The Impact of Fintech, Green Finance, and Financial Inclusion on Energy Efficiency and Sustainability in GCC Countries

Thesis submitted in partial fulfillment for the degree of Master of Science in Finance in accordance with the requirements of Effat University

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Abstract

Due to the rapid emergence of financial factors as well as the sustainable development goals of energy efficiency, this research focuses on finding if financial factors can have a major impact on energy efficiency. The growing concern of environmental problems that are directly related to energy production and consumption include climate change. The methods the GCC countries are moving to use to reduce the consumption of energy, is through financial factors. The GCC is also seeking to lessen the reliance on oil dependency. This aligns with the sustainable development goals of the UN (united Nation), which is the global organization that the GCC is part of. This research will study if financial factors can influence energy efficiency. The method used to test the relationship is the Multiple linear regression model. Specifically, this method was chosen as there are seven independent variables and one dependent variable. A statistical software, EViews, was used to conduct different tests such as a unit root and Panel regression analysis. Tests were performed to see if the dependent variable, Energy intensity can be influenced by different variables of financial factors. The fixed effect model and Histograms were used to represent the level of distribution of the skewness and kurtosis as well as the impact of each variable. The results concluded that while it might be possible to have an influence, these financial factors showed a low effect on the size of impact.

Keywords: FinTech, Green finance, Financial Inclusion, Energy efficiency, Sustainability, GCC
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Chapter 1

1. INTRODUCTION

1.1 Background

The growing concern of environmental problems that are directly related to energy production and consumption include climate change.

The consumption of energy is high in the GCC countries relative to other developed countries, and this is one of the key challenges faced by the GCC.

One of the methods the GCC countries are moving to use to reduce the consumption of energy, is through financial factors.

Climate change is recognized as the most significant risk on the planet and is likely to control the political and economic landscape for many years to come.

Transitioning from conventional power usage to renewable power is still one of the best and most effective solutions available. Middle Eastern countries have a strong dependence on fossil fuels to drive economic growth.

Internationally, energy efficiency is one of the global goals in which many countries are striving to take advantage of to improve the economic benefits and environmental growth. Many factors and industries play a role in contributing to the development of energy efficiency. Each sector has a different impact on energy efficiency and how to accomplish economic and sustainable growth. In this study financial factors will be tested to see if they can play a role in having a significant effect on the economic growth and energy efficiency.
ENERGY EFFICIENCY

Energy efficiency refers to any approach that uses less energy to produce more or the same amount of useful output. Improving energy efficiency has economic benefits such as decreased utility bills for individuals, job creation, and helping to stabilize electricity prices and volatility. In addition, greenhouse gas emissions and demand for energy imports will be reduced due to the improvement of energy efficiency. Energy efficiency and the financial sector must work together in improving the increasing demand of sustainability of energy. The financial sector can have a great impact as a leading tool to efficiency in the GCC Countries. GCC Countries, for example, have recently increased their minimum energy efficiency standards for appliances and invested in energy efficiency labeling which highlights how energy efficient an appliance is using a letter-based scale. This initiative is a steppingstone into the energy efficiency sector. However, I want to test if financial factors can influence energy efficiency using different financial tools.

FINTECH

Fintech has become one of the leading components of the financial sector, and it stands for Financial Technology. It is the technology and innovation that tries to compete with established economic techniques in the delivery of financial services. It is an emerging industry that uses technology to improve activities in finance. The use of fintech globally is applied in a variety of industries. The most prominent applications of fintech are mobile payments, automated investment apps, cryptocurrency, online lending.
businesses, blockchain, and crowdfunding platforms. FinTech is one of the most widely demanded products as people are adopting urbanization.

During 2008 the global financial crisis, Fintech innovation was generated by advancements in e-finance and mobile technologies for financial institutions.

In Saudi Arabia, the launch of the nation’s strategic plan for the next decade, Vision 2030, focuses on transforming the Kingdom into a digital economy with an emphasis on the development and growth of the fintech sector.

Due to the rapid growth of the Fintech industry in Saudi Arabia, it has shown that between 2017 and 2019, the value of fintech transactions increased at a rate of over 18% each year, which reached over 20 billion USD in 2019. On the other hand, the number of smartphone payment transactions increased by 352% to 19.7 million in April 2020. The Fintech sector is expected to reach $33 billion in transactional value by 2023 in Saudi Arabia. While in Oman, the rapid technology advancements have transformed the financial sector in unforeseen ways and adapting to these changes has become unavoidable. As a result, Oman has prioritized the growth of Fintech and the improvement of financial sector innovation through the implementation of appropriate regulatory. Meanwhile, in Kuwait, the banking sector is experiencing a change, with Fintech playing a critical role in pushing a much-needed shift, since Kuwait is at the forefront of GCC Fintech innovation. The UAE has established a plan that involves the use of digital currencies in banking. The strategy fosters the UAE's financial services sector's digital transformation, which involves the utilization of cutting-edge technology such as artificial intelligence and big data. Fintech is emerging very rapidly and GCC Countries are starting to adopt different kinds of financial technologies that can grow the economy in an efficient way while the market for different innovations is growing.
GREEN FINANCING

Green finance is any structured financial activity that’s been created to ensure a better environmental outcome. It includes an arrangement of loans, debt mechanisms, and investments that are used to encourage the development of green projects or mitigate the impact on the climate of more regular projects. Green Finance is important as it promotes and supports the flow of financial instruments and related services towards developing and implementing sustainable business models, investments, trade, economic, environmental, and social projects and policies. One standard green finance instrument internationally is the green bond, which must adhere to the use of proceeds criteria, have a process for project evaluation and selection, ensure proper management of any profits, and offer detailed reporting.

Internationally, central banks are making commotion about prioritizing greener investment. The US, China, and France are the three biggest issuers of green bonds. European Central Bank holds around 20% of all euro-denominated green debt, even though it only started buying corporate bonds as recently as 2016, which indicates that banks see this as a way to further its green agenda.

Though, the green bond market in the GCC is still in its infancy. Countries of the GCC are starting to go green, by paving the way for a robust green financing industry. The Gulf Cooperation Council (GCC), like the rest of the world, has committed to economic diversification away from fossil fuels. The GCC countries primarily seek to lessen its reliance on oil. Which is why there are many new initiatives on the rise to achieve reduction of oil dependency.
FINANCIAL INCLUSION

Financial inclusion is an attempt to make every day financial services accessible to more of the world’s population at a reasonable cost. The increasing use of financial technology, for example, has provided innovative tools to address the problem of inaccessibility to financial services and conceived new ways for individuals and organizations to obtain the services they need at reasonable costs.

Financial inclusion strengthens the availability of economic resources and builds the concept of savings among the impoverished. Financial inclusion is a significant step towards inclusive growth. It helps in the overall economic development of the underprivileged population.

Introduction Conclusion

The financial sector is rapidly growing, as well as the demand for more everyday lifestyles to turn digital. As these changes are occurring, they help the economy become developed. However, financial inclusions need to be acknowledged for the occurring changes to be efficient and effective. Fintech, Green financing, and financial inclusion will be taken into consideration to see if these factors can have an influence on energy efficiency. The goal is to see if the financial sector can have an impact on energy efficiency and what can be done for this effect to influence a better future. As known in the GCC, Saudi Arabia has made significant progress over the previous years to achieve its aim for a sustainable economy through the vision 2030. The vision includes many factors that are there to assist in accomplishing this goal. This paper will study how financial factors in only four of the GCC countries can affect other factors, such
as energy efficiency to help lead the economy to become more efficient and sustainable. Given the limited research in this area in the GCC countries. The study is based on gathered available data from four of the six GCC countries. Included countries consist of Saudi Arabia, United Arab Emirate, Kuwait, and Oman.

1.2 Problem Statement
Due to the rapid emergence of financial factors as well as the sustainable development goals of energy efficiency, this research focuses on finding if financial factors can have a major impact on energy efficiency and sustainability.

However, previous research has been done on foreign countries, there are no research that has been done in the GCC Countries.

The research will answer the question of “Is there a relationship between fintech, green financing, financial inclusion, on Energy efficiency and sustainability?”

This study will test the relationship between financial factors and energy efficiency in the GCC countries. Furthermore, this research attempts to find whether financial factors are a good choice for the reduction of energy consumption and if financial factors are a leading tool in the energy sector.

1.3 Aims and Objective
By conducting this research, the study is going to provide an answer to whether the three financial factors are tied with energy efficiency in the GCC. This research will test the empirical role of fintech, green financing, and financial inclusion on the energy efficiency of four of the GCC Countries. Which include Saudi Arabia, United Arab Emirate, Kuwait, and Oman.
The research will study if financial factors have an impact on the energy efficient factor.

1.4 Research Question

The following research questions are expected to be answered in the research:

- What is the relationship between fintech, green financing, financial inclusion and energy efficiency in the GCC Countries?
- What is the Impact of Fintech on Energy Efficiency?
- What is the Impact of Green finance on Energy Efficiency?
- What is the Impact of Financial inclusion on Energy Efficiency?

1.5 Scope and Limitation

Given the limited research in this area in the GCC countries. The study is based on gathered available data from four of the six GCC countries. Included countries consist of Saudi Arabia, United Arab Emirate, Kuwait, and Oman. Data was gathered from the World Bank database under the Sustainable development goals index, Environmental Social Governance index, and financial development index. As well as the International Monetary fund index.
Chapter 2

2. Literature Review

“Financial technology or known as ‘fintech’ is an emerging concept as a core disruptor of every aspect of today’s financial system. Fintech covers everything from mobile payment platforms to High-Frequency Trading (HFT), and from crowd funding and virtual currencies to block chain” (Kim 2018, p. 200)

Due to these financial technology advancements, many traditional financial organizations, such as banks, are forced to rethink their business models (Davis et al. 2017). Which now has a great amount of advancement through financial technologies.

Additionally, Gimpel et al. (2018) have stated that Fintech Startups are even emerging in providing services such as lending, asset management, and insurance.

Financial innovations such as crowdfunding, robo-advisors or blockchain increasingly offer green investment opportunities for the general public (Blakstad and Allen 2018) and make the financial system easier accessible and more efficient (Castilla-Rubio et al. 2016). This is a great way to improve the environment as well as the economy.

Based on the definition of Dorfleitner et al. (2017) we cluster fintech’s into financing, asset management and blockchain to discuss possible applications in green finance.

Financial inclusion has been recognized as one of the nine key pillars of the global development agenda (GPFI, 2011).

Several empirical studies have shown that the financial sector can play an important role in reducing CO2 emissions by encouraging technological advances in the energy sector.

The literature has shown that the interaction between renewable energy consumption and financial development can play an important role in curbing CO2 emissions.
“If no action is taken to curb GHG emissions, the concentration of GHGs in the atmosphere could double as early as 2035 from its preindustrial level”. This affirmation was confirmed by the outcomes of the 2016 Paris Agreement conference of Parties COP 21.

Chapter 3

3. Methodology

This chapter outlines the methods utilized in this research to test the research objectives. It aids in determining the best strategy for improving and developing goals using facts. To deal with numerical and statistical data, the technique utilized in this methodology requires a mix of skills and statistical analysis.

3.1 Research design

The study employs a quantitative methodology based on secondary data. All data utilized in this study were gathered from several indices throughout a 20-year period, from 2001 to 2020. The information was gathered to examine the research hypothesis and objectives. Since most of the data were not available for all six GCC countries, this study chooses the countries with available data and analyzed them.

3.2 Quantified Method

The quantitative method used to test the relationship between financial factors and energy efficiency, which includes several statistical techniques such: Descriptive statistics, Unit root test, Regression analysis, and Histogram test are used to find the relationship between Fintech,
green financing, and financial inclusion on energy efficiency and sustainability as it explains which factors have an impact.

3.3 Hypothesis of the Research

The hypothesis that formulated for this research:

- H1: Natural resource conservation has an impact on energy efficiency.
- H2: Fintech has an impact on energy efficiency.
- H3: Environmental sustainability has an impact on energy efficiency.
- H4: Financial inclusion has an impact on energy efficiency.
- H5: Fossil Fuel has an impact on energy efficiency.
- H6: GNI has an impact on energy efficiency.
- H7: Green Financing has an impact on energy efficiency.

3.4 Model specification

The model that was used to study the effect is a Multiple linear regression model, is a branch of the simple linear regression model. The multiple linear regression model was used to determine the relationship among random variables. The multiple linear regression is a simple regression model that estimates the relationship between a quantitative dependent variable and several independent variables using a straight line. The dependent variable will be the Energy Intensity as the effect of financial factors on energy efficiency was studied. While the independent variables will be different variables such as, Fintech, Natural resource conservation,
Environmental sustainability, financial inclusion, Fossil fuel, GNI, and green finance. The multiple linear regression model will be as seen below:

**Multiple linear regression model**

\[ Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p + \epsilon \]

\[ Y \text{ Energy Intensity} = \alpha + \beta_1 \text{ Fintech} + \beta_2 \text{ NRC} + \beta_3 \text{ Environmental Sustainability} + \]
\[ \beta_4 \text{ Financial Inclusion} + \beta_5 \text{ Fossil Fuel} + \beta_6 \text{ GNI} + \beta_7 \text{ Green financing} + \epsilon \]

**Where:**

\( Y = \) Dependent variable

\( \alpha = \) Intercept

\( \beta_1 = \) Slope for \( X_i \)

\( X = \) Independent variable
3.5 Variables

The table below shows the dependent, independent variables, and each variable used. The table defines each abbreviation and the source of the data of each variable.

**Table 1: Variables table**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>VARIABLE</th>
<th>DEFINITION</th>
<th>DATA SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable</td>
<td>Energy intensity</td>
<td>Energy intensity: level of primary energy. A ratio between energy supply and gross domestic product measured at purchasing power parity. Energy intensity is an indication of how much energy is used to produce one unit of economic output.</td>
<td>SDG</td>
</tr>
<tr>
<td>Independent Variable</td>
<td>NRC</td>
<td>Natural resource conservation</td>
<td>ESG</td>
</tr>
<tr>
<td></td>
<td>FT</td>
<td>Fintech: Financial Technology</td>
<td>FD</td>
</tr>
<tr>
<td></td>
<td>ES</td>
<td>Environmental sustainability on CO2 emissions</td>
<td>ESG</td>
</tr>
<tr>
<td></td>
<td>FI</td>
<td>Financial Inclusion</td>
<td>FD</td>
</tr>
<tr>
<td></td>
<td>FF</td>
<td>Fossil fuel: comprises coal, oil, petroleum, and natural gas products.</td>
<td>ESG</td>
</tr>
<tr>
<td></td>
<td>GNI</td>
<td>Gross National Income=GDP+(money flowing from foreign countries – money flowing to foreign countries)</td>
<td>SDG</td>
</tr>
<tr>
<td></td>
<td>GF</td>
<td>Green financing</td>
<td>IMF</td>
</tr>
</tbody>
</table>
Chapter 4

4. Results and Discussion

4.1 Results

This chapter presents the results of the analysis and techniques that applied in testing the impact of fintech, financial inclusion, and green financing on energy efficiency.

In this section, I will focus on the results of my model by using a statistical analysis tool to estimate the multiple linear regression model. Statistical analysis is the gathering and analysis of data to discover patterns and trends. It is part of data analytics. Statistical analysis can be applied in scenarios such as research interpretation and statistical modeling.

The statistical analysis was used to estimate for the equation and test if the variables have a relationship. EViews statistical analysis software was used to conduct the tests for this specific topic. In EViews the ordinary least-squares model (OLS) was used to test for only four specific GCC countries. Including Saudi Arabia, United Arab Emirate, Kuwait, and Oman. For the period of 20 years, from 2001 to 2020. The data tested is a balanced panel data with 80 observations. On the software a total of one dependent variable and seven independent variables was used to estimate the effect of Energy Intensity, as it is the main indicator for energy efficiency, on different variables of several financial factors and energy factors. These variables are derived from fintech, green finance, financial inclusion, and energy efficiency. The test was conducted to see if Energy Intensity will be influence by the independent financial factors.
Estimated Equation:

First, the estimated equation accounts for one dependent variable and several independent variables to get the coefficient and probability of the variable.

Table 2: Estimated Equation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-1.231733</td>
<td>1.312936</td>
<td>-0.938152</td>
<td>0.3515</td>
</tr>
<tr>
<td>GNI</td>
<td>-0.002825</td>
<td>0.012804</td>
<td>-0.220662</td>
<td>0.8260</td>
</tr>
<tr>
<td>Natural Resource Conservation</td>
<td>0.080978</td>
<td>0.028387</td>
<td>2.852643</td>
<td>0.0057</td>
</tr>
<tr>
<td>Environmental sustainability</td>
<td>0.075268</td>
<td>0.040840</td>
<td>1.842982</td>
<td>0.0697</td>
</tr>
<tr>
<td>Fossil fuel</td>
<td>0.009647</td>
<td>0.005904</td>
<td>1.634132</td>
<td>0.1069</td>
</tr>
<tr>
<td>Fintech</td>
<td>0.007827</td>
<td>0.007685</td>
<td>1.018563</td>
<td>0.3120</td>
</tr>
<tr>
<td>Financial Inclusion</td>
<td>0.053958</td>
<td>0.015184</td>
<td>3.553665</td>
<td>0.0007</td>
</tr>
<tr>
<td>Green financing</td>
<td>-1.19E-12</td>
<td>4.40E-13</td>
<td>-2.693396</td>
<td>0.0089</td>
</tr>
</tbody>
</table>

R-squared: 0.113151; Mean dependent var: 5.394593
The dependent variable is the Energy Intensity. While the independent variables are the natural resource depletion, Fintech, Environmental sustainability, financial inclusion, fossil fuel, Gross national income, green financing.

**Descriptive statistics:**

Descriptive statistics summarizes and organizes results of a dataset.

**Table 3: Descriptive statistics**

<table>
<thead>
<tr>
<th></th>
<th>EI</th>
<th>NRC</th>
<th>FT</th>
<th>ES</th>
<th>FI</th>
<th>FF</th>
<th>GNI</th>
<th>GF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5.394593</td>
<td>13.84585</td>
<td>45.91477</td>
<td>19.06955</td>
<td>51.07098</td>
<td>94.95087</td>
<td>0.329822</td>
<td>4.68E+11</td>
</tr>
<tr>
<td>Median</td>
<td>5.485703</td>
<td>10.63922</td>
<td>47.34868</td>
<td>18.09149</td>
<td>50.68667</td>
<td>99.92802</td>
<td>0.481213</td>
<td>3.65E+10</td>
</tr>
<tr>
<td>Maximum</td>
<td>7.064693</td>
<td>39.42451</td>
<td>88.88447</td>
<td>29.62299</td>
<td>103.2593</td>
<td>100.0000</td>
<td>17.47491</td>
<td>1.78E+12</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>Std.Dev</td>
<td>Skewness</td>
<td>Kurtosis</td>
<td>Jarque-Bera</td>
<td>Probability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>-------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EI</td>
<td>3.085900</td>
<td>0.810110</td>
<td>-0.604325</td>
<td>3.358510</td>
<td>5.297880</td>
<td>0.070726</td>
<td></td>
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</tr>
<tr>
<td>NRC</td>
<td>3.065107</td>
<td>9.284599</td>
<td>1.113210</td>
<td>3.197428</td>
<td>16.65309</td>
<td>0.000242</td>
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<tr>
<td>FT</td>
<td>-53.02332</td>
<td>22.02475</td>
<td>-1.573515</td>
<td>8.087120</td>
<td>119.2753</td>
<td>0.000000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ES</td>
<td>11.01545</td>
<td>5.220408</td>
<td>0.358182</td>
<td>2.016973</td>
<td>4.931729</td>
<td>0.084935</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>17.25970</td>
<td>22.77071</td>
<td>0.405038</td>
<td>2.108327</td>
<td>4.837678</td>
<td>0.089025</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF</td>
<td>41.20915</td>
<td>11.69392</td>
<td>-2.924379</td>
<td>11.49288</td>
<td>354.4565</td>
<td>0.000000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GF</td>
<td>-15.46580</td>
<td>5.919695</td>
<td>0.291580</td>
<td>4.224303</td>
<td>6.129977</td>
<td>0.046654</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GNI</td>
<td>-6.55E+10</td>
<td>5.92E+11</td>
<td>0.843184</td>
<td>2.118828</td>
<td>12.06768</td>
<td>0.002396</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Variables above indicate:**

- EI: Energy Intensity
- NRC: Natural Resources Conservation
- FT: Fintech
- ES: Environmental Sustainability
- FI: Financial Inclusion
- FF: Fossil Fuel
- GNI: Gross National Income
- GF: Green financing

The Mean shows the average value for each variable. While the standard deviation tells the deviation from the sample mean. For the Jarque-Bera test, it measures the difference between the skewness and the kurtosis probability, as well as normality.
Skewness is also measured in the descriptive statistic test. If the skewness level is 0 than it is at normal distribution. While, if the skewness is greater than 1 it is considered long-right tail positive skewness. On the other hand, if the skewness is a negative value, it will be considered as a long-left tail skewness.

Kurtosis on the other hand is different. If the value of kurtosis is 3 it has normal distribution. Meanwhile, if the value is greater than 3 it will mean the dataset has heavier tails than a normal distribution. However, if the value is less than 3 the dataset has lighter tails than a normal distribution.

**Histogram:**

In the graphs below, a histogram test is provided for each variable individually. The histogram is an approximate representation of the distribution of numerical datasets. The histogram is a traditional way of displaying the shape of a group of data. It is constructed from a frequency distribution. The ideal shape to look for in the case of normality is a bell-shaped distribution.

**Energy Intensity**

Energy intensity is a measure of the energy efficiency of an economy. The activity or product that can be generated with a given quantity of energy is referred to as energy efficiency.

**Figure 1: Energy Intensity Histogram**
The Energy Intensity skewness is at -0.604325 that means long left tail skewness distribution and the kurtosis test is at 3.358510 at normal distribution.

**Natural Resources Conservation:**

Natural resource conservation is the process of rationally using, skillfully managing, and preserving the natural environment and all its resources.

**Figure 2: Natural Resources Conservation Histogram**

The skewness of the Natural resource conservation is a long right tail at positive skewness since it is greater than 1, at 1.113210. Whereas kurtosis has normal distribution since it is at 3.197428.
**Fintech:**

Financial technology is the use of technological innovation that competes with traditional financial techniques in the provision of financial services. It is a growing industry that employs technology to enhance financial activities.

**Figure 3: Fintech Histogram**

Skewness is -1.573515 meaning it is long-left tail skewness as it has a negative value. The kurtosis is greater than 3, at 8.087120 which means the dataset has heavier tails than a normal distribution.

**Environmental sustainability:**

Environmental sustainability is described as reasonable engagement with the environment to minimize resource depletion or destruction and to ensure long term quality.

**Figure 4: Environmental Sustainability Histogram**
Skewness level is at 0.358182, that means it is at normal distribution. Kurtosis is at 2.016973 less than 3 meaning the dataset has lighter tails than a normal distribution.

Financial Inclusion:

Financial inclusion is associated with the availability and accessibility of financial services. Such as banking, loan, equity, and insurance products.

Figure 5: Financial Inclusion Histogram

Normal distribution of skewness as the value is 0.405038. The dataset of kurtosis has lighter tails than a normal distribution as it is less than 3, at 2.108327.

Fossil fuel:
The main fossil fuels are coal, crude oil and natural gas. All containing carbon and were generated as a result of geologic processes reacting on organic materials left behind from photosynthesis.

**Figure 6: Fossil fuel Histogram**

Skewness will be considered as a long-left tail since it is negative at -2.924379. The kurtosis is greater than 3, at 11.49288 which means the dataset has heavier tails than a normal distribution.

**GNI (Gross national income):**

Gross national income is the total amount of money earned by a nation's people and businesses.

GNI=GDP+ (money flowing from foreign countries – money flowing to foreign countries)

**Figure 7: GNI Histogram**
Skewness is at normal distribution since it equals 0.291580. While kurtosis is greater than 3, at 4.224303 showing that the dataset has heavier tails than a normal distribution.

**Green financing:**

Green Financing is any structured financial activity that’s been created to ensure a better environmental outcome. It is important as it supports the flow of financial instruments and services.

**Figure 8: Green Financing Histogram**

Skewness is 0.843184 which equals to normal distribution. Meanwhile, Kurtosis is less than 3 at 2.118828 showing it has lighter tails than a normal distribution
**Unit root test**

The unit root test is used to examine the stationarity of data in a time series using an autoregressive model. It considered as a well-known test that is valid in large samples. So, this study uses Levin-Lin-Chu test for panel data. The null hypothesis, and the alternative one of LLC test for the data are:

1. **H0:** the data has a unit root and is non-stationary.
2. **H1:** the data does not have a unit root and is stationary.

**Table 4: Unit root test**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th>1st Difference</th>
<th>Stationarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Intensity</td>
<td>0.3404</td>
<td>0.0000</td>
<td>Nonstationary at level but stationary at 1st difference</td>
</tr>
<tr>
<td>Natural resources conservation</td>
<td>0.1060</td>
<td>0.0000</td>
<td>Nonstationary at level but stationary at 1st difference</td>
</tr>
<tr>
<td>Fintech</td>
<td>0.4566</td>
<td>0.0345</td>
<td>Nonstationary at level but stationary at 1st difference</td>
</tr>
<tr>
<td>Environmental sustainability</td>
<td>0.5528</td>
<td>0.0061</td>
<td>Nonstationary at level but stationary at 1st difference</td>
</tr>
<tr>
<td>Financial Inclusion</td>
<td>0.2248</td>
<td>0.0483</td>
<td>Nonstationary at level but stationary at 1st difference</td>
</tr>
<tr>
<td>Fossil fuel</td>
<td>0.4576</td>
<td>0.0000</td>
<td>Nonstationary at level but stationary at 1st difference</td>
</tr>
</tbody>
</table>
This table displays the unit root test of each variable and their stationarity. The Individual intercept and trend were applied for both at level and 1st difference. The unit root test is applied to check if the variable is stationary or nonstationary. Nonstationary data indicates that there will be a big jump in that data. Non-stationary data, in general, are unexpected and cannot be predicted or modeled. Stationarity refers to the fact that the statistical features of a time series do not vary with time. Stationarity is significant because it supports many valuable analytical techniques, statistical tests, and models.

If p-value > 0.05: Fail to reject the null hypothesis (H0)

If p-value <= 0.05: Reject the null hypothesis (H0)

Based on the results above the null hypothesis is rejected for all variables, indicating that those data series are stationary.

**Fixed effect model and Random effect model:**

A fixed effects model is a statistical model with fixed or non-random model parameters. While a random effect model is a statistical model where the model parameters are random variables. To know which model to use between the fixed and random effect model as Panel data is being used, the Hausman test needs to be tested. The Hausman test can be used to differentiate between
fixed effects model and random effects model in panel analysis. Hausman test evaluates the consistency of an estimator when compared to an alternative. However, due to the coefficient of the data being greater than the cross-sectional data it is not possible to test the random effect for this research. This indicates that the fixed effect model is more appropriate to portray the results of the available data of this study.

**Fixed effect model:**

A statistical regression model with fixed effects allows the regression model's intercept to differ freely among individuals or groups. It is frequently used with panel data to adjust for any individual-specific characteristics that do not change over time.

**Table 5: Fixed effect model table**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-1.231733</td>
<td>1.312936</td>
<td>-0.938152</td>
<td>0.3515</td>
</tr>
<tr>
<td>GNI</td>
<td>-0.002825</td>
<td>0.012804</td>
<td>-0.220662</td>
<td>0.8260</td>
</tr>
<tr>
<td>Natural Resource Conservation</td>
<td>0.080978</td>
<td>0.028387</td>
<td>2.852643</td>
<td>0.0057</td>
</tr>
<tr>
<td>Environmental sustainability</td>
<td>0.075268</td>
<td>0.040840</td>
<td>1.842982</td>
<td>0.0697</td>
</tr>
<tr>
<td>Fossil fuel</td>
<td>0.009647</td>
<td>0.005904</td>
<td>1.634132</td>
<td>0.1069</td>
</tr>
<tr>
<td>Fintech</td>
<td>0.007827</td>
<td>0.007685</td>
<td>1.018563</td>
<td>0.3120</td>
</tr>
</tbody>
</table>
In the fixed effect model table, we will analysis the Durbin-Watson statistic test. The Durbin-Watson statistic is a test for autocorrelation in the output of a regression model. The Durbin-Watson statistic has a value from 0 to 4, with a value of 2 signifying no autocorrelation. Where values less than 2 signify positive autocorrelation, and values greater than 2 signify negative autocorrelation.

In the fixed effect model, the Durbin-Watson test shows a value of 0.506642 indicating that autocorrelation is positive. Positive autocorrelation indicates that when a time interval increases, the delayed time interval increases proportionately.
The R-squared measures how well the regression model fits the observed data. The R-squared captures 43% of the data. This demonstrates that it has low effect size.

For linear models, adjusted R squared is a corrected goodness-of-fit (model accuracy) measure. It determines the percentage of variance in the target field explained by the input or inputs. R squared tends to estimate the fit of the linear regression. Adjusted R-squared can provide a more precise view of the correlation by also considering how many independent variables are added to a particular model. The Adjusted R squared is 34.93% this indicates that the additional input variables are not adding value to the model. The F statistics probability shows if jointly the independent variables can influence the dependent variable or not. If the probability is <0.05 it is significant and if it is >0.05 not significant. The F statistics probability is 0.000017 < 0.05 it means that the independent variables jointly have an influence on Energy Intensity the dependent variable.

**Major Findings:**

The major findings that answer the research question on the relationship and impact of energy efficiency hypotheses are as followed:

- Green Financing has a significant negative relationship on energy efficiency
- Financial inclusion has a significant positive relationship on energy efficiency
- Natural resource conservation has a significant positive relationship on energy efficiency
- Fintech has no impact on energy efficiency
- GNI has no impact on energy efficiency
- Environmental sustainability has no impact on energy efficiency
• Fossil fuel has no impact on energy efficiency

Discussion

This study took into consideration the effect of financial factors in comparison with different factors in energy efficiency to see if financial factors can have an impact on energy efficiency directly. The study considered four of the six GCC countries and the years from 2001 to 2020 to conduct this analysis. One dependent variable Energy Intensity and seven independent variables including the Natural resource conservation, Fintech, Environmental sustainability, Financial Inclusion, Fossil fuel, Gross national income, and green financing. My contribution was using the multiple linear regression model to find the relationship between several variables as well as using energy and financial factors that might have an influence on the dependent variable. As seen in the result section, it was concluded that while it might be possible to influence these different independent variables, R squared=0.4399 showed a weak or low effect size.

Chapter 5

5. Conclusion and recommendation

5.1 Limitation of the study

The time constraint is the first limitation of this research. Second, the primary source of data in this study was obtained from the World Bank database. However, information for all six GCC countries was unavailable. As a result of the lack of data for the six GCC nations, this study only included four countries from the periods of 2001 to 2020. Third, Lack of literature review on this topic in the GCC Countries.
5.2 Recommendation for future research

As some of the financial factors that were used in this study are relatively new in the GCC Countries, it might have affected the outcome of the study. Since the GCC countries are still growing, the aspect of financial technology and efficiency, it might take a couple of years to identify an effect of these variables on each other. However, 0.43% for new and rising factors in finance and energy efficiency can be consider a great lead. Which can be an opportunity for future studies to test the relationship between financial and energy efficiency tools on what factors may enhance each sector and the economic growth.

In conclusion, more financial and energy efficient variables can be taken into consideration for future studies. Applying the model to different countries such as the G20, may display a significant impact of the findings.


Local Energy Efficiency Benefits and Opportunities. (2021, July 14). US EPA.
https://www.epa.gov/statelocalenergy/local-energy-efficiency-benefits-and-opportunities#


https://doi.org/10.1016/0301-4215(96)00017-1
تأثير التكنولوجيا المالية والتمويل الأخضر والشمول المالي على كفاءة الطاقة والاستدامة في دول مجلس التعاون الخليجي

متطلبات الحصول على درجة الماجستير في العلوم المالية

وفق متطلبات جامعة عفت

إعداد

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إشراف

د. روزينا شاهين

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