CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY, ISLAMABAD

Impact of Energy Consumption on Firm Performance: Evidence from Pakistan

by

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A thesis submitted in partial fulfillment for the degree of Master of Science

in the

Faculty of Management & Social Sciences
Department of Management Sciences

2023

I want to dedicate this achievement to my parents, who always encourage and support me in every crucial time

CERTIFICATE OF APPROVAL

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MMS201015

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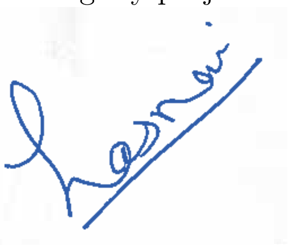
Acknowledgement

In the Name of Allah, The Most Gracious, The Most Merciful. Praise be to God, the Cherisher and Sustainer of the worlds. All thanks to Almighty Allah, The Lord of all that exist, who bestowed me with His greatest blessing i.e. knowledge and Wisdom to accomplish my task successfully. I would like to gratitude to Almighty Allah, for letting me through all the difficulties. I have experienced your guidance day by day. You are the one who let me finish my degree I will keep on trusting you for my future.

Thousands of salutations and benedictions to the Holy prophet **Hazrat Muhammad (PBUH)** the chosen-through by whom grace the sacred Quran was descended from the Most High. I would like to acknowledge and give my warmest thanks to my supervisor **(Dr. Jaleel Ahmed Malik)** (faculty member) at Capital University of Science and Technol- ogy, (CUST) Islamabad Pakistan, made this work possible. His guidance and advice carried me through all the stages of writing my research. I am indebted to **Dr. Jaleel Ahmed Malik** for his valuable guidance, motivation and moral and spiritual support that enabled me to complete my MS Degree Program.

At the end, I would also like to give special thanks to my family as a whole for their continuous support and understanding when undertaking my research and writing my project. Their prayer for me was what sustained me this far.



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Abstract

Since 2007, Pakistan's energy situation has had a detrimental influence on jobs and industrial development within the nation. In 2012, the problem got worse. Energy-intensive businesses are under stress to cut their usage and increase power conservation. It has not previously been determined how energy consumption affects a company's economic success in Pakistan. By evaluating the impact of energy consumption upon the economic output of non-financial firms in Pakistan, the research fills a gap in the current literature and intends to investigate this link using a panel data model ranging from the years 2006 to 2019. Three dependent variables were used in the study, which are represented as return on assets, return on equity and return on sales. Energy use is selected as the independent variable and three other independent variables (i.e; size, growth, and leverage) are considered in the study. The findings indicates that higher value of energy consumption means a higher energy use would lead to higher profitability of the firm. Results also indicates that firms keeping the higher amount of assets and sales growth are in a better position to improve the value of their profitability by adopting the energy related efficient sources to produce the goods. The study suggests that the non-financial firms should adopt the sources of renewable or environment friendly sources of energy may increase their capacity of their profit making.

Keywords: Firm Performance, Energy Efficiency, Firm Size, Firm Growth

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Chapter 1

Introduction

Profitability is the key objective of a firm. Every decision that leads toward better firm performance would be ideal. Increasing revenue is the key success factor for any firm. Firms can enhance the value of the profitability by increasing the value of sales as well by reducing the expenditure on energy. Energy is one of the components that have special importance in the list of expenditures used to produce the goods. Firms having the capacity to manage this expense have the also capacity to make more profit. Before analyzing the link between energy efficiency and business success, it is preferable to thoroughly introduce the idea of energy efficiency.

An energy crisis in the context of economics is either a significant increase in the price of energy or a serious shortage of energy. Typically, this means that there is a scarcity of some kind of natural resource, such as power, oil, natural gas, etc. As a result of globalization, many new problems have surfaced, but energy is one that has received a lot of attention from academics. There is an energy crisis because the demand for energy is rising faster than it is being produced in today's worldwide society. Most nations suffer from an energy deficit, which stunts their development and prevents them from modernizing society.

There are numerous theories and points of view that link energy to economic expansion. Energy is vital to the operation of any economy and has a significant influence on the level of life and economic development of a country. Industrialization cannot occur without energy because it is required for the operation of factories and other production facilities, for household and commercial consumption, for transportation, etc. Similar to how it is believed that an increase in energy supply will encourage growth, a drop in supply could hinder progress. In a nutshell, energy crises have a direct impact on all of the economy's many sectors, including agriculture, industry, unemployment, poverty, lower GDP, and higher inflation.

The current energy crisis in Pakistan is the worst in the country's history. Like many other emerging nations, Pakistan's rising economy is very energy-intensive, and the country must import vast volumes of oil to meet its need. It has been argued that Pakistan's energy infrastructure is underdeveloped and poorly managed. Population growth, economic expansion, and rising demand have all occurred over the last several decades, yet despite this, no significant attempts have been made to designed to produce energy for use. The problem has been exacerbated by energy theft and transmission losses caused by aging infrastructure.

Pakistan meets its energy demands primarily via its hydroelectric, petroleum, and natural gas resources. From hydro and nuclear sources (36%), furnace oil-fired sources (35%), gas-fired sources (29%), and coal-fired facilities (0.1%), Pakistan generates a total of 91% of its electricity needs in 2013. This is according to EAW 2013. Because of its political climate and depleted oil supplies, Pakistan must rely on Middle Eastern countries, particularly Saudi Arabia, for a significant portion of its petroleum needs. Pakistan's present industrial, financial, and energy crises has had a significant impact on the country's production, economic, industrial, and commercial activities. Workers are losing their jobs and taking to the streets as more and more factories go out of business.

It increases output, exports, and global competitiveness when governments in other nations offer the private sector significant incentives in the form of cheaper inputs. A decrease in output and, in the case of Pakistan's textile sector, the closure or relocation of factories to neighboring nations are the results of the majority of Pakistani industries' inability to produce their own electricity as well as the burden of high taxes and the high cost of energy supply (Ahmed et al., 2022b).

Pakistan is putting into action a number of solutions in the short term, including paying down circular debt, constructing a coal-based 600 MW electrical plant at Port

Qasim with assistance from China, constructing a 10,000-acre solar park in Punjab with assistance from China, and importing electricity from Iran. But in order to permanently address the energy issue, the government must act immediately and with the highest priority.

Energy is a key component of today's socioeconomic progress. The British Petroleum (BP) (2016) estimates that during 2014 and 2035 the world's power usage will probably rise approximately 34%. Energy is the backbone of every industry and therefore is essential for maintaining corporate, economic, and home operations. Power interruptions and shortfalls harm social stability in addition to stunting industrial development and eliminating jobs. Since 2007, Pakistan has been experiencing an energy shortage that worsened in 2012 and experienced a significant adverse impact on jobs and industrial progress. Supply-demand imbalance was caused by inadequate management, a lack of a commercially and monetarily feasible policymaking, and an ineffective controller. Substantial transmitting and distributing inefficiencies, the growth of

illegal trade for electricity, and diminishing taxation have all significantly aggravated this issue. This caused a continual buildup of public sector debt. Due to the massive amount of subsidy needed to close the economic deficits within the power sector, which on one hand threatened monetary sustainability and on the other increased government debt (Zhou et al., 2012).

In this situation, the administration promptly cancelled the circular debt (Rs 480 billion) upon gaining office, adding 1752 MW of additional power to the grid. The state created the National Power Policy (2013) to supply the population with cheap electricity using effective generation, transmitting, and distributing systems to permanently fix the problem. Pakistan is anticipated to be put on a path of significant socioeconomic progress as a result of the policy.

In essence, the administration is aware of the difficulties Pakistan's power sector is facing. As a result, attempts are being made to modify the current energy network in order to fulfill the goals of the power industry. According to projections, Pakistan would then move from being an energy-scarce state to a subnational energy export market by the conclusion of 2030, whereas advancements in transmission and distribution effectiveness would then lower the elevated price of electricity for the ultimate user, resulting in growth and socioeconomic advancement for the nation (**?**).

Energy-intensive businesses are under growing demand to increase energy conservation and cut cost of electricity use. Energy is a key factor in the contemporary economy as well as socioeconomic progress. It is crucial to investigate the link between a subset of Pakistani companies' economic success and energy conservation using a panel database spanning the years 2006 to 2019. Considering governmental initiatives, certain businesses view energy savings as a requirement instead of a chance to advance technological and administration standards and effect good corporate development. Energy efficiency (EE) effect directly and indirectly on non-financial firm's overall financial performance. Due to vast output bulk of studies are interpreted for financial firms according to need and technological advancement. This calls for urgent research into how incorporating energy-efficiency methods could benefit the bottom lines of energy-intensive businesses in Pakistan.

1.1 Theoretical Background

Pakistan's energy sector is vital to its economic performance, and several finance theories support this idea. One such theory is the Resource-Based View (RBV) theory, which argues that a company's financial, human, and physical resources can provide it with a sustained competitive advantage over its rivals (Barney, 1991). In the context of Pakistan, energy conservation is a valuable resource that can help energy-intensive companies to gain a competitive edge. By reducing their energy consumption and the cost of electricity use, these companies can enhance their profitability and overall financial performance, contributing to the nation's socioeconomic development.

The Stakeholder Theory is another financial theory with implications for business success. According to this school of thought, businesses should prioritize the needs of everyone who might be affected by their actions, not just their shareholders (Baird et al., 2012). In the case of Pakistan's energy sector, the government's efforts to reform the existing energy network can be seen as an example of the Stakeholder Theory in action. By prioritizing the needs of the population and implementing effective policies to improve the energy sector, the government is demonstrating its commitment to the welfare of all stakeholders. This is essential for the long-term growth of Pakistan's energy industry and the country's prosperity as a whole.

Energy is essential to a country's progress. It has always been essential to the progress and expansion of the nation. The country's demands can't be met without a sufficient amount of energy. Fighting poverty also requires energy. More vitality indicates sufficient availability of the growth-enabling resources of water and electricity.

There are four schools of thought among economists about the correlation between GDP expansion and energy use. The first camp maintains that monetary expansion influences energy usage. To a second set of people, energy is fundamental to a flourishing economy. The third camp maintains a causal relationship in both directions, whereas the fourth sees no connection between the two.

The significance of energy usage was highlighted by Ahmed et al. (2022a). They believe that there has been a rise in energy usage in emerging nations. The government of Turkey has made it a priority to attract both domestic and foreign capital for its energy infrastructure projects. More money should be put into the energy industry, they believe, so that the nation can advance.

They also take into account solar and wind energy as potential substitutes. Ahmed et al. (2022a) assert that energy is the "bone" of economic growth. They find a connection between economic growth and energy consumption. Since they result in higher national output, increases in energy consumption are positively correlated with economic growth. They contend that investing in this sector is crucial for the growth of the nation.

Using data from 1950 to 2000, Bunse et al. (2011) examine the correlation between Turkey's real GDP and its power usage. The author observes a clear relationship between one's electrical use and their disposable money. According to him, expanding economic activity requires more electricity.

In order to establish a causal link between the two, (Christoffersen et al., 2006) study looks at the association between real GDP and nuclear energy consumption from 1971 to 2005. According to the author, increasing the efficiency of the energy industry is necessary if we want to see economic growth.

By highlighting the importance of nuclear energy use, Clarkson et al. (2011) a short-run bidirectional causality between the two variables as well as a long-run unidirectional causation from nuclear energy use to GDP expansion are found in his analysis of the relationship between nuclear energy use and GDP expansion in sixteen different countries.

According to Çoban and Topcu (2013), energy is an essential component of every economic activity. In Taiwan, he discovers a correlation between GDP and energy usage. They believe that energy is the driving force behind economic expansion, and that saving energy might be counterproductive in the long term. Donaldson and Preston (1995) analyze the connection between Vietnam's rising energy needs and its expanding economy. He bases his calculations on measures of energy usage and GDP per person. They claim that strong economic development causes high energy consumption rather than the other way around. Researchers Endrikat et al. (2014) examine the connection between rising energy use and the economy. The authors establish a two-way causal relationship between increased energy use and economic development. The correlation between energy use and GDP growth was studied by Gallego-Álvarez et al. (2015). Energy usage is supposedly directly related to economic development. (Horváthová, 2010) elucidated why it's crucial to reduce energy use. He analyzes the correlation between Tunisia's energy usage and GDP growth from 1971 to 2009. He draws a line of reasoning from expanding economies to rising energy demands. They go on to say that if there is a causal relationship between GDP and energy consumption, then energy conservation will not hinder economic development.

The relationship between the two is estimated by Hsiao (2022). The author compares four different nations: India, Indonesia, the Philippines, and Thailand. A cointegration and error-correction model are used by him. He claims that in the long run, energy consumption is a leading indicator of national wealth in India and Indonesia, but in the short term, the relationship is bidirectional in Thailand

and the Philippines. According to research by Lannelongue et al. (2015), there is a clear link between GDP growth and energy consumption in Ghana. For 7 emerging Asian nations, Li and Lin (2016) investigated the connection between using renewable energy and economic development.

To reach their conclusions, they examined time series data from 1985 to 2007. The researchers came to the conclusion that growing use of renewable energy is strongly correlated with economic growth in these four nations—India, Iran, Pakistan, and the Syrian Arab Republic.

Lu et al. (2014) found the impact between energy consumption and economic growth in Nepal. They discovered a unidirectional relationship between GDP and electricity use. They claimed that increasing energy use would boost the economy. They claimed that a rise in wealth would lead to higher energy consumption because more people would be able to afford transportation and other energy-intensive products and services.

Greater development calls for energy infrastructure, and this expansion inevitably raises industrial energy demand. The author advises that in rural regions, alternatives such as biogas be developed via modest and microprojects.

Martin et al. (2012) examined the impact between trade, income growth and energy consumption. He thinks there's a direct correlation between using more energy and expanding the economy. Short-term economic growth and energy consumption were shown to be causative in both directions by Mishra and Suar (2010), but long-term causation ran only in one direction, from economic growth to energy consumption.

To minimize Pakistan's dependency on pricey imports, they advised that the country keep up its investments in the energy sector, notably in natural gas, wind, hydroelectricity, and nuclear power.

Pakistan's GDP was 6332.886 million US dollars in 1973, and its energy usage was 18720 kilograms of oil equivalent. Despite the fact that 2006 saw some significant developments. when Pakistan's GDP was 106,300 mls dollars and its energy consumption was 79294 kt of oil equivalent.

1.2 Research Questions

After the detailed literature review the following research questions have been developed and this study tries to answer the following questions.

1. What is the relationship between energy usage and company performance?
2. What is the influence of company size on the performance of a business?
3. What is the influence of sales growth on the success of a firm?
4. What is the influence of leverage on the performance of a firm?

1.3 Research Objectives

The objectives of the study are as follows:

1. To assess the influence of energy use on the operational and financial performance of firms.
2. To assess the influence of company size on firm performance, a comprehensive analysis is required.
3. To ascertain the influence of sales growth on the performance of a corporation.
4. To assess the influence of leverage on the performance of a corporation.

1.4 Problem Statement

Energy-intensive businesses are under growing pressure to increase energy effectiveness and cut back on power use. Energy is a key factor in the current economy and socioeconomic progress. Based upon a panel database for the years 2006 to 2019, this study examines the correlation between energy use and the financial viability of businesses. Despite governmental initiatives, certain businesses view power saving as a legal requirement instead of a chance to advance technological and administrative standards and effect good corporate development. It is very necessary right now to investigate if applying energy-efficiency methods could affect the economic viability of Pakistani energy-intensive enterprises.

1.5 Significance of the Study

While acknowledging that this correlation may not universally apply to all companies or industries, it is crucial to recognize the potential beneficial association between energy use and company success. The impact of energy consumption on the success of a corporation might vary depending on the specific characteristics of the company and the industry in which it operates. The subsequent strategies elucidate how energy utilization might potentially optimize the operational effectiveness of enterprises.

First, Operational costs can be decreased by businesses that efficiently manage their energy consumption and adopt energy-efficient procedures. Higher profit margins and better financial performance may result from lower energy costs. Second, For a firm to run smoothly, an adequate and dependable energy supply is essential. Energy is a key component of production and service delivery in sectors with energy-intensive processes, such as manufacturing or data centers. Increased productivity and less downtime can result from efficient energy consumption, which will benefit a company's overall performance. Third, Companies frequently make investments in cutting-edge practices and technologies in order to increase energy efficiency. A company's competitiveness and market positioning can be improved by embracing renewable energy sources, smart grids, and energy-saving technologies. Fourth, Governments frequently use grants, tax breaks, or other financial incentives to promote and fund sustainable practices. Participating companies can gain financial advantages and boost their general performance.

It is important to consistently have in mind the correlation between energy use and company performance. Excessive energy use might potentially lead to increased expenses for certain firms, without a corresponding rise in income. Moreover, companies operating in industries characterized by stringent regulatory frameworks or significant carbon dioxide emissions may have difficulties in effectively mitigating their energy use and carbon dioxide output.

The utilization of energy has the potential to enhance a company's operational efficacy, contingent upon the company's adept management of energy consumption, ability to adapt to evolving energy environments, and adherence to sustainable practices that are suitable for its unique business model and industry.

1.6 Organization of the Document

Second chapter contained the literature review about the relationship between energy efficiency and firm performance. In the third chapter the study reported the details of data and methodology used to answer the research questions. In the fourth chapter, detailed explanation of the results is available. The last chapter is about the conclusion of the study.

Chapter 2

Literature review

Modern economic is significantly influenced by energy. British Petroleum estimates that between 2014 and 2035, the world's energy consumption will likely rise by 34%. It is well recognized that both the government and businesses must work together in order to meet the nation's energy conservation goals. Despite government initiatives, some firms see energy conservation as a legal necessity rather as a chance to improve technology and management, promoting good organizational development. Corporate management may worry that improving energy efficiency or decreasing energy intensity may hurt their finances. Several studies have used industrial or manufacturing business data to study this issue (Pons et al., 2013).

Numerous macroeconomic studies (e.g., Zhang (2011); Shahbaz and Lean (2012); Omri and Kahouli (2014) have investigated the link between energy use and GDP or economic growth. The majority of the aforementioned studies have shown a positive association between the two. Subrahmanya (2006b) looked at the connections between labor productivity, energy intensity, and economic performance at the micro level of firm clusters. His research showed that higher energy use is associated with lower economic output. The authors Pons et al. (2013) discovered no clear and statistically significant relationship between these characteristics and organizational performance.

This study adds to the current body of literature by examining the link between energy intensity and company expansion in Pakistan, as well as the impact of energy consumption on the economic success of businesses in that country.

Waste emissions (Iwata and Okada, 2011), sulphur dioxide (Qi et al., 2014), and carbon dioxide emissions Gallego-Álvarez et al. (2015) have been identified as indicators of resources and environmental conditions in scholarly literature. Currently, the government's primary emphasis lies in the realm of environmental preservation, namely on energy conservation and the mitigation of emissions. Therefore, it is imperative that researchers do an additional step and examine alternative variables.

Insufficient energy levels have a deleterious effect on the financial viability and operational efficiency of businesses, hence negatively impacting the local economy. Furthermore, this phenomenon exerts a detrimental influence on their ability to allocate resources towards enhancing their productive capabilities and reaping the advantages of economies of scale (Montabon et al., 2007). Industrial sectors have substantial economic constraints in the form of recurrent and prolonged energy and power disruptions, together with an insufficient electricity provision (Qi et al., 2014). Pakistan's position in the World Bank's 2019 Ease of Doing Business Index was 108th out of 190 nations, a ranking influenced by the prevailing energy crisis. According to the World Bank Enterprise Survey (WBES), a significant obstacle to conducting business for around 25% of large corporations and 12% of medium-sized organizations is the absence of sufficient power supply.

According to Sadorsky (2010), the system faces many challenges including high transmission and distribution losses, an overburdened infrastructure, a substantial capacity deficit, a substantial accumulation of cyclical debt, and atypical load shedding. According to the Pakistan Electric Power Company, in April 2011, there was a deficit of 5000 MW in the electricity supply, resulting from a disparity between the required power capacity (14,475 MW) and the actual power generation (9465 MW). In the context of Pakistan, it is observed that there was a significant occurrence of load shedding, lasting for around 20 hours per day in rural regions and 14 hours per day in urban areas. In the latter half of 2012, there was a deficit of 6000 MW in power supply, resulting from a decrease in power output of 9000 MW in comparison to the increased demand of 15,000 MW.

The absence of a reliable electrical supply has a detrimental effect on Pakistan's economic growth. Moreover, it exerts a significantly detrimental impact on employment rates, competitiveness in the global market, international export capabilities, and efforts to alleviate poverty. The substantial occurrence of load shedding considerably disturbs the everyday activities of inhabitants. In light of the prevalence of energy or electricity disruptions and deficiencies, enterprises may use diverse strategies to mitigate the financial implications connected with such power outages. A commonly employed strategy involves the allocation of resources towards the development of electricity self-generation. Consequently, these investments have the effect of diminishing a company's output capacity by necessitating the allocation of resources towards less efficient endeavors.

According to empirical findings from Sahaym et al. (2010) electricity from the public grid is less expensive than electricity produced on-site. Users in the agricultural, commercial, and industrial sectors have experienced significant cost increases as a result of this power scarcity. The Pakistani economy has been severely hampered by this power scarcity. The Pakistani textile sector, which accounts for more than 50% of exports and 40% of employment, was severely impacted.

The trend in electricity shortage from 2001 to 2017 is depicted in Figure 2.1. Beginning in 2005, there was a severe electrical shortage that persisted until 2012. However, the shortage began to progressively decrease until 2017 after reaching its peak level. This research aims to analyze the profitability and productivity of firms listed in Pakistan throughout the crisis. The study employed a chronological framework spanning from 2001 to 2017, dividing this period into four discrete stages. This approach was undertaken to examine the impact of energy scarcity on the financial viability and operational efficiency of enterprises operating within the energy sector, particularly during times of crisis. To provide an illustrative example, it can be observed that the time periods spanning from 2001 to 2004 were characterized by a state of neutrality, devoid of any electrical shortage. Subsequently, the periods from 2005 to 2008 witnessed a notable escalation in the occurrence of shortages. Moving forward, the years spanning from 2009 to 2013 were marked by the most severe shortfall experienced throughout the studied timeframe. Finally, the periods from 2014 to 2017 exhibited a discernible decline in the prevalence of electricity shortage.

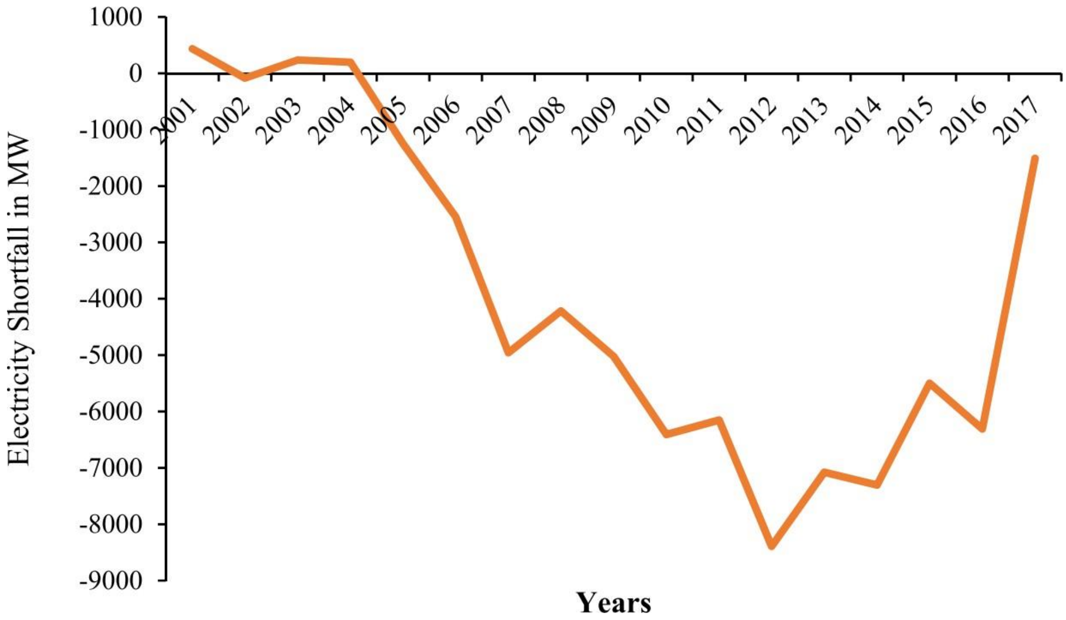

Figure 2.1: Electricity shortfall trend in Pakistan during 2001–2017

Source: Pakistan Economic Survey

This study contributes novel insights to the existing body of literature in several ways. This finding contributes to the existing body of information about the impact of energy crises on the productivity and profitability of publicly traded non-financial enterprises in Pakistan. This study is a pioneering effort in using a sample of 156 non-financial listed firms from Pakistan. The study spans a substantial time period of 14 years, namely from 2006 to 2019. The firms' success was evaluated by utilizing financial metrics such as return on assets (ROA), return on equity (ROE), and return on sales (ROS).

Over the course of time, the non-financial sector in Pakistan has had a substantial growth in its contribution to the nation's Gross Domestic Product (GDP). The industrial and service sectors, which constitute a significant proportion of the gross domestic product (GDP), are sometimes seen as the bedrock of the economy. According to the Economic Survey of Pakistan, there has been an increase in the GDP share of the service sector from 52.3% in 2007 to 56.2% in 2017. In contrast, the industrial sector's GDP share experienced a little decline from 21.4% in 2007 to 20.9% in 2017. When considering both sectors, their collective proportion increased from 73.7% in 2007 to 77.1% in 2017, indicating the importance of non-financial businesses in fostering economic expansion. Nevertheless, the financial sector in

Pakistan accounted for just 3.4% of the aggregate in 2017, exhibiting a decline from 3.8% in 2007. In light of this, the accessibility of energy is of paramount importance for the non-financial sector to sustain its supportive function in fostering economic growth.

Pakistan is classified as a developing nation characterized by an industry that consumes a substantial amount of energy. Consequently, a notable proportion of Pakistan's power needs are reliant on imports. The data from the past decade indicates that the rate of rise in overall energy consumption has exceeded the rate of population growth by a considerable margin. In spite of the population of Pakistan seeing a growth of less than 2.26% during the preceding decade, the demand for energy in the country exhibited an annual growth rate of 4.95%. The majority of researches within this collection of data now in existence study the link amongst socioeconomic development and energy conservation while concentrating on the macroeconomic scale of power usage and demand. Most research reveals a relation between energy conservation and socioeconomic expansion on a broad scale. A modest quantity of research additionally supports opposing viewpoints in various contexts. According to the analysis, the exact connection among power use and industrial expansion is significantly influenced by the level of socioeconomic progress of the studied subjects. Pakistan's rapid economic growth as the largest emerging nation on the planet has its own unique characteristics that significantly motivate the investigation.

Pakistan is classified as a developing economy among the South Asian countries. The economic growth of Pakistan is now experiencing a rapid expansion, and it is anticipated that this growth trajectory would persist in the foreseeable future. Pakistan's economy is heavily reliant on the agricultural sector, which serves as the primary driving force behind the country's economic activities. However, the rapid expansion of the industrial sector in Pakistan has resulted in the reduction of agricultural land. In addition to this, the exponential growth of the population has led to the phenomenon of deforestation. Pakistan stands out as one of the Asian nations that is most severely affected by this issue. The escalation of economic growth and the expansion of industrial sectors need the utilization of energy resources, which in turn leads to environmental damage.

Pakistan is now grappling with a substantial energy demand, necessitating the utilization of conventional energy sources to fulfill its rapidly escalating energy requirements. According to Scholtens (2008), the utilization of conventional energy sources leads to the emission of carbon dioxide, which contributes to the degradation of environmental conditions. According to the findings of Ahmed et al. (2022a), the degradation of the environment in Pakistan has significant implications for both the natural ecosystem and the well-being of its human population. According to Yang (2010), the phenomenon of environmental deterioration can be attributed to the significant release of greenhouse gases, such as carbon dioxide, nitrous oxide, and methane.

According to Shahbaz and Lean (2012), the utilization of fossil fuels in everyday activities, the significant release of smoke from industrial facilities, and the reliance on wood as an energy source contribute to the escalation of carbon dioxide (CO2) emissions. The release of carbon dioxide has been found to have detrimental effects on several sectors, including the economy, agriculture, and forestry.

Sun and Cui (2014) and Surroca et al. (2010) examined the relationship between energy use, economic growth, and environmental sustainability. Most study studies have focused on industrialized countries, particularly European and American nations Telle (2006); Wang et al. (2014). Previous studies on this topic have generally reached the consensus that there is a causal relationship between economic development, energy use, and the release of carbon dioxide (CO2). Numerous research investigations have elucidated the interplay of economic development, non-renewable energy utilization, and CO2 emissions. This information is crucial for comprehending and enhancing the developmental trajectory of emerging nations, such as Pakistan. Societies endowed with abundant natural resources possess the capacity to effectively reduce their reliance on fossil fuel imports and minimize carbon dioxide emissions. Wang et al. (2017) and Yang (2010) stated that the implementation of an energy plan has been confirmed as an effective means to reduce reliance on non-renewable energy sources. Non-renewable energy sources continue to exert a significant impact on the composition of the energy portfolio. This analysis examines the long-term viability of both renewable and non-renewable energy sources in terms of their sustainability. Different researchers identified that environmental degradation is caused by using non-renewable energy consumption and economic growth in developed countries.

Pakistan's Vision 2025 acknowledges the issue of energy security and sets a goal to attain Sustainable Development Goal 7, which is to ensure universal access to cheap, dependable, sustainable, and modern energy by the year 2025. Pakistan is now experiencing a severe shortage of power supply, which is the most significant deficit since the year 2007. This situation is exacerbated by the country's growing dependence on imported thermal resources, a trend that has been observed since the 1990s. The deceleration of economic growth may be attributed to several factors, including the social costs associated with it and the rising trajectory of CO2 emissions. Despite these repercussions, governments continue to prioritize the use of imported energy sources to meet the energy demands. The escalating need for hydrocarbons is an inevitable consequence of population growth; however, the rate at which this demand increases can be mitigated by prioritizing the generation of power from domestically abundant renewable sources. Pakistan is ranked among the top ten nations grappling with a significant energy problem. The country's reliance on imports currently accounts for 85% of its entire demand for petroleum products. Approximately 30% of the overall import volume, which amounts to 23.6 million metric tons, is specifically designated for power generation purposes.

Throughout history, there has been a consistent falling tendency in electrical variety, but there has been a noticeable upward trend in CO2 emissions. It is imperative for Pakistan to prioritize the utilization of contemporary energy sources due to its pivotal significance in achieving the Sustainable Development Goal (SDGs) and enhancing the investment climate. Therefore, it is imperative to establish a development process that is equitable and does not compromise the well-being of future generations. In contrast, an increased dependence on contemporary energy utilization has the potential to facilitate the engagement of impoverished individuals in developing nations in productive activities rather than consumptive ones, so contributing to enhanced living standards (Zhang et al., 2017; Zhou et al., 2012).

The United Nations Development Program incorporated access to electricity as a component of the Multidimensional Poverty Index in 2010, so contributing to the enhancement of energy security to a certain degree. The inclusion of electricity accessibility and reduced dependence on imported energy resources need to be a pivotal element inside a nation's strategic framework. Ban Ki-Moon asserts that energy serves as the pivotal element that establishes a connection between economic advancement, social fairness, and ecological durability. Pakistan is currently experiencing a severe crisis, which has resulted in a decline in both social and economic growth. Additionally, the existing traditional sources of energy are unable to fulfill the growing demand. The research conducted by Zhang et al. (2016); Zhou et al. (2012), and Zhou et al. (2017) has extensively examined the viability of biomass and solar energy in Pakistan.

Pakistan is among the nations that are now grappling with a severe energy crisis. For a period of nearly thirty years, the political leadership of the country has failed to adequately address the issue of energy generation, despite the concurrent increase in population, economic development, and high levels of demand. Furthermore, the exacerbation of the problem might be attributed to power theft and line losses resulting from antiquated infrastructure. Over time, there has been a noticeable increase in energy consumption, and it is projected to reach higher levels in the future. Figure 2.2 illustrates the energy consumption trends in Pakistan over the years 2002 to 2030. The data presented in the figure 2.2 suggests that there is a very modest projected expansion in energy supply, but the anticipated rise in energy demand is significantly larger.

Source: Pakistan Economic Survey

The energy industry has several challenges that impede its ability to effectively supply energy demands. These challenges stem from various underlying reasons. Potential factors contributing to the aforementioned issues encompass an inequitable distribution of energy sources, limited exploitation of indigenous energy resources, inadequate allocation of funds towards power infrastructure, political volatility, ineffective energy policies, and exorbitant energy production expenses. The exacerbation of the problem may be attributed to a political dispute around mega-energy projects, instances of corruption within both producers and consumers, as well as the utilization of conventional and outdated infrastructure for the exploitation of natural resources (Rauf, 2020).

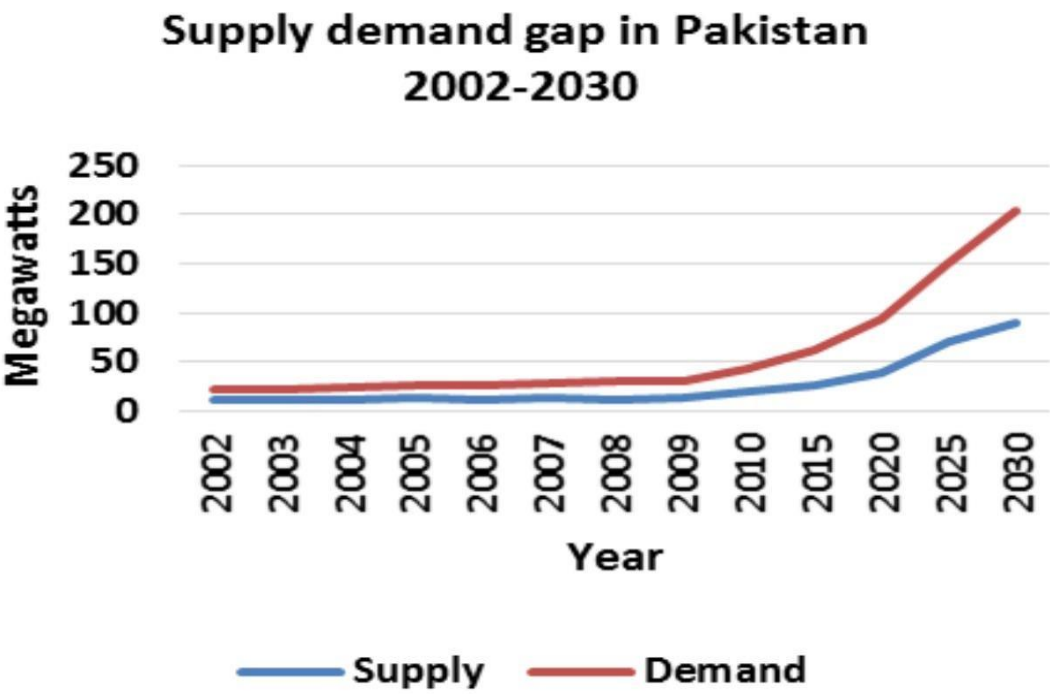

FIGURE 2.2: Supply Demand Gap in Pakistan 2002-2030

This analysis aims to examine several factors in order to evaluate the limitations and challenges faced by the industry in question. The primary factor contributing to the energy problem in Pakistan is the pervasive presence of corruption. The aforementioned technique is commonly observed within the oil and gas business, a sector that is frequently associated with a susceptibility to corrupt activities.

Corruption has grown prevalent in several aspects of business operations, including licensing processes, permit applications, and subcontracting arrangements. According to many sources, it was found that national and multinational oil and gas corporations had misappropriated a sum of 134 billion Pakistani rupees over the period of 2012 to 2015.

The businesses who were granted oil and gas exploration licenses in 2002 had neither made any financial investments nor had they undertaken the construction of oil wells. In the year 2018, the National Accountability Bureau (NAB) initiated investigations into a total of 19 cases pertaining to allegations of corruption, abuse of authority, and embezzlement within the industry.

The presented scenarios exemplify the spectrum of integrity leverage and encompassed several instances:

1. The phenomenon of collusive contracting among officials at Pakistan State Oil is seen.

2. The appraisal reports were subject to manipulation, wherein assets obtained by Pakistan Petroleum Limited, a state-owned corporation, were significantly inflated in return for illicit bribes.

3. The misallocation of public funds towards the provision of excessively high wages to preferred individuals.

The matter under consideration pertains to the prevalence of unauthorized appointments and promotions within regulatory bodies. The energy industry in Pakistan is now facing significant governance issues, which have resulted in a state of disorder and instability. The endeavors of both the government and the National Electric electricity Regulatory Authority (NEPRA) in relation to enhancing the electricity sector have shown limited progress. The interference of governmental bodies, political entities, and various pressure groups has persisted, leading to disruptions in the operational efficiency of firms. Consequently, the power of management has been significantly restricted. Consequently, the inadequate operational and technical performance of these enterprises has hindered the growth and development of the electricity industry in Pakistan. The major performance metrics in this sector have not exhibited any signs of improvement. The examination of adjacent states has revealed that the reduction of losses and theft, as well as the improvement of efficiency in public sector generating plants, has not occurred at the same pace. (Wahab, Yasir, Aziz, & Ahmad, 2017). Moreover, the energy industry in Pakistan is afflicted by a fragmented energy governance structure. The management and regulation of the industry entail almost six ministries and a significant number of ancillary agencies. The collusion exhibited by these actors hinders the participation of private firms in this management endeavor.

Lastly, the utilization of traditional approaches to energy production has not yielded significant advancements in the field at a quick pace. In the contemporary era characterized by a pursuit of excellence and specialization, Pakistan continues to adhere to an infrastructure that has persisted for generations. Currently, there is a lack of contemporary technology for the extraction of natural resources, and there has been a dearth of innovative techniques for the reprocessing of existing natural resources. Based on the findings of the Energy Annual Report of 2013, it is evident that Pakistan exhibited a significant reliance on oil and natural gas, constituting 35 percent and 29 percent of its energy output, respectively. According to Wahab, Yasir, Aziz, and Ahmad (2017), hydro energy accounted for 36 percent of the total energy contribution, whereas coal-fired facilities contributed a mere 0.1 percent. Recent studies and reports indicate that there is a modest variation in the proportion of conventional sources utilized for power generation, as seen in Figure 2.3.

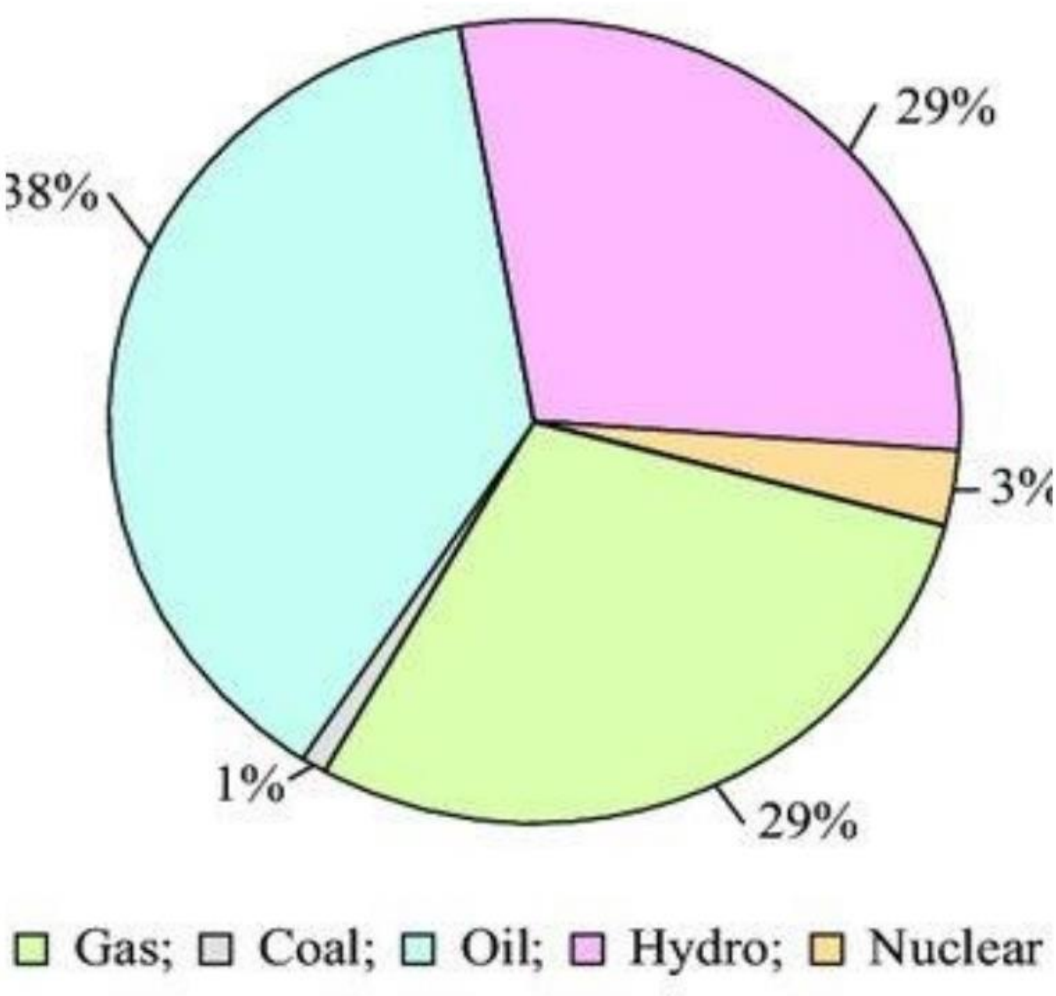

Figure 2.3: Share of conventional sources for power generation in Pakistan

Source: Pakistan Economic Survey

Based on the data shown in this figure, it can be observed that the utilization of oil for power generation surpasses that of all other resources, accounting for 38 percent of the total. Each gas and hydro output is coupled with a 29 percent stake. Nuclear power accounts for 3% of the total energy production, whilst coal constitutes a mere 1% proportion. It might be argued that if Pakistan aims to stabilize its energy sector, the production of gas and oil should be jointly replaced by hydropower, which now accounts for 29 percent of the country's energy generation.

Pakistan holds significant strategic and geographical importance within the South Asian area, primarily due to its status as one of the most populated nations globally. The region has a significant abundance of both metallic and non-metallic minerals, rendering it very suitable for the large-scale production of energy. Regrettably, the pursuit of power generation targets, oil availability, and natural gas supply has been hindered by political discord and inadequate management within the energy sector. As a result, these objectives remain unattainable. Presently, the nation is grappling with an energy crisis, which has engendered several hurdles that impede the facilitation of social issues and the prevention of social maladies. Several of these issues have had a negative impact on social activities in Pakistan. There is a growing discontent among individuals due to the prevailing scarcity of power and the frequent occurrence of gas load shedding. The company's business operations are seeing little growth. They are experiencing several ramifications related to travel. A considerable number of individuals have assumed the role of psychological patients, evident in their public presence during protests aimed at expressing discontent with government policy.

The study has elucidated significant societal ramifications arising from the dire circumstances of the energy crisis. Firstly, the occurrence of load-shedding in gas and power supply, coupled with the unavailability of oil for transportation, has significantly marred Pakistan's reputation among the international community. A significant number of individuals from other countries exhibit hesitancy when it comes to seeing the picturesque landscapes of Pakistan. The portrayal of local adversities by the media has instilled fear among tourists, since it amplifies the extent of discontent experienced by the Pakistani populace. Due to these perspectives, a significant proportion of visitors express a lack of interest in visiting

Pakistan, instead categorizing it as a nation beset by crises. The reduction in tourism in Pakistan, which holds a substantial portion of the country's GDP (Wahab, Yasir, Aziz, & Ahmad, 2017), has had a negative impact.

Access to fuels such as Compressed Natural Gas (CNG), petrol, and diesel for travel purposes is not readily available to the Pakistani population, despite the country's possession of appealing tourist destinations that are sought after by individuals worldwide. Likewise, the presence of uncertainty regarding essential needs within a society leads to the emergence of a multitude of psychological issues among its population. In a similar vein, the occurrence of unplanned load-shedding in Pakistan has given rise to a range of associated problems, leading to widespread frustration among the populace. This has led some to express their dissatisfaction by engaging in acts of vandalism on both public and private infrastructure. During various instances of protest, participants vocalize chants that exhibit a notable degree of vulgarity and lack of refinement. The current chaotic state not only induces psychological disturbances among the local population but also generates negative impressions among foreign observers when they see these events through many domestic and international media outlets (Sun and Cui, 2014; Sadorsky, 2010).

Consequently, Pakistan is burdened with a significant population of disenchanted individuals who frequently engage in the violation of legal norms, so causing disruptions that impact the entire nation. They cause harm to stationary assets, such as businesses, banks, stalls, hotels, and marriage halls. In light of the advent of the Covid-19 pandemic, the general populace in Pakistan has encountered several challenges stemming from the scarcity of petroleum resources. The scarcity in question has had the greatest impact on the transportation infrastructure. During the first stage of the epidemic, the decreased oil costs were expected to provide facilitation for transportation providers. Subsequently, an abrupt escalation in these prices not only resulted in the deprivation of gasoline for transporters, but also generated a contentious exchange of accusations between the government and oil firms. In April 2020, the Indian government instructed state-owned oil companies to enhance their reserves in response to a significant decline in worldwide rates, reaching the lowest point in two decades. The reduction in imports led to a severe criticism of the government's planning. Refineries saw challenges in adapting to a biweekly price adjustment system as opposed to a monthly one, which served as a safeguard against price volatility. Conversely, the government attributed responsibility on oil firms, such as ECC, for their refusal to accept a suggested new price structure put out by the Petroleum Division. The ongoing conflict between oil corporations and the government has compelled both transporters and the general population to mobilize in protest over the lack of availability of fuel resources.

Previous studies have predominantly reached the consensus that there is a potential for simultaneous achievement of enhanced energy saving and cost effectiveness. Essentially, the implementation of enhanced energy conservation practices has the potential to yield cost savings and enhance a company's ability to navigate problems such as volatile energy prices and budgetary limitations, so fostering sustainable and steady corporate expansion. Moreover, with regards to environmental conditions, the Chinese government has made a commitment to enhance its monitoring of enterprises' energy use and to introduce various economic measures aimed at imposing limitations on and incentivizing firms to reduce pollution and energy consumption. According to Ahmed et al. (2022a), firms that implement strategies to reduce their energy use may have a corresponding increase in their financial gains.

Several nations, including Taiwan, China, and Korea, provide clear indicators of a positive correlation between industrialisation and GDP. The process of industrialization exerts a substantial and noteworthy impact on the overall measure of economic output known as Gross Domestic Product (GDP). The impact of imports and exports on balance of payments has also been examined by the industrial sector. Electrical energy is vital to industry, particularly in emerging nations like Pakistan, according to the World Bank (2005). Power in Pakistan comes from the Karachi Power Supply Company (KESC) and the Water and Power Development Authority. These companies generate, distribute, and transmit energy. The NEPA has regulated the energy industry. Pakistan has been grappling with a substantial electricity shortfall since 2005, mostly due to the increased demand from both residential and commercial customers. The Financial Report of Pakistan (2008) clearly indicated that there is a pressing need for responsible authorities to enhance electricity output by 50% in order to meet the current level of demand.

In terms of expansion, the industry sector has the position of being the second-largest in Pakistan. The aforementioned entity offers main and secondary support to two other significant economic sectors, namely agriculture and commerce. The progress made by the industry during the course of the previous three years might be seen as indicative of the sector's positive trajectory in the long run. The industrial sector plays a crucial role in supporting governmental initiatives aimed at enhancing tax revenue and fostering job opportunities for those engaged in agricultural and industrial occupations. This sector comprises the subareas of production, mining, and infrastructure. According to the Ministry of Finance's report in 2017, the rate of growth in large-scale manufacturing increased from 4.6 in 2016 to 5.1 during the months of March and July.

The industry missed its 2016-17 goal of 7.7% with a 5.0% outcome. The Economic Survey of Pakistan (2017) states that the power crisis, which reduces electricity and gas supplies, hurts all industry production. Large-scale production reached 4.9%, much below the 5.9% objective.

Extensive research has been conducted on the interconnected matter at hand. The influence of an insufficient power supply on the number of exports in Pakistan's textile business was examined in a research conducted by Ahmed et al. (2022a). Pakistan has been facing a significant electricity shortage, which has had a negative impact on the country's overall economic progress if left unresolved (Kotani, 2014). The interconnection between economic expansion and the electricity predicament has resulted in a hindrance to Pakistan's anticipated GDP growth in the previous decade due to insufficient power generation (Ahmed et al., 2022b).

By this analysis, 2 scientific gaps were addressed. Firstly, researchers have already examined the impact of electrical power on GDP, economic expansion, and many industries, including the textile sector (Kotani, 2014; Kiran et al. (2016); Khan (2015). The total industry sector, which includes a variety of industries like production and infrastructure, has been highlighted in this research. Secondly, to reach their conclusions, prior investigations using secondary information up until 2010 have been analyzed (Kotani, 2014; Khan, 2015). In accordance with the research goals, secondary information from 2005 to 2015 have been taken into account.

Electrical energy is seen as a crucial resource for the industry; in the event of a deficit, none of the variables could generate anything. Due to such a major issue, several businesses in Pakistan have relocated to neighboring nations. Since 2005, Pakistan has experienced a significant issue of electrical deficit; such research could aid in the development and implementation of policies. The power crises are currently the primary topic of debate amongst economists and scholars, which forces researchers to investigate how the electrical problem is affecting industrialization in Pakistan.

The effect of power generation on economic productivity in Nigeria was underlined by Nwankwo and Njogo (2013). In this research, demographic characteristics, industrial output, total fixed capital creation, and power availability are all examined. Secondary information from 1970 to 2010 are employed, and multivariate regression approach was performed to analyze the information. A significant and considerable association between rapid industrialization, power availability, total formation of fixed capital, and demographic was found depending on the findings of multiple regression assessment. The effects of the electrical shortage on the textile sector in the country were discussed by Kiran et al. (2016). Both primary as well as secondary information has been examined. Workers of different textile enterprises that operate within the textile industry received 150 surveys. The results of this investigation showed that the production rate, earnings, job prospects, and textile exports are all significantly impacted by the electrical problem. It is significantly advised that such difficulties be resolved if current electricity supply is secured by appropriate agencies.

Kotani (2014) offered a comprehensive analysis of the electricity deficit in Pakistan. The evaluation of the electricity deficit using a time series dataset including the period from 1971 to 2010. According to the report's findings, the state of Pakistan's price-adjusted approach fails to produce outcomes satisfactory in the short term. The issue of an electrical deficit could be solved by effectively utilizing the privatized electricity producing alternative. Pakistan's industrial progress is ultimately impacted by the lack of electrical energy. The connection between Nigeria's industrial sector productivity and electrical consumption, production, and supply was described by Osobase and Bakare (2014). The supplementary data included in this study spans the years 1975 to 2011. Various aspects are analyzed, including federal capital spending, the inflation rate, currency value, resource usage, power output, and the industrial output index. The data processing methods encompass Johnson co-integration and correlation.

The results indicated a clear and consistent correlation between electrical output and the index of industrial production, demonstrating a positive relationship between the two variables. The findings of the investigation indicated that there was an estimated monthly outage duration of 10.3 hours. Business enterprises face significant expenses in the production process and maintain consistent labor prices due to the absence of alternative electrical power sources. This research came to the conclusion that small and micro businesses are affected by a continuous supply of power. In one study that included industrial companies in Nigeria, Kotani (2014) gave quantitative proof of how electrical outages affect production. Quantitative tools like OLS and the Tobit model were employed. A firm's performance was determined to be negatively and significantly impacted by the electrical disruption factor.

2.1 Impact of Energy Shortfall on Firm Performance

The growth and economic expansion of any nation are contingent upon energy resources in various capacities. Electricity is widely recognized as a very versatile kind of energy due to its capacity to enhance the profitability and productivity of all sectors within an economy (Sadorsky, 2010). A reliable and uninterrupted provision of electricity is an essential element in facilitating critical company activities. Hence, it may be concluded that an unreliable supply has the potential to diminish a company's productivity. An unstable electrical supply is a major barrier to economic growth in many emerging nations (Ahmed et al., 2022b). All industrial sectors are affected by a lack of electricity, but the extent to which each sector is hurt varies. According to certain research, Pakistan's industrial output loss is primarily attributable to a lack of energy, and the industrial sector's annual production alone saw losses of more than $1 billion (Ahmed et al., 2022b; Braimah and Amponsah, 2012).

The absence of electrical power may potentially result in a range of consequences for a company's manufacturing output and financial performance. Initially, the absence of electrical power may necessitate firms to allocate financial resources towards the acquisition of costly captive diesel generators, so redirecting cash from potentially more lucrative endeavors. Furthermore, in situations when feasible alternatives to power are absent, firms are compelled to cease operations, resulting in the wastage of semi-flexible and non-flexible inputs such as labor and perishable raw materials (Sadorsky, 2010).

Third, businesses can decide to buy electricity-intensive intermediate inputs rather than manufacturing them when there are acute energy shortages. The lack of electricity would cause production expenses to rise dramatically because outsourcing is more expensive (Yang, 2010). Finally, enterprises that employ energy-intensive technological systems may opt to discontinue their utilization altogether. The adoption of less advanced technical manufacturing processes has a detrimental impact on the long-term profitability and productivity of firms due to reduced power consumption (Ahmed et al., 2022b; Braimah and Amponsah, 2012).

Electricity shortages have varying effects on a company's production and profitability. Industries that use a lot of electricity are likely to suffer more from a shortage. The sort of electricity shortfall would also affect how much of an impact there would be.

When opposed to planned load shedding, the unexpected load shedding has a bigger impact. By storing perishable material inputs, modifying the labor schedules, and providing advance notification of load shedding, it is possible to lessen the impact of an outage, which considerably reduces the loss of semiflexible inputs. Instead, businesses without captive generators are far worse equipped to handle unexpected electrical shortages (Sadorsky, 2010).

2.2 Impact of Energy Consumption on Firm Performance

According to Hanafi and Hakim (2019), the presence of energy has a vital role in augmenting economic production. The increase in energy consumption is driven by the expansion of industrial activities, which is a result of the growth in economic conditions. The phenomenon of economic globalization (EC) has resulted in a notable upsurge in industrial expansion and population growth across several Asian nations, with a special emphasis on the case of Pakistan. In recent years, Pakistan, classified as a low-middle income country, has encountered a severe energy problem. In addition, the demand for energy in the region has consistently risen in response to its economic expansion and population development (Hanafi & Hakim, 2019). The possible impact of a country's financial development on economic conditions (EC) is a subject of academic interest. At the industrial level, enterprises find it comparatively more convenient to acquire financial resources in order to either expand their current operations or establish new ventures. This phenomenon leads to a greater availability of funds for investment initiatives, as well as higher diversification of leverage for both individuals and enterprises, thereby generating a wealth impact. Consequently, there is a resultant growth in the economy and an increased need for items that need significant energy consumption. Consequently, there is an elevation in consumer and corporate confidence (Sun and Cui, 2014; Surroca et al., 2010). According to Lannelongue et al. (2015), the authors put out the proposition that the growth and progress observed in the industrial sector lead to a rise in the energy consumption, manifesting itself through two distinct mechanisms. Furthermore, when industrial development expands, there is a corresponding rise in the demand for labor, leading to an increase in income and the consumption of goods. Consequently, the profitability and productivity of firms experience growth as economic conditions improve Sadorsky (2010).

The energy intensity metric is frequently employed as a standard for evaluating energy consumption and efficiency inside organizations, and research has indicated that it has a favorable influence on business performance. Based on a study done by Lannelongue et al. (2015), which utilized data obtained from Chinese listed corporations, it was shown that companies exhibiting higher levels of energy efficiency tend to exhibit superior financial performance and market outcomes. This suggests that the utilization of energy resources not only aligns with social responsibility but also yields profitability. Consequently, the adoption of energy conservation strategies can yield advantageous outcomes for businesses in relation to their financial and market performance, ultimately contributing to their long-term sustainability.

It is essential to bear in mind that there is not always a direct correlation between energy use and company performance. Some businesses may have higher expenditures without a corresponding gain in income due to their excessive energy consumption. Moreover, organizations operating in heavily regulated industries or those with significant carbon dioxide emissions may have challenges in reducing their energy use and mitigating carbon dioxide emissions.

2.3 Impact of other Variables on Firm Performance

While controls such as size, growth, and leverage have also been found to have an impact on firm performance, they should be considered in addition to the energy use. For example, a study conducted by Li and Lin (2016) found that larger firms tend to have better access to resources, higher bargaining power with suppliers and customers, and greater operational efficiency, which can lead to increased profitability and better firm performance. In a separate investigation conducted by Hanafi and Hakim (2019), it was observed that mature enterprises exhibit superior performance due to their established relationships with customers and suppliers, acquired knowledge and expertise, and enhanced financial stability. Furthermore, it has been established that profitability serves as a noteworthy indicator of corporate performance, as it signifies the organization's capacity to earn income, regulate expenses, and efficiently allocate resources. Hence, it is important to take into account several business-specific characteristics in addition to the energy index when evaluating firm performance.

2.4 Research Gap

Energy use directly effects both financial and non-financial firm's overall financial performance. Due to vast output bulk of studies are interpreted for financial firms according to need and technological advancement. Thus, it makes a void for non-financial firm studies and their macroeconomics variable effect with respect to energy index. This leads a major research gap in research when discussing this phenomenon in Pakistan.

2.5 Hypothesis Development

This research bases its assumptions on corporate social responsibility and stakeholder theory. Corporate social responsibility research has examined the relationship between environmental sustainability and financial performance. The research uses a variety of financial performance criteria related to varied stakeholder viewpoints, a novel characteristic. The stakeholder theory examines how managers make choices to balance the interests of all important stakeholders. Stakeholder theory, as opposed to conventional shareholder conciliarism, argues that the progress of an organization is intricately tied to the engagement and contribution of its many stakeholders. It posits that organizations have an obligation to operate in the best interests of all stakeholders (Donaldson and Preston, 1995).

Primary stakeholders include shareholders, creditors, employees, and business partners (including customers and suppliers). Secondary stakeholders include government agencies, local residents, local communities, the media, environmentalists, and other relevant entities. Additionally, stakeholders include the environment and future generations who may be affected by an enterprise's actions. In the context of social legitimacy, corporations are obligated to meet the requirements of the internal, external, and environmental stakeholders described before. In the absence of appropriate measures, organizations may encounter adverse consequences that might potentially lead to a decline in shareholder value (Rauf et al., 2001).

Enterprise success and growth depend on how well they respond to the interests of diverse stakeholders, not just shareholder needs and demands. Businesses want to conserve energy, and lowering usage is a means to balance the needs of auxiliary stakeholders. A strong social reputation, customer loyalty, and market longevity are just a few of the competitive advantages that effective stakeholder management can give businesses (Surroca et al., 2010).

There are notable similarities between stakeholder theory and corporate social responsibility in relation to the subject of energy conservation. Corporate social responsibility (CSR) entails the prioritization of the well-being of individuals, the environmental impact of the organization, and the overall welfare of society as a fundamental aspect of corporate operations. This statement challenges the traditional belief that the sole objective of businesses is to maximize profits. The concepts of social and economic responsibility are intricately interconnected and have the potential to mutually reinforce one other. The obligation towards the government constitutes a crucial element of corporate social responsibility. Based on the Twelfth Five-Year Plan implemented by the Chinese government, it is anticipated that companies would actively and positively respond to initiatives aimed at reducing energy usage, therefore assuming a pioneering role in accomplishing the stated objective (Mishra and Suar, 2010).

The prevailing focus of scholarly inquiry within the existing corpus of literature revolves around investigating the relationship between economic growth and energy use, with a particular emphasis on the macro-level analysis of energy consumption. The existing body of literature (Sadorsky, 2010; Çoban and Topcu, 2013; Zhang et al., 2017) predominantly supports a positive association between energy consumption and macroeconomic expansion. A limited amount of research also provides evidence for conflicting perspectives in many circumstances. Based on our data, the correlation between energy consumption and corporate performance is notably impacted by the degree of economic growth exhibited by the entities under study.

Many scholarly studies on energy usage and economic development concentrate on organizations. Christoffersen et al. (2006) found that industrial energy management may benefit economically and environmentally. Energy affects economic performance statistically in two Indian industry clusters, according to Subrahmanya (2006a).

In a study conducted by Yang (2010), an energy audit was performed on a Chinese shoe manufacturing firm. The findings of this research indicate that by investing US$1.9 million in energy improvement measures, the company has the potential to boost its net present value by US$9.8 million. According to Sadorsky (2010), the augmentation of energy consumption has the potential to substantially enhance the net present value and decrease the payback period.

Our analysis of the existing literature reveals that, in contrast to the prevailing findings of previous studies, there is evidence to suggest that an increase in energy use can be accompanied by financial prosperity. Internally, the augmentation of energy use may yield cost savings and enhance a company's ability to navigate challenges such as volatile energy costs and limited resources. This, in turn, can foster resilient and sustainable corporate expansion. In response to environmental factors, the Chinese government has made commitments to enhance its regulatory supervision of corporate energy use. Furthermore, it has suggested the introduction of different financial measures to control and incentivize businesses to cut emissions and energy use. In this context, businesses that take steps to maximize their energy efficiency may have a positive impact on their bottom line. Based on a comprehensive evaluation of the existing literature pertaining to the correlation between energy and company performance, this study has formulated the subsequent hypotheses.

H_1: *Energy consumption has a significant positive impact on firm performance.*

H_2: *Size has a significant positive impact on firm performance.*

H_3: *Growth has a significant positive impact on firm performance.*

H_4: *Leverage has a significant positive impact on firm performance.*

Chapter 3

Data and Methodology

Data is essentially the precise facts and statistics obtained during business operations. Despite the fact that the data by itself may not appear very informative, it forms the basis for all studies which makes it crucial to the business. The research utilizes panel data as its principal sources of information.

3.1 Research Data

There are two types of research data is used in the financial research. First is primary and second is secondary data. Secondary data is knowledge that has already been obtained from primary sources and is made available so that scholars can use it to perform their own independent research. It is a category of information which has previously been gathered. Manuals, private resources, publications, periodicals, blogs, official documents, etc. are examples of secondary information sources. In comparison to original information, secondary information is thought to be easier to find. Using such resources involves relatively minimal study and labor (Formp, 2019).

Cross-sectional data comprises of assessments of a variety of people, individuals and things at a particular period, with every measurement falling under a distinct category (**?**). The sample used for this study comprises individual non-financial enterprises, which serve as the cross-sectional units in the panel data. The data pertaining to non-financial enterprises is gathered to examine the correlation between energy use and corporate performance. The study aimed to investigate if there is a significant association between the variables of interest within the selected sample. This study examines each business as a separate cross-sectional unit.

A set of statistical sets that have been categorized in time pattern is referenced to as time series information or time-stamped information. Information that has been time-stamped was gathered over a period of time. Such pieces of information are employed to monitor modifications as time passes and comprise of sequential observations taken from the identical source throughout a timeframe (Chatfield, 2000). In the financial data, time frequency can be divided into multiple options. The data can also be categorized into many time intervals, including yearly, quarterly, monthly, weekly, and daily. The data utilized in this study was obtained from the financial records of the companies. It is a mandatory requirement for a company to annually publish at least one of its financial statements in an audited format. Therefore, this study utilized audited annual financial statements released by non-financial enterprises in Pakistan as the primary data source. These statements are provided on a yearly basis by the non-financial firms. The analysis is conducted using an annual time frequency, or alternatively, the data utilized in the study is collected on an annual basis. The data pertaining to the variable of interest, namely energy consumption, is acquired from the official website of the World Bank.

A subset of data called panel data consists of measurements on multiple cross-sections over a specific time period. Countries, companies, individuals, or demography classifications are examples of the various groups typically included in panel data sets (Aptech, 2016; Hsiao (2022)). In the study, panel data is used. As it is based on different non-financial firms as cross sections and collected the data annually. So, the combination of cross sections of non-financial firms and the annual data jointly develops the new form of data that is panel data.

There are essentially two types of panel data. Panels may be classified as either "balanced" or "unbalanced," with "balanced" panels being the more common term. Each cross-sectional unit in a balanced panel has the same amount of observations across all years in the data collection. This may be calculated by summing the data from each time period recorded for each cross-sectional unit. In conclusion, panel data is said to be "balanced" when each member is observed each year, and "unbalanced" when at least one member is not seen each year. When you multiply the number of cross sections by the number of time periods, you get the total number of observations in a balanced panel. Conversely, in an imbalanced panel, the total number of observations is smaller than the product of the cross sections and time periods employed.

There exist two distinct forms for recording panel data: the long format and the broad format. In the extended format, the values of each variable are documented in a single column, including all time periods and cross-sectional units. Conversely, in the broad format, the values of the variables are recorded in various columns, representing different time periods.

Panel data is commonly utilized in most financial research investigations. The utilization of panel data offers several advantages. This tool is utilized to gather information at both the individual and group levels. The dataset has a substantial quantity of observations, rendering it more informative and valuable in comparison to time series and cross-sectional data. The statistical conclusions derived from panel data sets are generally considered to be more valuable in comparison to the individual effects observed in cross-sectional and time series data. Estimation biases sometimes manifest when disparate groups converge at a singular temporal juncture. Panel data effectively reduces these biases.

3.2 Sample and Data Sources

The data was gathered from 2006 to 2019. The State Bank of Pakistan's Balance Sheet Analysis and Financial Statement Analysis for Non-Financial Firms of Pakistan (BSA and FSA) were the study's main data sources. The research also used financial statements from Pakistan Stock Exchange-listed non-financial enterprises. The World Bank website provided energy usage statistics. The Pakistan Stock Exchange (PSX) listed 365 non-financial companies during this time. Businesses who could not give complete information on their energy and resource expenditures and other relevant factors were omitted from the research. Firms with extreme values, missing data, or incorrect asset and liability signals are also removed. In order to obtain better findings, the study additionally removed the firms that lacked an uninterrupted period of eleven years of data. Three hundred and sixteen non-financial companies have been included finally, distributed among 13 industrial sectors.

3.3 Research Methodology

The basic advantage of the research that is based on panel data is to observe the effects of heterogeneity. As in simple time series models it is not possible to find the impact of different cross sections in analysis. In case of panel data settings panel data models allows to capture the heterogeneous effects of individual cross sections in the analysis. A change in any member of the sample or cross section can be captured in the panel data settings holding other conditions constant in other members of the sample. It is also possible to capture the effects of changes in any the two or three members in the sample. In simple words, panel data techniques are designed to capture the effects of these individual change or the effects of heterogeneity. On the other hand, time series models are not capable to capture the heterogeneity. In this section the study tried to model the panel data collected with appropriate techniques to capture the heterogenous effects in the sample overtime.

There are two types of panel data models. First is the homogenous and second is the heterogenous panel data models. In the prior set of models, it is primarily assumed that each cross section is same or individual paraments are same across the sample. In heterogenous models it is priorly assumed that the cross sections are different at different parameters and all the members varies on different parameters. Fixed effects models are used to capture the heterogeneity of the sample in panel data. Within the groups of the model's variation of the sample will decide that which model to be used.

To explain the homogenous and heterogenous models let's consider the following basic homogenous a simple linear model.

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it} \tag{3.1}$$

In this homogenous model, the constant and coefficients of the equation is same for all cross sections and time. The variability in the data set can only be introduced in error term only. Any change in data set will be captured in the error term only. In this model it is primarily assumed that every member in the sample is same and have no different or unique differences. In the research it is also possible to have a sample that contained different individuals. All individual firms in the sample have unique characteristics. To capture this heterogeneity in the sample researchers used the fixed effects model or the least square dummy variable (LSDV) model as follows

$$Y_{it} = \beta_i + \beta_1 X_{it} + \varepsilon_{it} \tag{3.2}$$

The only difference in Eq 3.1 and 3.2 is the change in constant term. The constant term of Eq 3.2 is group specific and allows any change within the groups. There are three major types of models used in the panel data are:

1. Pooled ordinary least square (POLS)
2. Fixed effects model
3. Random effect model

The details of each of the following is as follows

Pooled ordinary least square model Consider the following model

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_i + \varepsilon_{it} \tag{3.3}$$

Where, dependent variable depends upon the independent variable which are observed along with the unobserved variables or component. The example of unobserved characteristics is growth opportunities in the economy, political situation of the country and company potential are the major examples. Sometimes, it is possible that there is no individual firm specific effects and all the observations within the sample are independent then in this case second term of unobserved heterogeneity becomes zero and the model will be as:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it} \tag{3.4}$$

This model is used when it is assumed that there is each firm is independent within the sample and there is no chance of dependence within the sample. In this case to find the values of different paraments pooled ordinary least square will be used.

The question arises that whether in case of empirical research, the cross-section independence holds? The answer is no it is not. In the research, pooled ordinary least square is rarely used as most of the cross sections are dependent. To capture these effects, another model used that is known as the fixed effects model.

3.4 Fixed Effects Model

Every individual firm in a sample remain different with the other firms. Some firms are bigger and some are smaller. It is also possible that every firm in a pooled sample have different opportunities of growth. In this case to capture the heterogeneous effects fixed effects model is used.

In this case unobservable component is identical and remain specific for each individual section. Regression model for fixed effects model can be as:

$$Y_{it} = \beta_i + \beta_1 X_{it} + \varepsilon_{it} \tag{3.5}$$

Here, the constant term remain fix for each section across time. By using pooled ordinary least square parameters remain biased and the final estimates will be the inconsistent. There are three different techniques are used to estimate the unique effects of the firms within a sample across time.

- Fixed effect estimation
- Least square Dummy variable
- First difference estimation

Least square dummy variable used individual dummy for each sector within the data set and the other two techniques capture the identical effects before the estimation.

3.5 Random Effect Model

The third type of model in the list of panel data models is random effects model. In this model all firm specific parameters remain changes across time and acts like a stochastic error term. It is assumed that these unobserved characteristics remain uncorrelated with the observed characteristics or with other independent variables. It does not produce the biased estimates but the parameters could be inefficient. The point that may differentiate the random effect model from the fixed effect model is that unobservable characteristics does not have any final value rather it follows a random distribution which should be account for. By keeping this point the random effect model can be written as:

$$Y_{it} = \beta_i + \beta_1 X_{it} + \varepsilon_{it} \tag{3.6}$$

$$Y_{it} = (\beta + \beta_1) + (b_i + \beta_1) X_{it} + \varepsilon_{it} \tag{3.7}$$

$$b_i \sim N(0, r_{i1}^2) \tag{3.8}$$

$$\beta_i \sim N(0, r_{i2}^2) \tag{3.9}$$

Most of the time series are dependent upon the value of the previous time period. Then dynamic models introduce in the time series. Lagged dependent variable models are introduced to capture the dynamic and lagged effects. Panel data is also based on cross sectional and time series components so, it is possible to have the dynamic effects in data sets. Panel data models also allows to capture the effects of such autocorrelation. The basic model of panel data with one autoregressive term (AR1) can be mentioned as:

$$Y_{it} = \beta_1 Y_{it-1} + \beta_2 X_{it} + \varepsilon_{it} \tag{3.10}$$

In the presence of lagged effects, the ordinary least square produces the biased estimates. Finally, the generalized method of moments (GMM) is used to capture the effects of dynamic panel data models. Generalized Methods of moments is introduced by Arellano and Bond in 1991.

3.6 Comparison of Pooled Ordinary Least Square and Fixed Effects Model

Pooled ordinary least squares (OLS) and fixed effect models are two prominent methodologies frequently employed for estimating panel data. In the context of a pooled ordinary least squares model, the estimation of pooled data is conducted on the assumption that there are no discernible differences among businesses, and that individual effects are not influenced by the explanatory factors. In contrast, the fixed effect model is employed to estimate panel data by accounting for individual-specific effects. In this scenario, it is posited that the impacts of individual factors are interconnected with other explanatory variables.

There are different parameters upon which the two panel data techniques can be differentiated. First is treatment of invariant time variables.

The fixed effect model can estimate time-invariant variables, while pooled ordinary least squares cannot. The second differentiation dimension is the relationship between persons and explanatory variables. Pooled ordinary least squares will provide biased and inconsistent estimates if the individual effects and explanatory factors are correlated. In such cases, a fixed effect model may effectively address the relationship between explanatory factors and individual effects. The fixed effect model may handle such linkages and provide unbiased, consistent results. The Hausman test distinguishes pooled OLS and fixed effects models. Hausman and likelihood ratio tests reveal that the fixed effects model is appropriate if the individual effects and explanatory factors are correlated. In order to facilitate a comparative analysis, the third parameter under consideration is the coefficient of determination, commonly referred to as R-square. Pooled ordinary least squares (OLS) effectively accounts for the entirety of the variation present in the dataset, resulting in a typically greater R-square value compared to the R-square value seen in the fixed effect model.

3.7 Comparison of Fixed Effects Model and Random Effects Model

Fixed effects and random effects models are the main panel data estimation methods. The research compared the two methodologies on numerous factors. We begin with the model assumption. The fixed effects model assumes a connection between individual effects and explanatory variables, whereas the random effects model assumes a normal distribution with constant variance. Interpreting coefficients is also crucial. The fixed effects model interprets the coefficient as individual explanatory variable changes. It is the impact of a one-unit increase in the explanatory variable in an individual. However, in the random effects model, coefficients show the average impact of explanatory variables on the population. Efficiency is another consideration. The fixed effects model is efficient when explanatory variables and individual-specific effects are linked. When these two variables are uncorrelated, the random effects model is valid. The fourth criterion that distinguishes fixed and random effects models is time invariant variables. The random effects model cannot handle time-invariant variables, whereas the fixed effects model can.

The Hausman test is the last test for identifying the two methods. If the F-statistics p-value is statistically significant, the fixed model may capture the relationship between individual-specific effects and explanatory variables. A test with an insignificant result implies no association between individual-specific effects and independent factors. This research uses the Hausman test to identify fixed and random effects models.

3.8 Panel Unit Root

The degree of stationarity of a financial data series is contingent upon the temporal frequency at which the data is observed. The issue of stationarity is less pronounced at lower frequencies compared to higher frequencies. The assessment of stationarity is necessary when incorporating macroeconomic data with extended time periods into the model. The statistical test detects unit roots in panel data series. A unit root explains a series' temporal dynamics. A time series with a unit root is non-stationary if its mean and variance change over time. Long-term trends and interdependencies characterize this series. Before undertaking econometric analysis, make sure the data is stationary throughout time. In the event that the data or series lacks stationarity, the outcomes obtained would exhibit inconsistency and potential bias.

Panel data may be tested for unit roots using many methods. These tests include LLC, IPS, and Fisher-type panel unit root testing. These tests have distinct assumptions and techniques for discovering series unit roots. These tests have been conducted on the basic hypothesis of having an unit root in series as follows

H_0: *the variable is non-stationary and contains a unit root,*

H_1: *the variable is stationary and does not contain a unit root.*

Once it has been established that the series utilized in the panel data set lacks stationarity, it becomes necessary for the analysis to first transform it into a stationary series. There are other econometric methodologies that may be employed to address this issue, such as employing the first difference of the series. The panel unit root test is a fundamental need for the use of any panel data approach. In the presence of a unit root, it is necessary to transform a series into a stationary form.

3.9 Dependent Variable

Firm performance was the dependent variable in this study. To illustrate the rewards of various stakeholders independently, three dependent variables, return on assets (ROA), return on equity (ROE), and return on sales (ROS), were chosen to reflect shareholders' assessment and external stakeholders' and financing organizations' attitudes toward the companies' possibilities. ROE reflects shareholders' assessment of companies, while the other indicators help determine the attitude of stakeholders towards a firm's evaluation and the potential of firms of other creditors and lending institutions.

Return on asset (ROA) is the proxy of firm performance that is used to determine whether the firm is efficient in generating net income out of utilizing its total assets properly. The formula used to find the return on assets is net income over total assets. Return on equity (ROE) is the second measure used to find the financial performance of the firm. The formula used to find the return on equity is net income to total equity. This is the proxy that is used to capture the effect of proper use of equity proceeds. Firm performance would be high if the firm is in a position to enhance its capacity to generate more net income out of its total equity used. Greater the value will be the indicator of the goof performance.

The third performance indicator utilized in finance research to assess the financial success of a corporation is commonly referred to as return on sales. The metric in question serves as a significant determinant of a firm's ability to effectively translate revenues into profitability. A higher ratio serves as a sign of improved efficiency inside the organization. The metric in question pertains to the proportion of operational profit in relation to net sales.

The concept of return on investment is commonly employed in the academic field of finance as a substitute measure to assess the financial success of a company. The return on investment (ROI) serves as a crucial indication for comparing various investments, as a higher number signifies a greater assurance of obtaining a favorable return on the invested cash. The return on investment (ROI) is calculated by dividing the return on an opportunity by the cost of the investment. A higher value of the ratio indicates that the business is effectively employing its money to meet its cost of funding. The aforementioned variable was mentioned in the literature, but, the study did not provide any findings for it since it was found to be statistically insignificant in the context of Pakistan. Therefore, the outcomes associated with this proxy variable have not been documented.

The aforementioned factors are employed to ascertain the correlation between the financial performance of the organization and its energy consumption. The research conducted by Fan et al. (2017) employed proxies to assess company performance in connection to energy.

3.10 Independent Variable

The basic idea behind the research is to find the relationship between energy use and the firm financial performance. Energy use (EU) is term that is used that how the firm is efficient in utilizing its energy related resources. If the firm is efficient then it is an indication that the demand for the energy related items is decreasing for the firms over time. If the firm is producing more goods by utilizing more and more energy in use is an indication that firm is inefficient in term of energy utilization. Throughout this research, EU was chosen as the independent variable. There are various proxies for determining EU, spanning straightforward energy demands to increasingly complex compound metrics like the overall variable EU obtained from nonparametric or parametric frontier approaches (Yildirim E, 2012).

The study used the data of energy used collected from world development indicators downloaded from the website of the World Bank. Increase in operating revenue by holding expenditure on energy resources constant is an indication of energy use of the firm. It means that the firm is able to produce more goods by adopting other renewable energy sources as well. It is also the signal of using latest and efficient technology that as the production level increase the per unit cost of the goods due to the high cost on energy used.

3.11 Control Variables

Throughout this investigation, control factors like size, growth and leverage were taken into account. When evaluating a company's economic success, the company's scale must be taken into consideration. Larger businesses typically make more money versus smaller ones. The revenue of a company could depend on the growth phase at which it is now operating. Asset transfers involve the selling of a company's real assets, whether they are physical or immaterial, in part or in full.

Although the vendor no longer possesses a claim to the transferred assets, they remain the lawful property of the firm that leased the assets. It is obvious that economic volatility and company success are closely related.

A company is increasingly inclined to avail advantage of fresh prospects and technological advancements if economic threat is minimal since it is simpler to persuade investors and secure finance in this kind of situation. Profitability varies between businesses. Different businesses consume different amounts of power (i.e. power consuming industrial sectors against power saving industrial sectors). The complete list of every variable included in this quantitative research is shown in Table 3.1.

3.12 Econometric Model

Energy use is related with firm financial performance. To evaluate the relationship between the energy use and other dependent variables the following econometric model is used. Development of the accompanying modeling employing the regression equations is done to evaluate the assumption. Panel regression model evaluating the hypotheses of the study specifically are mentioned below.

$$FP_{it} = \beta 0 + \beta 1 EE_{it} + \beta 2 Growth_{it} + \beta 3 Risk_{it} + \beta 4 Size_{it} + \varepsilon it \tag{3.11}$$

Where, FP_{it} represents the firm performance of company "i" at year "t" and EE_{it} signifies the energy intensity of a company "i" at year "t" while Size, growth and risk of company "i" at year "t" are represented as $Size_{it}$, $Growth_{it}$ *and* $Risk_{it}$ respectively.

As the study used different proxies to evaluate the firm financial performance and the regression estimate shave been found by using different dependent variables at the same time. These specific regression models have been used to explain the connection between energy efficiency and the firm financial performance.

The following regression model has been built to account for the impact of energy efficiency on return on assets (ROA).

$$ROA_{it} = \beta 0 + \beta 1 EE_{it} + \beta 2 Growth_{it} + \beta 3 Risk_{it} + \beta 4 Size_{it} + \varepsilon it \tag{3.12}$$

Where, ROA is stand for return on assets. The following regression model has been built to fully account for how energy efficiency affects return on equity (ROE).

$$ROE_{it} = \beta 0 + \beta 1 EE_{it} + \beta 2 Growth_{it} + \beta 3 Risk_{it} + \beta 4 Size_{it} + \varepsilon it \tag{3.13}$$

Return on sales is the third measure used to gauge the firm financial performance. The following regression model has been constructed to accurately represent the impact of energy efficiency on return on assets.

$$ROS_{it} = \beta 0 + \beta 1 EE_{it} + \beta 2 Growth_{it} + \beta 3 Risk_{it} + \beta 4 Size_{it} + \varepsilon it \tag{3.14}$$

Where, ROS is return on sales. By using appropriate panel data techniques, the above-mentioned model has been estimated.

Table 3.1: Description of Variables

VARIABLE	DESCRIPTION	SOURCE
ROA	The ratio of net profit to total assets used to measure a firm's profitability	(Forbes, 2020)
ROE	A performance metric known as return on equity (ROE) assesses a company's financial performance by dividing the averages of after-tax revenues by stockholders' equity.	(Li & Wu, 2020)
ROS	Return on sales calculates a company's financial performance by dividing after-tax profits by sales.	(**?**)
EU	Energy use (Kg of oil equivalent per capita) measured as ln(Energy use)	(Ahmed et al., 2022a)
Size	It refers to all assets of a non-financial firm and it is calculated as natural logarithm of total assets.	(Arcgis, 2022)
Growth	A firm's growth can be gauged by its sales revenue's yearly growth percentage. Formula used to measure the growth is current year sales minus sales of the previous year divided by the sales of the last year.	(González et al., 2020)
Risk	Measuring the debt-to-asset ratio, that compares a company's overall debt to its overall assets, is one way to assess financial risk.	(Naeem & Majeed 2020)

Chapter 4

Results and Discussion

4.1 Descriptive Statistics Results

The Descriptive Statistics produced a comprehensive summary of the measures of central tendency, dispersion, and distribution for each variable within the dataset. The provided data offers insights into many statistical measures for each variable, including the mean, median, minimum, maximum, standard deviation, skewness, kurtosis, Jarque-Bera statistic, probability, sum, sum of squared deviations, and number of observations. This test does not yield data about the interrelationships among variables or the causal effects of one variable on another. Furthermore, it does not ascertain the presence of a statistically significant disparity between groups or the existence of a statistically significant alteration over a certain period. The Descriptive Statistics exam is solely focused on providing a description of the data and does not draw any inferences or make any judgments. This process establishes a fundamental basis for conducting further analyses, facilitating the identification of patterns or anomalies within the dataset.

Descriptive statistics are employed to analyze and present data in a manner that conveys its significance. Descriptive measurements are employed to get an understanding of the data and inform subsequent decision-making on data processing. Various measurements of descriptive statistics are employed to elucidate the data. Firstly, measurements of central tendency are employed to elucidate the manner in which data exhibit a propensity towards a central point. The fundamental metrics of central tendency encompass the mean, median, and mode. There exist additional metrics that are associated with quantifying the dispersion of the data. The fundamental metrics of dispersion encompass the range, variance, and standard deviation. Prior to doing any analysis, it is important to elucidate and examine the inherent characteristics of the data. This study employs various metrics of central tendency and measures of dispersion to elucidate the data.

Descriptive statistics is frequently employed as a means to furnish a comprehensive summary of a dataset, facilitating the identification of patterns, trends, and correlations inherent in the data. Additionally, it may be utilized for the purpose of identifying outliers or atypical observations within a given collection. Descriptive statistics holds significant utility across several disciplines, encompassing business, economics, social sciences, and psychology.

The factors included in this study are company performance, energy consumption, firm expansion, financial leverage, and firm size. Table 4.1 displays the descriptive statistics for the variables. The data was analyzed in the table using several metrics in an attempt to elucidate its meaning. The initial metric employed to describe the variables is the mean. The mean is a statistical measure of central tendency that is utilized to identify the central point around which data tends to concentrate. The formula utilized to calculate the sample mean, which represents the average, involves dividing the sum of the observations by the total number of observations. The mean value of the first variable, return on asset, is 0.031112. This suggests that, on average, the companies included in the sample are producing an income of 0.03 for every one unit of their assets. The standard deviation of the dataset is 0.147552, suggesting that there is a nearly 0.15 level of variance in the return on assets throughout the company. There exist certain businesses that possess a maximum value exceeding the average value, while concurrently there are firms that exhibit a value below the average. The presence of a negative minimum return on assets (ROA) indicates that certain organizations exhibit suboptimal utilization of equity and may experience negative net income. If the Jarque-Bera test yields a statistically significant result, it indicates that there is evidence to suggest that the series under consideration follows a normal distribution.

Another indicator for company performance utilized in the dataset is return on equity (ROE). This proxy is employed to assess the efficiency with which a corporation utilizes its equity in generating revenue. In general, the mean return on equity (ROE) surpasses the return on assets (ROA), suggesting that non-financial enterprises in Pakistan demonstrate proficient use of equity. Furthermore, the mean return on equity (ROE) is calculated to be 0.078254, with a maximum value of 10.92 and a lowest value of -8.6. The calculation of Return on Equity (ROE) involves dividing the net income by the shareholders' equity, and it serves as a metric for evaluating the financial success of a company. The calculated value for the standard deviation of the return on equity (ROE) is 0.68961.

Furthermore, the average rate of return on sales (ROS) is calculated to be -0.051964, with a standard deviation of 0.660031. The range of ROS values spans from a maximum of 6.41 to a minimum of -10.92. The Return on Sales (ROS) is a metric utilized to assess operational efficiency by quantifying the profitability created per unit of sales revenue. A declining return on sales (ROS) may indicate the potential emergence of financial challenges.

Energy use is the value of energy consumption. It is measured as natural log of energy use. Greater value of the is desirable as compare to other time period values. Energy use can achieve when the value of the energy amount remains constant and a higher value of the operating revenue can be achieved. It also has a negative relationship with firm performance as the lower value is indicating the energy use of the firm that may lead to decrease the value of firm performance. EU is energy use and has an average score of 6.134701 and a range from 6.1370 to 6.1350. It has a 0.160923 standard deviation.

Size is used to measure the relevant information of the firm size. Larger value of the variable suggest that the firm is bigger in its assets size and lower value is for smaller firms. Larger firms normally have the good financial performance as it has enough resources to grow. The highest and lowest numbers for SIZE are 20.26025 and 8.735204, correspondingly, while the average score is 15.15033, with a standard deviation of 1.710247. Moreover, the probability value of Jarque-Bera statistic of the variable is significant that is indicating the variable is normally distributed.

Table 4.1: Descriptive Statistics

	ROA	ROE	ROS	EU	SIZE	GROWTH	RISK
Mean	0.031112	0.078254	0.083956	0.018256	15.15033	0.008750	0.110311
Median	0.029000	0.090000	0.051324	0.011258	15.06620	0.090000	0.070000
Maximum	3.126000	10.92000	0.379066	1.070000	20.26025	4.460000	0.880000
Minimum	-1.907000	-8.600000	0.010098	0.002589	8.735204	-9.780000	0.018400
Std. Dev.	0.147552	0.689610	0.099016	0.160923	1.710247	0.662120	0.122978
Skewness	1.877597	0.853680	3.061939	26.54183	0.114343	-7.714017	1.939867
Kurtosis	82.22781	78.30458	11.42546	882.9666	3.113533	92.76587	7.448168
Jarque-Bera	1035680.0	934032.0	1003131.0	1.28E+08	10.73141	1365718.0	5735.294
Probability	0.000000	0.000000	0.000000	0.000000	0.000674	0.000000	0.000000

The growth variable pertains to the expansion of a company in relation to its sales performance. When companies have the ability to increase their sales growth, they are also able to raise the value of their market share. Sales growth is a characteristic that is contingent upon time and is utilized to assess how companies are creating and enhancing their sales over a period of time. A higher magnitude of the present time period serves as an indicator of the firm's growth in terms of positive sales. Conversely, the negative figure pertains to the decline in sales in relation to the preceding year. The average growth rate of sales for the businesses over time is 0.00850 points. The presence of a sufficiently high positive maximum value (4.46000) suggests that there is a significant degree of variation in the sales fluctuations seen across a small number of enterprises over time. The presence of a negative minimum value suggests that certain organizations may see a decline in sales growth. Negative growth refers to a decline in revenue as compared to the prior year. The Jarque-Bera statistic suggests that the series is regularly distributed.

Leverage is a quantitative metric employed to assess the extent to which non-financial enterprises, namely those included in the selected sample, create their assets. The debt to asset ratio pertains to the financial composition of the company. A higher mean value indicates that a majority of enterprises rely on debt financing to generate their assets, whereas a lower value signifies a reduced reliance on debt financing. On average, non-financial enterprises in Pakistan tend to employ a somewhat lower level of debt for financing purposes. The average amount of leverage in Pakistani non-financial enterprises indicates that a mere 10.3% of their assets are funded by debt. Determining whether this figure is larger or smaller is a challenging task. The way enterprises in other emerging nations finance their assets in comparable sectors is contingent upon many factors. The LEVERAGE metric exhibits a range of scores, with the highest and lowest values being 0.88 and 0.018, respectively. The average score for LEVERAGE is calculated to be 0.10311, accompanied by a standard deviation of 0.122978. Descriptive statistics also indicate that the variable exhibits a normal distribution.

4.2 Correlation Matrix Results

Table 4.2 provides insight into the factors' effects. The researchers used Pearson correlation analysis to establish the factors' association. The parallel increasing trend of Return on Assets (ROA) and Return on Equity (ROE) shows a favorable association. However, return on assets was positively correlated with the EU. The EU also showed a positive association with ROE and a negative correlation with ROS. Compared to "EU" and "ROE," "GROWTH" is positively correlated with "ROA" and "ROS." "SIZE" correlates positively with "ROA" and "ROS," but negatively with "EU." Energy usage seems to be strongly linked with virtually all other variables, indicating that enterprises in the sample have a negative relationship with them. Positive readings may be related to manufacturing energy usage. The research has virtually gathered data on major, excellent Pakistan Stock Exchange-listed enterprises attempting to increase profitability via energy consumption. SIZE strongly correlates with all factors except energy usage. This relationship is supported by the aforementioned logic. Negative energy consumption indicates enterprises' attempts to increase profitability by lowering energy use.

Descriptive statistics and correlation analysis are two different techniques used to analyze data in statistics. Descriptive statistics provide summary measures such as mean, median, mode, range, and standard deviation of a dataset, while correlation analysis examines the strength and direction of the impact between two or more variables.

Table 4.2: Correlation Matrix the Variables

	ROA	ROE	ROS	EU	GROWTH	LEVERAGE	SIZE
ROA	1.000000						
ROE	0.149154	1.000000					
ROS	0.464168	0.009801	1.000000				
EU	0.021511	0.042210	-0.002447	1.000000			
GROWTH	0.090295	-0.001503	0.085168	-0.014718	1.000000		
LEVERAGE	0.081602	-0.022227	0.052207	0.011841	0.016930	1.000000	
SIZE	0.111358	0.058822	0.118715	-0.123415	0.048366	0.066420	1.000000

Descriptive statistics provide a general overview of the data, such as the central tendency, dispersion, and distribution of the data. In contrast, correlation analysis allows us to examine the degree of association between two or more variables. In the case of the given Table 4.2, it shows the Pearson correlation coefficient values for the variables included in the study.

The correlation coefficient values range from -1 to +1, where a value of 1 represents a perfect positive correlation, 0 represents no correlation, and -1 represents a perfect negative correlation. Positive correlations indicate that the two variables tend to move in the same direction, whereas negative correlations indicate that they tend to move in opposite directions.

In the given Table 4.2, we can see the correlation coefficients for the variables ROA, ROE, ROS, EE, GROWTH and RISK. The correlation coefficient between ROA and ROE is 0.149154, indicating a weak positive correlation between these two variables. The correlation coefficient between ROA and ROS is 0.464168, indicating a moderate positive correlation between these two variables. The correlation coefficient between ROE and ROS is 0.009801, indicating a weak positive correlation between these two variables.

Overall, the correlation matrix provides a more detailed understanding of the association between variables than descriptive statistics alone. It allows researchers to identify which variables are significantly correlated, which are weakly correlated, and which may be negatively correlated. This information can be useful in identifying which variables to include in further analysis, and in developing models to predict future outcomes based on these variables.

4.3 Panel Unit Root Test Results

Unit root analyses are used to assess if progressing information must first be permuted or regressed on predictable variables of time to attain stable information. Because of the enormous amount of information in a panel data collection, there could exist a unit root, which might produce skewed conclusions. The foundation of unit root analyses is the presumption that the set of data is unrestricted. The first and second generations panel unit root analyses were simultaneously used in this research to determine whether a unit root existed in the original dataset for every variable. The first generation of testing considers that each variable is independent, whereas the second generation permits some interactive dependency. The assumption that a unit root arises within either of the chosen dependent factors was tested using the four different forms of unit root test panels.

The Levin, Lin, and Chu t* test is a statistical method used to assess the presence of a unit root in a panel of time series data. The presence of a unit root implies that the series under consideration is non-stationary. A non-stationary time series refers to a type of time series data in which the statistical properties, such as mean, variance, or autocovariance structure, exhibit variations with time. This characteristic poses challenges in terms of modeling and forecasting. The test statistic utilized in this examination is computed as a t-statistic, with the null hypothesis positing the presence of a unit root inside the panel. In the event that the test statistic exceeds the critical value derived from the t-distribution, it is appropriate to reject the null hypothesis. This rejection provides substantiation for the presence of a stationary panel of time series. If the calculated test statistic is smaller than the critical value, it is not possible to reject the null hypothesis. Consequently, the conclusion drawn is that there is insufficient evidence to support the claim that the panel of time series is stationary.

The Im, Pesaran, and Shin (IPS) W-statistic test is a unit root test that is specifically developed to assess the existence of a unit root in a given time series. The IPS test incorporates the consideration of cross-sectional dependency and variability across time series, factors that might introduce complexity in the study of time series data. A unit root is a property of a time series that renders it non-stationary, and the IPS test is employed to ascertain the presence or absence of a unit root in a time series.

The IPS W-statistic test utilizes regression analysis to estimate the relationship between each individual time series and its lagged values, as well as the lagged values of the other series within the panel. The regression analysis is performed with the time-demeaning (TD) methodology, which involves the subtraction of the average value of each time series over the observed period. The W-statistic is computed by summing the individual t-statistics of the unit root test for each time series in the panel. The test can be employed to detect a unit root in either the individual time series inside a panel or in the panel's common unit root. One advantage of this test is in its ability to withstand the presence of cross-sectional dependency and heterogeneity, two prevalent characteristics often observed in panel data. In addition, it is worth noting that the test statistic adheres to an asymptotic distribution that is devoid of any cross-sectional dependency and heterogeneity. The W-statistic exhibits a distribution that deviates from the standard distribution when the null hypothesis of a unit root is assumed. The critical values required for conducting the test may be derived by means of Monte Carlo simulations.

In brief, the IPS W-statistic test is specifically developed to identify the existence of a unit root in panel data that exhibits both cross-sectional dependency and heterogeneity. The test is conducted by doing regression analysis on each individual time series using lagged values of the series and lagged values of the other series in the panel. The W-statistic is then calculated as the sum of the individual t-statistics obtained from the unit root test across all time series in the panel.

The ADF Fisher chi-square test, known as the Augmented Dickey-Fuller (ADF) test, is a widely used statistical method for identifying stationarity in the study of econometric time series. The examination is grounded on the supposition that the sequence exhibits non-stationarity, and that its mean, variance, or auto-covariance structure undergoes temporal fluctuations. The computation of the test statistic involves doing a regression analysis on the initial differences of the series, with the inclusion of a constant term and a temporal trend. The null hypothesis posits that the series exhibits non-stationarity, whereas the alternative hypothesis suggests that the series displays stationarity. The test statistic conforms to a chi-square distribution, and its degree of significance is established by comparing it to critical values obtained from a chi-square distribution table. The Augmented Dickey-Fuller (ADF) test is frequently employed in conjunction with other statistical techniques to ascertain the appropriate level of differencing necessary for achieving stationarity, as well as to make predictions for the series. It is essential to acknowledge that alternative tests, such as the KPSS test, can also be employed to examine the presence of stationarity. In general, the ADF Fisher chi-square test is considered a dependable approach for examining the presence of stationarity in time series data.

The Phillips-Perron (PP) test is a statistical test employed to ascertain the presence of a unit root in a time series, hence determining its stationarity or non-stationarity. The proposed method is a modification of the Dickey-Fuller test, specifically designed to account for the presence of serial correlation in the residuals of the regression model. The Phillips-Perron (PP) test employs an extended Dickey-Fuller regression model to address this issue, using a Newey-West correction to appropriately alter the standard errors. On the other hand, the Fisher chi-square test is a statistical procedure employed to assess the disparity between actual and anticipated frequencies inside a contingency table, utilizing a theoretical distribution. This statistical method can be utilized to assess the independence of two categorical variables or to evaluate the goodness-of-fit of a given collection of observed frequencies to a theoretical distribution. It should be noted that the validity of this test is contingent upon the predicted frequencies in each cell of the contingency table being larger than 5, since lower values can compromise the reliability of the test.

Panel unit root tests were conducted to assess the stationarity of the financial indicators, namely ROA, ROE, ROS, EE, FROWTH, LEVERAGE, and SIZE. The objective of the tests is to examine whether the panel series exhibit unit roots, which suggest non-stationarity, or if they display stationarity. The null hypothesis given for these tests is that the series under consideration possesses a unit root, whereas the alternative hypothesis assets that the series is stationary.

TABLE 4.3: Correlation Matrix the Variables

Variables	Levin, Lin & Chu t*		Im, Pesaran and Shin W-stat		ADF - Fisher Chi-square		PP - Fisher Chi-square	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
ROA	-3.19865	0.0007	-1.77646	0.0378	32.7482	0.0359	68.0443	0.0000
ROE	-2.96966	0.0015	-1.67316	0.0471	25.0714	0.0339	32.0600	0.0039
ROS	-3.33155	0.0004	-2.12317	0.0169	36.5748	0.0132	58.4420	0.0000
EU	-106.345	0.0000	-37.4733	0.0000	2754.63	0.0000	203.084	1.0000
GROWTH	-3.21755	0.0006	-2.14644	0.0159	23.4024	0.0094	54.2938	0.0000
LEVERAGE	-4.28074	0.0000	-1.53593	0.0623	19.9431	0.0298	7.49502	0.6780
SIZE	-6.25070	0.0000	-2.82648	0.0024	49.6293	0.0003	76.2670	0.0000

According to the results of the panel unit root test, it may be inferred that the series "FP" exhibits a stationary process. This conclusion is drawn based on the rejection of the null hypothesis, which suggests a unit root process, at a significance level of 5%. The t-test statistic proposed by Levin, Lin, and Chu yields a p-value of 0.0007, which provides substantial evidence supporting the notion of a stationary process. Furthermore, the W-statistic proposed by Im, Pesaran, and Shin, as well as the ADF - Fisher Chi-square test, both indicate the presence of a stationary process, with corresponding p-values of 0.0378 and 0.0359, respectively. In addition, the PP - Fisher Chi-square test yields a p-value of 0.0000, indicating strong evidence against the hypothesis of a unit root. The findings of this study indicate that the "FP" series has a deterministic trend, implying that it follows a mean-reverting pattern and does not exhibit unit roots. It is important to acknowledge that these tests constitute just a portion of the study, and additional analysis, such as cointegration analysis, may be indispensable in comprehending the essence of the series.

The findings of the panel unit root test conducted on the "ROE" series indicate that the data exhibits a stationary process. The test probability fall below the customary threshold of 0.05, suggesting that the null hypothesis of a unit root (non-stationary process) may be rejected. This implies that the series "ROE" exhibits stationarity, with its mean and variance remaining constant across time. It is crucial to recognize that the results of the test might differ based on the choice of the test, as well as the specified number of lags and exogenous variables. The test results suggest that the "ROE" series demonstrates stationarity.

The acronym "ROS" represents "Return on Sales," a financial performance indicator utilized to gauge the level of return a company has generated in relation to its sales volume. The calculation involves dividing the net profit by the net sales. The Return on Sales (ROS) statistic is frequently employed by investors and management as a means to assess the financial performance of a company and make comparisons across many organizations. Both Return on Sales (ROS) and Return on Equity (ROE) are significant financial performance indicators that offer vital insights into the returns and performance of an investment or a firm. However, they are computed using distinct inputs, resulting in differing viewpoints on performance. The concept of Return on Sales (ROS) primarily emphasizes the overall profitability of a company's operations, whereas Return on ownership (ROE) specifically measures the profitability created per unit of shareholder ownership. The results of the unit root tests conducted on the different tests for ROS suggest that no unit root is present in the series, indicating that the series is stationary.

The outcomes of the Panel Unit Root Test indicate that the "SIZE" series does not provide sufficient evidence to reject the null hypothesis of a unit root process. This observation implies that the series exhibits non-stationarity and lacks conclusive evidence of mean reversion or trend-stationarity. The test results also demonstrate the robustness of this conclusion when subjected to various types of testing and when considering both a common unit root process and an individual unit root process as assumptions. In the field of finance, the term "SIZE" often denotes the aggregate quantity of assets that a firm possesses, serving as an indicator of its overall worth. A non-stationary series pertaining to size may suggest that the size of firms within the sample exhibits temporal fluctuations lacking a discernible long-term trend or pattern.

The results of the panel unit root test indicate that the time series of the dependent variable "LEVERAGE" exhibits characteristics consistent with stationarity. The findings of the Levin, Lin, and Chu t* test and the Im, Pesaran, and Shin W-stat test both suggest that the null hypothesis of a unit root may be rejected with a significance level of 5%. Put simply, the data pertaining to "LEVERAGE" does not exhibit a unit root, indicating that it is stable and lacks a trending element.

Nevertheless, the outcomes of the ADF - Fisher Chi-square test and the PP - Fisher Chi-square test present less definitive findings. At a significance level of 5%, the results suggest a 6.23% and 67.80% probability, respectively, that the null hypothesis, which posits the presence of a unit root, cannot be refuted. Put otherwise, it is somewhat more probable that the "LEVERAGE" series lacks stationarity and has a component that exhibits a trend.

It is important to take into account many tests in order to ascertain the stationarity of a time series, as different tests may provide disparate outcomes. In this particular instance, the outcomes of the Levin, Lin & Chu t* test, the Im, Pesaran, and

Shin W-stat test, and the ADF - Fisher Chi-square test all indicate that the "LEVERAGE" series exhibits stationarity. However, the findings of the PP - Fisher Chi-square test present a conflicting perspective, suggesting the possibility of non-stationarity. The study's conclusion suggests that the variable exhibits stationarity at the level, given the substantial value seen in most of the series.

The findings of the panel unit root test indicate that the "GROWTH" series has potential stationarity. The aforementioned conclusion is derived from the statistical significance of the p-values obtained from the Levin, Lin & Chu t* test and the PP - Fisher Chi-square test. The p-values of 0.0006, 0.0159, 0.0094, and 0.0000, respectively, suggest that the null hypothesis of a unit root, which implies non-stationarity, may be rejected at commonly accepted levels of significance, such as 5% or 1%.

The following findings present the outcomes of four distinct panel unit root tests conducted on the panel dataset pertaining to the series denoted as "EU". The null hypothesis for each test is that the series has a unit root and is not stationarity. The alternative idea is that the series is stationary, meaning it has no unit root.

The four tests are:

1. Levin, Lin, and Chu t* test
2. Im, Pesaran, and Shin W-statistic test
3. Augmented Dickey-Fuller (ADF) Fisher Chi-square test
4. Phillips-Perron (PP) Fisher Chi-square test

Every exam produces a statistical measure and probability. If the probability falls below 0.05, reject the null hypothesis and conclude stationarity. All four tests show a probability substantially lower than 0.05. Thus, we may reject the null hypothesis and conclude that "EU" is stationary.

The overall data show that most p-values fall below the significance threshold of 0.05 for all metrics. This implies that the alternative hypothesis, which supports stationarity, may be accepted above the null hypothesis, which proposes a unit root. This suggests that panel data modeling is appropriate since the series have stationarity.

This research used the Levin, Lin, and Chu t* test, Im, Pesaran, and Shin W-stat test, ADF-Fisher Chi-square test, and PP-Fisher Chi-square test. The asymptotic chi-square distribution and normality are used to calculate p-values. Panel unit root tests are statistical methods used to detect unit roots in panel data. Unit roots occur when a time series variable is not stationary, complicating statistical analysis.

The panel least square test, fixed effects model, and random effects model focus on independent-dependent relationships in panel data. Their use is to estimate regression model variables and determine statistical significance.

In contrast, the panel unit root test evaluates time series stationarity in a panel dataset. Unit roots may cause erroneous regression results; therefore panel data regression analysis must account for them.

To summarize, the aforementioned test primarily concentrates on estimating and examining the effects between variables in panel data. On the other hand, panel unit root tests evaluate time series data stationarity in panel datasets.

4.4 Likelihood Ratio and Hausman Test

Pooled ordinary least square model assume that coefficients remain same across all the sections of the data rather fixed effect model allows to change in the value of the coefficients throughout the sections.

Selection of the model between these two totally depends upon on the nature of the data. If the all the sectors selected in a sample are same then there is less variation and if the firms in the sample are different in many parameters, then there is a greater variation in the data set is possible.

Fixed models are often employed to capture the impacts of time-invariant variables, whereas pooled ordinary least squares is utilized when the objective is to capture the influence of time-varying factors. The Hausman model is employed to examine the individual-specific effects. The utilization of a fixed effect model would be acceptable in situations when individual-specific effects are present.

The likelihood ratio test distinguishes pooled ordinary least squares and fixed models. The findings indicate that the fixed effect model is suitable, as evidenced by the substantial probability values of the chi-square and cross section F tests. The likelihood ratio test was employed to assess the appropriateness of the fixed model for each dependent variable individually.

The results indicated that the selected forms in the sample retain certain individual effects. The findings pertaining to the distinction between the two models are presented in table 4.4, only employing the dependent variable of return on assets (ROA). The study has also obtained substantial findings when utilizing other proxies.

Table 4.4: Likelihood ratio test

Effects Test	**Statistic**	**d.f.**	**Prob.**
Cross-section F	2.203784	(304,2087)	0.0000
Cross-section Chi-square	667.040496	304	0.0000

The Hausman test is employed in panel data analysis to distinguish between fixed and random effects models. The basic assumption behind the Hausman test is to analyze that whether estimated coefficients in two methods are same or not. To check the relationship behind this assumption, the following hypothesis is tested.

H_0: *Random effects model is appropriate*

H_1: *Fixed effects model is appropriate*

If the test statistic surpasses the crucial value at the requisite level of significance, reject the null hypothesis and conclude that the fixed and random effects model coefficients vary significantly. The fixed effects model is best in this case because it produces more accurate and reliable estimates.

The test statistic must be greater than the critical value to reject the null hypothesis and conclude that the coefficients from the two models are not significantly different. Considering the superior precision of estimates provided by the random effects model in this particular scenario, the selection of this model is preferred.

Table 4.5: Hausman test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section F	2.203784	(304,2087)	0.0000
Cross-section random	14.328622	4	0.0063

The outcomes of the Hausman test are presented in Table 4.5. The results clearly demonstrate that the chi-square value is statistically significant, indicating that the fixed effect model is suitable and the null hypothesis should be rejected. The identical test was employed for all other dependent variables, yielding statistically significant results. Nevertheless, the findings of Return on Assets (ROA) are only documented in this research.

4.5 Impact of Energy Use on Firm Financial Performance

The fundamental objective of this research is to analyze how business energy use impacts profitability. In order to complete the study's aims and test its assumptions, researchers used panel data covering the years 2006-2021. Three distinct panel data methodologies have been employed to ascertain the necessary outcomes. Based on the Hausman test, it has been determined that the fixed effects model is suitable for analysis. The outcomes of the fixed effects model have been obtained and documented in table 4.6.

The focal point of investigation in this research is the variable of energy use. The term in question is drawn from the macro-level notion of energy intensity. Energy intensity is a metric employed to assess the efficiency of an economy in generating GDP by reducing its energy consumption costs. At the macro level, the energy intensity may be defined as the ratio of energy use to gross domestic product (GDP). A higher value of the ratio indicates a greater cost associated with the conversion of energy into GDP, hence referred to as high energy intensity. A reduction in energy intensity would result in a corresponding decrease in the energy to GDP ratio. A lower ratio is seen preferred due to the positive correlation between reduced spending on energy use and increased efficiency in the production of goods and services. The study employed the variable "energy used" and obtained the data from the World Bank data site. This study used the proxy of energy usage, specifically measured in kilograms of oil equivalent per capita, to assess the energy consumption.

By following the same idea at micro level or at firm level Fan et al. (2017) used the ratio of total value of energy consumed by a firm to the operating revenue. The ratio is used to measure the energy use at firm level. Lower the value for the firm is an indication of the efficiency of the firm in producing goods by spending lesser amount in the form of energy. It is also expected that the ratio would have the negative relationship with the firm performance.

These discussions are also a good for investors that the company that efficient is viable for investment. A firm having a larger use of energy is more attractive for an investor as compare to the lesser one. It is also the case of other stakeholders which are interested to evaluate the energy use value before entering in any loan related activity. For increasing the value of the variable used, firm may seek to opt those methods of production which are environment friendly and would save the energy in long run.

Over the years the trend of the industries is changing and the voice of sustainability is raising. Now a days firms in all over the world are focusing that how to reduce the pollution and how to save the future of generations. So, as a result they are focused to reduce the size of the pollution and to change the methods of the production by focusing other sources of energy which are less costly and pollution free.

Bunse et al. (2011) have reported that not only the investors remain interested in investing the opportunities in those firms which are focusing on sustainability rather the consumers are also the party which is also remain interested to consume the product of those firms which are qualifying and adopting the qualities of the sustainability. Consumers always have the tendency towards those firms which are adopting these practices.

The preceding discourse pertains to the varying perspectives of scholars on the use of energy at both micro and macro levels, and its repercussions on firms and the overall economy. This discourse encompasses a broad overview and analysis of energy utilization and production trends inside firms. The present study aimed to investigate the correlation between energy use and company performance. The fixed effects model is employed in order to accomplish this purpose. The outcomes of the fixed effects model are displayed in the subsequent table.

Table 4.6: Impact of Energy use on Firm Performance

	ROA	**ROE**	**ROS**
Variable			
C	0.222477	3.594867***	-0.046052
	(0.622697)	(0.705516)	(0.157350)
LEVERAGE	0.362909	0.343074	0.398552***
	(0.283290)	(0.318756)	(0.153656)
SIZE	-0.003502	-0.105633***	0.002752***
	(0.023688)	(0.026922)	(0.010539)
GROWTH	0.060576***	0.054650***	0.076471***
	(0.018075)	(0.020429)	(0.013427)
EU	0.000371	0.004485***	0.936324**
	(0.000796)	(0.000900)	(0.432254)
R-square	0.248047	0.391927	0.548554
Adj. R-square	0.078630	0.245788	0.446280
S.E. of regression	0.230354	0.252774	0.123109
F-statistic Prob.	21.44309	2.681875	5.363551
	(0.000000)	(0.00000)	(0.00000)

Notes: The first line numbers are coefficients and the second numbers in parentheses are standard errors. The asteleverages ***, **, and * indicate 1%, 5%, and 10% of significance levels, respectively.

The value of energy use remains significant in two of the proxies of firm performance, these are return on equity (ROE) and returns on sales (ROS). The results with the third proxy of firm performance i.e; return of assets (ROA) remain insignificant. Another proxy of firm performance also used in the analysis, but the results found insignificant. The results remained insignificant in case of return on investment and have not been reported in the study. Fan, Pan, Liu and Zhou (2017) have also found insignificant results with other proxies of the firm performance which are based upon the data of the market price like Tobin' Q.

In the twenty-first century, economic activity has increased throughout time. This increase could result in higher energy demand in both developed and developing countries. Energy is essential for the creation of goods and services, which makes it equally important for a business's operation and growth. Energy is an essential element of business success because it must be provided and used for every company in order to generate goods and services.

The proliferation of environmental hazards can be attributed to the heightened demands placed on energy production. Given that the production of nearly all goods and services is reliant on energy, it is inevitable that enterprises in developing nations would progressively want a greater energy supply in order to satisfy their expanding demands. According to the Energy Information Administration (EIA), there is an anticipated increase of 56% in global energy use from 2010 to 2040. China, India, Canada, Russia, Germany, Japan, South Korea, Brazil, and France are identified as the leading global energy users, with subsequent mention of the United States, China, and India. The yearly growth in energy consumption in prominent Asian countries, such as India and China, is projected to surpass 3%, contributing to almost 40% of the overall increase in global energy demand. Simultaneously, substantial increments in energy consumption may potentially impede the economic prosperity of enterprises inside these nations.

By examining the intersection of economic expansion, we can observe and analyze patterns of energy use and demand. It results in many transformations inside a nation. For example, countries with robust and well-established systems see lower borrowing costs, leading to enhanced accessibility to financial resources and heightened transparency for both borrowers and creditors. Economic growth is associated with the expansion of industries, the development of new infrastructure, and the heightened need for energy consumption. Furthermore, as the financial sectors expand, there is an increase in asset allocation diversity. The existence of the wealth effect presents a potential avenue for fostering trust among consumers and companies. In certain countries characterized by limited financial resources, the implementation of effective administration and efficient resource use has been seen to result in increased productivity despite resource constraints. Financial growth has a crucial role in facilitating industrial expansion and facilitating the construction of new infrastructure facilities, hence exerting a positive influence on energy consumption. Hence, the establishment and effective governance of a robust financial sector play a crucial role in allocating adequate financial resources to the energy industry and ensuring equilibrium between energy supply and demand.

The relationship between financial progress and energy usage was theoretically discussed by several schools of thought. The first is connected to the inverse relationship between energy usage and financial progress. Additionally, granting debts, credits, or loans more readily would raise investor confidence, which would increase energy demand. Additionally, the potential for consumers to utilize greater financial resources is created by the reduced debt rate. According to a theoretical analysis, there are two opposing effects of financial growth on energy use that may be challenging to pinpoint. Nevertheless, it is worth noting that empirical investigations employing diverse methodology, samples, or countries have been selected, and their findings exhibit substantial disparities, hence indicating variations in the effects of financial advancement and energy use across different nations. The empirical research presented in this context offer robust evidence that supports the viewpoints put forward by the theoretical investigations. The findings of this study are consistent with the research conducted by Ahmed, Raies, Farooq, and Subhani (2022), Ahmed, Rehman, Zuhaira, and Nisar (2022), Farooq, Ahmed, and Shahbaz (2021), Wen, Farooq, Tabash, Ghaleb, Ahmed, and Subhani (2021), Clarkson, Li, Richardson, and Vasvari (2011), Coban and Topcu (2013), and Farooq, Ahmed, Tabash, Anagreh, and Subhani (2021).

The measurement of LEVERAGE is often expressed as the debt to asset ratio, which provides insight into a firm's financing behavior and how it chooses to fund its assets through debt financing. The study's findings indicate a positive correlation between the variable under investigation and both return on assets (ROA) and return on equity (ROE). Additionally, a positive and statistically significant association was seen between the variable and return on sales (ROS). The analysis also considers the expansion of the business, revealing a positive and statistically significant coefficient. This suggests that as the firm's sales expand, there is a corresponding increase in profitability. The findings validate the existence of this correlation across all other proxy variables. The measurement of growth of a corporation is typically quantified by evaluating its sales performance. This is achieved by calculating the difference between the sales of the current time period and the sales of the previous time period, and then dividing this difference by the sales of the previous time period. The findings of the study demonstrate a clear relationship between sales growth and company success, suggesting that non-financial enterprises in Pakistan are generally achieving favorable outcomes in terms of their output sales. The findings suggest that a one percent increase in firm sales, on average, is associated with a six percent rise in firm performance.

Size of the firm variable is based on the data of total assets which are the signal of having enough resource to grow in future. As the asset size of the firms increases it is the signal for the firm to grow in terms of its profitability. Results for this proxy are mixed as the study found positive and negative results with different proxies. As, firm size is negatively significant with ROE and positive significant with ROS. Based on the findings presented, it is apparent that an escalation in the valuation of fixed assets would result in a rise in returns on sales, while concurrently leading to a decline in return on equity.

The value of R-square and adjusted R-square is enough high to explain the model. R square in different regressions with different proxies remain satisfactory as the value in one of the models (ROS) showing that the variables used in the model are explaining the firm performance almost 54 percent. In other models the variation captured by the model are 39 and 25 percent. Standard error of the regression is also very low. Probability value of the F-statistics is significant in all three models. Overall variables in each regression are also jointly significant as the F-statistics is significant.

Chapter 5

Conclusion

The analysis starts by focusing on the primary purpose of incorporating energy sources in order to improve the firm's performance in terms of its financial viability. Energy usage is quantified by the notion of energy intensity, which serves as a metric for assessing the efficiency with which an economy obtains its output by utilizing various energy sources. The study's overarching goal was to expand this concept to non-financial companies trading on the Pakistan Stock Exchange. Over a fourteen-year period, information from 316 non-financial listed firms was gathered. This research used panel data techniques to look at how energy use affects productivity in businesses. The data collection organizations were very different from one another, hence the Hausman test suggested using a fixed effects model. Using a fixed effects model, this research finds that higher energy usage is associated with worse corporate performance. These findings are consistent with previous study, which indicated that businesses that actively pursue energy exploration tend to see improvements in company performance. The rise in energy consumption indicates that the company is adopting a mode of energy use that has the potential to attract investors and other stakeholders. In summary, the findings of this research offer significant insights into the influence of energy use on the financial outcomes of non-financial corporations in Pakistan.

Various indicators of corporate financial performance have been employed to accurately assess the profitability of the organization. Various proxies for company performance have been documented in the existing literature. However, this particular study focused solely on three proxies, namely return on assets, return on equity, and return on sales. The proxies utilized in this analysis are derived from the information presented in the financial statements. Additionally, there exist other indicators that can serve as proxies for assessing corporate financial success. The utilization of these specific proxies is justified due to the reliance of other proxies on market data calculations. Since the research did not gather any data pertaining to the stock prices of the company, these proxies have been excluded from the available options.

The research utilized the dataset of non-financial enterprises in Pakistan. The economy of Pakistan is classified as a developing economy, as it endeavors to secure its position among the global economies. The study's findings strongly indicate that enterprises employing environmentally friendly production practices have the potential to attract additional stakeholders. Pakistani companies are likewise endeavoring to embrace this phenomena. Given that energy-related concerns constitute a significant challenge within Pakistan's industrial sector, efforts are being made to transition towards alternative energy sources that are more efficient in terms of energy consumption and have lower pollution emissions. The findings validate the notion that larger and more successful organizations, as shown by their sales growth and size, are actively pursuing the implementation of these strategies in order to improve their overall performance. Larger corporations consistently demonstrate the ability to achieve high performance levels through the utilization of a greater array of energy resources.

5.1 Limitations of the Study

Although this study provides valuable insights, it is important to acknowledge its inherent limitations, which should be addressed in future research endeavors. Pakistan's voluntary approach of disclosing corporate social responsibility (CSR) and sustainable development information leads to a limited sample size and an insufficient dataset on energy practices. This work makes a valuable contribution to the existing literature by examining the relationship between energy usage and financial success at the business level in Pakistan. However, it is important to acknowledge that the findings of this study are subject to several limitations, including the small sample size and the absence of a comprehensive dataset. Another issue pertains to the inclusion of dynamic panel effects in the data analysis. The application of the Generalized Method of Moments (GMM) is appropriate subsequent to the examination of endogeneity outcomes. The study aimed to prioritize the examination of major enterprises due to their provision of comprehensive energy consumption data in the financial statement notes. However, it is important to emphasize that this may not hold true for small firms.

5.2 Future Directions

The examination of the relationship between carbon efficiency and financial performance at the organizational level is of significant importance, given the increasing global emphasis on carbon emission reduction and the diverse energy sources employed by various organizations. The research may consider additional elements that might potentially impact organizations' performance. The methodology employed for data evaluation may be modified in accordance with the specific requirements of the sample and data gathered. It is advisable to examine the correlation between energy intensity at a macroscopic level, and by extending the temporal scope of study, more refined outcomes could potentially achieve.

5.3 Policy Recommendations

The analysis of the data reveals a clear correlation between energy use and company performance. The use of high levels of energy, or energy intensity, serves as an indicator for shareholders, stakeholders, and regulatory authorities that the organization is proficient in its production processes, resulting in reduced pollution emissions. Given the evolving customer behavior that places greater emphasis on energy efficiency, it is advisable for manufacturing enterprises to consider incorporating renewable energy sources into their production processes. It is recommended to the investors that may find the value of energy intensity of the firm as it translates into the better performance of the firms. Regulatory authorities can also find the values to look at the method of energy consumption and process of production of the firm's overtime. From time to time the regulatory bodies may inform to the production units to change the method of energy resource so that they can get the better ranking as well.

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