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THE IMPACT OF ENERGY CONSUMPTION ON FINANCIAL DEVELOPMENT IN JAPAN

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**NEAR EAST UNIVERSITY**

**INSTITUTE OF GRADUATE STUDIES**

**DEPARTMENT OF BUSINESS ADMINISTRATION**

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**Msc. THESIS**

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**February, 2024**

## Approval

We certify that we have read the thesis submitted by Joshua Kisungu Kipulu titled **"The impact of energy consumption on financial development in Japan"** and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Business Administration.

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## Declaration

I hereby declare that all information, documents, analysis and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

Joshua KIPULU

07/02/2024

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**Joshua KISUNGU KIPULU**

## Abstract

### The Impact of Energy Consumption on Financial Development in Japan

**KIPULU KISUNGU, Joshua**

**Msc., Department of Business Administration**

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The aim of this study is to examine the impact of energy consumption on financial development in the economy of a developed nation, specifically Japan. This study used secondary data as a scope of analysis. The data was extracted from World Bank Open Data. The relationship between energy consumption and financial development was focused from the perspective of three sub-variables i.e., renewable energy consumption, fossil fuel consumption, and energy use by using data from the year range between 2000 to 2020 (20-year period). The selected sample included data specifically from the financial sector in Japan.

Eviews 13 was used to analyse the data from the selected time period. The results of this study revealed that all the researcher's hypotheses were tested and found to be correct. According to the statistical findings, energy consumption had a significant positive effect on financial development, particularly in the case of Japan. Specifically, all three sub-variables i.e., renewable energy consumption, fossil fuel consumption, and energy use had significant effect on financial development in Japan. The results suggest that energy consumption has improved the performance and profitability of Japan's financial sector over the period between 2000 and 2020.



***Keywords***: Energy Use Consumption, Financial Development, Renewable Energy Consumption, Fossil Fuel Consumption

## Abstract

### Japonyada Enerji Tüketiminin Finansal Gelişmişlik Üzerindeki Etkisi

**Kipulu Kisungu, Joshua**
**Yüksek Lisans, İşletme Bölümü**

**Şubat 2024, 75 sayfa**

Bu çalışmanın amacı gelişmiş bir ülkenin, özellikle Japonya'nın ekonomisinde enerji tüketiminin finansal kalkınma üzerindeki etkisini incelemektir. Bu çalışmada analiz kapsamı olarak ikincil veriler kullanılmıştır. Veriler Dünya Bankası Açık Verilerinden alınmıştır. Enerji tüketimi ile finansal gelişme arasındaki ilişki, 2000-2020 yılları arasındaki (20 yıllık dönem) veriler kullanılarak yenilenebilir enerji tüketimi, fosil yakıt tüketimi ve enerji kullanımı olmak üzere üç alt değişken perspektifinden odaklanılmıştır. Seçilen örnek, özellikle Japonya'daki finans sektöründen verileri içeriyordu.

Seçilen zaman dilimindeki verileri analiz etmek için Eviews 13 kullanıldı. Bu çalışmanın sonuçları, araştırmacının hipotezlerinin tamamının test edildiğini ve doğru olduğunu ortaya koymuştur. İstatistiksel bulgulara göre, özellikle Japonya örneğinde enerji tüketiminin finansal gelişme üzerinde önemli derecede olumlu etkisi oldu. Spesifik olarak, yenilenebilir enerji tüketimi, fosil yakıt tüketimi ve enerji kullanımı gibi üç alt değişkenin tümü Japonya'daki finansal kalkınma üzerinde önemli etkiye sahipti. Sonuçlar, enerji tüketiminin 2000 ile 2020 arasındaki dönemde Japonya'nın finans sektörünün performansını ve karlılığını iyileştirdiğini gösteriyor.



**Anahtar Kelimeler**: Enerji Kullanımı Tüketimi, Finansal Kalkınma, Yenilenebilir Enerji, Fosil Yakıt Tüketimi

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## List of Abbreviations

| | | |
|---|---|---|
| **NREL** | **:** | National Renewable Energy Laboratory |
| **WB** | **:** | Word Bank |
| **CEA** | **:** | French Atomic Energy and Alternative Energies Commission |
| **EMS** | **:** | Energy Management System |
| **DOE** | **:** | The U.S. Department of Energy |
| **EESI** | **:** | Environmental and Energy Study Institute |
| **IFC** | **:** | International Finance Corporation |
| **IEA** | **:** | International Energy Agency |
| **FFC** | **:** | Fossil Fuel Consomption |
| **REC** | : | Renewable Energy Consumption |
| **STTV** | : | Stocks Traded Total Value |
| **U.S** | : | United States |
| **U.K** | : | United Kingdom |
| **GDP** | : | Gross Domestic Product |
| **EU** | : | Energy Use |
| **FDI** | : | Foreign Direct Investisment |
| **NEU** | : | Near East University |
| **ADF** | : | Augmented Dukey Fuller |
| **C02** | : | Carbon Dioxide |

# CHAPTER I
## Introduction

Industrialized countries are dependent on energy consumption, both operationally and financially. It is essential to analyse the impact that energy consumption can bring on financial development in developed or industrialized countries, in a context where sustainability and financial development are increasingly important.

Energy, like water and food, is essential to life and to the financial and economic development of nations. The concept of "energy" is very broad, touching many areas of life, and what interests us is to understand it as a system, substance or body capable of producing work or heat, in order to put into action a device, a motor, etc. Energy has had a major influence on the way we live. Kumar, M. (2020). The economy, society, and environment are all impacted by the expansion of energy usage. Increased consumer choice in health, technological breakthroughs (including the first industrial revolution), and job possibilities are some of the societal advantages brought by energy. Nonetheless, a few basic elements are considered for the good of humanity, including the climate, living standards, level of education, and the area rural or urban from an agricultural aspect.

Energy has greatly influenced the evolution of mankind, and its discovery has changed the world, notably with electricity, technology. However, the evolution of energy sources has meant that man's need for energy remains growing and insatiable, just as it was for the original energy sources. Today, the global economy is undergoing a transformation from a capitalist to an ecological production model. A corporation or any other sector of the national economy might adopt a system for managing energy as a collection of procedures and practices to foster a culture of ongoing energy performance improvement. Thanks to a suite of quantitative tools that monitor energy consumption patterns, guide decision-making, and assist in putting energy-saving policies into action, businesses that have a system for managing their energy will be able to save energy and money (DOE, 2022). Because of its high cost and environmental impact, energy management has become a major concern for industrialized countries. Policies and regulations have been adopted by governments and international organizations to encourage the reduction of energy consumption and the transition to more sustainable energy sources. In this

regard, nations have an obligation to decrease their carbon footprint and raise energy efficiency in order to advance financially. According to the Japanese Ministry of Economy, Japan's energy policy is based on four pillars: safety, energy security, environment and economic efficiency. This policy translates into improvements through technological and governance reforms, the Wider and Better Choice on self-sufficiency through technological means, the Challenge of abandoning fossil fuels, as well as the improvement of industrial competitiveness. METI (2023) in Japan the government has set the following targets for 2030: a reliable energy mix and a 26% reduction in greenhouse gases. In order to achieve these targets, the Japanese government has put in place the following measures: increase energy consumption from renewable sources to 24%, up from 10% before Fukushima. The government has also resolved to reduce reliance on nuclear power by 25% by 2030, from around 22% before 211. There is also the reduction of fossil fuel power generation by 56% by 2030, from 65% before 2011. Finally, promoting hydrogen, energy storage and decentralized energy systems were included as well.

Renewable energy consumption is one of the ways in which this new economic thinking is being accompanied by sustainable development and corporate social responsibility and sustainable development. However, implementing energy efficiency measures can entail high initial costs for countries. Energy efficiency means using as little energy as possible to carry out an operation or service. Its mission is to eliminate unnecessary energy consumption. Its advantages involve cheaper prices for households and the economy at large, as well as a decrease in greenhouse gas emissions as well as the need for imported energy. Increasing the efficiency of energy is the least expensive and frequently the most direct means to accomplish these goals, even though renewable energy innovations additionally have a role in them (EESI, 2023). So understanding how these investments affect the financial development of developed countries like Japan is crucial. Poor management of energy consumption can lead to higher production costs, lower competitiveness and a reduction or depreciation of economic and financial indicators. An effective energy policy, on the other hand, can reduce operating expenses, improve financial development performance and enhance the international reputation and image of the country's financial system.

Energy consumption continues to rise in line with the greater needs of both developed and developing countries. This rise is predicted to continue in accordance with projections. The requirement to meet nations' general consumption needs and

keep up with technical advancements will probably result in greater utilization of energy. Even while fossil fuels account for a large amount of energy consumption, the low rates at which renewable energy sources can supply demand has raised questions concerning the future of sustainable energy. This is the trend that research in the fields of energy economics or national energy strategies are heading. Concerns about fixing challenges connected to the effective financial system that nations must develop are rooted in the unpredictability of fossil fuel resources, the reliance of countries on imports, political crises, and the detrimental effects of fossil fuel resources on the environment.

We may already inquire about the true effects of energy consumption, on the financial development of a developed nation such as Japan from this broad perspective. Indeed, developed countries like Japan need to maintain a balance between the energy and financial sectors. In order to effectively manage Japan's energy resources, it is critical to understand the short-, long-, and medium-term effects of energy use on financial development. Finding out if energy use affects Japan's financial development is the goal of this research. More precisely, the impact of energy consumption—both fossil fuel as well as renewable—on financial development was examined.

**Problem statement**

Within the present research, it will be examine how energy use affects financial development in a developed nation that is adopting a sustainable energy strategy.

A key component of rising nations' policies for green growth, sustainable development, and an effective financial system is the use of energy from renewable sources. It's due to the fact that it lessens the harm that their operations do to the environment. Renewable energies, such as solar, wind, hydro and geothermal power, are produced from natural sources that renew themselves rapidly and are considered less polluting than the energy sources that are generally used, e.g coal and oil.

Developed nations may contribute to the fight against climate change and lower greenhouse gas emissions by promoting the use of renewable energy sources. They can also reduce their long-term energy costs and improve their financial development value. The 21st International Climate Change conference (COP21), which took place in the French city of Paris in the year 2015, revealed that

developed and developing countries have put in place initiatives to maximize energy generation capacity by 300 GW by 2030, while addressing the serious issues of traditional energy mitigation and carbon dioxide emission reduction (Can, 2017).

Conversely, Japan's energy policy is based on the values of economic efficiency, sustainability of the environment, safety, and energy security. As a small country with little natural resources, no international pipelines for gas, and no power connections, Japan has significant hurdles with regard to energy security. Depending on imported petroleum products made up 94% of the energy supply in 2014; however, due to the development of nuclear power, the rise in renewable energy sources, and the decline in energy consumption, this percentage has dropped to 88% in 2019. The financial institutions sector's efforts may be compromised by this (IEA, 2020).

It should be noted that a financial system has a dual role in the national economy: on the supply side, it mobilizes and efficiently distributes capital to producers; on the demand side, it guarantees a fair remuneration to suppliers of capital to households, in particular a remuneration that will enable them, at least in part, to consume (Jocelyn, 2016). The Japanese financial system, led mainly by the banks, has failed to play this role, and has been in difficulty since 1995 due to bad debts. As a result, it is rationing credit to companies seeking new loans, which hampers its role as a transmission channel for monetary policy (Flouzat, 2004).

In light of this, it's necessary to determine whether energy consumption actually contributes significantly to Japan's financial development and if there's a positive or negative correlation between financial as well as energy indicators.

**Objective of the study**

The relationship connecting energy consumption and financial development is examined in this research, as well as the ways in which energy policies pertaining to the use of fossil fuels, renewable energy sources, and energy consumption might impact a nation's financial system and promote financial development. The principal goal of this research is to determine the degree to which energy consumption—renewable or non-renewable—affects financial development in a developed nation like Japan, which still relies heavily on non-renewable energy sources. The particular goals are the following: what is Japan's optimal margin for using renewable energy to support the success policy of its financial system? Determine the effect that the use of energy that is not renewable has on financial

development. Find the energy source that Japan needs most to support its financial progress.

**Research questions**

In order to fulfill this study's goal, the following research questions must be answered:

1. Is it there an existence of an essential relation, either negative or positive, between energy usage and financial development?

2. Is there a noteworthy linking, either positive or negative, between the use of renewable energy and financial development?

3. Does the use of fossil fuels and financial development have a substantial positive or negative relationship?

4. Is there a noteworthy correlation, either positive or negative, between energy use and financial development?

**Research hypotheses**

H0: There is not an association between financial development and energy consumption.

**Main Hypothesis:** Energy use and financial development have a strong and significant positive connection.

H1.a) Renewable energy consumption has significant positive effect financial development.

H1.b) Fossil fuel consumption has significant positive effect on financial development.

**Importance of the study**

Nowadays, it's impossible to talk about sustainable development without solving the problems of financial development. Improving energy efficiency has become a major priority for the public and economic players alike (Gharnit et al., 2021).

Experts, world leaders and international organizations are constantly finding solutions to the problem of climate change because of its crucial importance. The use of renewable energies to protect the global ecosystem and promote environmental sustainability is one of the recommendations (Somoye, 2022).

Strategic corporate management has a multi-dimensional mission, encompassing finance, strategy, operations, leadership, customers, social responsibility, risk and different departments of an organisation (Jones, 2020). By focusing on the effect of energy consumption on financial development in Japan this study aims to shed light to the companies in the financial sector i.e., showing the effect of energy consumption, renewable energy and fossil fuel consumption strategies of companies on the company finances reflected to the financial development of a country. This clearly shows the importance of this work for professionals, researchers and students in the field of business administration by guiding companies regarding their strategy selection on the area of energy consumption.

Because at the operational level, good business management also requires a good knowledge of energy management, and every company needs to be more financially viable there is a need for studies focusing on the effect of energy strategies of companies on their performance (Robbins et al., 2019). If the relationship between energy and financial development is established for a company, this will enable a projection of the relationship between energy and a good financial performance which is a relationship that concerns the presence and future of companies in deep.

So, for us, this study is of great importance, because it helps to evaluate two major indicators that are essential to sustainable development. Furthermore, Japan's situation is crucial because, despite its limited resources, Japan continues to occupy a place among the world's largest economies, and it has power in the energy sector. Focusing in the energy strategies of companies located in the financial sector may guide positively future investment by other companies in the sector. Based on this work, any country or institution will be able to draw inspiration for good management of energy resources, in order to achieve sound financial and ecological development.

**Restrictions and limitations**

Ross, & al., (2019). Study limitations are weaknesses in a research design that may affect the results and conclusions of the study. So, as with any scientific work, for the credibility of the results it is important to mention the limitations of this study. These limitations make this work very contextual and specific in terms of the results.

With regard to spatial limitation, the study is based on a single country, Japan. This choice is explained by the characteristics of its economy, its energy requirements and the fact that Japan is one of the world's major economic powers. From a temporary point of view, the study covers the period from 2000 to 2020. The accessibility of data for the two variables, considering the usage of secondary data, explains this period of research.

The study can be carried out using several financial indicators, and the results will also vary according to the indicators chosen. But in this study, based on the literature review, the author has chosen three energy sub-variables: energy use, fossil fuel consumption and renewable energy. For financial development, the author has chosen the variable Stocks traded total value. So it won't always be easy to satisfy everyone's expectations, since not all indicators will be taken into account in this study. Future researchers may study the same subject for other countries or other variables.

**Definition of terms**

*Key terms:* energy consumption, renewable energy consumption, fossil consumption, energy use, financial development.

***Energy***

The word "energy" comes from the Greek "énergéia", meaning "force in action". This scientific idea originated with Aristotle and has evolved considerably over time. Today, the definition of energy is considered to be the capacity to perform transformations. In other words, energy is what enables a body to produce movement, modify temperature or change the state of matter. Every human action requires energy, whether it's moving around, cooking, making things or even surviving. The main forms of energy are: Muscular energy, which moves the muscles. Thermal energy, to generate heat; Electrical energy or electricity, which circulates particles - electrons - in electrical wires; Mechanical energy, which moves objects; Chemical energy, which binds atoms into molecules; Radiation or light energy, which generates light; (CEA, 2017).

*Energy consumption*

The total quantity of final energy consumed by an economic entity, whether it be a country, is what determines its energy consumption. The entire sum of energy

utilised by a given period, reflects the general situation of energy consumed by different industries and local residents in a certain region (Palme, M. 2017). There are two sources of energy, renewable and non-renewable.

According to Selin (2015), renewable energies, usually referred to as "alternative energies," are useable forms of energy derived from renewable sources, including the sun, wind, rivers, hot springs, tides, and biomass (biofuels).

Energy that is not renewable is created when fossil fuels like coal, natural gas, petroleum, and uranium are burned. However, as for non-renewable energies, they require very significant human intervention to be consumed. Fossil fuels consist mainly of carbon. It is believed that fossil fuels originated more than 300 million years ago, during a time when the Earth's terrain was significantly altered.

Fossil fuel and nuclear power are the two primary forms of energy that are not renewable.

**Fossil fuel**

Energy resources known as fossil fuels are obtained from the remains of modified living organisms that have spent several million centuries under extreme conditions of pressure and heat, buried in sediments. They have been classified as non-renewable due to the lengthy production process. (Gerali and Francesco, 2020).

Snehal and Pratibha (2019) Fossil fuels cannot be renewed since their consumption is exceeding the rate at which new reserves are being created. An additional disadvantage of growing reliance on petroleum and coal is the approximately 21.3 billion tonnes of carbon dioxide released annually during burning (İlhami, 2018). Global primary energy consumption has always been dominated by fossil fuels.

Atoms may generate energy from nuclear reactions by splitting their nuclei within fewer parts. A significant amount of energy is produced when plutonium 239 and uranium 235 fission. The power released by burning three metric tons of coals is equivalent to the explosion of a single gram of uranium 235. Uranium or plutonium fission can be used to generate electrical power, propel spacecraft and fuel weapons such as the atomic bomb (Lana & al., 2014).

According to Martina Igini and Global (2023). The debate on whether to continue using nuclear power or look for other alternatives will certainly continue to be debated in the years to come, as there are a multitude of advantages and

disadvantages associated with this technology. Despite the fact that nuclear power is a very destructive weapon, there is little chance of a nuclear accident. The many nuclear disasters in history can be counted on our fingers, as they have all had devastating impact and deadly consequences.

### *Development*

Development is a concept used in many fields. Above all, it is a process that leads to disproportionate system growth. In economics, development can be defined as a multi-faceted process that produces economic, technological, social and institutional changes aimed at promoting national prosperity and the general well-being of individuals in a society (Coccia and Mario, 2019).

### *Type of development*

#### Economic Development

To improve the quality of life, earnings, job opportunities, and productivity of work, economic development often refers to the fundamental change of a country's economy using the implementation of more sophisticated and industrialized technologies. To facilitate the transition of the economy, economic development must be accompanied by improvements in institutional, social and political factors as well as infrastructure (Myint and Krueger, 2016).

#### Financial development

The expansion of financial markets' dimensions, effectiveness, and durability along with their accessibility are all considered aspects of financial system development, which can be very advantageous for the economy. And can be defined as financial development. A strong financial market, for instance, helps a country allocate savings toward successful investments, lowers information costs that allow for better capital allocation, (Greenwood and Jovanovic, 1990) and lowers corporate governance expenses (Yadav and Guru, 2019). A financial system has five main functions: (i) to provide exante data on potential investments and capital allocation; (ii) to supervise investments and maintain corporate governance after financing has been granted; (iii) to facilitate negotiation, diversification portfolio, and risk management; (iv) mobilization and pooling of savings; and (v) support of the World Bank (WB).

Sustainable development is a development which consists of finding solutions to currents necessities while not hampering the capacity of generations yet to come to meet their own requirements. The aim of sustainable development, is to provide a resilient, inclusive and sustainable future for people and the environment.

To promote sustainable development, three essential components—economic expansion, societal integration, and ecological preservation—must be harmonized. All of these interdependent elements are essential to people's and societies' well-being (UN, 2018).

Financial viability is the ability of a business to produce the cash flow required to pay off debt and cover present operational costs. Also its ability to meet customer expectations while maintaining growth at the desired pace is also to its advantage. The ability of a company, project or entity to maintain profitable operations over the long term by generating sufficient revenues to cover costs, repay debts, invest in future development and provide an adequate return to stakeholders is known as financial viability. It is an important measure for assessing a company's financial health and sustainability. There are a variety of financial indicators and measures that can be used to assess financial viability, including profitability ratio, debt ratio, profit margin, interest coverage ratio and liquidity ratio, among others. These measures assess an entity's ability to generate regular income, manage its debts and maintain a solid financial position.

The financial system is often defined as the set of markets and intermediaries (financial and non-financial) that households, economic operators and governments use to effectively manage their financial decisions. It includes banks, insurance companies and markets for stocks, bonds and other financial securities. Funds are transferred within the financial system from entities with surplus funds to those with deficits, often via a financial intermediary (Allen, & al, 2016).

Neave, (2009) Economies worldwide offer a wide range of financial systems, the development of which seems to be influenced both by the historical context of the economies and by institutional and legal frameworks. Markets and institutions are the common elements of financial systems, but the way in which these elements are combined varies considerably from country to country. The USA and the UK have examples of systems that are predominantly market-based, while Japan, France and Germany have examples of systems that are predominantly intermediation-based.

The financial markets facilitate the transfer of funds from investors (or units of service) to debtors (or units of service) by expediting the creation and negotiation of financial instruments (titles). This makes it possible to direct funds to UADs that can use them most effectively, as evidenced by the promise to pay returns that are appropriate for the highest levels of risk. Furthermore, the financial markets provide liquidity, allowing service and administrative units to quickly and affordably adjust their portfolios even before a title reaches maturity (George, 2009).

# CHAPTER II

## Literature Review

### Theory of Energy Consumption

The world around us is shifting and it's happening very quickly. The deep and enduring ecological catastrophes we are currently experiencing can be attributed to human activity, particularly to our dominance over the planet's ecosystems since the Industrial Revolution. Since the end of the eighteenth century, there has been a rapid increase in financial and economic progress. This development has accelerated since 1950, and starting in the early 1990s, it has become more globalized. These developments have provided unprecedented wealth to humanity while also putting the planet's ecosystems in unprecedented danger (Eloi, 2015). Energy demand in developing nations is increasing quickly, whereas that in developed nations is stabilizing after increasing substantially and is likely to decline slightly due to increased energy efficiency. In fact, the latter want to catch up to industrialized nations economically, and in order to do so, they require energy (Ngô, 2010).

And it should be remembered that many abundant natural resources are, even today, "free of rights", i.e. they are common goods, and can therefore be exploited, without limit, by all those who can access them, and that the costs of their degradation or depletion will also be borne by all, including those who have taken no part in their exploitation, including, of course, future generations: (Eloi, 2015). As far as energy consumption is concerned, it should first be noted that it has grown spectacularly, especially since the beginning of the 20th century, mainly fuelled by fossil energy resources whose prices have remained relatively low: the world consumed around 400 million tonnes of oil equivalent (toe) in 1800; it consumed over 30,000 million in 1990 (McNeill, 2000). Almost all the energy consumed was renewable until the end of the 19th century; energy consumption per person rose, on a global average, from around 20 giga joules per person per year in 1820 to around 80 in 2000, while the world's population multiplied by a factor of around 7. (Eloi, 2015).

Moreover, fossil fuels, especially petroleum, keep monopolizing the primary energy consumption market and will do so for many more decades to come. Nearly 90 percent of the energy consumed by businesses in 2008 came from oil (80% from

non-commercial energy), and nothing has been able to quantitatively or economically replace it yet. Global primary energy consumption increased from approximately 1 Gtoe to approximately 10 Gtoe between the start and end of the 20th century (Christian Ngô, 2010).

Against this backdrop, two factors are set to increase energy demand in the future. These are global population growth and the desire of developing countries to raise their standard of living. Over the next thirty decades, world energy consumption is expected to double, assuming a growth rate of 2.5% to 3.5% annually in energy. The development of nuclear power and renewable energies, which together only make up about 20% of the world's energy consumption, will be necessary to meet these additional needs without significantly increasing the greenhouse impact (Christian, 2010).

An integrated system using renewable energies always gives better results, i.e. more benefits for the system, and each member benefits more from the integrated system than from the decentralized one. (Kar, March 2023). Furthermore, abrupt variations in carbon emissions are a major contributor to the warming of the planet, which either directly or indirectly leads to climate change. With regard to these realities, renewable energy sources have currently become a crucial alternative to replace fossil fuels. When using renewable energies there is no carbon pollution in the environment, this energy source is indeed a trigger for the reduction of carbon emissions. (Serhat Yüksel & al, 2023).

While renewable energies can help reduce European greenhouse gas emissions by 55% by 2050, their impact on the environment is not neutral. Solar photovoltaics and solid biomass are the main energies concerned, according to the latest report from the European Environment Agency (Floréane, 2021). While renewable energies are considered clean in themselves, another problem arises over time: the infrastructures required to use them produce waste. The main problem concerns the batteries used to store energy, which require the use of rare metals (demainlaville.com).

However, it goes without saying that in order to fulfill the European Union's aim of lowering greenhouse gas emissions by 55% by 2050, the generation of energy from renewable sources needs to rise by 70% by 2030. Although using renewable energy sources instead of fossil fuels is better for the environment and human health, there are drawbacks to renewable energy production as well. The most recent assessment from the european environment agency, which is based on

the life cycle analysis and changes in the energy mix since 2005, emphasizes this (Floréane, 2021). Photovoltaic solar power has had the greatest impact. According to the report, this is mainly due to metal emissions from mining and smelting operations, as well as chlorine from the purification of the silicon used to manufacture solar panels. To reduce the impact, the European Environment Agency recommends better recycling of materials at the end of their life cycle to reduce demand for raw materials. It could also be offset by the growing use of renewable energies in manufacturing processes (Floréane, 2021).

**Theory of Financial Development**

The financial sector of an economy is made up of businesses specializing in the acquisition and sale of financial debts. The financial systems of primitive economies are very limited and simple, restricted to unwritten interpersonal claims and rudimentary currency such as beads or metal. The financial structures of contemporary developed nations are incredibly intricate and varied, with millions of different mechanisms and organizations as well as intricate ownership and regulatory patterns for markets and institutions.

Financial development, according to Edward Shaw (1974), is the procedure of financial deepening that occurs when the "stocks of financial assets... increase in relation to income" and their variety of attributes increases. Longer maturities enable a greater variety of debtors to access financial markets.

In contrast to this emphasis on the expansion and diversity of financial instruments, markets, and participants, other authors have highlighted the emergence of modern types of financial institutions, such as central and development banks, securities, and money markets, as harbingers of financial development. Divergent opinions exist about numerous causality and desirability issues, despite the fact that financial tools and institutions tend to be stimulated and diversified by economic progress. What metrics are suitable for evaluating the dimensions, configuration, and evolution of the financial system? What causes the expansion of the financial system? Is economic growth aided by financial development, or is it impeded by a slowing financial sector? Does inflation diminish national savings and impede financial progress? Exists a perfect financial development level and structure? How is optimality determined? Can we have free and competitive financial markets, or are failures and limitations inherent to the market? Does the structure of ownership and control affect the financial system's

effectiveness, ability to promote economic growth, and distribution of income? What is the relationship between ownership and regulatory patterns of the financial sector and the nation's larger political-economic structure? The development literature has been paying more and more attention to these and other significant concerns regarding the organization of financial systems and financial development.

Following years of indifference, several writers have endeavored to create enhanced metrics of financial advancement to ascertain if discrepancies in the dimensions, configuration, and arrangement of the financial system have significance. A number of case studies have been carried out in an effort to provide a detailed account of how financial systems have developed in particular nations and to ascertain what theoretical difficulties these cases illustrate (Salah and al., 2015).

Financial development is influenced by a wide range of elements, many of which have been categorized in various publications. Vohgouei et al. (2011) suggest the following classifications of factors: Various elements such as political economics, financial liberalization, openness policy, legal conventions, and institutions hold significant importance.

According to Bc. Eri Bzhalava (2014), it should be noted that these financial theories represent diverse approaches and perspectives on understanding financial development. Assessing a nation's financial development is a complex process that requires in-depth analysis of the distinct aspects of each country's finance, economy and operations. As such, we will use some of the theories already mentioned above and others for our study, and the list is not exhaustive. Each of them presents captivating analytical perspectives.

**Related Research**

According to many books on energy economics, electricity generation plays an essential role in national productivity growth. Investments are worthless without adequate, sustainable, and efficient energy (Abdulkadir & al., 2016).

Jian Xu (2022), comes to the conclusion in his article that energy consumption has a negative impact on ROE and a positive impact on ROA and ATO. This means that industries with high energy consumption have higher productivity and profitability among listed businesses. The aforementioned study

also discovered that Pakistani businesses had noticeably reduced output and profit during the energy crises.

Salah et al. (2015) came to the conclusion that energy use is statistically significant at the 10% level and positively affects financial development. A 1% rise in energy demand results in a 0.30% increase in financial development. Additionally, the study notes that, at the 5% significance level, the relationship between energy consumption and economic growth is both positive and statistically significant. Lastly, energy consumption contributes to economic growth at a noteworthy rate of 1%. The same concept is put forth by Odhiambo (2010), Ahmed (2017), Ma and Fu (2020), and others: energy consumption raises demand for financial services, which benefits financial development. The growing function of a nation's financial development may also be seen in consumer energy consumption (Bayer et al. 2021). Based on his examination of the potential relationship between finance and energy for Asian nations, Furuoka (2015) verified the results of causality tests in a heterogeneous panel, thereby demonstrating the presence of a unidirectional causal relationship between energy consumption and financial development. Nevertheless, another study that used panel methodology looked at the relationship between energy and finance in sub-Saharan African nations (Aslan et al, 2014).

Consequently, other research indicates that the supply of renewable energy will have a positive impact on economic growth. The nation's economic expansion may also draw interest from overseas investors. In this case, foreign direct investment could increase in the country. Additionally, due of the favorable perception of the nation, portfolio investors will favor purchasing stock in domestic enterprises. Consequently, the use of renewable energies should ensure the country's financial development. In their study, Al-mulali and Sab employed panel causality and cointegration approaches to confirm the effects of energy consumption and carbon dioxide emissions on economic development and financial development in the 19 nations they examined. Their results revealed that due to increasing energy consumption, countries achieve high economic and financial development.

Bayer et al. (2021), their study led to two different conclusions. First off, it is thought that Turkey's financial development is positively impacted by the use of renewable energy sources. This assumption is mostly based on the idea that foreign investors make investments in nations with favorable perceptions of air pollution.

The second finding of the study was that the nation's economic growth is facilitated by the use of renewable energy. In theory, it is possible to increase investment and reduce imports by using renewable energies. As a result, the country's economic growth could be accelerated. If there isn't enough energy available, the country's production capacity will be considerably reduced. Additionally, this issue will discourage investment, which will hinder the growth of the economy of the nation (Mikayilov et al., 2020). Al-mulali and Lee, based on the study carried out, were able to note that financial development through national credits of the banking sector is a very crucial factor which leads to the increase, in energy consumption in the countries of the Council of Europe Gulf Cooperation. According to Alam et al. (2021), there is a noteworthy beneficial impact of financial development indicators on energy consumption. This effect is observed not only in South Asian Association for Regional Cooperation (SAARC) nations, but also in GDP per capita and foreign direct investment. It was also discovered that the relationship between energy consumption and CO2 emissions and financial and economic development indicators is logarithmic. Additionally, the Granger causality test results showed that energy consumption and CO2 emissions had an effect on the financial and economic development of the countries analyzed, based on a positive causal association in both the short and long term. Even while these nations' energy use has aided in their financial and economic growth, CO2 emissions have increased at the same time. However, there is another line of research that comes to different results from the first wave. These writers contend that financial development, not energy use, is the real driver of energy consumption; in fact, some of them even find a bidirectional causal relationship.

For instance, the findings of a Japanese study demonstrated a relationship between economic growth and power consumption as well as financial development, capital, and trade openness. The study revealed that financial growth increases electricity consumption in Japan. Electricity demand increases due to economic growth, while capital decreases. Trade openness, imports, and exports all lead to higher electricity use. The study discovered a feedback relationship between power consumption and financial development in a related field, and the same conclusion holds true for capital and economic growth. Granger also linked trade openness, exports, imports, and economic expansion to Japan's electricity use (Rafindadi et al, 2016).

The study conducted by Şahin (2021) concluded that there is a significant impact of financial development on the consumption of renewable energy in the economies of the developed countries studied, when looking at the two main indicators of financial development: market capitalization and domestic credit to the private sector. In other words, cheaper or more affordable credit and a highly developed capital market could propel the sustainability of renewable energy investments. This study does, however, highlight the fact that deposits—which are essentially an approximation of savings—do not significantly affect the amount of renewable energy used. Additionally, Sahin (2021) discovered that in the developing nations he examined, there was a negative correlation between renewable energy usage and foreign direct investment.

Xu (2023), the association of financial development as a moderator through the channel of good institutional quality and renewable energy will have a negative impact on CO2 emissions in the long term. Danish (2021) found that energy consumption (EC), globalization, economic expansion, and financial development were normally distributed based on descriptive statistics. The correlation matrix's findings demonstrated a substantial positive association between energy consumption and the variables of globalization and economic growth as well as a positive relationship between energy consumption and the financial development indicators.

On the other hand, there is a current that believes that the two variables can influence each other, therefore they have a bidirectional relationship, as mentioned above: In his research, Gharnit (2021) showed that, at various thresholds, there is a bidirectional relationship between GDP and imports of fossil fuels. The paper contends that there is a unidirectional relationship between GDP and the consumption of renewable energy and notes that there is a corresponding unidirectional relationship between the consumption of renewable energy and energy imports. We might deduce that the GDP is indirectly impacted by the use of renewable energy. According to a study conducted in the African region, Furuoka (2015) supports a bidirectional causal relationship between energy consumption and financial development. It also suggests that financial development directly affects energy consumption and vice versa.

A review of the literature makes it abundantly evident that more renewable energy must be used. The two variables are causally related in both directions. However, research on how energy use affects financial development has not been

done. Many have verified this relationship through the GDP channel, and even fewer have focused on the case of Japan.

Here, using indicators not employed by other writers, our work finds its importance to be explored in order to provide a specific case analysis on the influence of energy consumption on financial development.

## Theoretical Framework

### The Relation between Renewable Energy Consumption and Financial Development

The amount of research examining the connection between financial development and the use of renewable energy sources is constantly increasing due to the significance of the topic and the necessity of sustainability in the economic process. Environmental quality management can benefit greatly from financial development and the use of renewable energy sources (Fu Qiang, et al., 2022). In an article published in June 2023, JeuneAfrique magazine reports an energy deficit in sub-Saharan Africa, and the IEA and IFC propose creating funds to finance renewable energy projects, given the solar potential of this part of the continent. This should stimulate investment in renewable energies, attracting potential investors who see in this sector a potential for stable financial returns (Maher, 2023).

Determining the pattern that leads to the potential relationship between financial development and the use of renewable energy is crucial to establishing the relationship itself. In his study Pradhan et al, (2018) explains that when there is a good allocation of financial resources this will increase the efficiency of savings. Shahbaz and Lean, (2012) underlined that today's new financial models achieve economic development by strengthening the spirit of entrepreneurship and technological innovation. Economic growth that is produced by financial development will always require better (renewable) energy consumption strategies, which can have a direct or indirect impact on the financial development of countries. Following this logic, it's clear that energy consumption will tend to grow with each increase in economic activity through the channel of enhanced financial development.

Renewable energy sources are currently of major importance due to the increased focus on climate change and the promotion of sustainable development. (Mathiesen et al., 2011). To address the issue of global warming due to carbon emissions, the revision of the nature of economic activities and the nature of the source of energy consumption have been of great help, and the consumption of energy from renewable sources has automatically increased.

Renewable energy consumption has important effects on financial development, including reducing costs, stimulating innovation, creating jobs,

reducing risk and increasing investment attractiveness. These benefits can contribute to more sustainable economic growth and greater financial stability for a nation. Dogan et al. (2016) noted in his study that there are two scenarios about the influence of the relationship between the use of renewable energy and financial development. First, he contends that the manufacturing sector is stimulated by financial development. The consumption of fossil fuels and carbon emissions will rise as a result. Second, he makes the case that initiatives involving renewable energy and environmentally friendly growth can be aided by financial development. By doing so, climate change may be lessened (Dogan & Seker, 2016).

Three consequences are identified by Bertaç (2021) in relation to the consumption of renewable energy: direct impact, business impact, and wealth impact. *Direct impact:* because of a positive impact on financial development, economic operators may find it easier to use credit to purchase durable goods. As a result, these economic operators and households will be able to consume more energy.

*Impact on businesses:* financial capital will be more easily accessible to families and economic operators when there is a good impact on financial development. This is because well-developed securities markets are one of the sources of additional financing for economic operators. As a result, companies consume more energy as their business volume increases.

Finally, *the impact on wealth:* an increase in stock market transactions creates wealth and has a positive effect on economic operators' confidence in the market. On the other hand, the economy benefits from this increased confidence in the economic climate, which will raise demand for energy.

**The Relation between Fossil Fuel Energy Consumption and Financial Development**

As mentioned above in the literature review, several authors have demonstrated that it is energy consumption that affects financial development, and some even think the opposite. The relation between fossil fuel energy and financial development involves the implementation of major investment projects for electricity production, given the advantage of this energy source, which is cheaper to invest in, thus creating an economic opportunity (Youmatter, 2023).

Energy consumption, despite its polluting nature, is at the root of the initial growth of many of the world's economies. This initial growth has enabled many

nations to see their financial systems improve, and this has contributed to their development in international trade, given the high level of national production.

**The Relation between Energy Use with Financial Development**

WB (2023) underlined that energy is at the heart of development. It opens doors for capital inflows, creative thinking, and the emergence of new industries that drive inclusive growth, shared wealth, and the creation of jobs.

In his study, Pagano (1993) mentions three scenarios by which financial development can influence economic growth. First, financial intermediaries have the capacity to increase investment productivity and promote growth; collecting data and evaluating competing investment projects; and encouraging people to invest in riskier but more efficient technologies by sharing the risks. Second, he mentions that a successful financial company has the potential to reduce transaction costs, which will encourage the channeling of greater savings into profitable investments. Such a sector can also increase investment liquidity.

Ulusoy & Demiralay (2021) counter that, although stock market evolution can have a significant impact on energy consumption, most prior research has only used two financial indicators—domestic credit produced by the financial sector initially, and then domestic credit produced by the private sector—to assess the effects of financial developments on energy demand. Additionally, Shahbaz & Lean (2012)'s analyses revealed that cointegration and causality tests support the existence of a long-term relationship between energy consumption, economic growth, and financial development—which is measured by domestic credit to the private sector as a percentage of GDP. Additionally, they observed a causal association that was bidirectional between energy usage and financial progress. According to Islam et al.'s findings, energy consumption has both short- and long-term effects on financial development, but it also leads to it over time. Komal and Abbas (2015) have examined the connections among economic expansion, energy usage, and financial advancement. Their findings show that financial development has a favorable and statistically significant effect on energy consumption through economic expansion.

According to Mayssa (2021), a number of other studies have confirmed that, when actual economic activity and the use of fossil fuels rise, so does the impact of financial development on CO2 emissions. Regarding the development of stock markets, these upward effects on energy efficiency, carbon emissions as well as

economic growth appear to have an important influence, especially on developed stock markets. Using data from the panel, Henri et al. (2022) also demonstrated the existence of a Granger-type causal relationship between GDP and fossil energy use on the one hand, and CO2 emissions and energy consumption on the other.

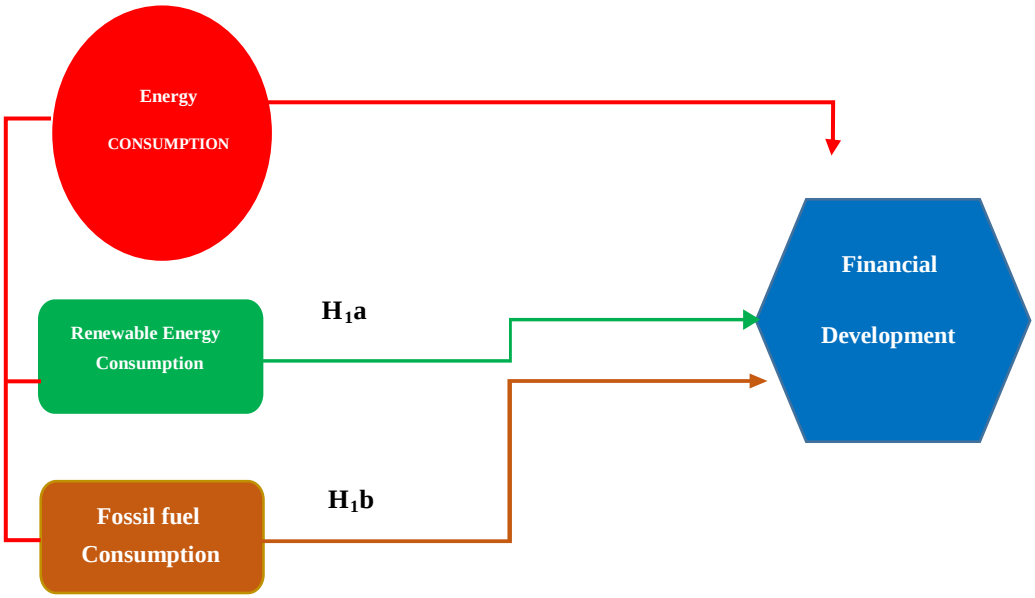
On the basis of the concepts defined and the existing relationships between the variables, as presented above, the author of this study has arrived at the following hypotheses:

**Main Hypothesis:** Energy use and financial development have a strong and significant positive connection.

**Hypothesis 1a:** There is a significant positive relationship between renewable energy consumption and financial development.

**Hypothesis 1b:** There is a significant positive relationship between fossil fuel consumption and financial development.

Figure 1: Conceptual model and hypothesis




Source: Autor' own drawing.

# CHAPTER III
# Methodology

This study aims to investigate how Japan's financial development is affected by energy use. The data was extracted from World Bank (WB) database, for Japan. The primary goal of this study was to identify the variables that most significantly affect the relationship between energy use and financial advancement. The results of this research are going to improve the understanding of the financial impact of energy consumption and provide practical recommendations for managers in developed countries, Japan in particular, to improve their financial development. This thesis aims to encourage developed and developing countries to take a more proactive approach to select the right energy consumption components affecting their financial development.

## Research Design

This study opted for a quantitative data analysis. Comparatively speaking to quantitative research focuses on the analysis of discrete, digital, or numerical data (Judithe, 2018). This study is a quantitative study because the data from energy consumption and financial development are concrete (numerical) and not discrete (qualitative). Specifically, secondary data was used to analyse data regarding the selected model of the study.

Secondary data can come from a variety of sources, including institutional and corporate databases, extensive surveys, and data gathered for individual studies (Tripathy, 2013). This means that the analysis involved using research data already available from certain scientific sources to find an answer to the questions of the original work. The data used for this research comes from the WB DataBank.

### World Bank DataBank

The World Bank DataBank includes several indicators, statistical capacity indicators, world development indicators and focus areas, including topics such as energy consumption, financial development, health, nutrition and population statistics, gender statistics, education statistics. The primary set of development indicators maintained by the World Bank is called the World Development Indicators (WDI), and it is gathered from officially acknowledged worldwide

sources. They comprise national, regional, and global estimates and provide the most up-to-date and reliable data on global development (World Bank, 2023).

This research was modeled on the following regression model:
If the mathematical function is:

EnCo: f (STTV)

EnCo: Energy Consumption

STTV: Stocks traded total value

The regression model can be:

$$\mathbf{Y = \beta_0 + \beta_1 x_1 + \beta_1 x_{1_a} + \beta_1 x_{1_b} + \beta_1 x_{1_c} + \varepsilon}$$

Where:

Y: Dependent (prediction) variable

X1, X2, …, Xk : Independent variable

β0 = Y Intercept of regression"

βi = Coefficient of regression

Ɛ = Normal Random Variable

**Participants/Population and Sample**

For the purposes of our study, the target population was selected as Japan's economic zone. The financial sector was selected as a target sample of this study with a specific focus on the topics of both energy consumption and financial development areas. The sample secondary data extracted has specific focus on to analyse on the impact of energy consumption on financial development by specifically focusing if renewable energy consumption or fossil fuel energy

consumption and energy use have individual effects on the financial development in Japan.

A sample is a representation of a group of individuals out of the whole population. It is a method of data collection that allows inferences about the whole population to be obtained from a subset, or sample, of the members of the population. As an example, we may wish to know the average length of hospital stay for surgical and non-surgical stays in the United States and its territories for the calendar year 2012. In this case, a sample of hospital discharges would be obtained, along with the length of stay for each discharge (Williams, 2014).

The sample of this study includes data from financial institutions of Japan where data regarding financial development has been measured using Stocks traded Total value via World Bank (WB). WB is one of the largest global sources of funding and knowledge for poor countries. Its five branches are committed to reducing poverty, increasing shared prosperity, and promoting sustainable growth. And it vision and mission is to increase prosperity and put an end to extreme poverty on a livable planet. To establish a world devoid of poverty on a sustainable earth (WB, 2023).

## Data Collection Tools/Materials

### *Measurement*

This study used a secondary data extracted from World Bank Databank. The measurement scales selected were energy consumption and financial development. Energy consumption was selected as the main independent variable of the study has been measured by three sub-variables: fossil fuel consumption, renewable energy consumption, and energy use. Financial development was selected as the dependent variable of the study.

*Renewable energy consumption* measures the quantity of renewable energy affecting financial development. Then *fossil fuel consumption* measure the level of non-renewable energy affecting financial development. Finally, the energy use measures the impact of general using of energy on financial development.

**Renewable Energy consumption**

Renewable energy consumption was measured by the percentage rate that the Japanese economy was able to consume annually during the study period. Energy consumption from all renewable resources is included in this category, including waste, geothermal energy, hydroelectricity, solid biofuels, solar power, wind power, liquid biofuels, biogas, and marine energy. In this case, renewable energy consumption can be considered as the quantity consumed of renewable energies out of the total final energy consumption.

**Fossil Fuel Consumption**

Fossil fuel consumption has been measured in gigajoules (GJ), a unit commonly used to measure large-scale fossil fuel consumption. One gigajoule equals one billion joules, and one billion joules equals one gigajoule. Also fossil fuel consumption was measured by the level of use in the Japanese economy. The percentage of fuel consumption was calculated by taking into account the consumption of different sectors of activity in the national economy of Japan. Word Bank (2023) Fossil fuel consumption is the total use of non-renewable energy sources: coal, oil, petroleum products and natural gas.

**Energy Use**

The tonne of oil equivalent, or simply toe, is the standard unit for measuring energy use, and is the unit used in Japan to measure energy consumption. The amount of energy that can be approximately recovered from one tonne of crude oil is what it is generally considered to equal. Energy consumption was measured by the general rate of energy consumption in the Japanese economy for each year. WB (2014) Energy usage is defined as primary energy use before it is converted into other end-use fuels. It is equivalent to domestic production plus imports, stock fluctuations, and exports less fuel supplied to international shipping and aviation. It also include waste and energy from renewable sources, such as animal products and solid biomass, biomass-derived gases and liquids, and garbage from industry and municipalities (Ayesha et al., 2020).

**Financial Development**

Financial development was measured by the stocks trade total value. The total quantity of shares traded, both domestically and internationally, multiplied by the prices of those shares is the value of traded shares. The value of shares traded is the automatic transfer of ownership carried out through the electronic order book of the stock exchange. Orders placed by trading members are typically exposed to all market users and are automatically matched in accordance with exact guidelines set forth by the stock exchange, typically based on price/time priority (World Bank, 2023).

***Procedure***

To carry out this study, secondary data was extracted directly from reliable sources, World Bank Databank, in order to build up an econometric analysis base for our study:

A specific focus was given to the analysis of the country's current energy consumption: It is important to understand current energy consumption, including the amount of energy consumed and the energy source used. This will help determine the environmental impact of the country the company is operating in, and identify whether a transition to renewable energy could have the greatest impact.

**Analytical Plans**

In terms of methodology, it was carried out of Japan's energy consumption with selected financial indicators, which will enable us to understand the factors that influence the financial sector positively or negatively, and to propose recommendations to encourage emerging countries to adopt an efficient energy policy focused on renewable energies in order to improve their financial systems.

*Analysis methods used were:*

Eviews 13 was used to analyse the study data:

In processing, was carried out *correlation analysis*: Check correlations between variables to see how they relate to each other. For example, we can analyse whether total reserves are correlated with non-renewable energy consumption.

It was done using *regression analysis approach*. Simple regression is used to model the relationship between a dependent variable (in this case, financial sustainability) and several explanatory variables (such as energy consumption, company size, company environmental sensitivity, etc.).

The regression analysis will proceed to model evaluation including specific methods that are relevant for the analysis of the study. This involves assessing the quality of the model using measures such as the coefficient of determination R square, the regression significance test, tests of normality of residuals, etc.

Data was obtained from non-renewable energy consumption, as well as explanatory variables such as stocks traded total reserves, energy use, renewable energy consumption and fossil fuel.

Finally, the model interpretation: Interpretation of model coefficients to understand the impact of each variable on financial development. This can help to identify the most important variables and propose recommendations for rising the consumption of energy from renewable sources in financial development processes, which will have repercussions on their financial system.

**Ethical Compliance**

This study is conducted in accordance with the ethical standards required in scientific research, with all stakeholders in the study having a considered choice. And all information collected is kept confidential, as are its sources.

A permission from the NEU Ethics Committee was obtained for using a secondary data. The permission document has been attached to the appendix part.

# CHAPTER IV

## Findings and Data Analysis and Results

The findings of the data collected are shown in this chapter. The results are presented using descriptive statistics for the variables studied, the stationarity test, correlation analysis and linear regression analysis.

### Descriptive Statistics

Yungwei (2016) underlined that descriptive statistics is one of the approaches used to carry out descriptive analyses on a sample. It's a set of tools for describing data quantitatively in the form of graphical summaries. The primary measurements of central tendency as well as dispersion can also be computed using these instruments. The primary measures of central tendency that are frequently employed in statistics are the mean, median, and mode. A different kind of usual value in the data is shown by each measure.

These central tendency indicators show where the position where the values in the sample seem to congregate. The mean is obtained, when the total number of values is divided by the sum of all character values. It is symbolized by $\bar{x}$. The median is a number that divides the population into two groups of equal size. It's symbolized by $\boldsymbol{Me}$, the mode is the value of the most frequent variable in the population studied. i.e., in a statistical distribution, the mode is the modality of the variable with the highest number of individuals or the highest frequency. Symbolized by M0.

To check if the data followed a normal distribution the Skewness and Kurtosis were checked. Knowing skewness is crucial since it aids in determining the degree and direction of asymmetry in the data, which can affect how statistical analyses are interpreted.

The "tailedness" of a probability distribution is measured by kurtosis, which shows how heavy or light the data's tails are in relation to a normal distribution.

In statistical analysis, skewness and kurtosis are useful metrics that aid in understanding the properties and form of a dataset for analysts and researchers. They aid in the interpretation and choice of suitable statistical techniques for additional research by offering insights about the distribution's symmetry, tail behaviour, and possible outlier existence.

**Descriptive Statistics of Stocks Traded Total Value (STTV)**

Table 1 shows that the average STTV in Japan is 4.54, over all the years considered. The median STTV is 4.84, and the mode which is the highest level of STTV in Japan, during the period studied, is 6.58. The Standard Deviation being 1.55, this indicates the data for the STTV variable are not clustered around the mean they are rather scattered. To check if the data of STTV followed a normal distribution the Skewness and Kurtosis were checked. The Skewness coefficient being equal to -0.48, which means the STTV variable is asymmetric. That mains, the distribution is left skewed. This variable has a Kurtosis value of 2.05, which is higher, implying that the STTV distribution is sharp in other words it is flattened.

**Table 1. Descriptive Statistics of Stocks Traded Total Value**

| Parameters | STTV |
|---|---|
| Mean | 4.54 |
| Median | 4.84 |
| Maximum | 6.58 |
| Minimum | 1.70 |
| Std. Dev. | 1.55 |
| Skewness | -0.48 |
| Kurtosis | 2.05 |

**Descriptive Statistics of Energy Use (EU)**

Table 2 shows that the mean EU in Japan is 96.33, over all the years considered. The median EU is 99.49, and the mode which is the highest level of EU in Japan, during the period studied, is 112.43. After descriptive statistics, the EU variable has a negative Skewness value, i.e. -0.13. So the distribution is skewed to the left (Fu Ze, et al., 2023). To check if the data of energy use followed a normal distribution the Skewness and Kurtosis were checked. And the Kurtosis hypothesis test shows that the distribution of energy use is flatter than the normal law, because it has a value lower than 3, or 1.55. The table 2 also indicates a large standard deviation, which explains that the energy consumption data is scattered around the mean, so there are several variances.

**Table 2. Descriptive Statistics of Energy Use**

| Parameters | EU |
|---|---|
| Mean | 96.33 |
| Median | 99.49 |
| Maximum | 112.43 |
| Minimum | 78.6 |
| Std. Dev. | 11.15 |
| Skewness | -0.13 |
| Kurtosis | 1.55 |

**Descriptive Statistics of Fossil Fuel Consumption (FFC)**

Table 3 shows that the mean FFC in Japan is 87.89, over all the years considered. The median FFC is 84.31, and the mode which is the highest level of FFC in Japan, during the period studied, is 97.35. The standard deviation shows that the data is widely dispersed from the mean because the standard deviation is 6.54, which implies the presence of several variances among the data. To check if the data of FFC followed a normal distribution the Skewness and Kurtosis were checked. The descriptive statistics of the fuel consumption variable showed by the Kurtosis hypothesis test that the distribution is flattened, the coefficient is less than 3, or 1.21. Also in table 3, it is observed that the distribution is right skewed with a Skewness coefficient of 0.16.

**Table 3. Descriptive Statistics of Fossil Fuel Consumption**

| Parameters | FFC |
|---|---|
| Mean | 87.89 |
| Median | 84.3 |
| Maximum | 97.35 |
| Minimum | 80.6 |
| Std. Dev. | 6.54 |
| Skewness | 0.16 |
| Kurtosis | 1.21 |

**Descriptive Statistics of Renewable Energy Consumption (REC)**

Table 4 shows that the mean REC in Japan is 5.17, over all the years considered. The median REC is 4.66, and the mode which is the highest level of REC in Japan, during the period studied, is 8.45. The variable data is scattered due to a lot of variance because the standard deviation is 1.42. To check if the data of REC followed a normal distribution the Skewness and Kurtosis were checked. The Kurtosis coefficient which is 2.69 shows that the distribution of the variable is very flattened than the normal law, because it is less than 3. But also the Skewness value of 0.92 means that the distribution of the variable REC is asymmetrical to the right.

**Table 4. Descriptive Statistics of Renewable Energy Consumption**

| Parameters | REC |
|---|---|
| Mean | 5.17 |
| Median | 4.66 |
| Maximum | 8.45 |
| Minimum | 3.5 |
| Std. Dev. | 1.42 |
| Skewness | 0.92 |
| Kurtosis | 2.69 |

**Tests of Stationarity**

In statistics or econometrics, there are several tests for analysing the stationarity properties of time series data. A time series is a set of numerical numbers that show how a particular quantity changes over a given period of time. Mathematical expressions of such random variable sequences can be used to analyse and, more generally, understand their historical evolution and forecast their future behaviour. To get an initial idea of the time series, it is necessary to plot the data series. This will provide a first hint and a gut feeling about the time series data. It's important to note that data graphing is equally crucial (Abdul et al., 2019).

To verify the stationarity of the data used in this research, the author used the ADF model (Abdul & Nasir, 2019). More specifically, the Dickey-Fuller (DF) test was applied using the ADF model. The Dickey-Fuller (DF) test was created and expanded in 1979 by Dickey and Fuller. The model indicates that there may be a unit root in an auto regression model, indicating that the data series is not stationary, under the null hypothesis of the DF test. Hence, stationarity or trend stationarity is frequently the alternative hypothesis; however, this could vary based on the test version utilized. Let's take this example to better understand the DF test.

$$Co_{2t} = \rho co_{2t-1} + \mu_t$$

As a metric of environmental degradation, CO2 depends simply on its previous value, or, to put it another way, the variable is explained by its own historical lag. This equation illustrates the first-order AR process. The coefficient of interest for figuring out stationarity or unit root is ρ. Therefore, CO2 shocks will be temporary and eventually disappear if ρ is smaller than one. The series can be considered stagnant in this situation. Conversely, in the event that ρ equals one, the shocks present in the CO2 data series are permanent and do not fade over time. In this instance, a unit root affects the series (Abdul J, and Nasir, 2019). A value larger than one causes the series to blow out. However, this equation poses a real problem: the starting assumption is the presence of stationarity, which is the very reason why the model was estimated in levels. But according to the notion, we should begin with the doubts we want to dispel. In this case, the doubts relate to the unit root of the series, so we need to incorporate these doubts into the test model (Abdul J, and Nasir, 2019).

Consequently, the model can be rewritten difference first, so the model will be such that:

$$\Delta Co_{2t} = (\rho - 1)\, co_{2t-1} + \mu_t = \delta co_{t-1} + \mu_t$$

Abdul et al., (2019) Here, the starting assumption is that the series is non-stationary, which is why the model is estimated in a different form. In this model here, δ is the coefficient of interest for determining the unit root or stationarity, if its value is zero, i.e. CO2 shocks will be transient and stop time. In this case, the series will be stationary in nature. On the other hand, in the event that $\delta = 0$, CO2 shocks are eternal in nature and do not fade with time. In this instance, a unit root characterizes the series. The unit root hypothesis is the name given to this.

In summary, the Augmented Dickey-Fuller (ADF) test consists in testing the null hypothesis that u = 1. If nullity cannot be rejected, this means that the existence of a unit root cannot be rejected either as mentioned in the example above, this test has two versions, one with level and the other with difference. It is the most common test encountered in the previous research's on the link between energy and growth, and is used in almost all studies as a benchmark.

**Stationarity of Fossil fuel consumption**

In table 2, the FFC stationarity test shows that the fossil fuel consumption series contains a unit root, because the statistical value of ADF is greater than the critical values, the P value is greater than 0.05, i.e. a value of 0.17, in other words there is acceptance of the null hypothesis of the test. This implies that the test must be run in difference according to the properties of the test. The stationarity test in Difference in Table 3 shows that the series is stationary, since the statistical value is above the critical values, and the P-value is 0.34, which is less than 0.05. Consequently, the null hypothesis of the test in Difference is rejected. The series can be validated for use with the regression model.

**Table 5. FFC ADF LV**

Null Hypothesis: FFC has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.94 | 0.17 |
| Test critical values: | 1% level | -4.53 | |
| | 5% level | -3.67 | |
| | 10% level | -3.27 | |

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| FFC(-1) | -0.53 | 0.18 | -2.94 | 0.01 |
| D(FFC(-1)) | 0.51 | 0.21 | 2.39 | 0.03 |
| C | 41.3 | 13.9 | 2.97 | 0.00 |
| @TREND("2000") | 0.52 | 0.19 | 2.70 | 0.01 |
| R-squared | 0.41 | Mean dependent var | | 0.88 |

**Table 6. FFC ADF FD**

Null Hypothesis: D(FFEC) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.89 | 0.034 |
| Test critical values: | 1% level | -4.57 | |
| | 5% level | -3.69 | |
| | 10% level | -3.28 | |

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(FFC(-1)) | -1.09 | 0.28 | -3.89 | 0.00 |
| D(FFC(-1),2) | 0.49 | 0.23 | 2.12 | 0.05 |
| C | 0.37 | 1.36 | 0.27 | 0.78 |
| @TREND("2000") | 0.05 | 0.10 | 0.43 | 0.67 |
| R-squared | 0.52 | Mean dependent var | | -0.015 |

**Stationarity of Energy Use (EU)**

In table 4, the EU stationarity test shows that the energy use data series contains a unit root, because the statistical value of ADF (-2.34) is greater than the critical values, the P value is greater than 0.05, i.e. a value of 0.33, in other words there is acceptance of the null hypothesis of the test. In other words, the null hypothesis of the test is accepted, which means that the test must be run in difference according to the properties of the test. The stationarity test in Difference in Table 5 shows that the series is stationary, since the statistical value is below the critical values, and the P value is 0.01, which is less than 0.05. Consequently, the null hypothesis of the test in Difference is rejected. The series can be validated for use with the regression model.

**Table 7. LEU ADF LV**

Null Hypothesis: LEU has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -2.46 | 0.33 |
| Test critical values: | 1% level | -4.49 | |
| | 5% level | -3.65 | |
| | 10% level | -3.26 | |

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LEU(-1) | -0.48 | 0.19 | -2.46 | 0.02 |
| C | 2.31 | 0.94 | 2.45 | 0.02 |
| @TREND("2000") | -0.00 | 0.00 | -2.57 | 0.019 |
| R-squared | 0.28 | Mean dependent var | | -0.017 |

**Table 8. LEU ADF FD**

Null Hypothesis: D(LEU) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.30 | 0.01 |
| Test critical values: | 1% level | -4.57 | |
| | 5% level | -3.69 | |
| | 10% level | -3.28 | |

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LEU (-1)) | -1.58 | 0.36 | -4.30 | 0.000 |
| D(LEU(-1),2) | 0.39 | 0.24 | 1.62 | 0.12 |
| C | -0.01 | 0.01 | -1.44 | 0.16 |
| @TREND ("2000") | -0.000 | 0.00 | -0.88 | 0.38 |
| R-squared | 0.63 | Mean dependent var | | -0.00 |

**Stationarity of Renewable Energy Consumption**

In Table 6, the REC stationarity test shows that the renewable energy consumption data series contains a unit root, because the statistical value of ADF (0.09) is greater than the critical values, and the P value is greater than 0.05, i.e. a value of 0.99, which means that the null hypothesis of the test is accepted. In other words, the null hypothesis of the test is accepted, which means that the test must be run in difference according to the properties of the test. The stationarity test in Difference in Table 7 shows that the series is stationary, since the statistical value of -4.53 is below the critical values, and the P-value is 0, which is less than 0.05, so the null hypothesis of the test in Difference is rejected. The series can be validated for use with the regression model.

**Table 9. REC ADF LV**

Null Hypothesis: REC has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | 0.09 | 0.99 |
| Test critical values: | 1% level | -4.49 | |
| | 5% level | -3.65 | |
| | 10% level | -3.26 | |

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| REC(-1) | 0.01 | 0.11 | 0.09 | 0.92 |
| C | -0.09 | 0.36 | -0.24 | 0.80 |
| @TREND("2000") | 0.02 | 0.02 | 1.04 | 0.31 |
| R-squared | 0.35 | Mean dependent var | | 0.2375 |

**Table 10. REC ADF FD**

Null Hypothesis: D(REC) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.53 | 0.00 |
| Test critical values: | 1% level | -4.53 | |
| | 5% level | -3.67 | |
| | 10% level | -3.27 | |

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(REC(-1)) | -1.12 | 0.24 | -4.53 | 0.00 |
| C | -0.02 | 0.12 | -0.21 | 0.83 |
| @TREND("2000") | 0.028 | 0.01 | 2.43 | 0.02 |
| R-squared | 0.56 | Mean dependent var | | 0.04 |

**Stationarity of Stocks Traded Total Value (STTV)**

In table 10, EU's level stationarity test shows that the energy use data series contains a unit root, because the statistical value of ADF (-3.82) is lower than the highest critical value, the P-value is lower than 0.05 or a value of 0.04, in other words there is no acceptance of the null hypothesis of the test. Consequently the null hypothesis of the level test is rejected. The series can be validated for use with the regression model.

**Table 11. LSTTV ADF LV**

Null Hypothesis: LSTTV has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=4)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.82 | 0.04 |
| Test critical values: | 1% level | -4.66 | |
| | 5% level | -3.73 | |
| | 10% level | -3.31 | |

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LSTTV(-1) | -1.56 | 0.41 | -3.82 | 0.00 |
| D(LSTTV(-1)) | 0.33 | 0.24 | 1.379 | 0.20 |
| D(LSTTV(-2)) | 0.45 | 0.19 | 2.32 | 0.04 |
| D(LSTTV(-3)) | 0.62 | 0.22 | 2.83 | 0.01 |
| D(LSTTV(-4)) | 0.32 | 0.23 | 1.35 | 0.20 |
| C | 45.26 | 11.80 | 3.83 | 0.00 |
| @TREND("2000") | 0.04 | 0.01 | 2.57 | 0.03 |
| R-squared | 0.73 | Mean dependent var | | 0.037 |

Since the stationarity test shows that the two variables, energy consumption and financial development, have stationary series, this implies the adoption of the null hypothesis of the said test. Consequently, the regression model does not have a spurious regression problem, and should be approved for future experimentation in the long or medium term.

According to the descriptive analysis and the results of the stationarity test, it should be noted that the variables do not have a multicollinearity problem, as the variables are not correlated with each other.

**Results of the Hypotheses Testing**

A main hypothesis “Energy consumption has significant effect on financial development” was constructed for the aim of this study. The main hypothesis has been measured by using 2 sub-variables: renewable energy consumption, and fossil fuel consumption. If all these two relationships are accepted them this means that the proposed main hypothesis has been accepted.

**Regression Analysis**

To verify the study hypotheses' statistical significance, regression analysis was done.
The following is the general formula for the simple linear regression model that was used:

$$Y = \beta_0 + \beta_1 x_1 + \beta_1 x_{1_a} + \beta_1 x_{1_b} + + \varepsilon$$

**Where:**

- Y: Dependent Variable
- X1: Independent Variable
- B0: The value that y will take when the independent variable is set to zero
- $B_1$: The constant regression coefficients. It shows the change in y when there is a one-unit change in the respective independent variable
- E: The random error that shows the variation in our estimation of y

**Simple Linear Regression Analysis**

**Main Hypothesis:** There is a significant positive relationship between energy use consumption and financial development.

Simple linear regression analysis of the relationship between energy use and financial development, expressed as STTV, showed that 46% of financial development was explained by general energy use, but revealed that the relationship was not significant. Because the EU coefficient is 9.46, this means that for every unit of energy consumed in Japan, financial development will tend to increase by 9.48. And since the P-value is less than 0.05, this again shows that the relationship is indeed positive, also with an error threshold that is greater than 0. Renewable energy consumption therefore has a positive linear effect, but one that is not significant.

**Table 13. Relationship between Energy Use Consumption and Financial Development.**

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* |
|---|---|---|---|---|
| Constant | 1.37 | 2.27 | 6.02 | |
| Energy Use | 9.48 | 2.34 | 4.05 | **0.0007** |
| $R^2$ | **0.46** | | | |

**H1.a)** There is a significant positive relationship between renewable energy consumption and financial development.

Simple linear regression analysis of the relation between renewable energy consumption and financial development expressed as STTV, showed that financial development is 39% explained by renewable energy consumption and reveals that there is a significantly positive relationship. Because the REC coefficient is 6.82, this means that for every unit of renewable energy consumed, financial development increases by 6.82. And since the P-value is less than 0.05, this again shows that the relationship is indeed positive, also with an error threshold greater than 0, so renewable energy consumption has a significantly positive linear effect.

**Table 14. Relationship between Renewable Energy Consumption and Financial Development.**

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* |
|---|---|---|---|---|
| *Constant* | *1.00* | *1.047* | *0.96* | |
| *Renewable Energy Consumption* | *6.82* | *1.95* | *3.49* | ***0.0024*** |
| $R^2$ | **0.39** | | | |

**H1.b)** There is a significant positive relationship between fossil fuel energy consumption and financial development.

Simple linear regression analysis of the relationship between fossil fuel consumption and financial development, expressed in STTV, showed that 28% of financial development is explained by renewable energy consumption, revealing a significant positive relationship. Since the FFC coefficient is 1.25, this means that for every unit of renewable fossil energy consumed, financial development increases by 6.82. And as the P-value is less than 0.05, this again shows that the

relationship is indeed positive, also with an error threshold greater than 0, so that renewable energy consumption has a significantly positive linear effect.

**Table 15. Relationship between Fossil Fuel Consumption and Financial Development.**

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* |
|---|---|---|---|---|
| Intercept | -6.47 | 4.08 | -1.5835 | |
| Fossil Fuel Consumption | 1.25 | 4.63 | 2.7 | **0.014** |
| $R^2$ | **0.28** | | | |

**Table 17.** ***Results of the Research Hypotheses***

| **Hypotheses Developed for the Research Study** | **Results** |
|---|---|
| **Main Hypothesis**: There is a significant positive relationship between energy consumption and financial development. | Supported |
| **Hypothesis 1a:** There is a significant positive relationship between renewable energy consumption and financial development. | Supported |
| **Hypothesis 1b:** There is a significant positive relationship between fossil fuel consumption and financial development. | Supported |

# CHAPTER V
# Discussion

This chapter includes an explanation and synopsis of the findings, a conclusion, and a couple of recommendations or strategies relevant to the study questions and hypotheses.

The results of the said research suggest that general energy consumption has significant effect on financial development in Japan digital financial development more particularly through the traded stock totals in the institutions in the financial sector. The main objective in this analyse was to demonstrate and understand the impact and importance of energy consumption on financial development in a developed country like Japan. The aim was to determine the nature of the relationship of the three variables as well as the degree of influence of them on the financial development levels of Japan. The statistical results show that financial development (total shares traded) was influenced by energy consumption. This means that energy consumption has an important impact on the performance and profitability of financial development in Japan.

The results support the idea that; renewable energy consumption has a significant and positive effect on financial development into Japan, showing and proving that the financial sector to use and have a green consumption in terms of their energy consumption. This means that Japan's financial sector is committed to the fight against global warming, as their financial development is more influenced by the consumption of renewable energy. The choice of this renewable energy source option is not only explained by the need to fight pollution, but also because Japan, as a major economic power, needs to have a competitive edge, and to do so it must use an energy source that is highly effective and efficient.

Based on the results, these analyses show that companies need to have a strong understanding of the relationship between energy consumption and financial development especially renewable energy and financial development (financial performance). For the results found demonstrate that energy consumption has a positive impact on a company's financial performance. In order to achieve better financial performance, it is necessary to put in place genuine energy strategies. Maximizing better energy quality will enable the company to perform better, and gain competitive advantage in the market and hence in long run add both the company performance and the financial development levels of the country they operate.

However, the existence of the positive link that was noted between the consumption of renewable energies and financial development, the same goes for the consumption of non-renewable energies. This means that, despite Japan's efforts to invest in renewable energy, its energy consumption is not 100% green. Part of its financial development is still dependent on fossil fuel consumption, which can further weaken its financial sector. This can be explained by the fact that investment in renewable energy is expensive.

**Theoretical Implications**

The theory of financial development (Schumpeter 1912) suggests that the development of a financial sector has an essential role to play in a nation's economic growth. Furthermore, it is important to underline that easy access to financial services, such as loans, investments and banking, encourages investment, promotes entrepreneurship and also stimulates economic growth. But when we talk about growth, we're talking about national production, which requires sufficient energy consumption.

Research carried out by Schumpeter (1912) and Gurley and Shaw (1955), indicates that analysis of the role of the financial system in the growth process has continued with the development of theoretical models of endogenous growth integrating the field of finance. It was recognized that capital accumulation and technological progress were not the only factors affecting economic and financial development. Simply, explaining differences in levels of development between countries and defining factors leading to them is of great importance. Recent literature has emphasized the role of financial development and institutions respectively as fundamental determinants of economic growth (Furuoka, 2015). It should be noted that energy consumption has a major role to play in the development of the financial system, particularly in Japan, which is the case studied in this study.

Theoretically, it has been demonstrated that all energy consumption has an impact, regardless of the efficiency of this impact. In a way, development is dependent on energy consumption; the hypotheses of this study have therefore been verified according to the theory of financial development.

**The most significant results that can be drawn from the analyses carried out on this study in relation to the hypotheses and research questions are presented below:**

Firstly, the implementation of strategies for better consumption or exploitation of digital energy can have a positive effect on the performance and profitability of financial institutions leading to increase financial development on a country level, here represented by the dependent variable STTV in Japan. The years selected for the study period were from 2000 to 2020 and were characterized by a positive impact of energy consumption on financial development in Japan. Statistical results showed that general energy consumption has a positive impact on the improvement of the financial sector. However, every energy channel that was employed in this study demonstrated a very strong positive impact on the financial development's profitability and performance. *More precisely:*

*It was found that there is positive relationship, between renewable energy consumption and financial development. This means that* renewable energy use may help to support the image of countries since they decrease the air pollution levels. This leads to the fact that more foreign investments will come to the country since the perspective of sustainability and the environmental awareness levels are increasing globally. All these factors may lead to the improvement of the financial systems of countries supporting their financial development levels.

*It was found that there is an essential positive relationship between fossil fuel consumption and financial development.* This means that Japan didn't reach a sufficient level of reduction of fossil fuel use. It is important to underline that the consumption of fossil fuels damages the environment and its natural resources (Orubu & Omotor, 2011). On the contrary the positive results show that there is a significant amount of use of fossil fuels, and this is not affecting negatively the financial development of the country but leading to the improvement of the financial systems of countries supporting their financial development levels.

Secondly, it was observed that between renewable and fossil fuel consumption, it is renewable energy that has more influence on financial development. Japan's financial sector during the period under study was oriented towards the consumption of renewable energies compared to non-renewable energies. Renewable energies have a large proportion in Japanese financial development.

**Practical Implications**

The study's conclusions support its goals and hypotheses because they demonstrate how energy use improves the efficiency and profitability of Japan's financial development. The author of the study maintains a positive relationship between energy consumption and financial development, with financial institutions giving greater priority to achieving their ecological objectives, as the study shows that 40% of financial development in Japan is explained by the consumption of renewable energies. The results of this thesis can help managers in Japan and elsewhere work more efficiently and quickly adapt to market changes while spending less money than before.

The findings of this study clearly show that energy consumption is essential to the continued success and dynamism of financial development. Energy consumption is a major factor, among many others, in determining the best quality of a financial sector, which can be achieved either directly or through growth, depending on the production model.

When financial institutions, businesses and industries invest in maximizing energy consumption, they improve their chances of attracting new investors and economic actors, which can excite the opening of new markets, which will allow to appreciate a better quality of growth via the financial development sector, which is essentially based on energy consumption.

In light of the findings of this study, we can already suggest that financial institutions, businesses and industries need to invest more and use the energy mix to promote the effectiveness and efficiency of the effect of energy consumption on the performance, profitability as well as competitiveness of the financial sector.

# CHAPTER VI

## Conclusion and Recommendations

This chapter contains recommendations in accordance with the research's purpose and/or sub-objective(s) and delivers conclusions from the data analysis.

### Recommendations and Conclusion

#### *Recommendations*

##### Recommendations related to findings

The following recommendations can be made to enhance the performance and profitability of financial institutions, businesses, and industries in order to achieve the highest calibre of financial development, based on the study's findings in relation to the research questions, hypotheses, and concept of financial development theory. First off, as the statement of the issue mentions, a number of programs and regulations have been put in place to enhance the functionality and profitability of financial systems, in order to guarantee the security of investment in both the financial sector and the operation and consumption of energy. Despite efforts to promote financial development, developed countries, notably Japan, continue to face considerable difficulties in promoting their financial development, which is also a pillar of sustainable development. This hinders sustainable development and green growth in terms of the volume of renewable energies consumed, industrial production, the acquisition of new investors, and so on.

This study recommends that government and financial sector leaders in general, and in Japan in particular, adopt and strengthen the energy mix policy and, above all, put in place an investment facilitation policy supporting green projects in order to improve their performance. Aware that the use of renewable energies explains the financial development up to 40%, a source of energy that fights against pollution, the Japanese authorities, and other countries can use and produce more renewable energies at their reach for purposes of financial and sustainable development. Companies must use renewable energies to the maximum, so that their energy use can contribute to the maximum of their financial performance.

## Recommendations for Further Research

First, this research analysed the effect of energy consumption on financial development through fossil fuel consumption, renewable energy consumption, and energy use. Future studies are suggested to use different indicators for energy consumption. This is going to widen the perspective of indicators related with financial development and guide positively the industries and countries.

Second, future research is suggested to widen the focus of the topic by applying it in different countries apart from Japan. Making comparisons among continents can benefit the literature as well.

Third, future research is suggested to pay attention to study the topic in different levels of economic development which is going to add a different angle to the topic since the implementation of the rules and regulations in different countries is different from each other.

Fourthly, future research should be focused on corporate cases, in order to have a direct and close-up analysis of the subject.

## Conclusion

This analysis, in contrast to previous studies, led to the finding a positive and an important relationship between energy consumption and financial development. It is important to note that in the past other studies have produced similar results on the same subject. For example, Al-mulali and Furuaka's research reached comparable conclusions. Additionally, Furuoka's 2015 study, focused on analysing the possible link between finance and energy in Asian countries, found that energy consumption was the cause of financial development in a unidirectional manner. , rather than the reverse. In a home study, Al-mulali and Sab (2012) employed panel causality and co-integration approaches to examine the effects of energy consumption and carbon dioxide emissions on the financial and economic development of the 19 nations they examined. They found that nations attain high levels of economic and financial growth in proportion to increases in energy consumption.

To put it briefly, developed nations as a whole and Japan specifically need to assess their energy resources and capacities first. These could be government-led projects, proprietary technologies, or business experience. These resources can then be exploited to create a dynamic energy system that will set them apart in the financial market. Companies also need to align their renewable energy investment efforts. Once they have identified their operational needs, they need to ensure that their energy production efforts are aligned with them. This will help companies to operate their value chain efficiently and differentiate themselves from their competitors. Developed countries are also investing in the creation and strengthening of their energy institutions and funds, in support of the financial development sector. This can help them maintain a competitive edge over time, and thus achieve sustainable financial development.

Finally, Japan and its financial institutions need to keep abreast of trends and developments in the energy or financial sector, and be ready to evolve their strategy of renewable energy production, as well as the minimization of non-renewable energy consumption, to stay ahead of the competition from other economic powers. This may involve investing in new technologies or adopting

changes in sources and strategies that encourage the consumption of renewable energies at all levels of financial development.

In the analysis, financial development was represented by STTV, which comes from all Japanese companies. In a way, if energy consumption has a positive impact on financial development expressed in STTV, this means that a company's financial performance will also be impacted by energy consumption.

Based on these analyses, strategists and companies should favour renewable energy consumption for better financial performance.

The value and supply chain must minimize the consumption of non-renewable energy, or risk having a negative impact on the bottom line. So it's quite possible that, by starting with good energy management, we can achieve greater financial viability.

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# Appendix 1: Ethical Committee Report


**SCIENTIFIC RESEARCH ETHICS COMMITTEE**

17.11.2023

Dear Blanchard Kisungu Kipulu

Your project **"The impact of energy consumption on financial development in Japan"** has been evaluated. Since only secondary data will be used the project does not need to go through the ethics committee. You can start your research on the condition that you will use only secondary data.

Prof. Dr. Aşkın KİRAZ

The Coordinator of the Scientific Research Ethics Committee

**Appendix 2**

**Turnitin Similarity Report**

The impact of energy consumption on financial development in Japan 20213224)

ORİJİNALLİK RAPORU

| %10 | %4 | %8 | %5 |
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| BENZERLİK ENDEKSİ | İNTERNET KAYNAKLARI | YAYINLAR | ÖĞRENCİ ÖDEVLERİ |

BİRİNCİL KAYNAKLAR

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|---|---|---|
| 1 | Abdul Jalil, Nasir Hamid Rao. "Time Series Analysis (Stationarity, Cointegration, and Causality)", Elsevier BV, 2019<br>Yayın | %1 |
| 2 | Thai-Ha Le. "Dynamics between energy, output, openness and financial development in sub-Saharan African countries", Applied Economics, 2015<br>Yayın | %1 |
| 3 | David C. Cole, Yung Chul Park. "Financial Development in Korea, 1945–1978", Brill, 1983<br>Yayın | %1 |
| 4 | Submitted to Yakın Doğu Üniversitesi<br>Öğrenci Ödevi | %1 |
| 5 | docs.neu.edu.tr<br>İnternet Kaynağı | <%1 |
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