Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Trade and Finance

Bachelor Thesis

The Impact of Adopting Renewable Energy Technologies on the Economic Growth in Kazakhstan

Almas Kaneshev

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Almas Kaneshev

Business Administration

Thesis title

The Impact of Adopting Renewable Energy Technologies on The Economic Growth in Kazakhstan

---

Objectives of thesis

The objective of this thesis is to analyze the current state of play in the domain of renewable energy sources in the country of Kazakhstan and in addition to this, to analyze the the effect of the renewable energy sources on the economic growth and development of the country.

Methodology

The thesis considers primarily quantitative techniques with the emphasis put on the secondary data collected from the World Bank data and other reports. The thesis employs the econometric estimation technique and also the technique of the time series analysis based on the time period between 1997 and 2020 using Gretl.

The proposed extent of the thesis

45-50

Keywords

Kazakhstan, renewable energy, economic growth, development, pollution, fossil fuels

---

Recommended information sources

Boute, A. (2020). Regulatory stability and renewable energy investment: The case of Kazakhstan. Renewable and Sustainable Energy Reviews, 121, 109673.

Jianzhong, X. U., Assenova, A., & Erokhin, V. (2018). Renewable energy and sustainable development in a resource-abundant country: Challenges of wind power generation in Kazakhstan. Sustainability, 10(9), 3315.

Karatayev, M., & Clarke, M. L. (2016). A review of current energy systems and green energy potential in Kazakhstan. Renewable and Sustainable Energy Reviews, 55, 491-504.

Karatayev, M., Hall, S., Kalyuzhnova, Y., & Clarke, M. L. (2016). Renewable energy technology uptake in Kazakhstan: Policy drivers and barriers in a transitional economy. Renewable and Sustainable Energy Reviews, 66, 120-136.

Mouraviev, N. (2021). Renewable energy in Kazakhstan: Challenges to policy and governance. Energy Policy, 149, 112051.

Expected date of thesis defence

2023/24 SS – PEF

The Bachelor Thesis Supervisor

Ing. Ghaeth Fandi, Ph.D.

Supervising department

Department of Trade and Finance

Advisor of thesis

MSc. Mohammad Rehabi

Electronic approval: 18. 10. 2023

prof. Ing. Luboš Smutka, Ph.D.

Head of department

Electronic approval: 9. 11. 2023

doc. Ing. Tomáš Šubrt, Ph.D.

Dean

Prague on 19. 02. 2024

Declaration

I declare that I have worked on my bachelor thesis titled "The Impact of Adopting Renewable Energy Technologies on the Economic Growth in Kazakhstan" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 15.03.2024 _____

Acknowledgement

I would like to thank Ing. Ghaeth Fandi, Ph.D. and all other persons, for their advice and support during my work on this thesis.

The Impact of Adopting Renewable Energy Technologies on the Economic Growth in Kazakhstan

Abstract

The objective of this thesis is to analyse the current state of play in the domain of renewable energy sources in the country of Kazakhstan and in addition to this, to analyse the effect of renewable energy sources on the economic growth and development of the country.

The thesis considers primarily quantitative techniques with an emphasis put on the secondary data collected from the World Bank data and other reports. The thesis employs the econometric estimation technique and also the technique of the time series analysis based on the time period between 1997 and 2020 using Gretl.

It is concluded that there is a strong positive degree of association between the adoption of renewable energy in Kazakhstan and the real GDP growth rate, thus confirming the main hypothesis of the study.

Keywords: Kazakhstan, renewable energy, economic growth, development, pollution, fossil fuels

Dopad přijetí technologií obnovitelné energie na hospodářský růst v Kazachstánu

Abstrakt

Cílem této práce je analyzovat současný stav v oblasti obnovitelných zdrojů energie v zemi Kazachstán, a kromě toho analyzovat vliv obnovitelných zdrojů energie na hospodářský růst a rozvoj země.

Práce se zabývá především kvantitativními technikami s důrazem na sekundární data shromážděná z dat Světové banky a dalších zpráv. Práce využívá techniku ekonometrického odhadu a také techniku analýzy časových řad na základě časového období mezi lety 1997 a 2020 pomocí Gretl.

Dospělo se k závěru, že mezi přijetím obnovitelné energie v Kazachstánu a mírou růstu reálného HDP existuje silná pozitivní míra asociace, což potvrzuje hlavní hypotézu studie.

Klíčová slova: Kazachstán, obnovitelná energie, hospodářský růst, rozvoj, znečištění, fosilní paliva

Table of Contents

1 Introduction 10

2 Objectives and Methodology 12

2.1 Objectives 12

2.2 Methodology 12

3 Literature Review 14

3.1 Renewable Energy 14

3.1.1 Concept 14

3.1.2 Climate Change and Renewable Energy 16

3.2 Economic Growth 18

3.3 Economic Situation in Kazakhstan 21

4 Practical Part 24

4.1 Concept 24

4.2 Economic Model and Data Collection 24

4.3 Estimation and Verification 32

5 Results and Discussion 38

6 Conclusion 40

7 References 42

List of pictures

Figure 1, the chart of GDP growth, inflation and unemployment 27

Figure 2, the chart of renewable energy consumption 29

Figure 3, the chart of oil prices 29

Figure 4, the correlation matrix 31

Figure 5, the estimated model 32

Figure 6, fitted and actual values 34

Figure 7, the econometric verification of model 35

List of tables

Table 1, the collected dataset 26

Table 2, the table of elasticities 36

List of abbreviations

GDP	Gross Domestic Product
CPI	Consumer Price Index
PPP	Purchaser Power Parity
COVID-19	Coronavirus-19
SEZ	Special Economic Zone
FDI	Foreign Direct Investment
SME	Small and Medium Enterprises
PV	Solar Photovoltaic
OLS	Ordinary Least Squares
BECCS	Bioenergy with Carbon Capture and Storage
UNFCCC	United Nations Framework Convention on Climate Change
HDI	Human Development Index
HPI	Human Poverty Index
GNP	Gross National Product
GVA	Gross Value Added
GNI	Gross National Income

1 Introduction

The urgent need to confront the issues posed by climate change and its consequences on economic and environmental sustainability has progressively captured the attention of people all around the world over the course of the past several decades. The widespread implementation of technology that generates renewable energy is one of the most important steps that can be taken to lessen the impact of the negative impacts of climate change. This has caused a paradigm change in many different nations, including Kazakhstan, where policymakers and stakeholders are now actively searching for feasible solutions to transition towards a low-carbon economy. Incorporating technology that runs on renewable energy sources has the potential not only to lower emissions of greenhouse gases and ensure that the environment will remain habitable for future generations but also to propel economic growth and progress (Houghton, 2005).

Kazakhstan is a country that is plentiful in natural resources and has a large potential market for renewable energy sources; as a result, the country has begun an ambitious plan to adopt environmentally friendly energy practices. Kazakhstan is a significant participant in Central Asia; hence, the country's energy industry is extremely important to the country's overall economic growth and influence in the area. As a result, there is a great interest, both academically and practically, in investigating the possible influence that Kazakhstan's adoption of renewable energy technology might have on the country's economic growth. The purpose of this research is to make a contribution to the existing body of knowledge by using econometric estimating and time series analysis to investigate the connection that exists between the implementation of renewable energy technology and the expansion of the economy in the setting of Kazakhstan (Karatayev & Clarke, 2014).

The primary impetus behind carrying out this investigation is borne from an intense worry about the long-term viability of Kazakhstan's economy and the lives of Kazakhstan's children and grandchildren. The researcher is a native of Kazakhstan, and as such, he has a strong sense of duty to contribute to the development of his home country while also working to address urgent problems on a worldwide scale, most notably climate change. In order to guide Kazakhstan towards a future that is both more sustainable and affluent, it is essential for the country to have a solid understanding of the possible economic ramifications of

making the shift towards renewable energy technology. In addition, the researcher's own interest in economics and environmental studies highlights the significance of examining the link between the utilisation of renewable energy sources and the expansion of the economy. The purpose of the study is to provide significant insights to stakeholders operating in both the academic and policy worlds in order to help bridge the gap that currently exists between the two.

Utilising econometric estimates and time series analysis, the purpose of this study is to investigate the effect that Kazakhstan's adoption of renewable energy technology could have on the country's overall rate of economic expansion. The research hopes that by doing so, it would be able to provide useful direction to policymakers, boost investor confidence, and add to the expanding body of knowledge on sustainable development and energy economics. In the end, it is intended that the findings will help influence decision-making that is based on facts, so encouraging a future that is cleaner, more resilient, and affluent for Kazakhstan and its population.

2 Objectives and Methodology

2.1 Objectives

This bachelor's thesis seeks the main objective of identifying if the degree of association between the economic expansion of a country located in Central Asia and the contribution of renewable energy sources is strong. The studied country is Kazakhstan, which was a part of the Soviet Union for nearly a century and started its independent development in the early 90s. The thesis does also have a series of sub-objectives that involve the time series analysis of the recent economic performance of the Kazakh economy and the formulation of an econometric model that will perfectly capture the development of the country's real GDP.

Henceforth, it is possible to reformulate the previous paragraph into two primary hypotheses that will be tested using the methodology implemented in the analysis. These hypotheses are:

1) There is a statistically significant relationship between the economic growth in Kazakhstan and the share of renewable energy.
2) The Kazakh economy has experienced a very favourable period starting from its independence until the present day, which can be noticed in the outstanding performance of the main indicators – inflation, unemployment and the GDP growth rates.

2.2 Methodology

The methodology employs two fundamental methods – qualitative and quantitative. Qualitative methods are represented by the literature review, where relevant and recent publications are critically assessed and compared with each other – this will help to lay the foundation for the empirical research conducted in the final chapters of the bachelor thesis.

The quantitative analysis is represented by both time series and econometric analyses, where the data from the World Bank is used, covering the period of 24 years – from 1997 to 2020, which is explained by the logical considerations of the study and also by constraints created by the data unavailability. Ultimately, the method used for the linear estimation is

the OLS, which stands for the ordinary least squares method. The application used for the estimation is Gretl.

3 Literature Review

3.1 Renewable Energy

3.1.1 Concept

The necessity to slow the progression of climate change and lessen reliance on finite fossil fuel supplies has been a driving force behind the enormous shifts that have been taking place in the global energy environment over the past several decades. Renewable forms of energy have recently come to the forefront as a potentially effective approach to these difficulties since they provide environmentally friendly alternatives to more conventional forms of energy delivery. This chapter dives into the many facets of renewable energy, including topics such as its relevance, recent technology breakthroughs, legislative frameworks, and future possibilities (Change, 2018).

The use of renewable sources of energy is critical to the goals of achieving energy independence, protecting the environment, and fostering economic growth. In contrast to fossil fuels, renewable energy sources including sun, wind, hydro, geothermal, and biomass make use of naturally regenerating resources. As a result, the generation of energy from these sources is both cleaner and more environmentally friendly. Renewable energy makes a contribution to the fight against climate change and to the accomplishment of global climate objectives by dramatically lowering emissions of greenhouse gases. In addition, because it is decentralised, it promotes energy independence and resilience, which ultimately helps to enhance the energy infrastructure as a whole (Gross et al., 2003).

Over the course of the past several years, considerable progress has been achieved in the research, development, and implementation of many renewable energy technologies. Solar photovoltaic (PV) systems have seen exponential growth in recent years. As a result of increased efficiency and decreasing prices, these systems are now considered a viable energy source for both household and utility-scale applications. Wind power has also experienced significant progress thanks to the development of wind turbines with larger rotors, better blade designs, and grid integration that is more effective. The advent of energy storage technology like batteries, for example, has significantly improved the dependability and dispatch ability of systems that rely on renewable energy sources (Dincer, 2000).

The widespread adoption of renewable energy sources has been helped along by a variety of regulatory frameworks and incentive programmes that have been adopted by governments all over the world. Investment in renewable energy projects has been encouraged by a variety of policies and programmes, including feed-in tariffs, renewable portfolio requirements, tax credits, and subsidies. In addition, the implementation of carbon pricing systems has helped to further incentivize the shift away from the use of fossil fuels. Countries have been compelled to make commitments to renewable energy objectives and collaborate on climate change mitigation initiatives as a result of international accords such as the Paris Agreement (Twidell, 2021).

Although there is a tremendous amount of untapped potential in renewable energy, there are also a number of obstacles and problems that prevent its widespread use. Intermittency is one of the most significant obstacles, as the generation of energy from solar and wind sources is subject to the prevailing climatic circumstances. Because of this, we need energy storage solutions that are effective as well as flexible grid management. In addition, the high initial capital expenditures associated with renewable energy projects may discourage investment, particularly in countries that are still emerging. Innovative solutions as well as ongoing research and development are required in order to address these difficulties (Bull, 2001).

Challenges in terms of both technical and operational complexity are presented by the integration of renewable energy sources into the world's current energy infrastructure. Due to the intermittent nature of renewable energy sources, it is necessary to have a grid that is both flexible and intelligent in order to achieve supply and demand parity. Tools for advanced grid management, methods for demand response, and technological solutions for energy storage are necessary components for facilitating smooth integration. In addition, combining renewable energy sources with other types of clean energy technology, such as the creation of green hydrogen, can help the move away from fossil fuels (Lund, 2007).

Given the consistent leaps in technological capability and governmental frameworks that are supportive of the industry, there is reason to be optimistic about the future of renewable energy. In the future decades, renewable energy is expected to become more cost-

competitive than other forms of energy and gain market share. This will position it to take the lead in the global energy landscape. Research into novel renewable energy technologies, such as solar cells of the next generation, floating offshore wind farms, and bioenergy with carbon capture and storage (BECCS), has the potential to revolutionise the energy sector even more (Kaltschmitt et al., 2007).

Renewable energy is an essential component of sustainable development because it provides an environmentally preferable, more trustworthy, and commercially practicable alternative to the use of fossil fuels. Despite the fact that the world is working to battle climate change and move towards a future with lower carbon emissions, it is nevertheless vital that renewable energy sources have their potential fully realised. Accelerating the transformation towards renewable energy sources and paving the path towards a cleaner and more resilient energy future may be accomplished by societies through the promotion of technical innovation, the enactment of supporting laws, and the promotion of international collaboration (Da Rosa & Ordóñez, 2021).

3.1.2 Climate Change and Renewable Energy

The effects of climate change are one of the most critical problems that humanity must solve in the 21st century. Burning fossil fuels and other human activities have led to an unprecedented increase in greenhouse gas emissions, which in turn has led to an increase in average global temperature, an increase in the frequency and severity of extreme weather events, an increase in sea level, and other negative effects on the ecosystem. In this chapter, we will investigate the complex link that exists between climate change and renewable energy. We will place particular emphasis on the significant part that renewable energy sources play in reducing the negative consequences of climate change and in making the transition to a more sustainable energy future (Olabi & Abdelkareem, 2022).

The overwhelming agreement among scientists about climate change underlines the critical need for quick and extensive action. The effects of a warming globe are widespread and severe, ranging from an increase in the frequency and severity of heatwaves, droughts, and wildfires to the thawing of polar ice caps and changes to ecosystems. It is vital that dramatic reductions in greenhouse gas emissions be made in order to avert results that might be catastrophic and bring global warming down to tolerable levels. It is possible to

considerably reduce greenhouse gas emissions and put a stop to the acceleration of climate change by switching to renewable sources of energy (Owusu & Asumadu-Sarkodie, 2016).

Because they result in a significant cut in emissions of carbon dioxide and other greenhouse gases, renewable forms of energy are an essential component of climate change mitigation strategies. Solar and wind power both create electricity without releasing greenhouse gases into the atmosphere. When sustainably produced, biomass energy and biofuels, on the other hand, can provide an option that is carbon neutral. The widespread implementation of renewable energy technologies has the potential to supplant the use of fossil fuels in a variety of industries, such as the generation of electricity, the transportation industry, and the heating industry. This can assist in bringing the emissions curve down and putting a cap on the rise in global temperature (Sims, 2004).

Transitioning to an economy with lower levels of carbon emissions is essential to meeting climate targets and reducing the rate of global warming. Renewable energy is at the forefront of this transformation because it provides an alternative to fossil fuels that is both environmentally friendly and sustainable. As the technologies that generate renewable energy continue to improve and become more cost-effective, they make it possible for nations and industries to transition away from carbon-intensive practices. Investing in the infrastructure of renewable energy sources also encourages economic growth, the creation of new jobs, and increased energy security, which further propels the transition to a more sustainable future (Quaschning, 2019).

In addition to lowering emissions of greenhouse gases, renewable sources of energy also contribute to increased climate resiliency and adaptability. Because of climate change, there has been a rise in the amount of weather variability and extreme occurrences, which has an effect on the supply and infrastructure of energy. When paired with energy storage, decentralised renewable energy systems have the potential to increase energy resilience in the face of catastrophic weather events and power outages. In addition, irrigation and water management systems that are driven by renewable sources of energy might be of assistance to farmers in adapting to shifting climatic circumstances and mitigating the risks associated with water shortages (Moomaw et al., 2011).

Although there are many advantages to using renewable energy, there are still several obstacles in the way of its general acceptance. Among the many obstacles that stand in the way of a smooth transition to renewable energy are unpredictability in policy and regulation, insufficient investment in infrastructure, and opposition from industries that rely on fossil fuels. In order to overcome these obstacles, governments, international organisations, and the private sector will need to work together to provide supportive and stable legislative frameworks, financial incentives, and investment in research and development (Edenhofer, 2011).

To effectively combat climate change, international collaboration and climate diplomacy are required. In order to successfully implement renewable energy sources, the global community has to join together and share information on successful strategies, technologies, and experiences. Climate change conventions and initiatives, such as the United States Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, play a significant part in developing international collaboration and pushing states to raise their commitments to the use of renewable energy sources (Lin & Zhu, 2019).

The linked relationship between climate change and renewable energy sheds light on the crucial part that renewable energy plays in the fight against the worldwide climate problem. Renewable sources of energy provide a potentially game-changing approach to mitigating the effects of climate change and ensuring a more secure and prosperous future. This can be accomplished through the reduction of emissions of greenhouse gases, the improvement of climate resilience, and the promotion of sustainable economic growth. It is vital for governments, organisations, and individuals to come together to embrace renewable energy solutions and work together on a global scale to expedite the transition to clean energy in order to create a meaningful effect (Sen, 2008).

3.2 Economic Growth

Although the terms "economic growth" and "development" are sometimes used interchangeably, they really refer to two separate notions in the context of the progression of a nation. Economic development comprises a wider set of indicators than economic growth does, including increases in living standards, education, healthcare, and general well-being. Economic growth refers to the increase in a country's output of goods and services

through time, whereas economic development refers to a country's total well-being. This chapter investigates the distinction between economic growth and development, investigates the important indicators for assessing each, and places an emphasis on the significance of sustainable development for long-term prosperity (Lewis, 2013).

The qualitative and quantitative aspects of an economy's expansion are at the heart of the concept of economic growth. It is frequently assessed by the Gross Domestic Product (GDP), which measures the total value of all products and services generated within a country's boundaries in a certain period of time. Growth in the economy reflects not only the rate of economic activity but also the degree of industrialization and the rate of innovation in technology. On the other hand, economic progress encompasses more than just a growth in GDP on its own. It involves qualitative gains in a variety of different facets of human existence, such as education, healthcare, infrastructure, economic distribution, and environmental sustainability. Although economic growth is an essential component of economic development, the latter places a greater focus on factors such as environmental considerations, social advancement, and inclusion (Jorgenson, 1991).

The Gross Domestic Product (GDP) is the major statistic that is used for gauging the expansion of the economy. The Gross Domestic Product (GDP) is computed using three distinct methodologies: production, income, and spending techniques. It offers a snapshot of the economic production of a country during a given time period as well as the monetary worth of all of the products and services that were produced during that time period. Additional indicators, such as Gross National Product (GNP), Gross National Income (GNI), and Gross Value Added (GVA), provide insights on economic expansion that are complimentary to those provided by these three. Even if economic development is necessary for boosting the standard of living and making improvements to the infrastructure, it does not necessarily ensure a more fair distribution of income or an improvement in the well-being of society (Klasen, 2008).

A wider variety of metrics that represent the general health and happiness of a nation's people are included in the process of economic growth. The Human Development Index (HDI) is a composite statistic that is commonly used. It takes into account a variety of criteria, including life expectancy, education (which is assessed by literacy rate and school

enrolment), and per capita income, among other things. The Human Development Index (HDI) offers an analysis of human progress that goes beyond the influence of economic variables alone. The Gini coefficient, which assesses the degree of economic inequality, and the Human Poverty Index (HPI), which evaluates poverty from a variety of perspectives, are two more examples of indicators. Indicators concerning access to healthcare, sanitation, education, and basic infrastructure all play a part in determining the level of economic growth and societal advancement (Busu & Trica, 2019).

The key to long-term success that benefits all segments of society is to strike a healthy equilibrium between economic expansion and social progress. Unchecked economic expansion can result in the destruction of the environment, the depletion of resources, and a rising income gap between different groups of people. A primary objective of sustainable development is to fulfil the requirements of the here and now without jeopardising the capacity of future generations to do the same. For the purpose of supporting economic development, it is vital to enact policies that encourage ecologically friendly practises, address income inequality, invest in education and healthcare, promote inclusive growth, and invest in education and healthcare. In addition, a strong social safety net and actions that are specifically directed towards vulnerable people can assist to the reduction of poverty and the improvement of general well-being (Hanusch, 2011).

The promotion of equitable and environmentally responsible expansion of the economy is one of the primary contributions that renewable energy sources provide to the overall economy. Putting money into the infrastructure of renewable energy sources results in the creation of new jobs, the stimulation of economic activity, and reduced reliance on imports of expensive fossil fuels. In addition, decentralised renewable energy solutions have the potential to improve energy access in rural and underserved locations, therefore stimulating economic growth and enhancing people's standard of living. For the purpose of establishing successful policies and plans for nation-building, it is essential to have a solid understanding of the contrast between economic growth and economic development. Economic development refers to the process of achieving qualitative gains in areas such as living standards, education, healthcare, and general well-being, in contrast to the numeric increase that is the primary emphasis of economic growth. A complete collection of indicators that go beyond GDP to incorporate issues linked to human development, income distribution,

and environmental sustainability is required in order to accurately measure progress. These indicators are required for measuring progress. Societies may encourage equitable prosperity while also protecting the environment and guaranteeing a brighter future for future generations if they prioritise sustainable development and use renewable energy as a catalyst for economic growth. This can be accomplished by making sustainable development a priority and using renewable energy as a catalyst (Levine & Zervos, 1998).

3.3 Economic Situation in Kazakhstan

Kazakhstan, which is the biggest landlocked country in the world, is home to an abundance of natural resources and is strategically located in Central Asia. The nation has gone through major political and economic upheaval ever since it gained its independence in 1991. This chapter looks at the economy of Kazakhstan, focusing on its primary industries, the issues it has, and the steps it is taking to diversify its economy and achieve sustainable growth (Macerinskiene & Sakharova, 2011).

Throughout its history, Kazakhstan's economy has been primarily based on the extraction and sale of its natural resources, notably oil and gas. The abundance of reserves in the country has helped bring in significant amounts of income and revenues from exports, as well as investments from outside the country. However, because of this excessive reliance on the energy sector, the economy is now vulnerable to swings in commodity prices and the dynamics of the global market. Kazakhstan has made significant strides in recent years towards its goal of diversifying its economy and reducing its reliance on natural resource exports. To encourage the growth of industries other than oil and to bring in foreign direct investment (FDI), the government has enacted a number of economic reforms and investment incentives in recent years (Nurlanova et al., 2017).

In essence, it is possible to present the list of the most important economic subsectors and industries in the country:

1. Petroleum and Natural Gas: The petroleum and natural gas industry continues to be a pillar of Kazakhstan's economy. The nation is one of the leading oil producers in the world, and it has several important projects going on in the Caspian Sea region. Partnerships with foreign oil corporations have made the

transfer of knowledge and technology easier, which has contributed to greater production as well as expanded capacity for export (Jumadilova, 2012).

2. Mining: In addition to its substantial deposits of oil and gas, Kazakhstan also holds considerable amounts of other minerals and metals, including coal, uranium, copper, and gold. The mining industry is extremely important to the country's overall economic growth and to the growth of its industrial base (Mahmood & Orazalin, 2017).

3. Agriculture: Kazakhstan is home to extensive agricultural grounds, which makes agriculture an important industry for the nation's overall food security as well as chances for international trade. Cereals like wheat, barley, and a variety of other grains are one of the most important products of agriculture (Tokbergenova et al., 2018).

4. Manufacture: The government has been quite active in encouraging both the process of industrialization and the growth of various manufacturing enterprises. The sectors of machinery, chemicals, and light manufacturing are the primary focuses (Turkyilmaz et al., 2021).

On the other hand, Kazakhstan's economy is very vulnerable to the cyclical nature of global energy markets due to the country's substantial reliance on oil and gas income. This threat will be mitigated if the nation is successful in its efforts to diversify its sources of revenue by cultivating industries that provide value-added goods and services. Infrastructure Development: Despite great progress in the development of infrastructure, notably in metropolitan areas, Kazakhstan still confronts obstacles in the enhancement of transport networks and the efficiency of logistical operations, particularly in more rural locations. The development of human capital is vital for achieving both economic diversification and sustainable growth. Doing so requires the creation of a labour force that is highly educated and talented. In order to satisfy the requirements of a contemporary and diverse economy, Kazakhstan has been making investments in education and vocational training. Access to Finance: Ensuring that small and medium-sized businesses (SMEs) have access to financing is one of the most important things that can be done to encourage entrepreneurship and

innovation. The government is aiming to enhance the financial ecosystem and give greater access to finance for new businesses and small and medium-sized enterprises (SMEs) (Mukhtarova et al., 2017).

The government of Kazakhstan has devised long-term development policies with the goals of achieving economic diversification and maintaining sustainable growth. Initiatives with names like "Nurly Zhol" (Path to the Future) and "Nurly Zher" (Comfortable Housing), among others, are geared towards the construction of new buildings and the enhancement of the standard of living of the populace. In addition, the "Digital Kazakhstan" programme places an emphasis on the utilisation of digital technology and innovation in order to propel the country's economic development. In order to entice foreign direct investment (FDI) and to foster the expansion of industries other than oil, Special Economic Zones (SEZs) and industrial parks have been developed. The geographic location of the nation at the crossroads of Europe and Asia gives great prospects for transit and logistics. These opportunities are currently being capitalised on by the government through projects such as the "Nurly Zhol" infrastructure programme (Harutyunyan, 2022).

Since the country's independence was achieved, Kazakhstan's economy has made significant progress. The abundance of natural resources in the country has served as a sturdy basis for the nation's economic expansion and cultural advancement. Nevertheless, the focus of the government on economic diversification and sustainable growth indicates its commitment to decreasing dependency on the energy industry and developing an economy that is more resilient and varied. Kazakhstan's goal is to become a competitive competitor in the global economy by using its resources and strategic position. To achieve this goal, the country plans to implement strategic reforms, expand its infrastructure, and invest in its human capital. Kazakhstan is laying the groundwork for a thriving and environmentally responsible economic future by promoting innovative ideas and practises, supporting and promoting entrepreneurial endeavours, and embracing digital technology (Korgan et al., 2019).

4 Practical Part

4.1 Concept

One of many ways to understand the degree of association between the adoption of renewable energy sources is an econometric analysis, where the quantitative effect, as well as the direction of the relationship, will be estimated thanks to mathematical techniques and formulae. Therefore, an econometric model will be created, which will incorporate a mix of both economic and non-economic variables, where the former will represent the domain of economics and the latter will represent the energy domain.

After the estimation of the model, a pertinent verification process will be conducted, during which the statistical significance of each parameter will be assessed. Overall, the following subchapters are dedicated to individual steps of the linear estimation process.

4.2 Economic Model and Data Collection

The very first step of constructing any linear regression model is the collection of relevant economic theories about the phenomenon that is being estimated. Given the context of the research and the fact that the literature review has already helped to form the basis for the analysis, it is possible to already come up with a solid economic model that could be estimated.

Quite logically, when assessing any economic effect, the very first variable that comes to one's mind is GDP growth, which is an ultimate indicator reflecting either an economic expansion or economic recession. However, there are many different approaches to measuring the GDP, such as the per capita approach, real deflator approach, nominal approach and the PPP approach. For the purpose of capturing all movements in the production of the country, the real GDP indicator is incorporated, which is then transformed into the variable of chain indices representing the percentual change compared to the previous period.

One of the most important variables incorporated into the model but this time on the right side of the equation is the consumption of renewables. This variable is one of the most

important ones because it directly reflects the rate of adoption of renewable energy sources in Kazakhstan, so its presence is downright crucial in the context of the analysis. Consumption is selected because consumption is a crucial element connecting the production of energy and economic output.

The inflation rate is a crucial indicator that reflects price stability, which is tied to the economic well-being and purchasing power of individuals. This variable belongs to the list of 4 primary macroeconomic indicators that are usually used when assessing individual economies. Yet, it is vital to specify that there are 2 different approaches to measuring the inflation rate – the CPI approach and the GDP deflator one. The CPI approach is selected for this analysis due to its relative simplicity and straightforward logic behind the calculation.

The unemployment rate is among the most important and fundamental variables that describe any economic process. Unemployment's contribution to economic growth is often regarded as one of the strongest ones due to the fact that as more and more people are getting employed in a specific economy, this traditionally results in more disposable income and it drives the expenditure function up, which was regarded as the main driver behind an economic growth, according to Keynesian economics.

Oil price is a crucial indicator in the thesis because the Kazakh economy was often regarded as an oil-based one, where the country puts a huge emphasis not just on oil export but also on the utilization of the commodity for the generation of energy (fossil fuel energy). Henceforth, the variable is implemented in the thesis as well in order to assess its degree of association with the GDP growth in the country.

Consequently, when grouping all of the aforementioned indicators together, the final result is the following economic model:

$$\Delta GDP = f(C_r, U, \pi, P_o)$$

Yet, it is downright essential to focus on another important aspect that does also contribute to the study in a significant way – data. Traditionally, the quality of data reflects

the quality of an econometric estimation since with incorrect or inaccurate data, there is no way to approach the true parameters. For this purpose, one of the best datasets offering data for all important industries and dimensions is implemented – the World Bank. There is no doubt about the accuracy of the dataset since almost an entire century, the institution was downright helpful in describing the most important economic phenomena. Thanks to the World Bank, the dataset was finally created, which can be found in Table 1.

Table 1, the collected dataset

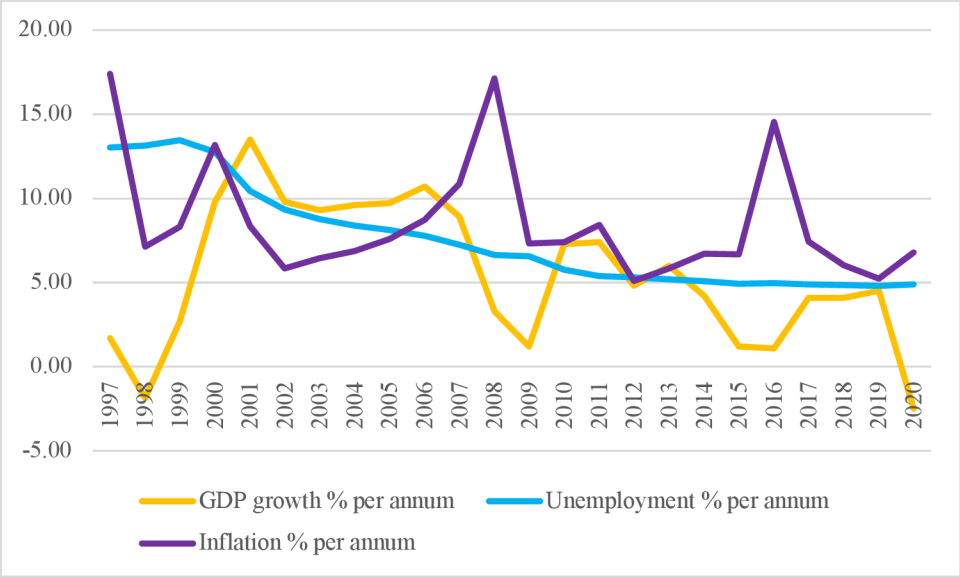
Year	GDP growth	Renewable Energy Consumption	Unemployment	Inflation	Oil Price
	% per annum	% per annum	% per annum	% per annum	$/barrel
1997	1.70	1.67	13.01	17.41	19.11
1998	-1.90	1.54	13.13	7.15	12.76
1999	2.70	1.79	13.46	8.30	17.90
2000	9.80	2.50	12.75	13.18	28.66
2001	13.50	2.41	10.43	8.35	24.46
2002	9.80	2.77	9.33	5.84	24.99
2003	9.30	2.28	8.78	6.44	28.85
2004	9.60	1.89	8.40	6.88	38.26
2005	9.70	2.09	8.13	7.58	54.57
2006	10.70	2.13	7.79	8.72	65.16
2007	8.90	1.83	7.26	10.85	72.44
2008	3.30	1.15	6.63	17.14	96.94
2009	1.20	1.31	6.55	7.32	61.74
2010	7.30	1.38	5.77	7.40	79.61
2011	7.40	1.38	5.39	8.42	111.26
2012	4.80	1.33	5.29	5.10	111.57
2013	6.00	1.16	5.20	5.85	108.56
2014	4.20	1.34	5.06	6.71	98.97
2015	1.20	1.72	4.93	6.67	52.32
2016	1.10	2.07	4.96	14.55	43.64
2017	4.10	2.01	4.90	7.44	54.12
2018	4.10	1.88	4.85	6.02	71.34
2019	4.50	1.85	4.80	5.25	64.30
2020	-2.50	1.78	4.89	6.77	41.96

Source: The World Bank, 2023

The data is collected based on both logical considerations and the availability. The data for the most indicators was available up to 1993, but it is essential to understand that the

time period between 1991 and 1997 was significantly obscured by the ongoing process of economic liberalization, so the real picture was somewhat distorted mainly due to the presence of astonishingly high unemployment and inflation rates well above the level of 100 and even 200 per cent, which was a normal thing back then. After dedicating a portion of the subchapter to the explanation of the background information about the dataset, it is equally important to focus on the development of the selected variables over time, which will be done with the help of time series plots. There will be a single time series plot for three variables – unemployment, inflation and GDP growth due to the fact that they all employ the percentages and represent the economic side of the analysis, so the chart with the plot is presented in Figure 1.

Figure 1, the chart of GDP growth, inflation and unemployment



Source: own analysis performed by the author on the basis of The World Bank data

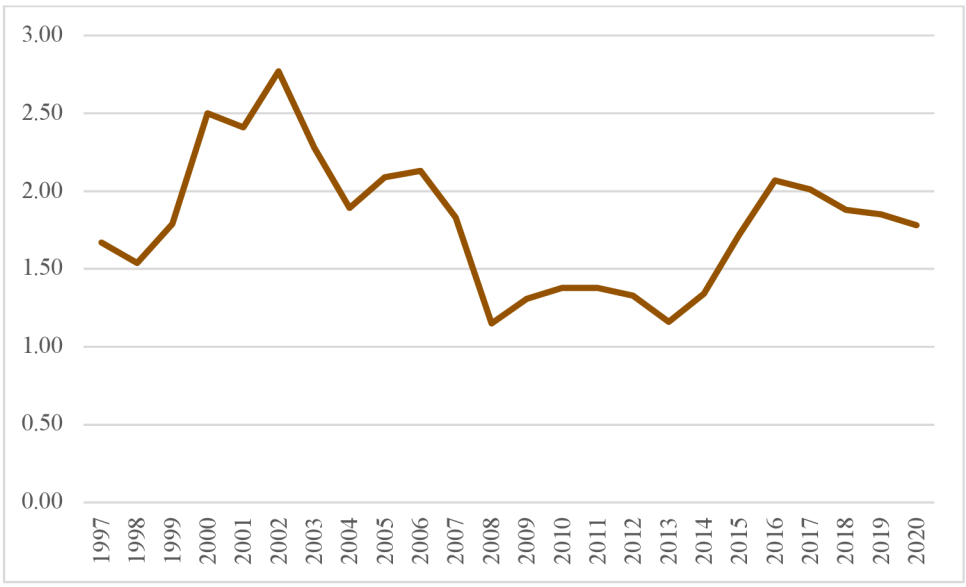
First, the development of the GDP growth variable in Kazakhstan was favourable for the majority of years with minor exceptions in 1998 and 2020. The first case was the year 1998 when the whole Post-Soviet Space was suffering from a period of hyperinflation and economic uncertainty. Furthermore, there is a logical dependency between Kazakhstan and the Russian Federation that lasted right after the collapse of the Soviet Union. This dependency is traditionally represented by the fact that the Kazakh national currency seems to behave itself in a similar way to the Russian ruble, meaning that for every significant period of depreciation of the Russian domestic currency, the tenge seems to follow, which

arises from the fact that Kazakhstan was considered to be dependent on the former country in all aspects of its independent economic life, which might not fully be true, but the financial market often follows individual perceptions and stereotypes rather than the economic logic. Returning to the year 1998, this was the year when the financial crisis in Russia broke out, leading to the devaluation of the ruble, which had its implications on the Kazakh economy and raised concerns about the country's solvency. The reason behind the recession in 2020 is pretty clear – the pandemic of COVID-19 nearly destroyed the world economy, so facing a recession in that year could not be seen as something special or extraordinary. Nevertheless, the pace at which the Kazakh economy was developing is favourable with two-digit figures for the period between 2000 and 2008.

Following the economic success in early 2000, when the first liberal reforms started to work, production increased and firms started to expand, which resulted in the declining share of unemployment in the country. Furthermore, as the country entered into a period of rapid economic expansion, it inevitably attracted foreign investors who opened branches of their companies in Kazakhstan, improving the overall situation with human capital and further decreasing the unemployment rate in the country. However, it might become the case that the unemployment rate will rise over time if the effect of the most recent economic crisis caused by the Russian invasion of Ukraine will become quite negative for the whole Post Soviet Space.

On the other hand, the price stability in Kazakhstan was not as favourable and good as the chart reveals. On one hand, this is a natural process for a developing economy, when the population experiences a gradual increase in the amount of disposable income on an annual basis, thus leading to the demand-pull type of inflation. On the other hand, the policy of the Kazakh Central Bank could have been much more effective, leading to the inflation rate below 10 per cent, which happened just during short periods of time in the middle of the 00s and in the period between the Great Recession and the shift towards the gloating exchange rate regime in 2015-2016. The next variable to be addressed in the narrative is the consumption of renewables, which can be observed in Figure 2.

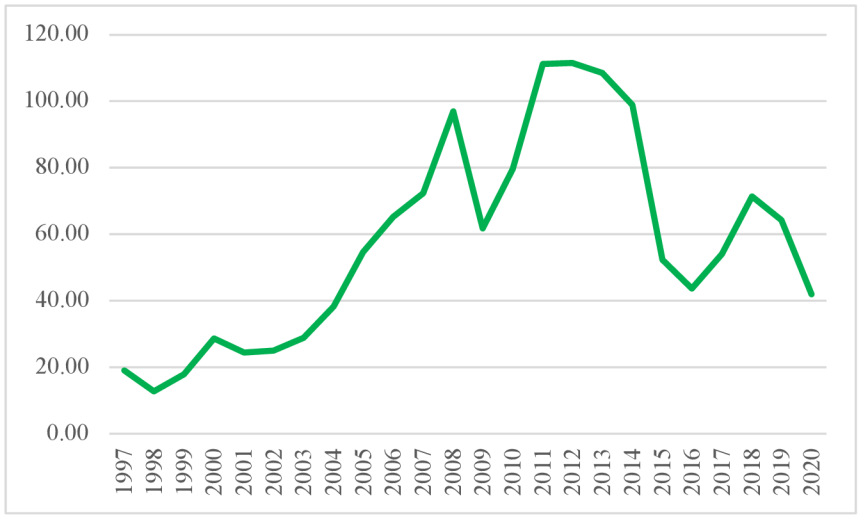
Figure 2, the chart of renewable energy consumption



Source: own analysis performed by the author on the basis of The World Bank data

The share of renewables remained static for most of the studied period, where the surges in the share happened just at the beginning of the new millennium and century – the share reached its peak in 2002, until eventually dropping to the historical low in 2008-2013. Overall, little effort was made by Kazakhstan in regard to renewable energy, if one judges by the situation observed in the chart. The final variable – the price per barrel of oil, can be found in Figure 3.

Figure 3, the chart of oil price



Source: own analysis performed by the author on the basis of The World Bank data

Before addressing the time series plot of the final variable, it is essential to note that Kazakhstan is in no position to influence the international price of oil. Notably, there is just one country whose reserve in the production capacity allows it to instantly influence the world price in case of significant changes in the tendency of production – Saudi Arabia. Instead, Kazakhstan enjoys benefits from the spillover of Saudi policy, when the kingdom decides to cut their production thus forcing the price to go up. Undeniably, it is expected that increases in the price of oil are likely to yield good results for the country's exports. In addition, it is important to specify that there are still other major factors that can prompt the price of oil to move in one direction or another, such as financial crises (2007-2009) and the pandemic of coronavirus that resulted in a significant decrement in the price of the commodity. After addressing all variables, it is essential to formulate an econometric model that will help to reach the goals and objectives of this bachelor thesis.

$$\Delta GDP_t = \beta_0 + \beta_1 C_{rt} + \beta_2 U_t + \beta_3 \pi_t + \beta_4 P_{ot} + \beta_5 t + \mathcal{E}_i$$

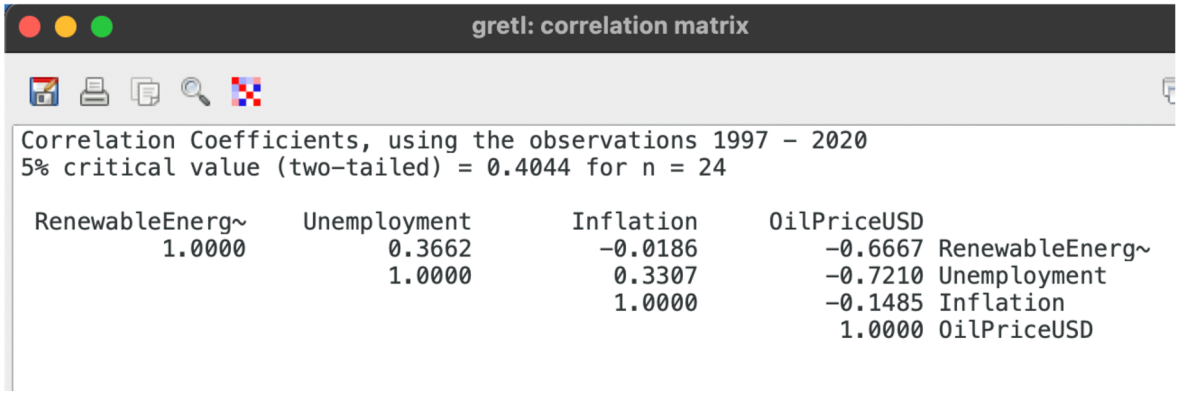
The econometric model that is being estimated cannot surely be classified as a simple regression model due to the presence of 6 regressors. The very first parameter represents the constant term, which usually indicates the average level of the dependent variable once other predictors are equal to zero. The first parameter is dedicated to consumption, and it is expected that it will be positive, meaning that a positive development in the consumption of renewables leads to a positive effect on the GDP growth in Kazakhstan. The third parameter is the parameter of the unemployment rate, and it is projected that it will be negative because there is no way for the unemployment rate to produce a positive effect on GDP growth simply because it will violate the very foundation of the economic theory. The same applies to the fourth parameter, which represents the effect of the inflation rate – it is projected that the sign will be strictly negative due to the damage that any surges in the inflation rate have on the purchasing power of the population. The fifth parameter is the parameter of the oil price, and it is expected that it will be positive because Kazakhstan is an oil-exporting country.

The model does also have 2 additional parameters, where the first one is deterministic. It is suggested that the GDP growth in Kazakhstan follows a particular short-run trend, where the country faces a decrease in the pace of economic growth due to diminishing returns on

capital and investment in the country. Therefore, it is suggested that the sign of the linear trend will be negative. Finally, the very last component of the econometric model is the stochastic error term, which is especially important in the context of understanding if the estimated model does violate fundamental econometric assumptions related to the absence of heteroscedasticity and serial correlation. Furthermore, it is desired that there will be no multicollinearity in the model, as well as it is desired that the residuals will be distributed normally.

The multicollinearity presence is likely to cause the model to be reformulated or transformed because, in the context of the study, a potential presence of multicollinearity will result in biased standard errors, just as the presence of both heteroscedasticity and serial correlation. Therefore, if either of the aforementioned phenomena will be encountered in the analysis, the model will be recreated. First, the multicollinearity will be verified with a correlation matrix. One has been generated and it can be found in Figure 4.

Figure 4, the correlation matrix



Source: own analysis performed by the author on the basis of The World Bank data

In this case, the majority of correlations between the explanatory variables are low and lie even below the level of 0.5. However, there are two pretty concerning cases, and both are associated with the oil price variable, notably its correlation with renewable energy consumption and unemployment. However, when referring to the basic principle of the verification of multicollinearity, as long as those coefficients are lower than 0.75 or even 0.8, there is no evidence for the presence of multicollinearity. Hence, the multicollinearity phenomenon was ruled out in this case and the estimation can finally be performed.

4.3 Estimation and Verification

The estimation is based on the ordinary least squares method due to the fact that all predictors are linear in parameters, and they are fixed, so the output can be found in Figure 5.

Figure 5, the estimated model

```
Model 5: OLS, using observations 1997-2020 (T = 24)
Dependent variable: GDPgrowth

                     coefficient  std. error  t-ratio  p-value
  ---------------------------------------------------------------
  const                -2.28578    8.27947    -0.2761  0.7856
  RenewableEnergyC~     9.16751    1.34745     6.804   2.27e-06 ***
  Unemployment         -0.792485   0.510827    -1.551   0.1382
  Inflation            -0.149002   0.125568    -1.187   0.2508
  OilPriceUSD           0.116193   0.0273461    4.249   0.0005   ***
  time                 -0.658002   0.176571    -3.727   0.0015   ***

Mean dependent var   5.437500   S.D. dependent var   4.195216
Sum squared resid    69.63199   S.E. of regression   1.966836
R-squared            0.827983   Adjusted R-squared   0.780200
F(5, 18)             17.32812   P-value(F)           2.53e-06
Log-likelihood      -46.83657   Akaike criterion     105.6731
Schwarz criterion    112.7415   Hannan-Quinn         107.5484
rho                 -0.279872   Durbin-Watson        2.547763

Excluding the constant, p-value was highest for variable 4 (Inflation)
```

Source: own analysis performed by the author on the basis of The World Bank data

At first look, it is pretty apparent that all signs were correctly estimated, which indicates that the model does not violate the underlying economic theory. The model follows the following structure:

$$\Delta GDP_t = -2.28 + 9.16C_{rt} - 0.79U_t - 0.149\pi_t + 0.11P_{ot} - 0.65t + \mathcal{E}_i$$

Based on the estimated signs and magnitudes of the slopes:

- If all regressors are equal to 0, the Kazakh economy will experience an economic degrowth in the magnitude of 2.28 per cent compared to the previous year.

- If the share of renewables increases by 1 percentage point, the Kazakh economy will experience a growth in the magnitude of 9.16 percentage points, if other predictors remain constant.
- If the unemployment rate increases by 1 percentage point, the Kazakh economy will experience a degrowth in the magnitude of 0.79 percentage points, if other predictors remain constant.
- If the inflation rate increases by 1 percentage point, the Kazakh economy will experience a degrowth in the magnitude of 0.149 percentage points, if other predictors remain constant.
- If the international oil price increases by 1$/barrel, the Kazakh economy will experience a growth in the magnitude of 0.11 percentage points, if other predictors remain constant.
- With each consecutive year, the rate of GDP growth in Kazakhstan decreases by 0.65 percentage points.

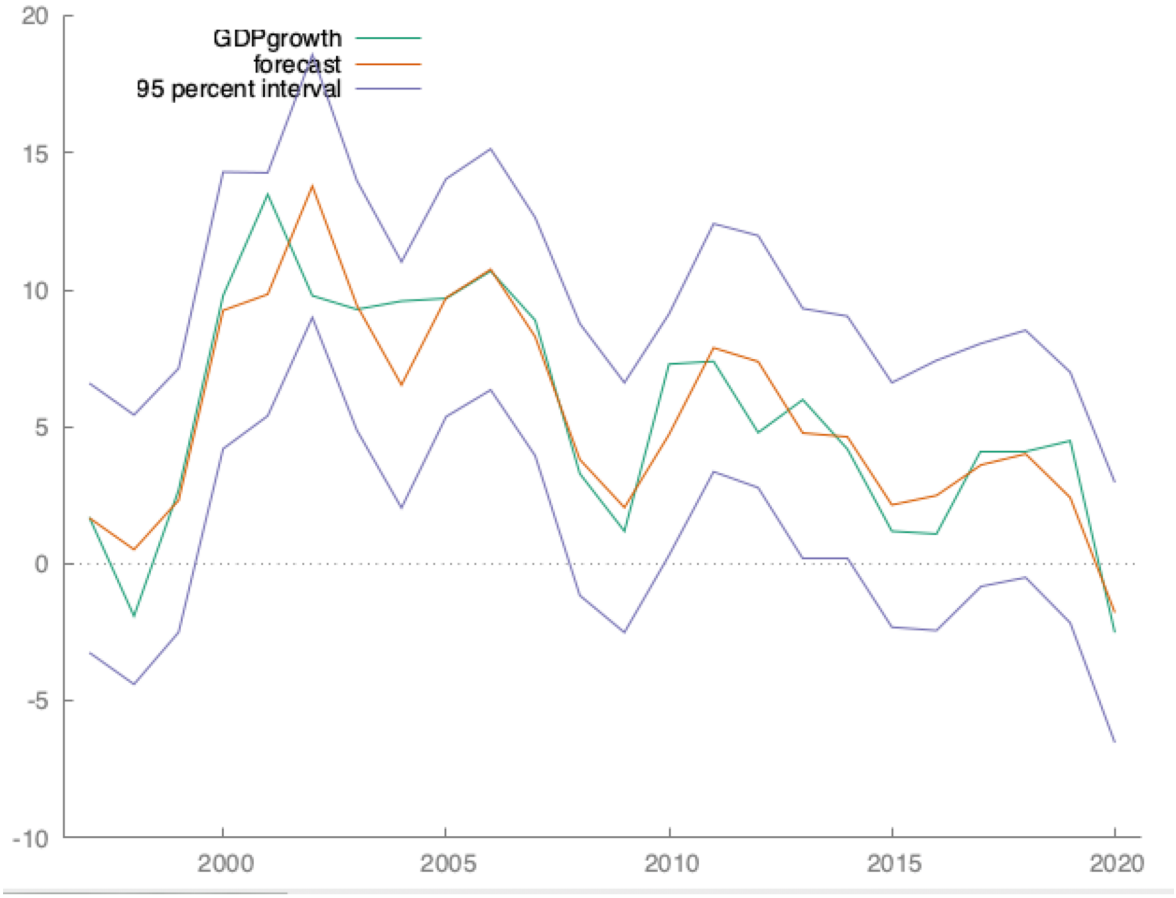
All signs are sound, as well as the magnitudes. Henceforth, there is enough evidence to claim that the model does not violate any underlying economic principles and assumptions stated earlier. Now, it is important to interpret the main statistical parameters of the model in order to understand which predictors are important contributors to GDP growth.

Out of the 6 regressors, there are just three that are significant. These predictors are the time vector, the international oil price per barrel and the share of renewables in consumption, which is a crucial observation in the context of the bachelor thesis. Alternatively, the inflation rate, the unemployment rate and the constant were categorized as not to be significant based on the analyzed time period. However, those variables are not ruled out entirely, because their insignificance can be explained by the low number of observations covered, so in the long run, there might be a statistically significant relationship between the two. In addition to the individual significance of the three elements, the whole model is significant, which is quite good.

The percentage of variation explained by the model is equal to 0.82 when judging by the simple coefficient of determination and to 0.78 when judging by its more complex adjusted version. Both percentages are acceptable, but the model does still lack some

important predictors. The disparity between the fitted and observed values can be observed in Figure 6.

Figure 6, fitted and actual values



Source: own analysis performed by the author on the basis of The World Bank data

At last, after assessing the statistical properties of the model, it is important to continue the verification of three vital econometric properties of the model – the normality of residuals, absence of heteroscedasticity and absence of serial correlation. The results of the three tests (Jarque-Bera, White's test and Breusch-Godfrey) can be found in Figure 7.

Figure 7, the econometric verification of the model

```
White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 19.4819
  with p-value = P(Chi-square(20) > 19.4819) = 0.49073

Test for normality of residual -
  Null hypothesis: error is normally distributed
  Test statistic: Chi-square(2) = 2.40645
  with p-value = 0.300224

LM test for autocorrelation up to order 1 -
  Null hypothesis: no autocorrelation
  Test statistic: LMF = 1.60656
  with p-value = P(F(1, 17) > 1.60656) = 0.222064
```

Source: own analysis performed by the author on the basis of The World Bank data

There is no heteroscedasticity because the null hypothesis is not rejected (0.49 > 0.05). Furthermore, there is normality of residuals because the null hypothesis is not rejected (0.30 > 0.05). At last, there is no serial correlation because the null hypothesis is not rejected (0.22 > 0.05). Overall, the model does possess desired econometric properties, which result in the fact that both the statistical inference is sound, and the standard errors are not biased. Henceforth, the interpretation of the model and the results of earlier performed statistical tests are fully sound and correct. Finally, for a better interpretation of the results and application of the model, elasticities for every single year and variable are calculated, which can be found in Table 2, where the very last row represents the averages for every variable belonging to the model.

Table 2, the table of elasticities

Year	Renewable Energy Consumption	Unemployment	Inflation	Oil Price
1997	9.09	-6.11	-1.54	1.32
1998	26.69	-19.63	-2.01	2.80
1999	7.05	-4.57	-0.53	0.89
2000	2.47	-1.09	-0.21	0.36
2001	2.24	-0.84	-0.13	0.29
2002	1.84	-0.53	-0.06	0.21
2003	2.21	-0.73	-0.10	0.35
2004	2.65	-1.01	-0.16	0.68
2005	1.97	-0.66	-0.12	0.65
2006	1.81	-0.57	-0.12	0.70
2007	2.02	-0.69	-0.19	1.01
2008	2.76	-1.37	-0.67	2.95
2009	5.82	-2.51	-0.53	3.47
2010	2.67	-0.96	-0.23	1.95
2011	1.60	-0.54	-0.16	1.63
2012	1.65	-0.57	-0.10	1.75
2013	2.22	-0.86	-0.18	2.63
2014	2.64	-0.86	-0.22	2.47
2015	7.30	-1.80	-0.46	2.81
2016	7.57	-1.57	-0.87	2.02
2017	5.09	-1.07	-0.31	1.73
2018	4.28	-0.95	-0.22	2.06
2019	6.99	-1.56	-0.32	3.07
2020	-9.22	2.18	0.57	-2.75
Average (%)	**4.23**	**-2.04**	**-0.37**	**1.46**

Source: own analysis performed by the author on the basis of The World Bank data

Based on the calculated table of elasticities for each single year, it is possible to draw the following conclusion about the elasticities of the variables:

- On average, a 1% increase in renewable energy consumption leads to a 4.23% increase in the GDP growth rate in Kazakhstan.
- On average, a 1% increase in the unemployment rate leads to a 2.04% decrease in the GDP growth rate in Kazakhstan.
- On average, a 1% increase in the inflation rate leads to a 0.37% decrease in the GDP growth rate in Kazakhstan.

- On average, a 1% increase in the price of oil leads to a 1.46% increase in the GDP growth rate in Kazakhstan.

Henceforth, it is possible to indicate that the most crucial indicator influencing the GDP growth rate in Kazakhstan is the share of renewables.

5 Results and Discussion

The diploma thesis evaluated a very serious topic that has a lot of relevance for the modern world that is actively focusing on the implementation of sustainable development strategies all around the globe. In this context, studying the current rate of adoption of renewable energy sources is downright crucial because it offers a comprehensive overview of the way how matters stand today. Furthermore, paying attention to developing countries is one of the most crucial processes since the world's greatest share of the population is represented by developing countries that today become more and more relevant for the world economy with giants such as India, China and Brazil quickly ascending to the economic Olympus, where until recently there was an evidence dominance of the United States of America.

In this context, Kazakhstan offered a perfect foundation for carrying out an econometric analysis dedicated to the effect that renewable energy has on the economic growth of the country. Kazakhstan, which is the 9th country in the world, according to its size, is the world's biggest landlocked country that is situated on the steppe, thus creating the perfect foundation for utilizing wind energy. However, as it was revealed during the analysis, the current rate of adoption of renewables in the country is not good with the share not exceeding the level of 5 per cent in a single year.

However, it was revealed that there is a positive degree of association between the renewable energy consumption variable and the economic growth in Kazakhstan. However, it is vital to recall that there can potentially be a situation with a simultaneous relationship between the variables, so it is vital to have a certain degree of scepticism towards the findings of the thesis. Additionally, one particular phenomenon may lead to the realization that it might indeed be the case – renewable energy is something that is traditionally developed during periods of economic development, which was happening throughout the whole 21st century. Henceforth, the results of the econometric analysis can be significantly influenced by the whole transformation of the country.

Therefore, it would be vital to focus on conducting a similar kind of analysis once the country touches firm ground and entirely finishes its transformation into a fully functioning

market-based economy without any significant problems caused by kleptocracy and corruption, which both were the cases of Kazakhstan for many years. However, the situation can change quite soon given the change in the political vector a few years ago.

6 Conclusion

The goal of the bachelor thesis was associated with the analysis of the current rate of adoption of renewable energy sources, where the biggest share of attention was paid to the study of the relationship between the rate of adoption of renewable energy sources and the economic growth of the country. Two hypotheses were created, where the first one was entirely dedicated to the assumption that the relationship is significant between the rate of adoption and economic growth, while the second hypothesis was dedicated to the assumption that the Kazakh economy was undergoing through a very favourable period of economic expansion.

When it comes to the first hypothesis, the results of the econometric analysis confirm that there is a statistically significant relationship between the economic growth in Kazakhstan and the rate of adoption of renewables. However, there potentially can be a situation when the econometric estimation is mainly influenced by the overall development of the Kazakh economy. For this purpose, it is recommended to conduct a similar kind of analysis once the economy will finish its transition and will create a fully functioning market-based economic mechanism.

For the second hypothesis about the favourable development of the Kazakh economy as a whole, it is possible to confirm that the hypothesis is also not rejected. Kazakhstan managed to perform a very successful economic leap forward, where the economy performed well from both the production and the employment points of view. On the other hand, there were considerable difficulties with price stability and inflation targeting – the country's inflation rate was soaring very quickly, but this is often regarded as a consequence of basing an entire economic system on the export of some commodity. Vulnerability to the "boom and bust" cycles has been regarded as a serious problem for Kazakhstan, so if the country will not manage to properly diversity its economy, it might become quite likely that those periods of soaring inflation will become more and more frequent, resulting in a higher degree of uncertainty and potentially lower volume of foreign direct investment poured into Kazakh economy.

For the final recommendation, it is suggested that the country should seize the opportunity and focus on wind energy due to its geographical position and nature.

7 References

Bull, S. R. (2001). Renewable energy today and tomorrow. *Proceedings of the IEEE*, *89*(8), 1216-1226.

Busu, M., & Trica, C. L. (2019). Sustainability of circular economy indicators and their impact on economic growth of the European Union. *Sustainability*, *11*(19), 5481.

Change, P. C. (2018). Global warming of 1.5° C. *World Meteorological Organization: Geneva, Switzerland.*

Da Rosa, A. V., & Ordóñez, J. C. (2021). *Fundamentals of renewable energy processes*. Academic Press.

Dincer, I. (2000). Renewable energy and sustainable development: a crucial review. *Renewable and sustainable energy reviews*, *4*(2), 157-175.

Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Kadner, S., Zwickel, T., ... & Matschoss, P. (Eds.). (2011). *Renewable energy sources and climate change mitigation: Special report of the intergovernmental panel on climate change*. Cambridge University Press.

Gross, R., Leach, M., & Bauen, A. (2003). Progress in renewable energy. *Environment international*, *29*(1), 105-122.

Hanusch, M. (2011). The doing business indicators, economic growth and regulatory reform. *Economic Growth and Regulatory Reform (June 30, 2011)*.

Harutyunyan, A. A. (2022). China-Kazakhstan: Cooperation within The Belt and Road and Nurly Zhol. *Asian Journal of Middle Eastern and Islamic Studies*, *16*(3), 281-297.

Houghton, J. (2005). Global warming. *Reports on progress in physics*, *68*(6), 1343.

Jorgenson, D. W. (1991). Productivity and economic growth. In *Fifty years of economic measurement: The Jubilee of the Conference on Research in Income and Wealth* (pp. 19-118). University of Chicago Press.

Jumadilova, S. (2012). The Role of Oil and Gas Sector For The Economy of Kazakhstan. *International Journal of Economic Perspectives*, *6*(3).

Kaltschmitt, M., Streicher, W., & Wiese, A. (Eds.). (2007). *Renewable energy: technology, economics and environment*. Springer Science & Business Media.

Karatayev, M., & Clarke, M. L. (2014). Current energy resources in Kazakhstan and the future potential of renewables: A review. *Energy Procedia*, *59*, 97-104.

Klasen, S. (2008). Economic growth and poverty reduction: Measurement issues using income and non-income indicators. *World development*, *36*(3), 420-445.

Korgan, B. B., Sabirova, R. K., & Adietova, E. M. (2019). Innovative economy of Kazakhstan. *News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Social and Human Sciences. ISSN*, 2224-5294.

Levine, R., & Zervos, S. (1998). Stock markets, banks, and economic growth. *American economic review*, 537-558.

Lewis, W. A. (2013). *Theory of economic growth*. Routledge.

Lin, B., & Zhu, J. (2019). The role of renewable energy technological innovation on climate change: Empirical evidence from China. *Science of the Total Environment*, *659*, 1505-1512.

Lund, H. (2007). Renewable energy strategies for sustainable development. *energy*, *32*(6), 912-919.

Macerinskiene, I., & Sakhanova, G. (2011). National economy competitiveness of Kazakhstan Republic. *Engineering Economics*, *22*(3), 292-299.

Mahmood, M., & Orazalin, N. (2017). Green governance and sustainability reporting in Kazakhstan's oil, gas, and mining sector: Evidence from a former USSR emerging economy. *Journal of cleaner Production*, *164*, 389-397.

Moomaw, W., Yamba, F., Kamimoto, M., Maurice, L., Nyboer, J., Urama, K., & Weir, A. D. (2011). Renewable energy and climate change. Cambridge University Press.

Mukhtarova, K., Ziyadin, S., Kupeshova, S., & Doszhan, R. (2017). Problems of developing the foundations of sustainable competitiveness of industrial and innovative economy in Kazakhstan. *Economic annals-XXI*, (168), 38-43.

Nurlanova, N. K., Kireyeva, A. A., & Ruzanov, R. M. (2017). Evaluation of economic potential and level of concentration of the regions of Kazakhstan. *The Journal of Asian Finance, Economics and Business*, *4*(2), 37-44.

Olabi, A. G., & Abdelkareem, M. A. (2022). Renewable energy and climate change. *Renewable and Sustainable Energy Reviews*, *158*, 112111.

Owusu, P. A., & Asumadu-Sarkodie, S. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering*, *3*(1), 1167990.

Quaschning, V. V. (2019). *Renewable energy and climate change*. John Wiley & Sons.

Sen, Z. (2008). *Solar energy fundamentals and modeling techniques: atmosphere, environment, climate change and renewable energy*. Springer Science & Business Media.

Sims, R. E. (2004). Renewable energy: a response to climate change. *Solar energy*, *76*(1-3), 9-17.

The World Bank (2023). The World Bank: Database. [Online] Available at https://data.worldbank.org/indicator. Accessed on the 7th of August 2023

Tokbergenova, A., Kiyassova, L., & Kairova, S. (2018). Sustainable Development Agriculture in the Republic of Kazakhstan. *Polish Journal of Environmental Studies*, *27*(5).

Turkyilmaz, A., Dikhanbayeva, D., Suleiman, Z., Shaikholla, S., & Shehab, E. (2021). Industry 4.0: challenges and opportunities for Kazakhstan SMEs. *Procedia CIRP*, *96*, 213-218.

Twidell, J. (2021). *Renewable energy resources*. Routledge.