits that often influence firm's decision to embark on such spending.

Investing in backup generation is a business fixed investment which comes at higher cost to firms and therefore has to be taken judiciously. A firm experiencing power outages would have to consider the marginal benefit of investing in backup and the marginal cost of purchasing and running the plant. For instance, a firm experiencing frequent power outages would have to decide whether to invest in backup generation and be able to continue operations in the events of outages but at the required costs, or not to invest in backup generation and shuts down operations during power outages. A firm will consider either of the options depending on which one makes a rational decision to them. A firm will invest in backup generation if it wants to continue to run its operation even when there is power outage and that there will be marginal gains in production

Manufacturing is largely dependent on electric power to operate and run the equipment and machines for the process of converting raw materials, components, or parts into finished goods. The Association of Ghana Industries (AGI) in its first quarter report of 2015 indicated that inadequate power supply is the number one on the list of ten major challenges facing the Ghana's manufacturing sector. In the view of Oviemuno (2006), one of the major requirements for the development of the manufacturing industries is affordable and abundant supply of electricity for driving the industries' machinery. Power outage is established as a major challenge to industries growth and performance. According to Khattak and Hussain (2014), electricity shortage has a significant effecton theperformance of industries. During long period of power shortage, some industries use alternative means of generating electricity such as electric generators, to produce electricity to power their activities and create convenient working environment for employees. This comes at a higher cost compared to the cost of grid power. Power outages affect output of most manufacturing industries(Doe & Selase, 2014). This is because it serves several purposes ranging from production, storage, powering of office equipment and illumination.

As a resource, power has never been enough for all those who need it for their activities. It is a scares resource and must be treated as such. In Ghana, there have been a number of times where power has to be rationed. This has resulted from inadequate generation capacity by the power generation companies to meet the demand of the country. The total installed power generationcapacity of Ghana is 2,936MW (Energy Commission,Ghana, 2014). With available generation capacity of 2,050MW compared to the installed capacity of 2,936MW, it is obvious that there are some challenges with the generation system. There are however, generation and transmission losses which make power production even less than the available generation capacity when all power generators are operational at 2,050MW (Volta River Authority,2015).

Statement of the problem

Electricity is very essential and its role in individual lives, industries and the development of economies cannot be overemphasized. This view is supported byBraimahand Amponsah (2012),Kweku(2014) Doe and Selase, (2014) and Allcott, Collard-Wexler, andO'Connellú, (2014).Niu et al. (2011) demonstrate the importance of electricity in modern economies as supported by Braimah and Amponsah (2012),Kweku(2014) Doe and Selase, (2014) and Allcott, Collard-Wexler, andO'Connellú, (2014). According to them, modern energy like electricity can be a requirement for economic and technological progress as it completes the production process. Similarly, Arouri,Youssef, M'Henni, and Rault (2012) rightly observe that making electricity accessible to various economic sectors can improve the quality of lives of population and achieve economic growth.

The nature of the relationship between electricity supply and industries performance has generated some controversies in recent times. For instance, some researchers believe that there is a negative relationship between power outages and performance of manufacturing industries (Braimah & Amponsah 2012; Doe and Selase, 2014). A study by Lee (2006) on the electricity-growth hypothesis provides evidence of an association between power supply and performance of manufacturing industries. Lee established that there is a positive relationship between electricity supply and performance of manufacturing industries. On the other hand, Cissokho and Seck (2013)also believe that there may not be any relationship between power outages and performance of manufacturing industries. The position by Cissoko and Seck on the relationship between electricity and performance of manufacturing industries has been confirmed by some previous empirical studies. One of such studies which suggest that there is no link between electricity supply and growth is the study by Chiou, Chen, Ching-fu and Zhu (2008). In their study of economic growth and energy consumption, they established that there is no relationship between electricity supply and performance of industries. Similarly, a study by Narayan and Smyth (2008) also established that there is no causality between electricity supply and performance of manufacturing industries. The conflicting results of these studies on the relationship between electricity and growth of firms suggest that the relationship between electricity and performance of manufacturing industries is not conclusive and consequently needs further studies. These studies did only establish the direction of causality between electricity supply and performance of manufacturing industries but did not explore how electricity supply affects the performance indexes of firms such as profitability and efficiency of the manufacturing industries.

Most research works have been conducted to establish the nature of relationship between power generation and performance of manufacturing industries (Allcott, Collard-Wexler & O'Connell, 2014; Chiou, Chen, Ching-fu & Zhu 2008;Narayan & Smyth 2008; Lee 2006) but only few have established the relationship between power generation and some performance indexes, such as profitability and efficiency, of manufacturing industries(Braimah & Amponsah, 2012; Doe & Selase, 2014).

The study by Doe and Selase (2014), an industry-wide study, only established the effect of power fluctuation on the profitability and competitiveness of Small and Medium Enterprises (SMEs) in Ghana without examining how electricity shortage affects the efficiencyof manufacturing companies. Also, the empirical study by Braimah and Amponsah (2012) only focused on the "Causes and Effects of Frequent and Unannounced Electricity Blackouts on the Operations of Micro and Small Scale Industries in Kumasi". However, the study did not fully explore how power generation affects the profitability and efficiency of manufacturing firms and thus reveals a research gap. This study includes efficiency as a means of performance measurement, which was absent in most of the studies that have been reviewed.

Similarly, Doe and Salase, (2014) only analyzed the effect of electric power fluctuations on the profitability and competitiveness of Small and Medium Enterprises (SMEs), using SMEs operating only within the Accra Metropolis. Though this study examined the impact of electric power fluctuation onReturn on Assets (ROA) and Return on Investment (ROI) of firms, the sample was limited to SMEs and thus the study is unable to establish the effect of power generation in the context of large scale manufacturing companies. More so the study did not examine how power supply affects the efficiency of manufacturing firms.

Studies conducted on power generation and performances of businesses have concentrated mainly on small and medium scale industries, neglecting larger firms, especially those listed on the Ghana Stock Exchange (Allcott, Collard-Wexler & O'Connell,2014; Doe & Selase, 2014; Kweku,2014&Braimah& Amponsah,2012).

The present study therefore comprehensively analyzes the effect of power supply on the performance of listedmanufacturing companies on the Ghana stock exchange using, profitability and efficiency as indices of performance. This will help manufacturing companies to have empirical bases for investing or otherwise in energy efficient technologies and also to maximize the use of the available power supply

Research objectives

The main objective of the study was to investigate the effect of power generation on the performance of manufacturing companies listed on the Ghana Stock Exchange

The specific objectives were to:

1. Examine theeffect of electricity supply on profitability of manufacturingindustries.
2. Analyze the effect of System Average Interruption Duration Index on profitability of manufacturing industries.
3. examine the effect of System Average Interruption Frequency Index on profitability of manufacturing industries.
4. Examine theeffect of electricity supply on efficiency of manufacturingindustries.
5. To analyze the effect of System Average Interruption Duration Index on efficiency of manufacturing industries.

6. Examine the effect of System Average Interruption Frequency Index on efficiency of manufacturing industries.

Research Questions

The research questions includes the following

1. What is theeffect of electricity supply on profitability of manufacturingindustries?
2. What is the effect of System Average Interruption Duration Index on profitability ofmanufacturing industries?
3. What is the effect of System Average Interruption Frequency Index on profitability of manufacturing industries?
4. What is theeffect of electricity supply on efficiency of manufacturingindustries?
5. What is the effect of System Average Interruption Duration Index on efficiency ofmanufacturing industries?
6. What is the effect of System Average Interruption Frequency Index on efficiency of manufacturing industries?

Justification of the study

Earlier studies have not established any generalized relationship between electricity generation and industrial performance. For instance, some researchers have the believe that there is a negative relationship between power outages and performance of industries Braimah and Amponsah(2012) and Doeand Selase, (2014). On the other hand, some researches also believe that there may not be any relationship between power outages and performance (Cissokho & Seck, 2013).

Research works conducted on Ghana in this field has largely focused on SMEs(Braimah & Amponsah, 2012 and Doe and Selase, 2014).These studiesare unable toestablish the effect of power generation in the sectors of manufacturing in Ghana.Findings of previous works showthat the relationship between power generation and performance of industries is not conclusive. Therefore, there is the need to undertake an empirical study to establish the relationship between power generation and the performance of manufacturing firms in Ghana to bridge the knowledge gap and establish an empirical evidence of the relationship between power generation and performance of manufacturing industries in Ghana

Thestudy can be accessed and utilized by manufacturing companies in Ghana to make a case to policy makers and government to improveelectricity supply to manufacturing industries. Thestudy will contribute to knowledge in academia and also provide improved information to the manufacturing sector in Ghana. In this regard, future researchers may also find the outcome of the study useful.Policy makers will also find the study beneficial andto know the effect of electricity supply policy on manufacturing industries so as to come out with policies to stabilize electricity supply in the economy. This will go a long way to influence where electricity supply will be concentrated to improve total output in the economy.

Limitations of the study

The first limitation of this study relates to its use of the few listed manufacturing companies on the Ghana stock market. The few manufacturing companies listed on the stock market are the very large ones in the country, leaving out the medium, small and micro enterprises. Thus the findings of the study are based on the peculiar circumstances of listed manufacturing firms. Therefore, the extent to which the findings of the study can be applied in the context of other population settings is limited.

The use of national indexes of System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI)are not the only measure of electricity service interruptions. There are many other forms of electricity interruption that may consumer. However, for the purposes of this study, SAIDI and SAIFI have been chosen to measure electricity interruption. This is because the that reliability of electricity supply is primarily concerned with duration and frequency of such service interruptions and it thus follows that reliability of supply is a customer-oriented quantity that does not consider the origin of the causes of interruptions.

Delimitations of the study

The study is delimited to cover only manufacturing companies listed on the Ghana Stock Exchange. Other firms involved in manufacturing industries, including Small and Medium Enterprises are not included.

Additionally, there are many factors that determine the performance and profitability of manufacturing industries. This claim of the multiplicity of factors that determine the performance of manufacturing firms has been underscored by Griffin (2015). Griffin(2015) states that real exchange rate, demand and structural changes are key determinants of performance of manufacturing firms. There are other factors such as quality of staff, government policies and business models that could also determine performance. However, this study looks at power generation and the performance of manufacturing companies listed on the Ghana Stock Exchange.

Moreover, the sampling period of the study spans 2008 to 2012. Most of the companies sampled have been listed on the Ghana Stock Exchange, at least, at the beginning of 2008. Thus the selection of the sampling period for the study is not exhaustive as far as the starts of the years of operation of the sampled companies are concerned.

Organization of the study

The study is organized into five chapters.

Chapter one focuses on the introduction which includes background to the study, research problem, the objectives and research questions, hypothesesformulation, justification of the study, limitations of the study and organization of the study.Chapter two covers the theoretical review, empirical review, conceptual and the theoretical frameworks.Chapter three explains the methodology in the study. These include the research design, population and sampling technique, data sources, model specification, measurement and estimation techniques, reliability and validity as well as the tools of data analysis.Chapter four discusses empirical results. The analysis and discussions were done in relation to the research objectives and research questions specified in chapter one of the study.The summary, conclusions and recommendations of the study are presented in chapter five. The chapter finally makes suggestions for areas of further research based on the findings made in the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

This part reviews both the theoretical and empirical literature on the relationship between electricity generation and performance of manufacturing industries. The chapter then proceeds to the description of the theoretical and conceptual framework and finally outlines the research gaps based on the review of related empirical studies.

Theoretical review

The relationship between energy, and apparently electricity and performance of manufacturing industries involve lots of theories. This review mainly looks at the nature of relationship between electricity generation and performance of manufacturing industries.There are somefew theories underpinning the relationship between electricity generation and performance of manufacturing industries. These are the deadweight loss theory, liberalized electricity markets theory, Cost-of-Production Theory of Value, “Neutrality hypothesis”,“Conservation hypothesis”,“Growth hypothesis” and “Feedback hypothesis”. Other theories includethe electricity intensity theory, supply side channel theory and Demand side channel.

The deadweight loss theory

The deadweight loss theory was developed by Joel Waldfogel in 1993. The theory explains that there is a consumer/producer loss, more or less due to certain constraint imposed on output by external factors.The production function combines capital, electricity as infrastructure services, labor and other production inputs. The poor and unreliable supply of electricity will impact negatively on the output produced. This impact would lead to an increase in the cost of production of the firm either through the higher cost incurred in the input substitution of private supplyof electricity or through output losses as a result shutdown, which affect those who cannot effectively find substitutes because they cannot afford to bear the extra cost that comes with it(Knetsch & Sinden, 1984).

The effect of this situation is to shift the supply curve to the left which imply that the producer will only be willing to supply a particular level of output at a higher price. In a very competitive market, the producer will be willing to supply at a marginal profit to stay in competition or will be forced to fold up. The higher market price of the product reduces both the consumer and producer surplus. Improvements in the quality of electricity supply will have a significant positive effect on the volume of output produced and would shift the supply curve of firms outwards and to the right. This would inspire improved production activities and a lower cost structure in the manufacturing sector (Waldfogel, 1996).

Liberalized electricity markets theory

The liberalized electricity market theory explains that electricity generation is not wholly regulated by the government but opened up for private participation. State owned and Independent Power Producers (IPPs) compete on the market to sell the power they produce to the bulk power consumers.Liberalized electricity market allows individual manufacturing companies to sign their own Power Purchase Agreement (PPA) with power producers on agreed terms and conditions. According to Gross, Bompard, Marannino, and Demartini (1999) economic efficiency is promoted by consumers choosing the least expensive power generators.

Liberalized electricity markets allow manufacturing firms to sign PPAs to power generators with the surety of getting constant and reliable supply of electricity for their operations. The competition from a liberalized electricity market creates an environment for manufacturing companies to negotiate for very competitive prices for the electricity they consume. It also compels power generators to produce power at a lower marginal cost therefore decreases the cost of electricity supplied to the manufacturing companies.

Meanwhile, the liberalizedelectricity market theory explains the right of firms to choose to invest in different types of power plants whichallow production of electricity at different levels of marginal cost. Electricityis not storable at reasonablecost and it is best for firms to invest in a differentiated portfolio of technologies in order to help serve thefluctuating supply.

Cost-of-production theory of value

This theory states that the price of an object or condition is determined by the sum of the cost of the resources that went into making the object(Smith,1937). The lower input cost that goes into the production of a product, the lower the cost at which the product is sold to consumers. Electricity is a major input to the manufacturing industries. Electricity generated at lower marginal cost provides manufacturing companies with lower input cost to production which eventually leads to competitive output prices of manufactured products. Following the law of supply and demand, as the cost of a product decreases, the demand for the product increases. This means manufacturers are able to produce and sell more to consumers, hence increasing the production output and profit margin of the firms. Manufacturing companies who sign Power Purchase Agreement with the power producers are able to negotiate for better cost of power which makes their overall cost of production lower.

Neutrality hypothesis theory

Proponents of the Neutrality hypothesis such as Soytas, Sari, and Ewing (2007) and Gross (2012)contend that there is no causality between energy, and apparently electricity and performance of manufacturing companies. This means that energy conservation may not adversely affect performance of manufacturing companies. According to Bartleet and Gounder (2010), proponents of theNeutrality hypothesis theoryare of the opinion that there are some contrivances by which performance of manufacturing companies could remain in the faceof a limited supply of electricity. The primary explanation for this thought is built upon the possibility of technological change, where manufacturing machine consumes less amount of electricity, and substitution of other physical inputs for energy so as to use the existing energy resources efficiently, Solow (1974). The neutrality hypothesis theory therefore explains that the performance of manufacturing companies is not influenced by electricity generation. Thus manufacturing companies can attain optimal performance without relying on power generation. The theory also explains that the performance of manufacturing industries do not affect or influence power generation.Soytas and Sari (2003) provide evidence in favor of the neutrality hypothesis for the United States of America in their study titled "*Energy Consumption and GDP causality relationship in G7 Countries* *and emerging markets*" in the period from 1950-1992 using Cointegration and Toda-Yamamotov test. Various theoretical explanations on the neutrality hypotheses such as the one exemplified by the study of Soytas and Sari have been outlined in the energy economics literature. Payne (2010) for instance suggests that electricity conservation policies such as demand management policies that essentially flatten the demand curve for electricity is reduced relative to the average load. Such action pertaining to electricity demand management would yield greater reliability of the electrical system but will have no significant effect on the performance of manufacturing industries. In this context, according to Bouoiyour, Selmi, and Ozturk (2014), neither conservative nor expansive policies in relation to electricity consumption have any effect on performance of manufacturing industries if manufacturing growth is complementary or otherwise analogous to economic growth.Arouri, Youssef, M'Henni, and Rault (2012), also observe that the lack of any link between electricity supply and growth of manufacturing firms or economic growth may be due to the rapid transition of these countries towards a digital economy that may profoundly affect energy usage. Households according to them switch to modern energy services yielding to high electricity consumption that stimulate growth in manufacturing industries.

Growth hypothesis theory

Contrary to the neutrality hypothesis is the Growth hypothesis. The proponents of this hypothesisargue that there is a unidirectional causality running from energy consumption to industrial growth. This indicates that energy conservation may reduce investment and negatively influence industrial growth. This view is supported by evidence from Narayan and

Smyth (2008), Apergis and Payne (2009),Odhiambo(2009), Bowden and Payne (2009),Tsani(2010),Wang, Zhou, Zhou, and Wang,(2011) and Yazdan and Hossein(2012). Oviemuno (2006) argues that electricity supply is the driving force for manufacturing industries, without which manufacturing industries do notexist.This argument is underpinned by the fact that manufacturing industries are the major users of any country's stock of energy. It is due to this fact that manufacturing industries always stress on the need for availability, reliability and affordability of electricity. Thus, the development of any country is determined by availability and reliability of energy for industries in that country.This argument is supported by Smith (2005) when he mentioned that developed countries consume high quantity of energy relative to that of the developing countries Thus, the developed countries are developed mainly because they consume higher amount of energy (AusAID, 2001; Todaro & Smith, 2009).

Electricity intensity theory

This theory seeks to explain the relationship between electricity consumption and performance of industries. The theory explains that there is relationship between electricity supply and performance of manufacturing industries. Markandya et al(2006), explain that electricity intensity helps energy authorities to understand howelectricity demand changes under conditions of structural change in the economy. Various researches show that the primary manufacturing sector is more electricity intensive than retail sector and financial services(Alter & Syed, 2011)and(Inglesi-Lotz&Blignaut 2011). Many firms are making effort to improve their electricity efficiency thus, having a lower value for electricity intensity.The World Energy Council

(2008)explained that improving energy efficiency is usually associated with technical and non-technical factors. The technical factors are largely technological changes, whiles the non-technical factors include better organization and managementor improved economic conditions in the sector.

Alter and Syed (2011) emphasized that electricity has an important role to play in economic development and growth and that for the determination of linkage between electricity consumption and performance of manufacturing industries, Electricity Intensity Ratio (electricity consumption/GDP) is used. It reflects the extent and divergence of electricity usage in different countries. However, the evidence available is ambiguous and the direction of causation of this relationship, which is whether energy consumption causes growthin manufacturing industries or whether energy use is determined by the level of outputremains controversial. Previous empirical studies found different results for different countries as well as for different time periods within the same country.

Supply Side Channel Theory

One of the major inputs to thermal electricity generation has been fossil fuel (oil). Be it gas, light crude oil or diesel, are all derivative of fossil fuel. Since electricity is a factor of production in most sectors and industries, a rise in electricity prices increases the companies' production costs and thus, stimulates reduction in output (Jimenez-Rodriguez & Sachez 2004). Given a firm's resource constraints, the increase in the prices of electricity as an input of production reduces the quantity it can produce. Moreover, workers and producers will counter the declines in their real wages and profit margins, putting upward pressure on unit labour costs and prices of finished goods and services.

From this perspective of the theory of supply, electricity, a key resource input for manufacturing activities when in shortage of supply compels firms to consider other alternative sources of energy which may be expensive. Given the resource constraints that face all firms, increase in the cost of power as a production input reduces the quantity of goods the firm can produce. Firms may also postpone investment decisions which have the greater propensity to affect their performance. Given this line of theoretical argument, the expectation (apriori) is that shortage of power supply will have a negative impact on performance of manufacturing companies.

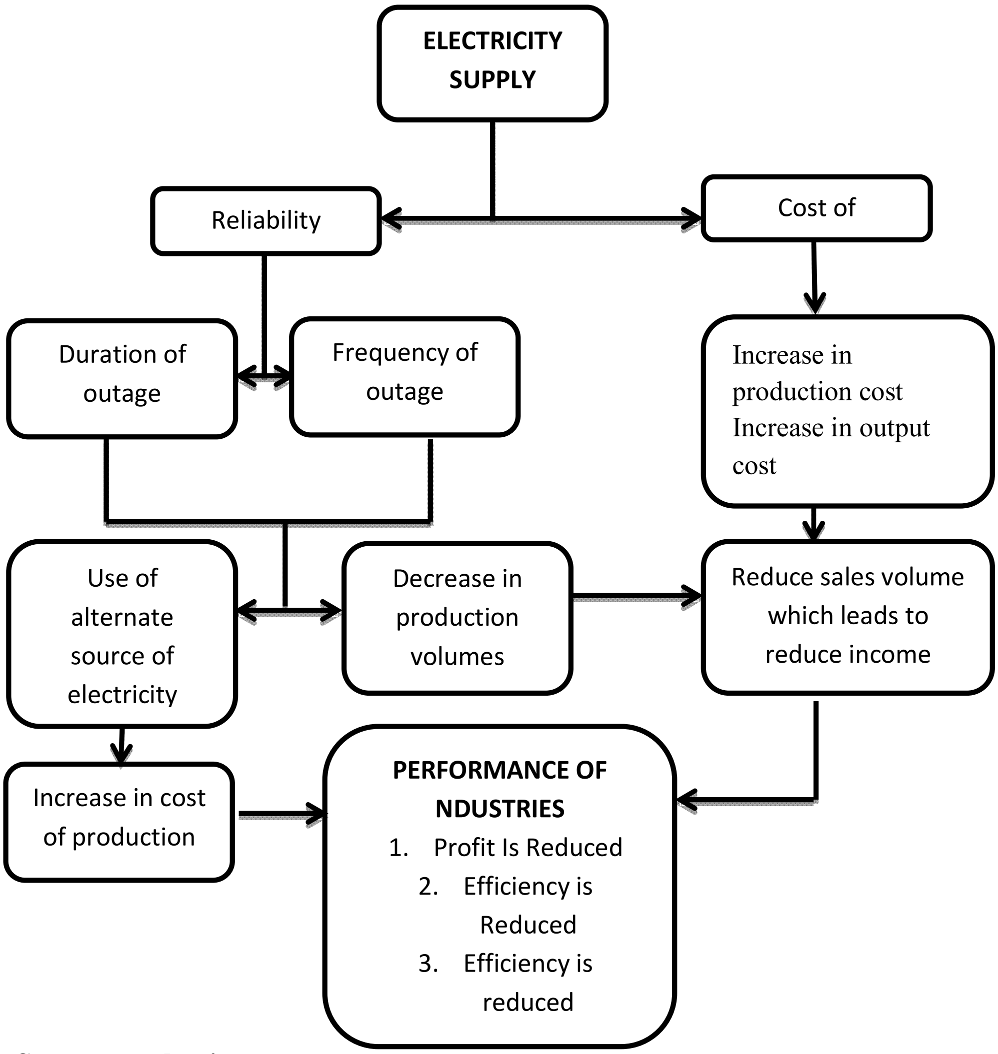
Demand Side Channel Theory

As outlined earlier under the supply side channel, electricity price increases translate to higher production costs, leading to commodity price increases at which firms sell their products in the market. Higher commodity prices then translate to lower demand for goods and services, therefore shrinking aggregate output and employment level. Furthermore, higher electricity price affect aggregate demand and consumption in the economy. All things being equal, as demand for electricity goes high the cost of electricity also goes high to shift the demand curve leftward. People may postpone consumption and investment decisions until they see an improvement in the economic situation. In sum, an increase in electricity prices causes a leftward shift in both the demand and supply curve, resulting to higher prices and lower output (Alan, 2012).

Conceptual and Theoretical framework

From the literature reviewed, it can be said that electricity supply has an effect of performance on manufacturing firms. Poor quality and quantity of electricity supply to firms negatively affect the performance of firms. All firms selected for this study are based in Ghana and relies on the national grid for the supply of electricity to run their plans and machinery to produce output. The demand for electricity supply in Ghana exceeds that which is supplied by the utilities. This is evident in the recent power outages experience all over the country. Because demand is not met, the utilities resort to power rationing/load shedding. With this load shedding practice, some consumers go off electricity supply for a period of time while other consumers enjoy electricity supply. During the load shedding period, affected firms may not produce. In addition, the utilities do not go strictly by the timetable for the load shedding, making it difficult for the firms to plan production. Firms operations are disrupted which may lead to wastage of in work in progress, inputs and finished goods that needs to be stored under particular weather conditions. This leads to losses in production hours and translates into cost to the firms. Firm who are able to afford and run standby generator or find alternative source of electricity supply may have an uninterrupted production. This, however comes at an extra cost to the firms which may reduce their profit and/or sales volume

Figure 1: Conceptual framework of the study



Source: author's concept

Figure 1 above shows the relationship between electricity supply as the independent variable and manufacturing firm's profit and firm's efficiency as the dependent variable. The figure postulate that firm's performance depends on electricity supply reliability and electricity supply cost. Unreliable supply of electricity leads to power outage. This compels firms to either decrease production volumes or resort to the use of alternate supply of electricity. The use of alternate supply of electricity increases the cost of production; whiles decrease in production volume leads to reduced sales volume and hence reduced income. Also, when the cost of electricity from the national grid goes high the input cost to production also goes high and translate into a higher cost of output. Per the law of demand, as the cost of an item increase the demand for the items decreases which results into low sale volumes and reduced income. Reduced income subsequently results in low performance of the firms.

The framework of the study essentially reflects the apriori expectations of the associations between the variables employed in the study, specifically the independent variables and the dependent variable based on the theoretical review. Based on the theoretical review comprising the endogenous growth model, deadweight theory, cost of production theory of value, neutrality hypothesis, the electricity intensity hypothesis, the growth hypothesis, and supply and demand channel theories, the following conceptual framework is developed. The relationship between firm performance measured by profitability, andefficiency on one hand and power generation comprising SAIDI, SAIFI and electricity supply on the other hand is expected to be negative specifically in the context of the cost of production theory of value, growth hypothesis, supply and demand channel theories and the electricity intensity theory. However, the relationship between firm performance and electricity production is expected to be insignificant in the context of the neutrality hypothesis

Empirical Literature Review

Several studies have been conducted to examine the impact of electricity shortage on performance of manufacturing industries. Most studies have reported a negative impact on manufacturing firms as a result of electricity shortage (Doe & Selase. 2014; Khattak & Hussainthat, 2014;Cissokho & Seck 2013).Power outages affect all modern industries in both developed and developing countries. This trend is shown in the relatively vast literature that covers firms from developed and developing countries. However, the extents of their magnitude, their frequency, as well as their underlying causes differ from one group to the other. Developing countries turn out to be more affected by insufficient provision of electricity power, and within these countries, SMEs appear to suffer the most (Steel & Webster, 1991).

A 1991 survey of small enterprises in Ghana by Steel and Webster, (1991) cited electricity supplyamong other infrastructure problems as the top four problems faced by Small and Micro Enterprises.Thus, the issue of electricity supply, its adequacy and reliability is very important for the overall performance of the manufacturing sector. However, the study did not explain how the electricity supply affects larger manufacturing industries and other factors of performance.

In an investigation into the existence of causal relationship between energy consumption and performance of industries in four Asian countries,Asafu-Adjaye (2000) using the co-integration and error-correction mechanism pointed out that there exist unidirectional causality from energy consumption to performance of manufacturing industries in India and Indonesia.

Reinikka and Svensson (2002) analyzed the impact of poor provision of infrastructure on firm performance in Uganda employing a discrete choice model on business survey. Following the study, they concluded that unreliable power supply causes firms to substitute complementary capital (for back up capital) as response to deficient public services. Applying the same data, they found that poor complementary public capital significantly reduced private investment.

Escribano, Guasch and Pena (2009) found that poor infrastructure quality has a significant impact on total performance and that poor quality electricity supply in the infrastructure element has the strongest negative effect on enterprise productivity especially in African countries. This study is also limited in scope in that it explored only how power deficit affects output of firms.

Akinlo (2009) conducted a study in Nigeria to investigate relationship between economic growth and electricity consumption during the period 1980 to 2006. The result revealed that electricity supply has a direct effect on the performance of manufacturing industries. Thus, a unidirectional Granger causality running from electricity consumption to growth and performance of manufacturing industries was observed.

In a study conducted by Owusu, (2010) to make a case on reliable and sustainable source of electricity for micro and small scale light industries in the Kumasi Metropolis.The researcher discovered that inadequacies in power generation affect the profits of SMEs in the Kumasi Metropolis. According to the researcher, firms invest a very significant amount of their income to acquire alternative sources of electricity such as petrol or diesel-powered generators to ensure continuous supply of electricity to run their businesses. Fueling and regular maintenance of these generators were

Moyo (2012) studied the effects of disruptions in power supply on firm performance in the manufacturing sector in Nigeria. The outcome of the study showed that unreliable electricity supply has a negative effect on performance of manufacturing industries. Further, the study found that power outages have a negative and significant impact on performance in small firms but insignificant effect in large firms probably due to generator ownership patterns.

Contrary to the finding of Moyo (2012) that electricity shortage insignificantly affect large manufacturing firms, using World Bank enterprise survey data for over 1000 firms in 10 Sub-Saharan African countries, Arnold,Mattoo and Narciso,(2006) argued that most manufacturing firms, especially the larger ones, invest extra capital in alternative source of electricity. Most of these alternative sources of electricity were cited to be diesel generators that are expensive to run and maintain. Arnold, Mattoo and Narciso, (2006),show that unreliable electricity supplies have a significant negative impact on firm total factor productivity. However, the study cannot tell anything about how power outages affect profitability of firms.

In a related study to the work done by Owusu, (2010) and Cissokho and Seck (2013) empirically tested the relationship between power outage and the performance of Small and Medium Enterprises (SMEs) in Senegal using cost technical and allocative efficiency. The results of the study show that power outage duration has a positive significant effect on cost and technical efficiencies. The authors attribute this finding to the suggestion that power outages stimulated better management practices which mitigated the negative effects of power supply interruptions. However, power outages, frequency and their perceived severity have negative effects on scale efficiency.

Cissokho and Seck. (2013) portrays a framework within the context of electricity insecurity and the firm’s cost effectiveness. According to the authors, interruption to power supplies potentially affect the firm’s cost of production through the expense of repairing or replacing damaged equipment, the cost of spoiled goods and the additional cost of alternative sources of energy such as generators. However, according to them, the effect of these costs on firms depends in part on their impact on total costs. Reliance on generators for electricity during outages can be expected to increase the cost of electricity and the effect of cost competitiveness is related to the proportion of total costs accounted for by electricity.

Doe and Selase, (2014) in an industry-wide study sought to establish the effect of power fluctuation on the profitability and competitiveness of Small and Medium Enterprises (SMEs) in Ghana. The authors used a cross sectional survey across several industries for their studies. The outcome of their work indicated that erratic supply of electricity leads to a declining performance levels among SMEs sampled in the study. Doe and Selaseused Return on Asset and Return on investment as their measure of performance. Though this study examined the impact of ROA and ROI of firms, the sample was limited to SMEs and the study is unable to identify the effect of power generation.

Power outage may have severe effect automated businesses. Power outage brings a total halt on automated and non-automated businesses. This is because it is used for varied purposes ranging from production, storage, powering of office equipment and product display Doe and Selase (2014). 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 (Doe& Selase, 2014).

Allcott, Collard-Wexler and O'Connell,(2014) conducted a study with the objective of examining how electricity shortage affectsthe performance of Indian manufacturing industries. The results of the study show that electricity shortages reduce efficiency of the manufacturing industries by about five percent. They went on to explain that low level of output of the manufacturing industries affected during electricity shortage was largely due to the type of manufacturing industry used for the research, thus the textile industry. They further explain that most input for this industry can be stored during power shortage. Plants without generators have much larger losses, and because of economies of scale in generator capacity, shortages more severely affect small plants. However, the study did not examine how power generation affects cost of production, the Return on Asset and Return on Investment of firms.

Qasim and Kotani (2014) argue that industries and other end-users opt for alternative sources of electricity anytime there is shortage. They say this phenomenon encourages the consumption of fossil fuel to generate electricity for private use which comes at a higher cost to industries and individuals, compared to the use of national grid electricity, and also have its own effect on the environment. The study also reveals industries and other end-users adjust their electricity demand to price only in the long run. Thus, industries satisfy their present demand for electricity irrespective of the cost as long as is available and reliable, and there is the urgent need for it. They further argue that the upward price adjustment tactics adopted by the Governments is not an effective policy to deal with power shortages in the short run.

Shahbaz, (2015) conducted a study to investigate the impact of electricity generation shortage on sectorial GDP such as agriculture, industrial and services sectors in case of Pakistan for the period of 1991-2013. The Ordinary Least Square(OLS) approach was applied for empirical analysis. The results show that electricity generation has a positive relationship with the output of industries and also indicated that electricity shortage negatively affects industrial sector output.

An analysis of power outages show that a 30-minute power cut results in an average loss of US$28,709 for medium and large industrial setups, and nearly US$95,000 for an eight-hour interruption (Volta River Authority, 2015). Even short power outages which occur several times a year in the United States of America add up to a loss of between US$104 billion and US$164 billion (Volta River Authority, 2015).

Forkuoh and Li (2015), in their study on "Electricity Power Insecurity and SMEs; A Case Study of the Cold Store Operators in the Asafo Market Area of the Kumasi Metro in Ghana" established that SMEs in the Ghana losses over US $686.4 million of sales annually since 2009. The researcher attributed this to unreliable supply of electricity is among the major cause of some businesses closing down and major challenge faced by SMEs in Ghana.

Doe and Selase, (2014) conducted a study to examine the effect of power generation on the profitability and competitiveness of industries. The result of their study indicated that power generation has a negative impact on the profitability of SMEs. They further explained that unreliable power leads to less production output and quality which result in poor sales and low level of profitability. According to the researcher, production, storage and service deliveryare the main areas affected by the shortage and fluctuations. The researcher cited costs during outage and fluctuation to include increased expenditure on alternate sources of power, increased costs in outsourcing repair services and cancellation orders due to delays.

Determinants of electricity generation

The theoretical literature emphasized that Electricity has attained a very important place in every household on this planet(Kamaludin, 2013). It is amajor contributor towards improvement of the standard of living of any individual, family and society,as well as industrial growth and economic development (Kamaludin, 2013).

Cebula and Herder, (2010) identified weather conditions, per capital of disposable income and the peak summer electricity capacity as the main determinants of commercial and industrial electricityconsumption.

Kamaludin (2013) observed that among the determinants of electricity generation is the high technological electrical appliancesin daily activities.

These electrical appliances are used in the industries and domestically and almost everywhere one finds himself. The author argues that rapid population growth and demand for higher standard of living are among the determinants in the increase of electricity consumption.

On the other hand, Sarantopoulos (2015) came out that the determinants of electricity generation are real GDP and urbanization. The author indicated that real GDP and urbanization are positively related with total electricity demand. However, the author quickly mentioned that Industrial efficiency in electricity use and coal price are negatively related. That is to say; electricity generation and demand is negative affected by industrial efficiency in electricity use and prices of fuel for electricity generation. Du and Sun (2015) also noted that research and development intensity, per capital productivity and electricity price are contributors to the decline of sectoral electricityconsumption.From the author, any sector of the economy that intensifies its research and development is likely to come out with more efficient means of conducting its activities and minimizing its electricity consumption.

Effiom, Okon and Oduneka, (2012) also identified other determinants of electricity generation. They observed that government funding, technology and level of power loss are the main determinants of power generation.They further stated that government funding/investment in the state of the art technology in transmission and distribution of electricity willultimately reduce power loss, manage consumption expansion crisis and boost electricity supplyeven in the face of an ever increasing population. Inefficient electrical network system generate sever losses of electricity generated which never gets to the consumer. The generation stations therefore have to generate more electricity to make up for the losses.

Measuring Performance of firms

Performance measurement systems were developed as a means of monitoring and maintaining organizational control which is the process of ensuring that an organization aims at strategies that lead to the achievement of its overall goals and objectives. Performance measures, the key tools for performance measurement systems play a vital role in every organization as they are often viewed as forward-looking indicators that assist management to predict a company's economic performance and may at times reveal the need for possible changes in operations (Naomi, Dixon, & Vollman,1990; Otley, 1999) as (cited in Maditinos, Sevic & Theriou, 2006).

However, the choice of performance measures is one of the most critical challenges facing organizations (Ittner & Larcker, 1998; Knight, 1998). Performance measures may be characterized as financial and non-financial. Financial measures include the use of financial ratios such as profitability ratio, liquidity ratio, leverage ratio etc. Non-financial include ownership characteristics and firm locations.

Poorly chosen performance measures routinely create the wrong signals for managers leading to poor decisions and undesirable results according to Maditinos, Sevic and Theriou (2007). Ferguson and Leistikow (1998) opine that wrongly chosen performance measures push management to take improper decisions.

According to Maditinos, Sevic and Theriou (2007), the last few years have witnessed an increasing number of consultants, corporate executives, institutional investors and scholars advocating different ways of measuring performance. Corporate executives show clearly that the performance models adopted by their corporations are the most appropriate and successful. Institutional investors debate the advantages of alternative performance models for screening underperforming companies in their portfolios. Lastly, scholars develop performance measurement models that test the extent to which existing performance valuation and incentive compensation systems inspire management decisions and performance itself (Rappaport, 1998).

These variations in performance measures nonetheless, this study uses Return on Asset (ROA) as a measureprofitability, and efficiency which according to Mathadinos, Sevic and Therious are extensively used in the literature on measuring corporate performance. Pantawala also observes that liquidity and profitability constitute the most vital aspects of business life. Return on Equity (ROE) and Return on Investment (ROI) are both means of measuring profitability but however, Return on Asset (ROA), unlike the other measures of profitability, takes into account the total value of assets of a firm used in generating net income. Hence, the use of ROA in the current study to measure performance of manufacturing companies is deemed appropriate. According to White, Sondhi and Fried (2002), the ROA measure is unaffected by differences in a company's tax position as well as financial policy.

Efficiency of a company measures how well companies utilize their assets to generate income. The efficiency of a company can be measured using efficiency ratios such as Accounts Receivable Turnover, Working Capital

Ratio, Inventory Turnover Ratio, Asset Turnover Ratio etc. this study employ the use of Asset Turnover Ratio to measure efficiency. The Asset Turnover Ratio (ATR) is an efficiency ratio that measures a company's ability to generate sales from its assets by comparing net sales with average total assets. In other words, this ratio shows how efficiently a company can use its assets to generate sales or earn income.

Research Gaps

The review of the literature reveals the following gaps:

a. Very few studies have been conducted in Ghana to examine the effects of power generation on manufacturing firm performance. Such few studies include the empirical studies by Adom (2011),Abebrese (2012), and Braimah and Amponsah (2012). Their studies focused on SMEs without giving attention to larger companies listed on the Ghana stock exchange.The dynamics of SMEs may be totally different from large companies listed on the Ghana Stock Exchange. This study focuses on large companies that are listed on the Ghana Stock Exchange.
b. Few sector specific studies have been conducted to examine the effect of power generation on various aspects of manufacturing firms' performance including profitability, efficiency and output. The study by Doe and Selase (2014), an industry-wide study only established the effect of power fluctuation on the profitability and competitiveness of SMEs in Ghana without examining how electricity shortage affects the efficiencyof manufacturing companies. This study includes efficiency as a means of performance measurement, which was absent in most of the studies that have been reviewed.

c. There is the methodological gap due to the fact that most studies have not employed quantitative approach research to estimate the relationships. According to Cresswell (2009), quantitative methods are best suited for establishing whether significant relationships exist between two variables. The study by Kwakwa (2011) on the effect of electricity shortage on firm performance was for instance based on a meta-analytical approach. Additionally, the study by Doe and Selase (2014) was also based on survey data which cannot establish significant relationships between two variables even if any relationship exists consistent with the assertion by Cresswell (2009) on the limitations of the qualitative approach. This study employs quantitative method to collect and analyze data to establish whether significant relationship exist between the various variables.

Conclusion from literature

From the review of literature, it can be concluded that several theories and postulations have been provided to explain how power generation affects the performance of firms. However, many studies in Ghana have not adequately explored how interruptions in power supply affect the performance of manufacturing companies. The present study therefore fulfills these gaps by examining the effect of power generation on firm performance.

CHAPTER THREE

RESEARCH METHODOLOGY

Overview

This chapter details the research approach that was employed to investigate the study. The chapter explains the research method, the population of the study and sampling techniques, type and sources of data, model specification, estimation technique, reliability and validity of data and data analysis.

Research design

According to Yates (2004), the two main approaches to undertaking research are quantitative and qualitative. The quantitative approach operates by developing testable hypotheses and theories which lend themselves to generalization. It is usually applied in the natural sciences and useful for data of numeric nature. Questionnaires, surveys, personality tests and other standardized research instruments are some of the data collection techniques used under this approach (Burell& Morgan, 1979).

The qualitative approach on the other hand bases research on systematic protocols. Its techniques, findings, interpretations and conclusions usually reflect the subjective opinion of the researcher. It is suitable where insightful understanding of a situation is needed. Data collection techniques adopted under this approach include observation, case studies, interview guides and reviews of literature (Crotty, 1998).The choice of the approach to be adopted for a particular study will largely depend on the purpose of that study (Boohene, 2006).

The study employs only quantitative research design in its analysis. Quantitative research is the systematic empirical investigation of observable phenomena via statistical, mathematical or computational techniques. The objective of quantitative research is to develop and employ mathematical models, theories and or hypotheses pertaining to phenomena. Quantitative methods are frequently described as deductive in nature consisting of the fact that inferences can be generated about the attribute of a given population through testing of statistical hypotheses. Creswell, (1994) conceptualizes quantitative research as type of research that is best suited to analyzing and explaining a phenomenon by collecting numerical data that are analyzed using mathematically based methods in particular those drawn from statistical fields. Because all the objectives of the study are quantitative in nature and specifically seeks to estimate relationship between the variables power generation on one hand and output, profitability, liquidity and efficiency on the other hand, quantitative research design in the context of the study is deemed appropriate.

Population

The population of the study comprises all the listed manufacturing companies on the Ghana Stock Exchange. This population covers various companies across different sectors such as food and beverages, pharmaceutical companies and other manufacturing companies. The population size is twelve.

Sample and sampling procedure

A sample of seven companies wastaken for the study.The companies selected wereAluworks Ghana Limited, Ayrton Drug, Camelot Ghana, Cocoa ProcessingCompany,Fan Milk, Guinness Ghana Breweries, and

StarwinPharmaceutical Company.All financial reports for the other five manufacturing companies were not available for sampling.

In particular, judgmental sampling was used because the study set criteria for the selection of samples for the study. To be selected as a sample, a listed manufacturing firm needs to have operated for more than five years. Additionally, firms with inconsistencies and anomalies in financial statements were not included in the study.

Data type, sources and collection

Only secondary sources of data were employed in this study. This is because there is existing data which can be used to answer the question raised by this study. The data on electricity supply was obtained from the Ghana Energy Commission and data on firms' profitability, output, and efficiency was also gotten from published financial statements of the sampled manufacturing companies. Specifically, the datacollected covered the period of five years (2008-2012). A panel data was then created out of the dataset gathered from the published financial statements of the sampled manufacturing companies across the five year period. Panel data according to Hsiao (2003) as (cited in Hurlin, 2010) is a type of data that follows a given sample of individuals over time and thus provides multiple observations on each individual in the sample. This data from the perspective of Baltagi (2005) involves the pooling of cross sectional units of observations over several time dimensions and produces estimate that are more robust than employing cross sectional or time series estimation technique alone. Another advantage, according to Hurlin, is that panel data usually gives the researcher a large number of data points and increases the degree of freedom which reduces collinearityamong the explanatory variables hence improving the efficiency of economic estimates.

Operationalization of variables

The following variables listed below are the main variables used in the study. This section operationalizes the variables used in the study, their measurement and justification.

Electricity supply

Electricity supply (ES) is the actual electricity that gets to the consumer. It is measured in kilowatts hour (kWh). The total electricity generated does not necessarily get to the consumer due to transmission and operational losses. This makes electricity supply to fall short of the electricity generated. Import from the growth hypothesis suggests that electricity supply is proportional to industrial performance. Hence, the firm's performance is expected to improve as electricity supply improves. In this study, electricity supply is an independent variable

Reliability

Electricitysupply reliability is definedas the ability of power system component to deliver electricity to all points of consumption, in the quantity and quality demanded by the consumer (Osborn &Kawann, 2001). Low level of reliability or unreliable electricity supply is a situation where consumers do not get the right quantity and quality required for their use. Unreliable electricity supply leads to power rationing. In this study, reliability is an independent variable.

The reliability of an electricity supply system reflects its ability to maintain service continuity. In this context, the service is to make electricity available for use to the end-user customers of the electricity supply system. When an electricity supply system fails to perform this task, there are customers that experience service interruptions, which means that these customers are de- energized. The reliability of supply thus depends on the performance of generation, transmission and distribution. Availability is often used as one measure of reliability. Availability is defined as the percentage of time a customer is uninterrupted. Availability is considered as a subset of reliability as it only provides information about annual interruption duration, and not about interruption frequency (Roos, 2005).

The frequency of interruption and duration of interruption is measured by System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI).

It is expected (apriori) that in this study, as the frequency and duration of electricity supply interruption increases, performance of manufacturing firms will decrease. Unreliable supply of electricity leads to power rationing.

Power rationing is a practice by electricity utility companies to cut off electricity supply to some sectors/locations of consumers for a given period of time when electricity demand exceeds the utility's electricity supply capacity. This is exercise is undertaken to safeguard electricity generation equipment and consumers' gargets. Putting excessive load on the power generation equipment causes overheating of the power system components and exposes them to risk of damage. Power rationing means certain consumers going off the electricity grid for a period of time rationing. This, to the manufacturing sector, means that there will not be electricity available from the electricity utility to power their productive equipment thus they cannot produce. Power rationing in this study is complementary to two of theindependent variables in the study namely SAIDI and SAIFI since power rationing is a precursor to electricity system unreliability.

Firm’s profitability

Profitability is simply the capacity to make a profit, and profit is a financial benefit that is realized when the amount of revenue gained from a business activity exceeds the expenses, costs and taxes needed to sustain the activity. Better still, profit is the money a business makes after accounting for all the expenses. Profitability is a measure of a firms’ performance and in this study, it is a dependent variable. As the input the production increases and/or production volume decreased, the firms’ profitability is expected to decrease. Return on Assets is used as a measure of profitability. Return on Assets (ROA) measures how effectively the company produces income from its assets. It is calculated by dividing net income (NI) for the current year by the value of all the company's assets (A) and multiplying the quotient by 100. Unlike other measures of profitability, ROA takes into account the total value of assets of a firm used in generating net income.

Firm’s efficiency

Firm’s efficiency is a measure of a company's ability to use its assets and manage its liabilities effectively to generate returns for the firm. It measures the cost incurred for earning a unit income. In this study, firm’s efficiency is a dependent variable and is measured by the ratio of the total revenue to the total cost.

Model specification

A specification of a model generally refers to the choice of variables in a model. Curwin, Eadson and Roger (2013) suggest that in building a regression model, it is better to build a model with more independent variables since the problem of increased variance may be easy to deal with than the problem of biased prediction. However, though it is prudent to build models with many variables, Mills 2011) contends that the choice of variables in a model should be theoretically relevant and appropriate. Thus whiles building models with numerous variables, the model must at the same time be subject to theoretical constraint.

Table 1: Explanation of Variables

Type of Variable	Name	Proxy Measure
Dependent	Return on Assets (ROA)	Profit after Interest and Taxes / Total Assets
Dependent	Efficiency (E)	Total revenue/Total cost
Independent	Electricity Supply (ES)	Annual level of electricity supplied
Independent	System Average Interruption Duration Index (SAIDI)	Natural log of System Average Duration Index
Independent	System Average Interruption Frequency Index (SAIFI)	Natural log of System Average Frequency Index

From this perspective, the variables selected in this study are electricity supply, System Average Interruption Duration Index (SAIDI), and System Average Interruption Frequency Index (SAIFI). Though the study examines the effect of power generation on the performance of manufacturing firms, power generated may not necessarily be supplied and thus overall power generation capacity is excluded in the model because of theoretical considerations. SAIDI and SAIFI are essentially key attributes of power supply and thus considered relevant in the model adopted for the study(Liang & Goel, 1997).The statistical technique employed in the study is the linear multiple regression model. Multiple linear regression is used to estimate the parameters of the study. Multiple linear regression is a statistical method that allows us to estimate and study relationships between two continuous variables. Multiple linear regression is best suited to establishing the relationship between two set of variables. Unlike simple regression model,multiple linear regression attempts to model the relationship between two or more explanatory variables and a response variable by fitting a linear equation to observed data. In the model, the dependent variables, profitability (ROA) and efficiency are conceptualized as functions of the independent variables Electricity supply (ES), SAIDI and SAIFI. Based on this conceptualization, two economic models are formulated namely:

ROA= f (ES, SAIDI, SAIFI) and E = (ES, SAIDI, SAIFI).

Where

ROA = Return on Assets

ES = Electricity Supply

SAIDI = System Average Interruption Duration Index

SAIFI = System Average Interruption Frequency Index

The economic models are then transformed into econometric models by applying natural logarithm in order to obtain a linear exponential trend if any in the panel data (Konor, 2014).

The following are the econometric models usedfor the study.

$ROA_{it} = C + B_1ES_{it} + B_2SAIDI_{it} + \beta_3SAIFI_{it} + + \mathcal{E}_{it}$ …………………… (1)

$E_{it} = C + B_1ES_{it} + B_2SAIDI_{it} + \beta_3SAIFI_{it} + + \mathcal{E}_{it}$ ……………………(2)

$\mathcal{E}$ is the error term, C is the constant term and B_1, B_2, and B_3 are the coefficients of ES, SAIDI, and SAIFI respectively. I and t are time and firm specific respectively.

Estimation technique

The estimation of the model parameters was done with the aid of the Statistical Package for the Social Sciences (SPSS) using the Ordinary Least Squares (OLS) Regression technique.

Reliability and Validity of data

Reliability of a scale gives an indication of how free it is from random error (Pallant, 2007) or the extent to which the scale produces consistent results if repeated measures are taken. Validity on the other hand is concerned with the extent to which an instrument effectively measures attributes it is supposed to measure (Easterby-Smith, Thorpe & Lowe, 2002).To ensure that the data collected best fits the model, the Durbin–Wu–Hausman test (also called Hausman specification test)was employed to test reliability and validity. Another approach to achieving validity of the study is the Analysis of Variance (ANOVA) Test. According to Curwin, Eadsonand Roger (2013), the ANOVA predicts the overall validity of a model in predicting the dependent variable.

Data analysis

Data was analyzed by means of multiple linear regression model. Correlation test was used to examine the degree of relationships between the dependent variables and the independent variable. Data was analyzed both descriptively and inferentially. The descriptive analyses help provide summaries about the sample and could be used to draw conclusions that extend beyond the immediate data alone.

The relationships between the dependent variablesand the independent variables in the studywere estimated by running two different regression models because of the use of two independent variables namely Return on Assets, and Efficiency of manufacturing firms.

Conclusion

This chapter has outlined the overall research methodology used in the study and the estimation techniques employed for the study.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Overview

The study had the general objective to examine the effect of power generation on the performance of manufacturing. Specific objectives were stated as the determination of the impact of ES, SAIDI, and SAIFI on the profitability and efficiency of firms. To do so, two variables all considered as variants of firm performance were adopted for the purpose of the study. These variables are namely Return on Assets, and Efficiency of firms. Specifically, Return on Assets which measures firms' ability to generate profits was defined as the quotient of profit after interest and taxes, and efficiency which measures the operating performance of firms is defined as the quotient of total cost and total revenue. Data on these variables of performance was adapted from these firms over a period of five years and the data on power generation was adapted from the annual published statistics on electricity of the Ghana Energy Commission. The sample size of firms was seven. The data collected was analyzed using multiple linear regression models. This chapter of the study presents the results and discussions of the study in accordance with the research objectives, questions and hypothesis specified in chapter one of the study.

RESULTS

Table 2: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ROA	35	-.14	.39	.0958	.14454
EFFICIENCY	35	.10	15763.89	9.3563E2	2653.54384
ES	35	9.03	9.39	9.2112	.13654
SAIDI	35	274.00	372.00	3.0800E2	34.84081
SAIFI	35	89.00	118.00	1.0100E2	10.75667

Source: Estimated from SPSS 16.0

Table 2 shows the descriptive statistics of the variables used in the study. From Table 2, there are 35 observations denoted by the sign “N”. The standard deviation shows how the various variables are spread from their respective Mean. The standard deviation of the variables for example the standard deviation of ROA is .144, ES is .136, SAIDI is 34.84 and SAIFI is 10.75. The variations in the figures of the standard deviations suggest that there is greater variability in the panel data of the study which is consistent with Baltagi and Hsiao position on the advantages of panel data. From Table 2, ES has the least standard deviation of 0.13654 and EFFICIENCY has the highest standard deviation 2653.54384. This means that the values of efficiency are the most widely spread from its mean and that of ES is the least spread from the mean.The Mean is the average value of the various variables. The Mean of ROA is 0.0958, EFFICIENCY is 935.63, ES is 9.2112, SAIDI is 3080 and SAIFI is 1010.

Table 3: Correlations matrix: ROA versus ES, SAIDI, and SAIFI

		ROA	ES	SAIDI	SAIFI
Pearson Correlation	ROA	1.000	.082	-.008	.041
	ES	.082	1.000	-.464	-.874
	SAIDI	-.008	-.464	1.000	.806
	SAIFI	.041	-.874	.806	1.000

Source: Estimated from SPSS 16.0

Table 3 shows the correlations between the dependent variable and theindependent variables. Table 3 at the same time shows the relationships between the independent variables. The correlation between ROA and ES is .082. This means that there is a weak positive correlation betweenROA and ES,and that a unit change in ES causes a corresponding 0.082 units change in ROA. If ES increases by one unit, ROA will increases by 0.082 units and if ES decreases by one unit, ROA also decreases by 0.082 units.Table 3 again shows a weak negative correlation of-.008 between ROA and SAIDI, and suggests that ROA and SAIDI move in opposite direction. A unit change in SAIDI will cause a corresponding change of .008 in ROA in the opposite direction. If SAIDI is increased by one unit, ROA will Decrease by 0.008 units and if SAIDI is decreased by one unit, ROA will increase by 0.008 units. The correlation between ROA and SAIFI is0.041 and means there is a weak positive relationship between ROA and SAIFI. A unit increase in SAIFI will cause a corresponding increase of 0.041 in ROA and a unit decrease in SAIFI will cause a decrease of 0.041in ROA. There is a collinearity of -0.874 between ES and SAIFI, and 0.806 between SAIDI and SAIFI. This suggests that ES and SAIFI are highly correlated and one cannot be held constant to estimate the effect of the other on ROA. Same also happens in the case of SAIFI and SAIDI. However, multicollinearity has no impact on the overall regression model and associated statistics such as R-square, F ratios and p values.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.567[a]	.32	.281	.15051

a. Predictors: (Constant), SAIFI, SAIDI, ES

Source: Estimated from SPSS 16.0

Table 4 indicates that the R Square is 0.32. The R-squared of 0.32 means that approximately 32% of the variance of ROA is accounted for by the model, in this case, SAIDI, SAIFI and ES. Table 4 shows that the R Square is 0.32. Because the R Square measures the proportion of the variance in the dependent variable that is accounted for by the independent variable, it suggests that approximately 32% of the total variation in the dependent variable, profitability, is caused by the independent variables namely SAIFI, SAIDI, and ES.

Table 5: ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.008	3	.003	.119	.018[a]
	Residual	.702	31	.023		
	Total	.710	34			

a. Predictors: (Constant), SAIFI, SAIDI, ES

b. Dependent Variable: ROA

Source: Estimated from SPSS 16.0

Table 5 provides the Analysis of Variance (ANOVA) test. The ANOVA is used to establish the overall validity of a regression model (Sosa-Escudero, 2009). From Table 5 the F-test is statistically significant at a confidence interval of 95%, which means that the model is statistically significant with a significant value of 0.018.The significance of the model as depicted by Table 5 is 0.018. This means the model for estimating the effect of ES, SAIDI, and SAIFI on ROA is significant and provides good estimation of the dependent variable

Table 6: Coefficientsa ROA versus ES, SAIDI, and SAIFI

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-2.763	7.324		-.377	.019
	ES	.283	.717	.268	.395	.025
	SAIDI	-0.26	.112	-.068	-2.32	.004
	SAIFI	.003	.014	.248	.244	.809

a. Dependent Variable: ROA

Source: Estimated from SPSS 16.0

Table 6 shows the relationships of the independent variable (ES, SAIDI AND SAIFI) with the dependent variable, ROA. From Table 6,the t-test for ES equals 0.283, and is statistically significant, meaning that the regression coefficient for ES is significantly different from zero. The t-test is significant at a confidence level of 95% and a significant value of 0.025. This means there is a positive relationship between Electricity Supply and ROA otherwise the profitability of firms. This suggests that a unit increase in electricity supply leads to an increase in profitability level by .283 units. It also holds that a unit decrease in electricity supply also leads to a decrease in

ROA by 0.283 units. The effect of electricity supply on profitability as suggested,at a confidence level of 95%, by the p value of electricity supply from Table 6 of 0.025 is also significant and cannot be said to be due to chance. The t-test for SAIDI equals -0.26, and is statistically significant, meaning that the regression coefficient for SAIDI is significantly different from zero. The t-test is significant at a confidence level of 95% and a significant value of 0.004. This means there is a positive relationship between SAIDI and ROA otherwise the profitability of firms.The t-test for SAIFI equals 0.003, and is statistically insignificant, meaning that the regression coefficient for SAIFI is equivalent zero. The t-test is significant at a confidence level of 95% and a significant value of 0.809. This means SAIFI has no significant effect on profitability.The constant is -2.763, and this is the predicted value of ROA when independents variables equals zero. From Table 6, ES has the largest Beta coefficient, 0.268, and SAIDI has the smallest Beta, -0.068. Thus, a one standard deviation increase in ES leads to 0.268 standard deviation increase in predicted profitability, with the other variables held constant. And, a one standard deviation increase in SAIDI, in turn, leads to a 0.068 standard deviation decrease inprofitability with the other variables in the model held constant. Also a one standard deviation increase in SAIFI leads to a 0.248 standard deviation increase profitability with the other variables in the model held constant and the vice versa.

Table 7: Correlations matrix on Efficiency versus ES, SAIDI and SAIFI

		EFFICIENCY	ES	SAIDI	SAIFI
Pearson Correlation	EFFICIENCY	1.000	.125	-.020	-.116
	ES	.125	1.000	-.464	-.874
	SAIDI	-.020	-.464	1.000	.806
	SAIFI	-.116	-.874	.806	1.000

Source: Estimated from SPSS 16.0

Table 7 shows the correlations between the dependent variable, Efficiency, and the independent variables, ES, SAIDI and SAIFI. Table 7 at the same time shows the relationships between the independent variables. The correlation between Efficiency and ES is .125. This means there is a weak positive relationship between Efficiency and ES and a unit change in ES will cause a corresponding change of 0.125 units change in Efficiency.The correlation between Efficiency and SAIDI is -0.020and suggests that Efficiencyand SAIDI are negatively correlated and the correlation s a weak one. A unit increase in SAIDI will cause a decrease of Efficiency by 0.020. The correlation between Efficiency and SAIFI is -0.116 and means there is a weak negative relationship between Efficiency and SAIFI. A unit increase in SAIFI will cause a decrease of Efficiency by 0.116 units and the vice versa. There is a collinearity of -0.874 between ES and SAIFI, and 0.806 between SAIDI and SAIFI. However, multicollinearity has no impact on the overall regression model and associated statistics such as R-square, F ratios and p values.

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.304[a]	.092	.004	2647.59339

a. Predictors: (Constant), SAIFI, SAIDI,ES

Source: Estimated from SPSS 16.0

Table 8 indicates that the R Square is 0.092. The R-squared of 0.092 means that approximately 9.2% of the variance of Efficiency is accounted for by the model, in this case, SAIDI, SAIFI and ES.Because the R Square measures the proportion of the variance in the dependent variable that is explainedby the independent variable, it suggests that approximately 9.2% of the total variation in the dependent variable efficiency is caused by the independent variables namely SAIFI, SAIDI, and ES otherwise illustrated as predictors as found in Table 8.

Table 9: ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.210E7	3	7367251.275	1.051	.014[a]
	Residual	2.173E8	31	7009750.739		
	Total	2.394E8	34			

a. Predictors: (Constant), SAIFI, SAIDI, ES

b. Dependent Variable: EFFICIENCY

Source: Estimated from SPSS 16.0

Table 9 provides the Analysis of Variance (ANOVA) test. The ANOVA is used to establish the overall validity of a regression model (Sosa-Escudero, 2009). From Table 9 the F-test is statistically significant at a confidence interval of 95%, which means that the model is statistically significant with a significant value of 0.014. The significance of the model as depicted by Table 9 is 0.014. This means the model for estimating the effect of ES, SAIDI, and SAIFI on Efficiency is statistically significant and provides good estimation of the dependent variable.The significance of the model as illustrated by Table 9 is 0.014. This means the model for estimating the effect of ES, SAIDI, and SAIFI on efficiency is statistically significant and provides good estimation of the dependent variable

Table 10: Coefficients[a] Efficiency versus ES, SAIDI, and SAIFI

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	15.71	12.82		1.220	.032
	ES	1.3	11.46	.98	0.113	.002
	SAIDI	-.5470	15.32	.860	0.035	.016
	SAIFI	-33.499	23.45	28.490	-1.42	.135

a. Dependent Variable: EFFICIENCY

Source: Estimated from SPSS 16.0

Table 10 shows the relationships of the independent variable (ES, SAIDI AND SAIFI) with the dependent variable, Efficiency. From Table 10, the t-test for ES equals 1.3, and is statistically significant, meaning that the regression coefficient for ES is significantly different from zero. The t-test is significant at a confidence level of 95% and a significant value of 0.002. This means there is a positive relationship between Electricity Supply and Efficiency of the firms. This suggests that a unit increase in electricity supply leads to an increase in Efficiency level by 1.3 units. It also holds that a unit decrease in electricity supply also leads to a decrease in Efficiency by 1.3 units. The effect of electricity supply on Efficiency as suggested, at a confidence level of 95%, by the p value of electricity supply from Table 10 of 0.025 is also significant and cannot be said to be due to chance. The t-test for SAIDI equals -0.5470, and is statistically significant, meaning that the regression coefficient for SAIDI is significantly different from zero. The t-test is significant at a confidence level of 95% and a significant value of 0.0016. This means there is a positive relationship between SAIDI and Efficiency of the firms. The t-test for SAIFI equals -33.499, and is statistically insignificant, meaning that the regression coefficient for SAIFI is equivalent zero. The t-test is significant at a confidence level of 95% and a significant value of 0.135. This means SAIFI has no significant effect on profitability. The constant is 15.71, and this is the predicted value of Efficiency when independents variables equals zero. From Table 10, SAIFI has the largest Beta coefficient, 28.49, and SAIDI has the smallest Beta, 0.86. Thus, a one standard deviation increase in SAIFI leads to 28.49 standard deviation increase in predicted Efficiency, with the other variables held constant. And, a one standard deviation increase in SAIDI, in turn, leads to a 0.86 standard deviation increase Efficiency with the other variables in the model held constant. Also a one standard deviation increase in ES leads to a 0.98 standard deviation increase Efficiency with the other variables in the model held constant and the vice versa.

DISCUSSION OF RESULTS

Effect of Electricity Supply on the Profitability of manufacturing firms

The first objective of the study was to establish the effect of Electricity Supply on the profitability of manufacturing firms.From Table 6, the coefficient of electricity supply is 0.283. This means there is a positive relationship between electricity and ROA otherwise the profitability of firms. This suggests that a unit increase in electricity supply leads to an increase in profitability level by .283 units. It also holds that a unit decrease in electricity supply also leads to a decrease in ROA by .283 units. The effect of electricity supply on profitability as suggested by the p value of electricity supply from Table 6 of 0.025 is also significant and cannot be said to be due to chance.

The results confirm the findings of previous studies such as Doe and Asamoah (2014), Abebrese (2013) and Reinika and Svensson (2002) who established that electricity supply has a significant positive relationship withprofitability of firms. This result of a positive association between electricity supply and profitability of firms may be due to the postponement of investment decisions which affects profitability levels as espoused by Cissoko and Seck. (2013) through the supply and demand side channels espoused by Jimenez-Rodriguez and Sachez (2004).

Further the positive relationship between electricity supply and profitability of firms may be attributed to the Growth hypothesis theory which is premised on the fundamental assumption that the major users of a country's stock of energy including electricity are manufacturing companies. This attribution of the positive association between electricity supply and profitability of firms is particularly so since firms heavily rely on electricity for production and it follows that electricity has the potential to reduce investments of firms and subsequently growth level which in itself moderates the relationship between electricity and profitability of firms. Moreover, the evidence of a positive link between electricity supply and profitability is consistent with the Electricity intensity theory which is at covariance with the Growth hypothesis in the context of theoretical thinking-that is the Electricity intensity theory also posits that manufacturing companies employ electricity as a key resource input and it follows that electricity supply and profitability move in the same direction. However, the evidence of a positive association between electricity supply and profitability of firms conflicts with the Neutrality hypothesis theory of power generation which suggests that there is no link between electricity supply and growth of firms as espoused by Sari and Ewing (2007) and Gross (2012).

Impact of System Average Interruption Duration Index on profitability of firms

From Table 6, the coefficient of SAIDI is -0.26. This indicates that there is a negative relationship between interruption duration index and profitability. This evidence of an inverse relationship between interruption duration and profitability of firms suggests that an increase in interruption duration leads to a decrease in profitability by 0.26 units. In the same way, a decrease in system duration also leads to an increase in profitability by 0.26 units. The effect of system interruption duration on profitability as illustrated by the p value of power generation from Table 6 of .0016 is also significant and cannot be said to be due to chance. The finding of this study of the negative effect of system duration on profitability of firms validates the theoretical thinking of the Growth hypothesis. It is possible that the growth of firms as a result of reliable electricity supply which leads to higher profitability has not been possible because of intermittent supply of electricity. However, the evidence of a negative association between system interruption duration and profitability of runs contrary to the neutrality hypothesis which admits to no effect of power generation on performance of manufacturing firms.

Effect of System Average Interruption Frequency Index on profitability of firms

From Table 6, the coefficient of SAIFI is 0.003. This means there is a positive relationship between system interruption frequency and profitability of manufacturing firms. A unit increase in System Average Interruption Frequency Index leads to an increase in profitability level by 0.003 units. A unit decrease in System Average Interruption Frequency Index, from the results of the coefficient, also leads to a decrease in profitability by 0.003 units. However, the effect of System Average Interruption Frequency Indexon profitability as shown by the p value of interruption frequency from Table 6 of 0.809 is foundto be insignificant and can be said to be due to chance. The findings of the study in the context of the insignificant positive effect of System Average Interruption Frequency Index on profitability of firms is inconsistent with the findings made in the study by Allcott, Collard-Wexter and O'connell (2014) who established that electricity shortages reduce output of firms by approximately 5%. The result also does not corroborate the findings by Escribano,Guasch, and Pena (2009), Moyo (2012) and Abebrese (2013) who found a significant negative impact of power shortages on the output of firms. Again, the finding conflicts with the findings in the study by Kwakwa (2011) who found thatthe link between energy and firm growth is indeterminate. Further the result of no significant effect of system interruption frequency on profitability conflicts with the theoretical proposition by the Growth hypothesis and the Electricity intensity theories but consistentwith the neutrality hypothesis.

Effect of Electricity Supply on the Efficiency of manufacturing firms

From Table 10, the coefficient of Electricity Supply is 1.3.This suggests that there is a positive relationship between electricity supply and efficiency of firms. A unit increase in electricity supply leads to an increase in efficiency level by 1.3 units. Similarly, a decrease in electricity supply also leads to a decrease in efficiency by 1.3 units.The associated significance value of electricity supply from Table 10 is 0.002and suggests that the positive effect of electricity supply on efficiency of firms is significant and cannot be attributed to chance. It is possible that manufacturing companies listed on Ghana Stock Exchange are not able to employ technological resource power inputs which are not subject to any supply constraints and which are more efficient. This evidence of a positive significant association between electricity supply and efficiency is inconsistent with the neutrality hypothesis theory on the effect of electricity on firm performance but however consistent with the Growth, Electricity intensity, supply and demand side channel theories of the electricity firm performance hypothesis.

Impact of System Average Interruption Duration Index (SAIDI) on Efficiency of firms

The fifth objective of the study was to establish the effect of System Average Interruption Duration Index (SAIDI) on the Efficiency of manufacturing firms. From Table 10, the coefficient of SAIDI is -.5470. This means there is a negative relationship between System Average Interruption Duration and efficiency of manufacturing firms. This means that System Average Interruption Duration and efficiency of manufacturing firms behave differently. A unit increase in system interruption duration will lead to a fall in efficiency of firms by .5470 units. In the same way, a unit decrease in System Average Interruption Duration Index will lead to an increase in efficiency of firms by .5470 units. The effect of SAIFI is also found to be significant. Thissignificant effect of SAIFI on efficiency of firms is substantiated by the p-value from the coefficients in Table 10, which is 0.016. This means the negative effect of SAIDI on Efficiency of firms may be due to chance.This significant negative effect of system interruption duration conflicts with the neutrality hypothesis which suggests that interruptions in electricity supply may lead firms to invest in energy efficient technologies to ass to reduce their susceptibility to interrupted electricity supplies. It is possible manufacturing firms are not investing in energy efficient technologies.

Effect of System Average Interruption Frequency Index (SAIFI) on Efficiency of firms

The sixth objective of the study was to establish the effect of System Average Interruption Frequency Index (SAIFI) on the efficiency of manufacturing firms. From Table 10, the coefficient of SAIFI is -33.499. This means there is a negativerelationship between System Average Interruption Frequency and efficiency of manufacturing firms.This means that System Average Interruption Frequency and efficiency of manufacturing firms behave in different directions. A unit increase in system interruption frequency will lead to a fall in efficiency of firms by 33.499 units. In the same vein, a unit decrease in System Average Interruption Frequency Index will lead to an increase in efficiency of firms by 33.499 units. However, the effect of SAIFI is found insignificant. This insignificant effect of SAIFI on efficiency of firms is substantiated by the p-value from the coefficients Table 6. From the coefficients Table 10, the p value of SAIFI is 0.135. This means the negative effect of SAIFI on efficiency of firms may be due to chance.

Conclusion

This chapter examined the panel data characteristics of the data used for estimation and discussed the estimated results. The result of the estimate indicates that both electricity supply (ES) and SAIFI have a positive relationship with profitability and efficiency of manufacturing industries. However, the result shows that relationship between SAIFI, and profitability and efficiency was insignificant and may be due to chance. On the other hand, SAIDI showed a negative relationship between efficiency and profitability.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter of the study presents the summary, conclusions and recommendations made following the conduct of this study. The summary, conclusion and recommendations are all made based on the peculiar findings in the study.

Summary

This study was carried out to analyze the effect of power generation on the performance of manufacturing firms in Ghana. The core objectives were to estimate the impact of electricity supply, system average interruption duration index and system average interruption frequency index on the profitability and efficiency of listed manufacturing firms on the Ghana Stock Exchange.

The study commenced by providing the context within which the study is deemed important. The study then proceeded to compare and contrast the current study to previous studies. This was done by situating the study in a theoretical perspective.

To achieve the specified objectives in the study, panel data covering the selected performance indicators of firms namely profitability and efficiency were adapted from the published financial statements of sampled firms over a period of five years from 2008 to 2012. Data on electricity supply and related attributes comprising system average interruption duration index and system average interruption frequency index, the two collectively termed reliability of electricity supply was adapted from the Ghana Energy Commission report on the energy sector.

The data collected was tested using a multiple regression statistical technique. The results of the study suggest that electricity supply has a positive relationship with the profitability of firms as measured by ROA ratio. Also, the effect of system average interruption duration on profitability was found negative. However, the effect on system average interruption frequency index was found insignificant. Again the effect of electricity supply on efficiency of firms was found positive. Moreover, the impact of system average interruption duration index on efficiency was established as negative.Further, the study establishes that system average interruption frequency indexhas no significant effect on the efficiency of manufacturing firms.

Conclusion

The general objective of the study was to examine the impact of power generation on the performance of manufacturing companies in Ghana. Specific objectives were to establish the effect of electricity supply, system average interruption duration and system average interruption frequency on the performance of manufacturing firms. The performance indices examined in the study were Return on Assets, a measure of firm profitability, and efficiency which measures the operating cost competitiveness performance of firms. To achieve the research objectives, panel data was adapted from a sample of 7 listed manufacturing spanning the period 2008-2012. The multivariate regression model was adapted for the study.The results of the study indicate that electricity supply has a significant positive impact on the profitability of firms. Additionally, it was established that system average interruption duration index has a significant negative effect on profitability. However, the study established that the effect of System Average Interruption Frequency Indexon profitability was not significant. Further, the effect of electricity supply on efficiency was found positive. Also the study found that ssystem average interruption duration index has a significant inverse relationship with efficiency. The effect of system average interruption frequency index on efficiency was however found insignificant.

From the theoretical perspective through which the performance of firms is affected, the study attributes these findings of the positive relationship between electricity supply and profitability and the negative relationship between system average interruption duration index and efficiency of firms to the supply and demand side channel theories, electricity intensity theories, the deadweight loss theory, growth hypothesis, cost of production theory of value.

Recommendations

Based on the findings of the study, the following recommendations weremade to improve power generation

The study revealed a positive relationship between power generation and performance of manufacturing companies which is an indication that power generation plays an important role in driving performance of manufacturing companies. In respect of this, policy makers should initiate prudent measures to improve power generation to ensure efficiency and profitability of manufacturing companies. Improvement in the efficiency and profitability of manufacturing companies will lead to improved output and this will have a positive impact on economic growth.

Supply of electricity has a positive effect on the profitability and efficiency of manufacturing companies. In this regard, there is the need for the government to encourage other Independent Power Producers (IPPs) to set up power generation plant to augment the supply of electricity in the country. This can be achieved through the provision of government guarantee and an off taker agreement between the IPPs and the government. In addition, this can also be achieved through provision of tax incentives for the IPPs.

The study showed that System Average Interruption Duration Index(SAIDI) has a negative effect on efficiency and profitability of manufacturing companies which is an indication that SAIDI plays an important role in driving efficiency and profitability of manufacturing companies. In this respect, power producers should initiate measures to mitigate SAIDI and ensure more reliable supply of electricity to manufacturing companies.

Manufacturing companies are to invest in other energy efficient technologies to ensure continuous electricity supply in the event of erratic supply of electricity from the national grid. Investing in high energy efficient technologies will mean a reduction in the demand of electricity supply from the national gridwhich will lead to improved efficiency and profitability of the manufacturing companies.

Suggestions for further research

The manufacturing sector is a broad one made up of so many subsectors like the pharmaceutical manufacturing sector, food and beverage manufacturing sector, steel and aluminum product manufacturing etc. the effect of electricity supply on these sectors may vary from one sector to the other. Electricity supply deficit may have less negative impact on some manufacturing sectors than others depending on the type of input they use in their manufacturing (Allcott et al, 2014). I recommend that further studies should look at the effect of power generation on a specific sector of the manufacturing industry.

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APPENDICES

Appendix A: Raw Panel Data

FIRMS	YEARS	Total Cost	Revenue
ALUWORKS GHANA LIMITED	2008	68490	57127000
ALUWORKS GHANA LIMITED	2009	34309	34271000
ALUWORKS GHANA LIMITED	2010	29546	25167000
ALUWORKS GHANA LIMITED	2011	51008	49716000
ALUWORKS GHANA LIMITED	2012	52738	49681000
AYRTON DRUG	2008	8492676	11902564
AYRTON DRUG	2009	9899765	15513573
AYRTON DRUG	2010	8383047	12455486
AYRTON DRUG	2011	13195776	20052755
AYRTON DRUG	2012	15250111	22996295
CAMELOT GHANA	2008	1456672	2048667
CAMELOT GHANA	2009	1451175	2579322
CAMELOT GHANA	2010	2856126	3788241
CAMELOT GHANA	2011	2261100	3491624
CAMELOT GHANA	2012	3006505	3648398
COCOA PRO COM	2008	66965696	59394197
COCOA PRO COM	2009	95778841	45541422
COCOA PRO COM	2010	876749555	84127817
COCOA PRO COM	2011	172692289	89164530
COCOA PRO COM	2012	23236007	104768846
FAN MILK	2008	38318	55041000
FAN MILK	2009	52732	82471000

FAN MILK	2010	62324	103775000
FAN MILK	2011	69290	109280000
FAN MILK	2012	91394	147212000
GUINNESS	2008	98090	137475000
GUINNESS	2009	167435	200968000
GUINNESS	2010	179550	206499000
GUINNESS	2011	209720	244293000
GUINNESS	2012	242001	292318000
STARWIN	2008	1563154	2468314
STARWIN	2009	1750193	3085508
STARWIN	2010	2122510	3761572
STARWIN	2011	2324769	4245918
STARWIN	2012	3180386	4808858

Appendix B: Panel regression data

ROA	EFFICIENCY	Electricity Supply	SAIDI	SAIFI
-0.05143	834.09	9.026	296	108
-0.09909	998.89	9.10	372	118
-0.14069	851.79	9.22	286	97
-0.06196	974.67	9.32	312	93
-0.03171	1082.79	9.39	274	89
0.21113	1.401	9.026	296	108
0.292291	1.567	9.10	372	118
0.185061	1.485	9.22	286	97
0.208661	1.519	9.32	312	93
0.14479	1.507	9.39	274	89
0.025993	1.406	9.026	296	108
0.03745	1.777	9.10	372	118
0.060942	1.326	9.22	286	97
0.065753	1.544	9.32	312	93
0.092898	1.213	9.39	274	89
0.006994	0.886	9.026	296	108
-0.086	0.475	9.10	372	118
-0.06675	0.095	9.22	286	97
-0.06354	0.516	9.32	312	93
0.07666	2.48	9.39	274	89
0.285684	1436.42	9.026	296	108
0.394784	1563.96	9.10	372	118
0.377433	1665.08	9.22	286	97

0.303932	15763.89	9.32	312	93
0.367073	1610.74	9.39	274	89
0.159579	1401.5	9.026	296	108
0.112753	1200.27	9.10	372	118
-0.02354	1150.09	9.22	286	97
0.101284	1164.85	9.32	312	93
0.13608	1020.3	9.39	274	89
-0.05008	1.579	9.026	296	108
0.05466	1.762	9.10	372	118
0.042588	1.772	9.22	286	97
0.181373	2.040	9.32	312	93
0.102431	1.512	9.39	274	89