Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics

Bachelor Thesis

Developmental trends in crude oil production: case study of Norway and Russia

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

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Developmental trends in crude oil production: case study of Norway and Russia

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Objectives of thesis

The main aim of the present Bachelor thesis is to define major developmental trends in crude oil production on the example of Norway and Russia. Since both countries are richly endowed with natural resources and oil production can be referred to as a central to Norwegian and Russian economies (when export revenues from oil and gas constitute more than a half of total exports), it becomes interesting to investigate main factors affecting crude oil production in these countries and identify links (if any) connecting selected macroeconomic indicators with the production of crude oil.

Methodology

The synthesis of relevant information from various reliable resources represented by printed literature, scientific articles, surveys, web sources will be done and used then in the practical part of the Bachelor thesis. Both theoretical and practical parts will rest on descriptive analysis and thematic synthesis. Own research work will be based on regression analysis along with comparative techniques and statistical inference.

The proposed extent of the thesis

30 – 40 pages

Keywords

Crude oil production; Developmental Trends; GDP; Macroeconomic factors; Regression analysis; Russia; Norway

Recommended information sources

Daniel Treisman; Oil and democracy in Russia; Cambridge, MA; National Bureau of Economic Research; 2010; NBER Working Paper No. 15667

GUJARATI, D N. *Econometrics by example.* London: Palgrave Macmillan Education, 2015. ISBN 978-1-137-37501-8.

John Urry; Societies beyond oil; London; Zed Books; 2013; ISBN 9781780321684

KENNEDY, P. *A guide to econometrics.* Malden: Blackwell, 2008. ISBN 978-1-4051-8258-4.

Paul Cleary; Trillion Dollar Baby: How Norway beat the oil giants and won a lasting fortune; Schwartz Publishing Pty. Ltd; 2016; ISBN 9781925435214

ROMER, D. *Advanced macroeconomics.* Boston: Irwin/McGraw-Hill, 2006. ISBN 0-07-287730-8.

WOOLDRIDGE, J M. *Introductory econometrics : a modern approch.* Mason: South-Western Cengage Learning, 2009. ISBN 978-0-324-66054-8.

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Declaration

I declare that I have worked on my diploma thesis titled "Developmental trends in crude oil production: case study of Norway and Russia" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 15.03.2019 ______________________________

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Developmental trends in crude oil production: case study of Norway and Russia

Abstract

In the 20th century crude oil has become one of the most influential and strategic commodities for the world economy. As a result the dramatic increase of crude oil market has been attracting a growing economists' attention, especially, the impact of crude oil production on a country's economy. The main aim of this bachelor thesis is to define major developmental trends in crude oil production on the example of Norway and Russia trough identification the existing links between selected macroeconomic indicators and volumes of domestic crude oil production. The theoretical part of the bachelor thesis focuses on general factors influencing crude oil production for the last 30 years. Having identified the most important ones, the practical part concentrates on the case study of selected countries using regression analysis. Two econometric models were constructed to investigate the relationships between volume of crude oil production and chosen macroeconomic indicators (GDP per Capita, Exchange rate, Inflation rate and Crude oil WTI Futures). Both models are confirmed to be statistically significant, however the significance of individual macroeconomic factors in explanation of crude oil production has appeared to be different in Russia and Norway. The analysis confirmed that Russian crude oil production is mainly affected by Exchange rate of Russian rouble to USD and price of WTI crude oil futures, whilst Norwegian one – by GDP per Capita and Inflation rate, meaning that developmental patterns in Norway and Russia are different.

Keywords

Crude oil production; Developmental Trends; GDP; Macroeconomic factors; Regression analysis; Russia; Norway

Vývojové trendy v produkci ropy: případová studie Norska a Ruska

Abstrakt

Ve 20.století se ropa stala jednou z nejvlivnějších a strategických komodit pro světovou ekonomiku. Výsledkem tohoto dramatického nárůstu trhu s ropou je přitahování rostoucí pozornosti ekonomů, zejména vlivu výroby ropy na ekonomiku země. Hlavním cílem této bakalářské práce je definovat hlavní vývojové trendy v produkci ropy na příkladu Norska a Ruska prostřednictvím identifikace stávajících vazeb mezi vybranými makroekonomickými ukazateli a objemem domácí výroby ropy. Teoretická část bakalářské práce se zaměřuje na obecné faktory ovlivňující výrobu ropy za posledních 30 let. Po určení těch nejdůležitějších, se praktická část soustředí na případovou studii vybraných zemí pomocí regresní analýzy. Byly postaveny dva ekonometrické modely, které zkoumají vztahy mezi objemem výroby ropy a vybranými makroekonomickými ukazateli (HDP na hlavu, směnný kurz, inflace a WTI futures). Oba modely jsou potvrzeny jako statisticky významné, avšak význam jednotlivých makroekonomických faktorů při vysvětlení výroby ropy se v Rusku a Norsku liší. Analýza potvrdila, že ruská výroba ropy je ovlivněna především směnným kurzem ruského rublu na USD a cenou WTI futures, zatímco norská výroba ropy - podle HDP na hlavu a míru inflace, což znamená, že vývojové vzorce v Norsku a Rusku jsou odlišné.

Klíčová slova

Výroba ropy; Vývojové trendy; HDP; Makroekonomické faktory; Regresní analýza; Rusko; Norsko

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List of abbreviations

Bbl/d	Barrels per day
Bil	Billion
Cum.	Cumulative
Freq	Frequency
GDP	Gross Domestic Product
GDP per Capita	Gross Domestic Product per Capita
GRETL	GNU Regression, Econometrics and Time-series Library software
H_0	Null hypothesis
H_1	Alternative hypothesis
Midpt	Middle point
NOK	Norwegian Krone
OLSM	Ordinary Least Squares Method
p.p.	Percentage point
Rel.	Relative
Resid.	Residual
RUB	Russian New Rouble
Std. Dev.	Standard Deviation
Std. error	Standard error
TWh	Terawatt-hour
USD	United States Dollar
Var.	Variable
WTI Futures	West Texas Intermediate Futures
α	The significance level (The First Type Error)

1 Introduction

Energy sources, in general, are essential to the most of the economic sectors. Crude oil, particularly, has grown into one of the most influential and strategic commodities for the world economy.

There were certain factors which caused a sharp increase in crude oil market both on the demand and supply sides. A rapid development of industrial sector (automobile and machinery equipment) and military sector (WW1, WW2) has stimulated the crude oil producing countries to discover more oil fields, to introduce new technology of drilling and mining.

Since then, the dramatic increase in crude oil market has become one of the economists' concerns. Especially, the impact of crude oil prices on a country's economy and links between them started to be investigated by oil producing countries. Moreover, crude oil has been playing an important role in economic activities even though this relationship has changed for last few decades. So, crude oil is still a factor that can lead to a change in macroeconomic policies and decisions.

The actuality and importance of the crude oil stimulates a constant interest. Different studies and researchers investigate the relationship between crude oil (prices, volume of production) and various macroeconomic variables (GDP, inflation, unemployment rate, government expenditures and etc.). The results of those studies can vary due to changing international political and financial situation as well as individual characteristics from country to country.

This bachelor thesis described general factors influencing crude oil production primarily for the last 30 years. It also investigated the relationship between crude oil production volume and chosen macroeconomic indicators (Annual GDP, GDP per Capita, Exchange rate, Inflation rate, Crude oil WTI Futures) in case of Norway (1989-2017) and Russia (1994-2017).

2 Objectives and Methodology

2.1 Objectives

The main aim of the present bachelor thesis is to define major developmental trends in crude oil production on the example of Norway and Russia. Since both countries are richly endowed with natural resources and oil production can be referred to as a central to Norwegian and Russian economies (when export revenues from oil and gas constitute more than a half of total exports), it becomes interesting to investigate main factors affecting crude oil production in these countries and identify links (if any) connecting selected macroeconomic indicators with the production of the crude oil.

The main objective of the theoretical part is to describe factors which influence the crude oil production in general. The literature review also provides a basic understanding of the current tendency in crude oil production. The main objective of the practical part is to concentrate on explaining the links between crude oil production and selected macroeconomic indicators on the example of Norway and Russia. The analysis aims at identifying the most influential among them and consequent at better understanding the developmental trends in crude oil production in these countries.

2.2 Methodology

The synthesis of relevant information from various reliable resources represented by printed literature, scientific articles, surveys, web sources will be done and then used in the practical part of the Bachelor thesis. Both theoretical and practical parts will rest on descriptive analysis and thematic synthesis. Own research work will be based on regression analysis along with comparative techniques and statistical inference. Created models for each country will be verified using economic, statistical and econometrical approaches.

First of all the declaration of the selected variables will be done along with providing their descriptive statistics. Then formulation of an econometric model will be done for each country (all the results with the regard to Norway and Russian will be given in different subchapters). The estimation of both model's parameters will be done with the use of the Ordinary Least Squares method (OLSM)[1].

$$\gamma = (x^T x)^{-1} x^T y \qquad (1)$$

Before the estimation of the parameters the possible problem of multicollinearity will be checked and eliminated using correlation matrix. Multicollinearity is a problem because it doesn't allow for separation the influences of regressors and regressand. It also undermines the statistical significance of an independent variable.[2]

After that and having estimated the parameters the verification of both models will be done in terms of economic inference, statistical significance and econometric assumptions validity.

Within the framework of economic verification the relationships between variables will be described in the light of economic theory. It is a quantitative way to describe how the dependent variable changes with a change of a single independent variable when all the others stay the same.

Within the framework of statistical verification the degree of conformity between the estimated models and data will be calculated and explained. The significance of the entire model along with the significance of individual parameters will be tested with the use of F-test and t-test correspondingly.

The overall significance of the model uses F-test as the formal test of the model utility.[3]

H_0: the model is not significant

H_1: the model is significant

Test of significance of parameters using t-test. It is an evaluation of the model which examines whether or not an individual estimated parameter is significant.[4]

H_0: an individual parameter is not statistically significant

H_1: an individual parameter is statistically significant

[1] WOOLDRIDGE, J M., Introductory econometrics : a modern approach, 2009, p.30
[2] ALLEN, M.P., Understanding Regression Analysis, 1997, p. 176-180
[3] DEVORE, Jay L., Probability and Statistics for Engineering and the Sciences (8th ed.), 2011, p. 561, ISBN 978-0-538-73352-6
[4] DEVORE, Jay L., Probability and Statistics for Engineering and the Sciences (8th ed.), 2011, p. 561, ISBN 978-0-538-73352-6

Econometric verification mainly aims at testing the presence of autocorrelation, heteroskedasticity and normality of residuals.

The error term observation of residuals is used to check for autocorrelation. If they follow a pattern, this pattern is evidence of autocorrelation. Autocorrelation in residuals will be tested with the use of the Breusch-Godfrey test.[5]

H_0: there is no autocorrelation of residuals in data.

H_1: there is autocorrelation of residuals in data.

Heteroskedasticity is considered to be a problem because OLSM assume that all the residuals have a constant variance. [6] Heteroskedasticity will be tested with the use of the White's test.[7]

H_0: heteroscedasticity not present (homoscedasticity)

H_1: heteroscedasticity present

Normality of residuals will be tested with the use of the Jarque-Bera test.[8]

H_0: error is normally distributed

H_1: error is not normally distributed

After all, the discussion of the results, obtained from the regression analysis, and the conclusion for this bachelor thesis are formulated.

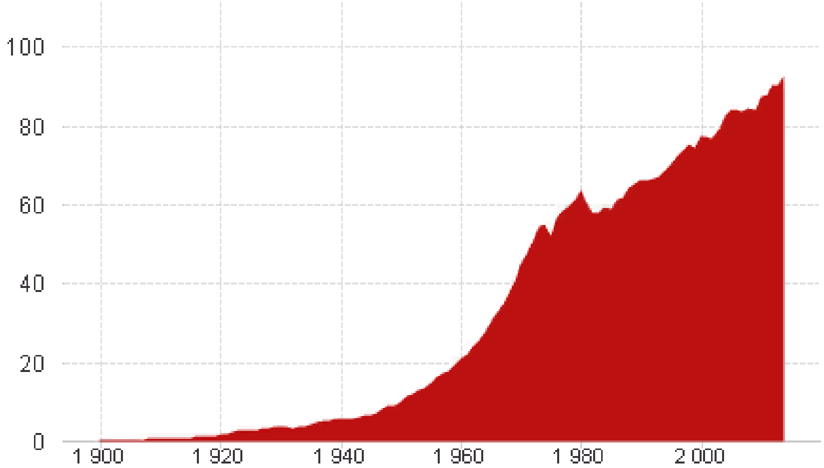
[5] WOOLDRIDGE, J M., Introductory econometrics : a modern approach, p.353
[6] WOOLDRIDGE, J M., Introductory econometrics : a modern approach, p.51
[7] WOOLDRIDGE, J M., Introductory econometrics : a modern approach, p.356
[8] WOOLDRIDGE, J M., Introductory econometrics : a modern approach, p.356

3 Literature Review

3.1 A brief historical overview of the world crude oil production

The development of the crude oil has increased significantly due to its uses range. Crude oil industry has expanded and become an important part of the world economy (Figure 1). The use of the crude oil has replaced other traditional energy sources for industrial power in the early 20th century. Crude oil became one of the main drivers of the global economy and still important as an energy source for various industries and transport infrastructure.[9]

Figure 1 The world crude oil production (mil. bbl/d) during the 20th century



Source: Available from http://www.tsp-data-portal.org/Energy-Production-Statistics#tspQvChart

The modern history of the crude oil industry began in the 19th century. The first influential oil company, Standard Oil, was founded in 1870 in the USA. Until 1950s the world crude oil market was dominated by American producers.[10]

The process of globalisation in the 20th century transformed the crude oil market. The industry became more international when other crude oil exporters started to be more

[9] The Oil and Gas Industry Issue, BERA (Business and Economics Research Advisor,), [online], 5/6 Winter 2005/Spring 2006, Updated July 2013, Available from https://www.loc.gov/rr/business/BERA/issue5/history.html

[10] Oil and Gas Exploration and Production: Reserves, Costs, Contracts, Paris: Center for Economics and Management, 2004, p. 5.

active.[11] A good example of this process is the Middle East region. The efforts in exploration and development of the crude oil production have led to major discoveries during the first half of the century. Iranian and Turkish oil fields were discovered before it happened in Kuwait in the late 1930s. After ten years the largest oil field was discovered in Saudi Arabia (Ghawar). [12]

Not only mentioned discoveries in the industry influenced its rapid growth. Automobile manufacturing increased the demand for fuel. Certain global political and economic changes were one of the factors for world oil shocks. In particular, wars in the Middle East during the late 1960's and 1970's had an impact on the world crude oil industry, fluctuating oil prices and increasing of uncertainty about the future of the market.[13]

Another effect caused by those events can be described as a shift of the control over crude oil production and price from oil-importing countries to oil-exporting countries. On the other hand crude oil-producing countries also expanded authority and control over their crude oil resources. It has been done for economical and geopolitical reasons in case of operating Integrated Oil Companies (IOCs). Especially Middle East and South America regions saw IOCs as instruments for their countries of origin (e.g. US and European countries). It was one of the reasons why in 1960 was founded the Organization of the Petroleum Exporting Countries (OPEC). The main purpose of OPEC was to negotiate with IOCs about crude oil production and prices. Developed strength of OPEC not only shifted control over crude oil production from Western IOCs to producing countries, but also meant the start of the National Oil Company (NOC) era. [14]

[11] The Oil and Gas Industry Issue, BERA (Business and Economics Research Advisor,), [online], 5/6 Winter 2005/Spring 2006, Updated July 2013, Available from https://www.loc.gov/rr/business/BERA/issue5/history.html

[12] Oil and gas history, [online], Available from https://grandemotte.wordpress.com/peak-oil-4-exploration-history/

[13] The Oil and Gas Industry Issue, BERA (Business and Economics Research Advisor,), [online], 5/6 Winter 2005/Spring 2006, Updated July 2013, Available from https://www.loc.gov/rr/business/BERA/issue5/history

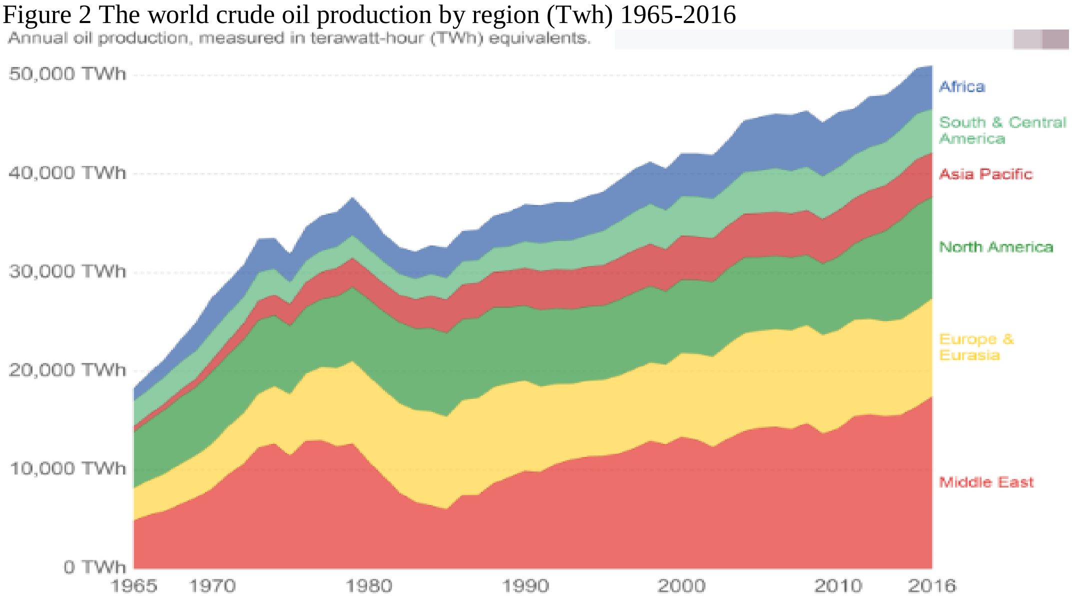
[14] EKT Interactive, Oil 101-History of oil, A timeline of the modern oil history, [online], Available from https://www.ektinteractive.com/history-of-oil/

3.2 Major trends in the world crude oil production during the last 30 years

The new world of the National Oil Companies has led to a more politically complicated situation. Their influence was based on the increasing demand, crude oil reserves, oil prices and was causing a change in a geopolitical climate. [15]

By 1988 the USSR was the largest producer of the crude oil in the world. Wars in the Middle East (1990, 1991) created a shock effect in supply in the end of 1991. Affected by the Asian Financial crisis in 1997, demand for the crude oil decreased dramatically. Uncertainty about the future of supply started again after invasion of Iraq by USA (2003) and the Arab Spring (2011). In the end of 2018 OPEC (including Russia) implemented the reducing agreement of the crude oil supply as a response to US shale production. The tendency for the next few years in the crude oil pricing system depends on the OPEC decisions, Asian demand and US shale oil production.[16]

Figure 2 The world crude oil production by region (Twh) 1965-2016



Source: BP Statistical Review of Global energy, available from https://ourworldindata.org/fossil-fuels

According to the data of crude oil production by region above (Figure 2) the Middle East is the largest oil producer in the world alone (about 35%). Both Europe and North

[15] EKT Interactive, Oil 101-History of oil, A timeline of the modern oil history, [online], Available from https://www.ektinteractive.com/history-of-oil/

[16] IG UK, History of crude oil, [online] Available from https://www.ig.com/uk/commodities/oil/history-of-crude-oil-price

America produce nearly 20% each. Asian region, Africa and Latin America produce about 10% of the crude oil in the world. The trend of regions' production was on the approximate same level for the last 30 years. [17]

3.3 Factors influencing the crude oil production

Crude oil industry plays an important role in the world's economy as it was shown in the historical overview section. Despite this fact, the crude oil production is a sensitive area which fluctuates accordingly to various factors. The origin of those factors can have a different nature and affect the world crude oil production as well as on a local production level.

In the next part of this bachelor thesis some of the factors regarding oil producing countries are listed. Among chosen factors influencing the crude oil production are domestic country's policy, economic situation within a country, international regulatory organisations, demand on the crude oil market, financial situation in the world, development of alternative (renewable) energy sources and environmental regulatory organisations.

3.3.1 Domestic country's policy

Economic development and macroeconomic policies in net oil-exporting countries have increased attention during the last decades. The term of a net oil-exporting country refers to a state for which more than 40% of its total export depends on the crude oil export.[18]

Monetary policy and fiscal policy are the main tools of regulating a national's economic activities. Monetary policy is connected to operations with interest rates, circulation of money and regulates by a country's central bank. Fiscal policy includes taxation system and government expenditures.[19]

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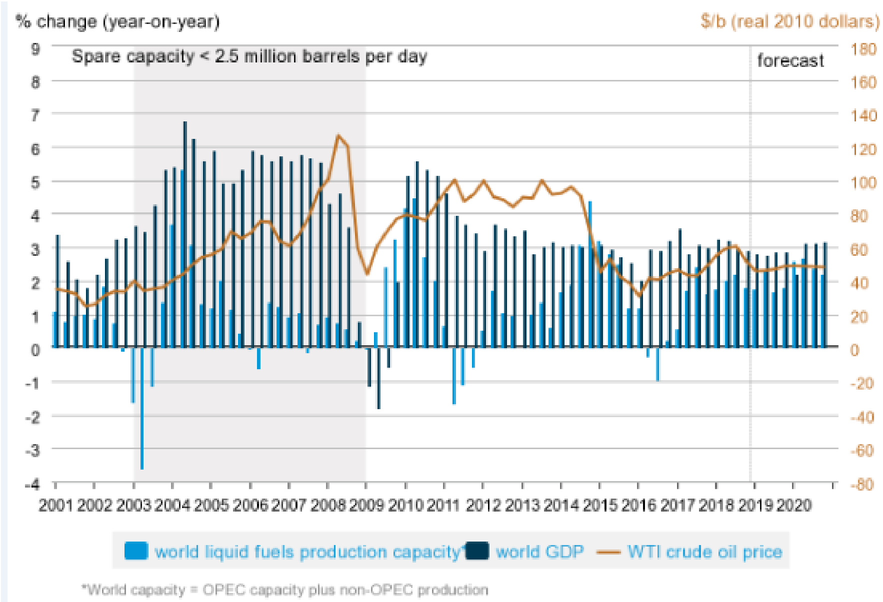
[17] RITCHIE , H., ROSER M., Fossil Fuels, [online], 2019, Available from https://ourworldindata.org/fossil-fuels
[18] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu
[19] SEGAL T., Monetary Policy vs. Fiscal Policy: An Overview, [online], 2019., Available from https://www.investopedia.com/ask/answers/100314/whats-difference-between-monetary-policy-and-fiscal-policy.asp

With growing revenue from crude oil industry, the importance of domestic fiscal policy increases. Its impact on the overall economic performance of an oil-exporting country influences inflation, economic growth and distribution of the revenue from the oil sector. Net oil-exporting countries do not only have common challenges in their fiscal policy but also face some specific problems. These issues are caused by fluctuating of the oil revenue and uncertainty about external demand.[20]

Figure 3 Changes in the world crude oil production capacity, world GDP and WTI crude oil price 2001-2020 (estimated)



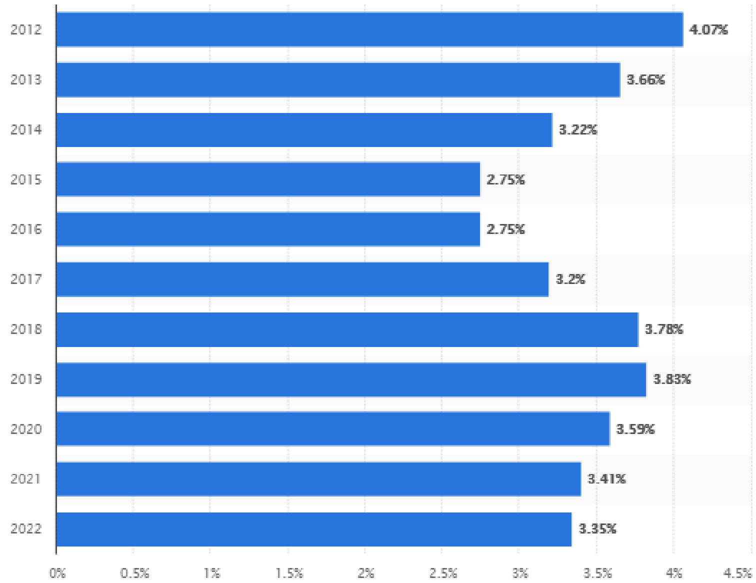
Source: US Energy Information Administrtion, available from https://www.eia.gov/finance/markets-crudeoil/supply-opec.php

For some oil-exporting countries there is a link between a weak macroeconomic performance during decreasing crude oil prices and economic growth, fiscal surplus and positive development when the price goes up. This situation of an economy often associated with the term of “resource course”. It means a country, rich with natural resources, have a lower economic growth and other macroeconomic indicators than other countries with no such a big exporting potential.[21]

[20] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu
[21] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

In the short-run perspective inflation is seen as a challenge for a fiscal policy system in many oil producing countries. Inflation of the net oil-exporting countries was relatively low during the last decades. At the same time it has a more cyclical trend compare to developing economies (Figure 4). Fiscal expansion has led to an inflationary pressure. In order to minimise this pressure monetary policy was adapted for the fighting inflation.[22]

Figure 4 The global inflation rate 2012-2022 (estimated)



Source: Statista.com, available from https://www.statista.com/statistics/256598/global-inflation-rate-compared-to-previous-year/

Monetary policy as a transformation of exchange rate regimes by higher exchange rate flexibility can help attempting a more balanced fiscal policy.[23]

In the long-run perspective fiscal policy of accumulation oil revenues helps to increase fiscal stability. This is one of the main purposes of creation various oil stabilisation and saving funds during the last decades. At the same time other oil exporting countries increase a diverse public investment, for example, infrastructure and education.[24]

[22] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

[23] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

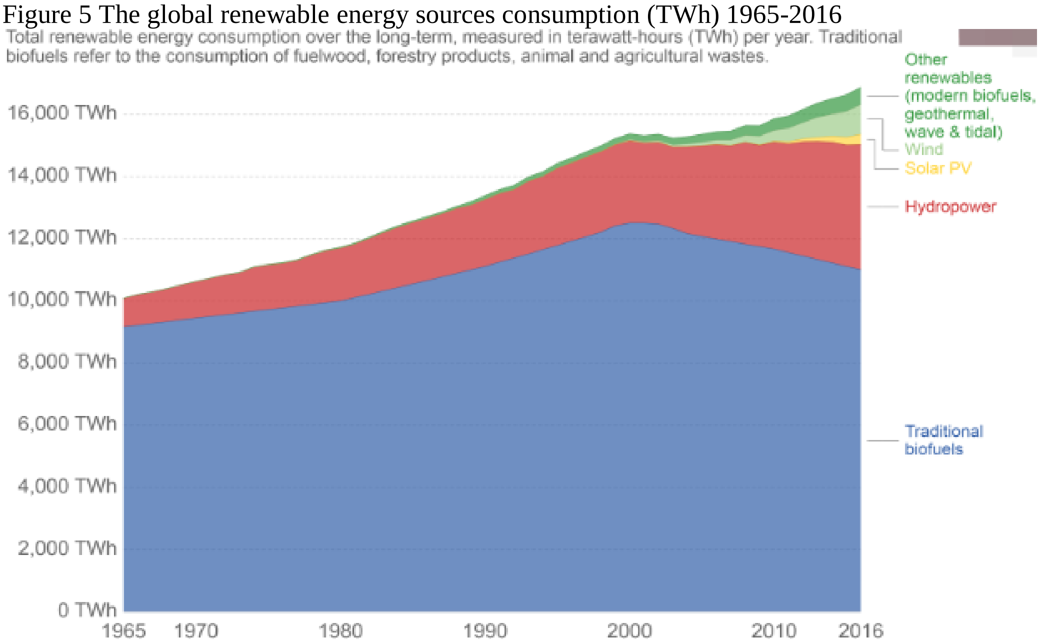
[24] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

3.3.2 Alternative (renewable) energy sources

Crude oil as one of the traditional energy sources has been an economically efficient way of providing power for industries, transportation and civil purposes. However, crude oil is a finite resource and it is decreasing over time. The potential for growth of all renewable energy sources (solar, hydro, wind, biomass, geothermal) is huge and perspective. They are not only able to cover the need for energy on different levels but also do not face challenges about environmental and health concerns. [25]

Solar, wind, hydro, geothermal kinds of energy called "renewable" because they regenerate in a much shorter period of time than, for example, the crude oil. [26]

Figure 5 The global renewable energy sources consumption (TWh) 1965-2016



Source: BP Statistical Review of Global Energy, available from https://ourworldindata.org/renewable-energy/

Any of the renewable technologies require significant finance resources. All investments into renewable energy can be divided into investment by region and investment by technology. The volume of global investments into renewable energy has been increased on more than 600 % from 2004 to 2015. China is the largest investor into

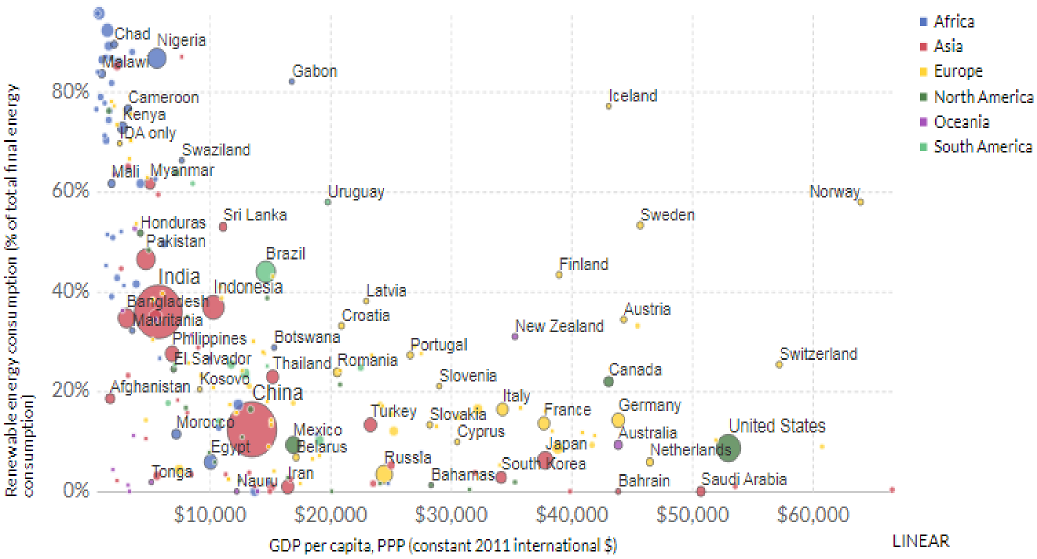
[25] The Oil and Gas Industry Issue, BERA (Business and Economics Research Advisor,), [online], 5/6 Winter 2005/Spring 2006, Updated July 2013, Available from https://www.loc.gov/rr/business/BERA/issue5/alternative.html

[26] LEFEBVRE, J-F., Renewable Energy: Myths and Obstacles, [online], 2013, Available from http://ebookcentral.proquest.com/lib/czup/detail.action?docID=3374965

renewable technologies today. Investments have grown across all regions, but at different rates. As a region Asia is the largest investor. Europe’s investment had different stages (it has been growing, has reached its peak and then has decreased) during the last years. Middle East and Africa are not large investors but they have significantly increased financing into renewable energy during the last ten years. Among all investments by technology there are two of them which receive the most of the financing. Wind and solar energy share around 94 % of the total investment nowadays. The financing has been increasing rapidly especially over the last couple of years. Based on this world trend it can be suggested that many investors see wind and solar energy sources as a future of a whole renewable energy industry. [27]

The volume of investment into renewable energy sources is also influenced by consumption of those sources. There is a relationship between renewable energy consumption and GDP per Capita.

Figure 6 Renewable energy consumption vs. GDP per Capita by country 2015



Source: Sustainable Energy for All, available from http://data.worldbank.org/data-catalog/world-development-indicators

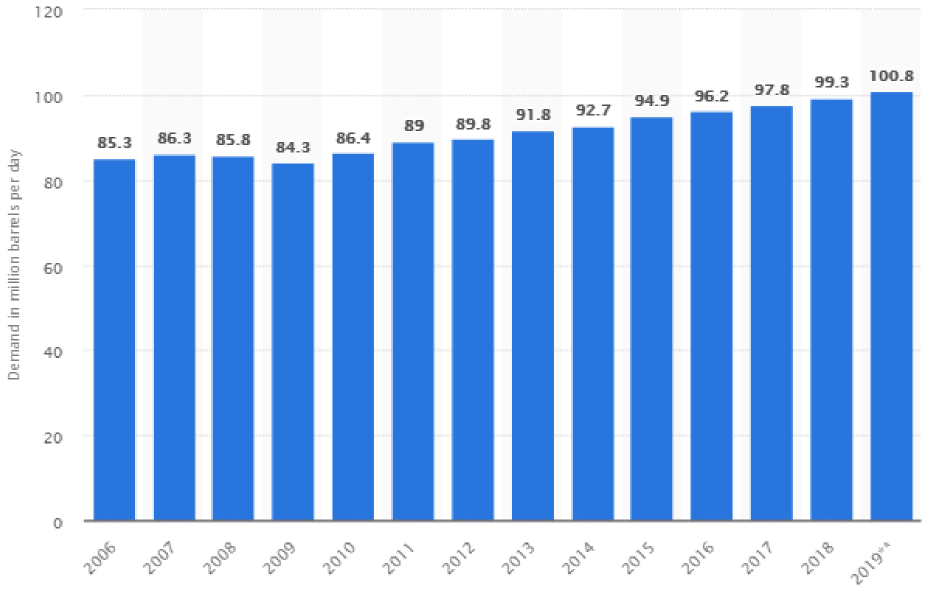
According to the Figure 6 higher GDP per Capita (which corresponds to developed countries) leads to a higher consumption.

[27] RITCHIE, H., ROSER M., Renewable Energy, [online], Available from https://ourworldindata.org/renewable-energy

3.3.3 Demand on the crude oil market

As an influential energy source, the crude oil production is driven by demand.

Figure 7 The world crude oil demand per day (mil bbl.) 2006-2019 (estimated)



Source: Statista.Com, available from https://www.statista.com/statistics/271823/daily-global-crude-oil-demand-since-2006/

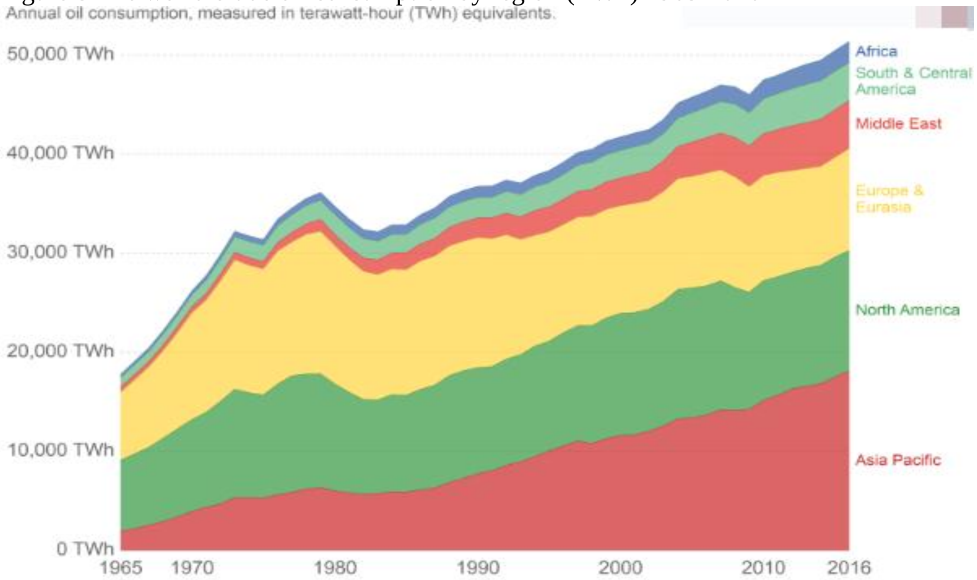
Despite an overall growing trend in world crude oil demand, there is a different tendency between regions (Figure 8). Over the last 50 years, the crude oil consumption from Europe and North America was decreasing in contrast to a rising consumption in all other regions, first of all in Asia.[28]

All oil consumption regions can be grouped into OECD and non-OECD countries. Organization for Economic Cooperation and Development (OECD) is an international organization helping governments with the economic, social and governance challenges of a globalized economy. It was founded in 1961 and consists of 30 member countries including United States and most European countries.[29] Usually, OECD countries associated with developed economies compare to non-OECD members.

[28] RITCHIE, H., ROSER M. Fossil Fuels, [online], 2019, Available from https://ourworldindata.org/fossil-fuels

[29] OECD (Organization for Economic Cooperation and Development), [online], Available from http://www.oecd.org

Figure 8 The world crude oil consumption by region (TWh) 1965-2016



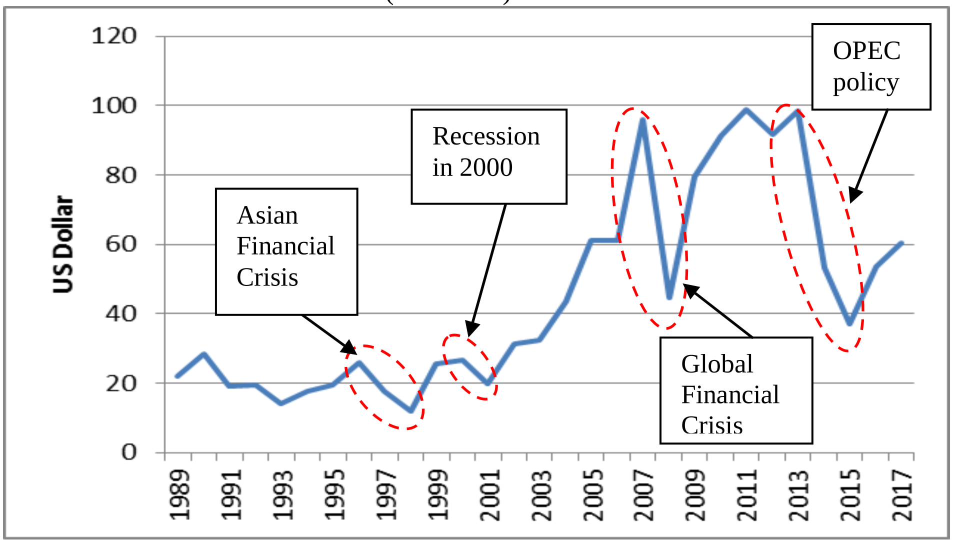
Source: BP Statistical Review of World Energy, available from https://ourworldindata.org/fossil-fuels

According to this classification it can be concluded that during the last 30 years crude oil consumption declined in OECD (developed) countries and increased in non-OECD (developing) countries.

3.3.4 Financial situation in the world

The oil industry is full of economic booms and declines (Figure 9).

Figure 9 The world crude oil WTI Futures (US Dollar) 1989-2017



Source: data available from https://www.investing.com/commodities/crude-oil-historical-data, created by author

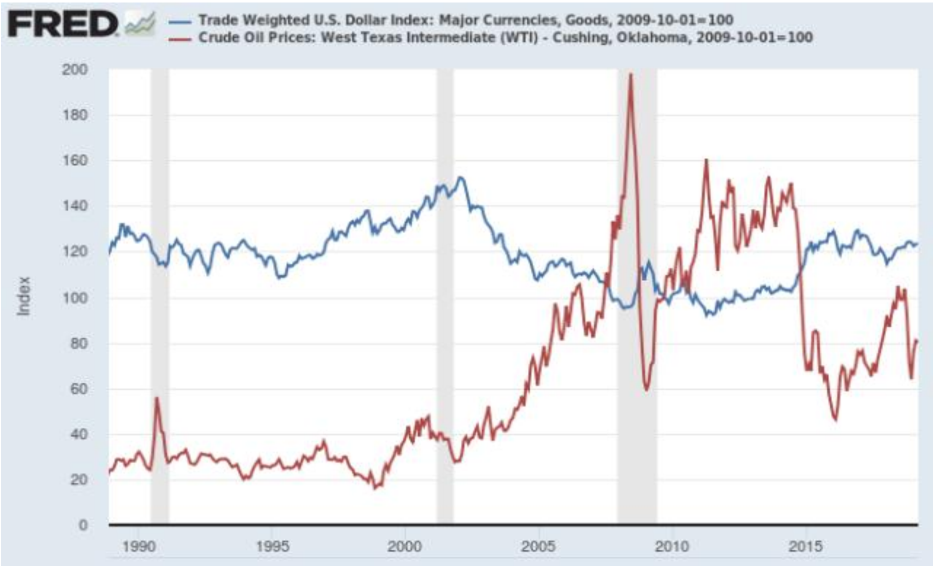
The Asian financial crisis in 1997 and the Global financial crisis in 2008 are considered to be one of the greatest crises after the Great Depression.[30]

The Global Financial crisis had a negative impact on the crude oil industry in 2008. Crude oil prices fell down influenced by the financial crisis which caused a significant decrease in demand.[31]

In 2015 the crude oil industry was in a downturn and the price dropped a lot. It happened because of a combination of different factors such as oversupply of crude oil caused by OPEC countries, the strong US dollar (global commodity prices are usually in dollars and they fall when the US dollar is strong) and declining demand (China, as the world's largest oil importer, has devaluated its currency).[32]

There is usually an inverse relationship between the price of the dollar and most of commodity prices including the crude oil (Figure 10). This is a general rule and the correlation is not perfect, but there is often a significant inverse relationship over time.[33]

Figure 10 US Dollar index vs. Crude oil WTI futures 1989-2017



Source: Board of Governors, available from https://fred.stlouisfed.org/graph/?g=NUf

[30] KRISTOPHER G., How an economic crisi affects price of crude oil, [online], 2019, Available from https://articles.marketrealist.com/2015/01/economic-crisis-affects-price-crude-oil/
[31] How did the 2008 financial crisis affect the oil and gas sector, [online], 2018, Available from https://www.investopedia.com/ask/answers/052715/how-did-financial-crisis-affect-oil-and-gas-sector.asp.
[32] TARVER E., Why the price of crude oil dropped in 2015, [online], 2016, Available from https://www.investopedia.com/articles/investing/102215/4-reasons-why-price-crude-oil-dropped.asp
[33] KOWALSKI C., How the Dollar Impacts Commodity Prices, [online], 2019, Available from https://www.thebalance.com/how-the-dollar-impacts-commodity-prices-80929

3.3.5 International regulatory organisations

With a tremendous increase of crude oil industry importance, there was a necessity to create specialised organisations which could regulate a sufficient functioning of the industry. Basically, all crude oil organisations can be divided into two categories according to the nature of their members whether it is a crude oil producing country or a certain oil company. Some of the organisations are listed below.

The European Union Offshore Oil and Gas Authorities Group (EUOAG) was established in 2012. It is a forum for the exchange of information and expertise between National Authorities (EU countries), Third Countries and the European Commission. The organisation works on issues related to major accident prevention and responses in offshore oil operations. The EUOAG discusses, assists and gives its opinions in the context of their authority. [34]

The International Association of Oil and Gas Producers (IOGP) was founded in 1974. It consists of the Management Committee responsible for the overall strategy and 79 members presented by national oil companies. Those members produce 40% of the world's crude oil and they operate in all regions. Among IOGP objectives are developments and improvements in security, social responsibility, engineering and operations, special projects, international regulators, legislative initiatives, debating issues. [35]

The World Petroleum Council (WPC) is a non-political organisation. It was founded in London in 1933. The WPC includes 70 member countries from around the world which represent about 96% of global crude oil production and consumption. The organisation has a unique and diverse structure which includes both OPEC and Non-OPEC countries on one hand with National Oil Companies (NOC's) and Independent Oil Companies (IOC's) on the other hand. The WPC concentrates on the promotion of sustainable management of the world's oil resources for the benefit of society, economy and environment.[36]

However, one the most influential one is considered to be Organization of the Petroleum Exporting Countries (OPEC). It was founded in 1960 and currently has 14

[34] EU Offshore Authorities Group, [online], Available at https://euoag.jrc.ec.europa.eu
[35] IOGP (International Association of Oil and Gas Producers), [online], Available from https://www.iogp.org/about-us
[36] WPC (World Petroleum Council), [online], Available at http://www.world-petroleum.org/about-us/introduction

member countries. The mission of OPEC is to coordinate the petroleum policies of its members, to stabilise the crude oil market, to secure an efficient and regular supply to consumers, and to have a stable income for the oil exporting countries.[37] The U.S. historically have seen OPEC as a threat to its supply of a cheap energy and as a cartel which is able to set high world market oil prices. The current U.S. policy tends to decrease the dependency from OPEC crude oil. Potentially, it can cause future diplomatic problems on the geopolitical arena of interests. As it was already described from different perspectives the strength of OPEC has shifted control of the crude oil production and pricing from Western IOCs to producing countries.[38]

3.3.6 Environmental regulatory organisations

Since a rapid increase in the crude oil industry it has denoted the widest development of chemical engineering, hydrocarbon catalysis and hydrocarbon manipulation. The refining and processing of the crude oil depends on all of them. As a result, there is no such an activity within a production or consumption process in the oil industry which can avoid adding CO_2 to the atmosphere.[39]

A rapid increase in CO_2 emissions leads to misbalance in the global carbon cycle and increases a warming impact on the planet. Global warming and changing climate have a wide range of potential ecological, physical and health impacts. They include more often happening extreme weather events (such as floods, droughts), the rise of the sea level, damaging of the water systems.[40]

This concerning ecological situation has led to scientific researchers, signing of international environmental agreements and creation controlling organisations.

United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992. At the beginning it was focussing on international negotiation process about climate change. Today the UNFCCC controls the implementation of the Kyoto

[37] OPEC (Organization of the Petroleum Exporting Countries), [online], Available at https://www.opec.org/opec_web/en/about_us/23.html
[38] EKT Interactive, Oil 101-History of oil, A timeline of the modern oil history, [online], Available from https://www.ektinteractive.com/history-of-oil/.
[39] ISLAM, M. R. Green Petroleum : How Oil and Gas Can Be Environmentally Sustainable, [online], 2012, Available at https://ebookcentral-proquest com.infozdroje.czu.cz/lib/czup/detail.action?docID=918279
[40] RITCHIE, H., ROSER M., CO_2 and other Greenhouse Gas Emissions, [online], Available from https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

Protocol (1997) and the Paris Agreement (2015). It also provides a technical expertise and assists in the analysis and review of climate change information.[41] International Petroleum Industry Environmental Conservation Association (IPIECA) sees its mission in working on issues such as greenhouse gas (GHG) emission, energy efficiency, reducing the impact of fuel emission and managing its environmental impact.[42]

The Carbon Sequestration Leadership Forum (CSLF) is an international climate change initiative which is focused on the development of cost-effective technologies for carbon capture and storage (CCS). It also promotes legal, financial and environmental support to such technologies. The CSLF consists of 26 member governments (25 countries and the European Commission). Membership is especially opened to countries which are the significant crude oil producers.[43]

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[41] UNFCCC (United Nations Framework Convention on Climate Change), [online], Available from https://unfccc.int/about-us/about-the-secretariat

[42] IPIECA (International Petroleum Industry Environmental Conservation Association), [online], Available from http://www.ipieca.org/our-work/climate-energy

[43] CSLF (Carbon Sequestration Leadership Forum), [online], Available from https://www.cslforum.org/cslf/About-CSLF

4 Practical Part

The practical part of the bachelor thesis is based on data which reflect certain economic indicators of Norway and Russia for the last 30 years. The main objective of the practical part is to concentrate on explaining the links between crude oil production and selected macroeconomic indicators on the example of Norway and Russia. The analysis aims at identifying the most influential among them and consequent at better understanding the developmental trends in crude oil production in these countries.

Formulation of an economic model as a relationship between independent and dependent variables:

$$y = f(x_{1;}\, x_{2;}\, x_{3;}\, x_{4;}\, x_5) \qquad (2)$$

$x_{1;}\, x_{2;}\, x_{3;}\, x_{4;}\, x_5$ – independent (explanatory) variables

y – dependent variable

Endogenous variable is a variable determined by the model and exogenous variable is a variable determined outside of the model.[44]

Econometric model is formulated as:

$$y = \gamma_0 + \gamma_1 x_{1t} + \gamma_2 x_{2t} + \ldots + \gamma_n x_{nt} + u_t \qquad (3)$$

u_t – stochastic variable (residual term), that includes all variations of y_t which cannot be explained by the suggested model

γ_n – parameter of the exogenous variables representing the quantitative relationship between y and x_{it}

γ_0 – intercept (constant)

Basic descriptive statistics of the underlying data is represented by mean (measure of location, arithmetical average of a set), median (measure of location, the middle value once the observations are ordered from smallest to largest in the sample), minimum (minimal value in the data set), maximum (maximal value in the data set), standard deviation (measure of variability, square root of the variance).[45]

[44] WOOLDRIDGE J. M., Introductory econometrics: a modern approach, 2009, p.556
[45] DEVORE, J. L., Probability and Statistics for Engineering and the Sciences, 2011, p. 28-35

OLSM using the principle of minimising the sum of squares of the deviations (differences) between observed values of the dependent variable and estimated (predicted) values of the dependent variable.[46]

Coefficient of determination R^2 can be interpreted as the proportion of observed y variation that can be explained by the multiple regression model fit to the data. [47]

Residual is the difference between observed and estimated value.[48]

Autocorrelation (also called serial correlation) occurs when the error term observations in a regression are correlated. The theoretical error term is a random variable that is part of the regression model, even before it is estimated. This error term represents a random "shock" to the model, or something that is missing from the model.[49]

Heteroskedasticity refers to residuals (error) and means systematic change in the spread of the residuals over the range of measured values. Situation when residuals do have a constant variance corresponds to the term of homoskedasticity. [50]

4.1 Overview of the crude oil production in Norway

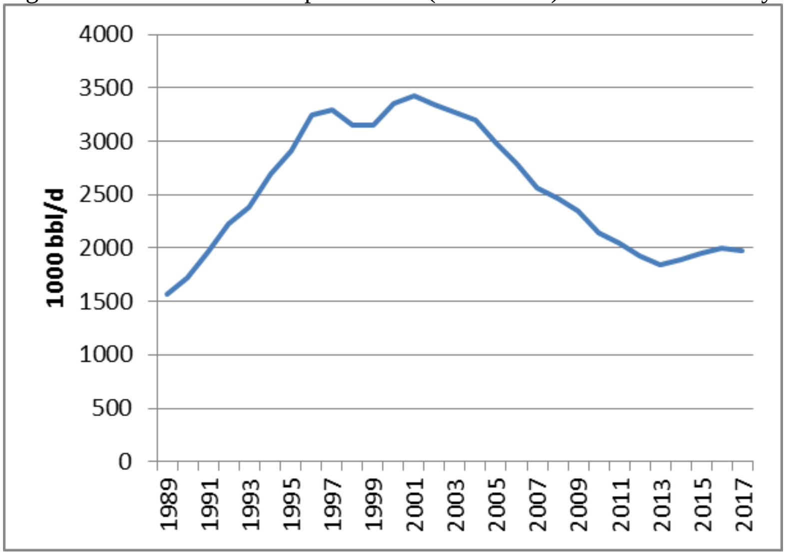
After the discovery of gas in the Nethelands in 1959 the attention was drawn to the energy potencial (crude oil resoures) of the North Sea. In 1963 government's regulation determined that the State owns any natural resources on the Norwegian Continental Shelf (NCS) and only the King (government) is authorized to award licences for exploration and production. The first crude oil field (Ekofisk) was discovered in 1969 and the productiond from the field started in1971. Statoil company was created in 1972 with 50% (today it is 67%) of the state participation.[51]

[46] DEVORE, J. L., Probability and Statistics for Engineering and the Sciences, 2011, p. 478
[47] DEVORE, J. L., Probability and Statistics for Engineering and the Sciences, 2011, p. 580
[48] WOOLDRIDGE J. M., Introductory econometrics: a modern approach, 2009, p.30
[49] HALCOYSSIS, D., Understanding Econometrics, [online], Available from https://www.cengage.com/resource_uploads/downloads/0030348064_54176.pdf
[50] WOOLDRIDGE J. M., Introductory econometrics: a modern approach, 2009, p.51
[51] Ministry of Petroleum and Energy Official, Norway's oil history in 5 minutes, [online], 2013, Available from https://www.regjeringen.no/en/topics/energy/oil-and-gas/norways-oil-history-in-5-minutes/id440538

Nowadays, Norway is one of the crude oil net-exporting countries with 1 395 000 bbl/day (the 11th country in the world). According to the data of crude oil proved reserves Norway is on the 21st position in the world with 6 611 000 000 bbl.[52]

As it was already mentioned, the crude oil in Norway was discovered in the late 1960s but production process started in the mid-1970s. After the development of oil industry, production first reached its highest volume (peak) at the end of 1990s-beginning 2000s (Fidure 11). Since then the crude oil production has been declyning but according to some forecasts another peak in production could happen by the early 2020s.[53]

Figure 11 Annual Crude oil production (1000 bbl/d) 1989-2107 Norway



Source: data available from https://www.eia.gov/beta/international/data, created by author

Many analytics describe fiscal policy in Norway as effective, stable and able to react in accordance with the world economic challenges. This fiscal policy is based on the rule of non-oil budget balance and a sovereign wealth fund.[54]

The wealth fund was founded in 1990 named as Government Petroleum Fund based on the petroleum revenue. Lately, in 2006 it was renamed into the Government Pension Fund-Global (GPF-G) as a response to the domestic political pressure to spend more on the

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[52] Central Intelligence Agency. Crude oil Exports and Proved reserves, [online], Available from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2242rank.html

[53] CABEZON E., GORNICKA L., HENN C., ZHANG Y.S. Norway Selected Issues, [online], 2018, Available from http://www.imf.org

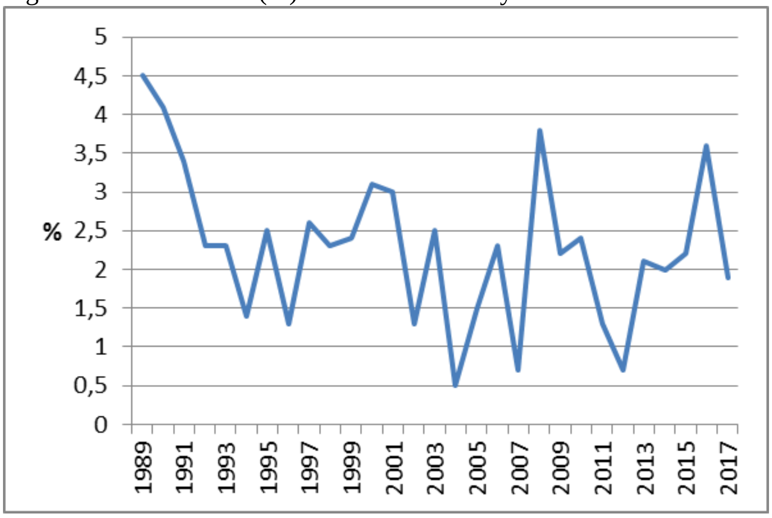
[54] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

future pension payments. The Fund is managed by Norges Bank Investment Management on "behalf of the Ministry of Finance, which owns the fund on behalf of the Norwegian people". The fund is set not to overheat economy and to help avoiding negative effects of the crude oil fluctuations. The fund invests its capital abroad using diversification rule. Therefore, the fund creates the possibility for changes in fiscal policy.[55] The fund has grown rapidly during the period of a high crude oil prices. The GPF-G fund is the largest souvereign wealth fund in the world reached 1 trillion US dollar.[56]

According to the fiscal rule (2001) only the expected real return of the fund can be transferred to the government budget (around 4 %) and be used for expenditure. This rule accepts some fluctuations in rate under certain negative impact in world economy. For example, it was changed due to the stock market decline in 2002-2003.[57]

Norway is one of the succesful examples of macroeconomic stability, which has also been supported by inflation targeting framework (Figure 12).

Figure 12 Inflation rate (%) 1989-2017 Norway



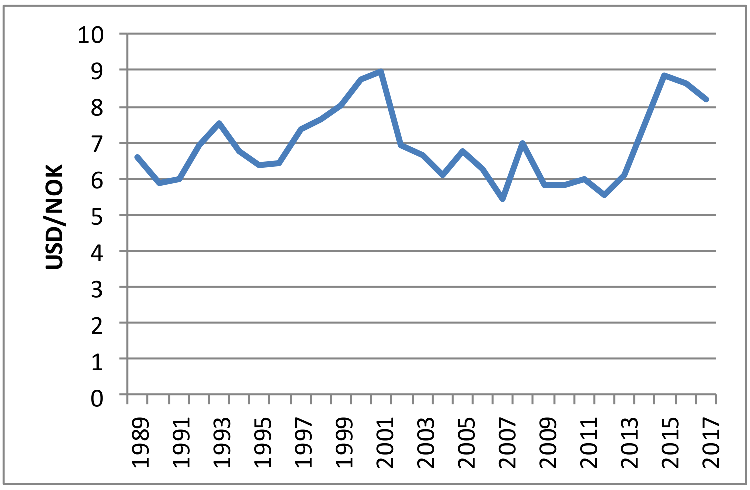
Source: data available from https://www.imf.org/external/datamapper, created by author

As already mentioned Norway has an inflation targeting framework what makes its monetary policy different compare to other net oil exporters. It doesn not have a strong

[55] Norges Bank Investment Management, About the fund, [online], 2019, Available from https://www.nbim.no/en/the-fund/about-the-fund
[56] BISHOP K., The world's biggest souveregn wealth funds in 2017, [online], 2017, Available from https://www.cnbc.com/2015/07/17/the-worlds-biggest-sovereign-wealth-funds.html
[57] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

orientation to the US dollar (the world's crude oil currrency). Another words Norway's exchange rate arrangements have an independent float (Figure 13).[58]

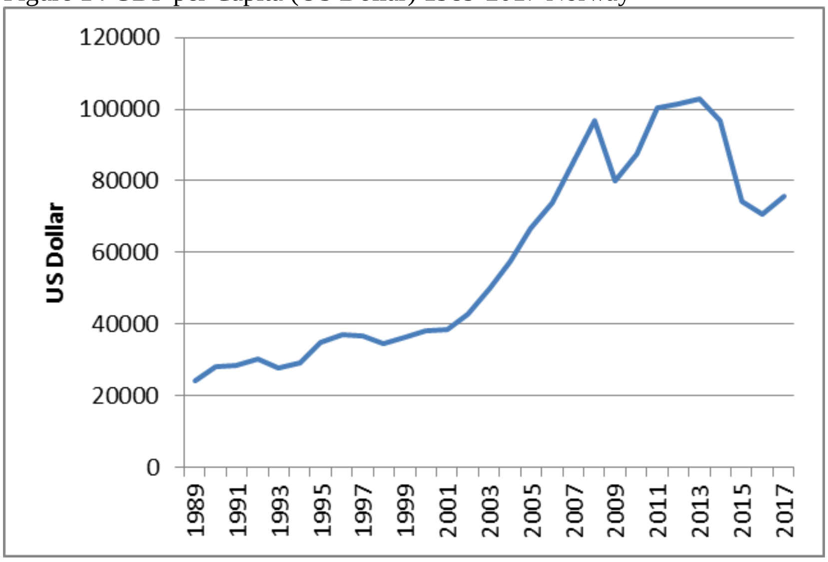
Figure 13 Exchange rate (USD/NOK) 1989-2017 Norway



Source: data available from https://www.investing.com/currencies/usd-nok-historical-data; created by author

Norway is a country with a high level of GDP per Capita and other human development indicators (Figure 14).[59]

Figure 14 GDP per Capita (US Dollar) 1989-2017 Norway



Source: data available from https://countryeconomy.com/gdp/norway, created by author

[58] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

[59] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

Norway’s successful fiscal policy is not only based on a professional managing of crude oil and other natural resources within the fund. There are some differences which help the country to stand out other oil exporters. It has a developed infrastructure and diversified economy with a high level of governance.[60]

Norways is an active player in the world crude oil organisations. It is a member of the World Petroleun Council (WPC), International Assosiation of Oil and Gas Producers. On the domestic level oil regulates by Norwegian Petroleum Industry Assosiation and Ministry of Petrolium and Energy. Norway is a non-OPEC country.

As it was previously described in the theoretical part of the thesis the interest for alternative (renewable) energy sources is increasing especially in developed countries. They tend to invest, produce and to consume more of these kinds of energy. Norway is typical example of such a counrty. Norway is one of the countries with the highest GDP per Capita which corresponds to high renewable energy consumption (Figure 6). It already produces most of its electrisity from hydropower followed by wind and thermal energy sources.

Concerns about impact of the crude oil production on the invironment is very influential in Norway. The tendency for sustainability in crude oil industry can be explained on the example of the country’s major energy company Statoil. After 45 years of operating under the name Statoil (from Norwegian – State Oil influenced by the fact of being a public property) the company changed its name in 2018 to Equinor which can be seen as a combination of “equi-“ (equilibrium) and “–nor” (Norway - country of origin). The company invests into climate change funds, implements strategy for reducing CO_2 carbon emission, develops plans for more sustainable production process. Norway is also a member of many environmental organisations both on the international level (United Nations Framework Convention on Climate Change, International Petroleum Industry Environmental Conservation Association and the Carbon Sequestration Leadership Forum etc.) and local level (Norwegian Society for the Conservation of Nature, Norwegian Environment Agency, Nature and Youth etc.).

[60] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

4.1.1 Formulation of an econometric model

Based on the preliminary described factors and their influential level on the crude oil production in Norway, following indicators are chosen to create a regression model: annual GDP, GDP per Capita, exchange rate, inflation rate, crude oil WTI futures. All this indicators are independent variables and, together with annual crude oil production as a dependent variable, create the model which will be analysed.

This created model can be transformed into function according to the equation (2) and formulated as: crude oil production in Norway can be explained by annual GDP, GDP per Capita, exchange rate, inflation rate, crude oil WTI futures.

Crude oil Production = f (GDP; GDP per Capita; Exchange rate; inflation rate; WTI futures)

For the purpose of better representation of information all variables were transformed into shorter notation. This form of variables was used as input data for GRETL software.

Table 4-1 Declaration of variables Norway

	Description	**Type**	**Units**
y	The annual crude oil production	Endogenous (dependent)	1000 bbl/d
x_1	Annual GDP	Exogenous (explanatory)	bil USD
x_2	GDP per Capita	Exogenous (explanatory)	$
x_3	Exchange rate	Exogenous (explanatory)	USD/NOK
x_4	Inflation rate	Exogenous (explanatory)	%
x_5	Crude oil WTI futures	Exogenous (explanatory)	USD

Source: created by author

According to the equation (3) the regression model represents connection between given dependent variable and all explanatory variables as followed:

$$y = \gamma_0 + \gamma_1 x_{1t} + \gamma_2 x_{2t} + \gamma_3 x_{3t} + \gamma_4 x_{4t} + \gamma_5 x_{5t} + u_t \qquad (4)$$

As the starting point of regression model analysis the descriptive statistics for all variables is done. It allows getting basic raw information about input data. For each variable it includes mean, median, minimum and maximum values, standard deviation.

Table 4-2 Descriptive statistics Norway

Observations 1989-2017					
Variable	**Mean**	**Median**	**Minimum**	**Maximum**	**Std. Dev.**
y	2546.2	2464.0	1570.0	3422.0	596.52
x_1	278.39	228.75	102.63	523.50	145.03
x2	58143.	50023.	24245.	1.0272e+005	27187.
x3	6.9205	6.7450	5.4362	8.9474	1.0432
x4	2.2828	2.3000	0.50000	4.5000	0.99393
x5	44.907	32.520	12.050	98.830	28.781

Source: author's calculation in GRETL

Before the model estimation and quantification of its parameters, correlation matrix has to be done to check the presence of multicollinearity between explanatory variables.

Table 4-3 Correlation matrix Norway

Observations 1989-2017 (5% critical value two-tailed = 0.3673 for n = 29)					
x_1	**x_2**	**x_3**	**x_4**	**x_5**	
1.0000	<u>0.9966</u>	-0.1958	-0.3249	<u>0.8790</u>	**x_1**
	1.0000	-0.2424	-0.3407	<u>0.8905</u>	**x_2**
		1.0000	0.2988	-0.4682	**x_3**
			1.0000	-0.4105	**x_4**
				1.0000	**x_5**

Source: author's calculation in GRETL

Correlation between three independent variables is considered to be a strong multicollinearity when its absolute value is more than 0.8. There is a strong multicollinearity between three pairs of variables:

- $\rho_{x1;x2} = 0.9966 > 0.8$
- $\rho_{x1;x5} = 0.8790 > 0.8$
- $\rho_{x2;x5} = 0.8905 > 0.8$

For the purpose of the following calculations multicollinearity was solved as:

✓ the data for variable x_5 was transformed by using the method of the 1st difference (a new time series for variable x_5 was created, each of a new observation is difference between a current value and a previous value, can be also described as $x_{5t} - x_{5(t-1)}$)

- ✓ variable x_1 was excluded from the analysis since it may be represented by related variable x_2 due to the similar specifics both of them

The new correlation matrix is the following.

Table 4-4 Correlation matrix (transformed) Norway

Observations 1990 - 2017 (5% critical value two-tailed = 0.3739 for n = 28)				
x_2	**x_3**	**x_4**	**d_x_5**	
1.0000	-0.2650	-0.2712	-0.0997	**x_2**
	1.0000	0.3600	-0.2893	**x_3**
		1.0000	-0.3373	**x_4**
			1.0000	**d_x_5**

Source: author's calculation in GRETL

Based on the outcome data from the new correlation matrix (Table 4-4) the problem of existed multicollinearity was successfully solved. The next step of the regression model analysing (estimation of the parameters) can be provided.

4.1.2 Model estimation using OLSM

Estimation of the model is made using OLS method to obtain information which is used for the further model's testing and verification.

Table 4-5 OLS Norway

Observations 1990 - 2017 (T = 28); dependent variable y					
	Coefficient	**Std. Error**	**t-ratio**	**p-value**	
const	2919.00	802.604	3.637	0.0014	***
x_2	−0.0115509	0.00384353	−3.005	0.0063	***
x_3	125.119	100.093	1.250	0.2239	
x_4	−236.270	118.747	−1.990	0.0586	*
d_x_5	0.690451	5.77730	0.1195	0.9059	

Source: author's calculation in GRETL

Table 4-6 OLS Norway (continuation of the table 4-5)

Mean dependent var.	2581.071	**S.D. dependent var.**	576.5900
Sum squared resid.	5539318	**S.E. of regression**	490.7544
R-squared	0.382896	**Adjusted R-squared**	0.275574
F(4, 23)	3.567717	**P-value(F)**	0.020979
Log-likelihood	−210.4628	**Akaike criterion**	430.9255
Schwarz criterion	437.5865	**Hannan-Quinn**	432.9619
rho	0.768546	**Durbin-Watson**	0.429911

Source: author's calculation in GRETL

Regarding to previously described process of eliminating multicollinearity from the model the original formula of regression (4) has been transformed into:

$$y = \gamma_0 + \gamma_2 x_{2t} + \gamma_3 x_{3t} + \gamma_4 x_{4t} + \gamma_{d5} x d_{d5t} + u_t \qquad (5)$$

After the substitution of coefficients obtained from the software into the equation (5) the final regression model equation:

$$y = 2919 - 0.0115509 x_{2t} + 125.119 x_{3t} - 236.27 x_{4t} + 0.690451 x_{d5t} + u_t \qquad (6)$$

4.1.3 Model verification

Results obtained from GRETL using output data of OLS method are crucial for analysing. Further, the model is verified with economic, statistical and econometrical approaches.

Economic verification of the model

Based on the results obtained from OLSM, individual coefficients of the parameters can be explained as a connection between that explanatory variable and dependent variable.

- If GDP per Capita increases by 1$, then Annual Crude Oil Production decreases by 11.6 (bbl./d); ceteris paribus
- If Exchange Rate increases by 1 USD/NOK, then Annual Crude Oil Production increases by 125.1 (thds. bbl./d); ceteris paribus

- If Inflation Rate increases by 1 p.p., then Annual Crude Oil Production decreases by 236.3 (thds. bbl./d); ceteris paribus
- If Crude Oil WTI Futures increases by 1$, then Annual Crude Oil Production increases by 690.5 (bbl./d); ceteris paribus

Statistical verification of the model

Coefficient of determination R^2 is the degree of conformity between the estimated model and data and the first indication of whether the chosen model is successful in explaining y variation.[61]

In the given model according to OLSM outcome $R^2 = 0.382896$. It means that only 38% of the variation y (crude oil production) is explained by regressors x_{it}. On the other hand 62% of information remains unexplained.

As already mentioned, coefficient of determination is a preliminary tool for evaluation of a model. For the purpose of testing overall significance of the model is used F-test.

Table 4-7 F-test Norway

p-value of F-test	Comparison	Level of significance
p = 0.020979	0.020979 < 0.05	$\alpha = 0.05$

Source: author's calculations in GRETL

The overall model is statistically significant at the level of significance $\alpha = 0.05$.

The next test for evaluation of the model is t-test which examines whether or not an individual estimated parameter is significant.

Table 4-8 t-test ($\alpha = 0.05$) Norway

	x_2	x_3	x_4	d_x_5
t-value	|-3.005|	1.25	|-1.99|	0.1195
$t_{\alpha(n-p-1)}$	2.069	2.069	2.069	2.069
Conclusion	H_1	H_0	H_0	H_0

Source: author's calculation in GRETL

[61] DEVORE, J. L., Probability and Statistics for Engineering and the Sciences, 2011, p. 580

Individual parameter x_2 is statistically significant at the level of significance $\alpha = 0.5$. Individual parameters x_3, x_4, d_x_5 are not statistically significant at the level of significance $\alpha = 0.5$.

Econometrical verification of the model

The final econometrical verification provides additional information for making more accurate conclusion. Three tests are completed: autocorrelation test, heteroskedasticity test and test for normality of residual.

For the purpose of autocorrelation testing was applied Breusch-Godfrey test. Based on the calculations in GRETL the following results were obtained.

Table 4-9 Autocorrelation test Norway

p-value	Comparison	α
p = 5.86e-006	5.86e-006 < 0.05	0.05

Source: author's calculation in GRETL

There is an autocorrelation of residuals of data in the model at the level of significance $\alpha = 0.05$.

The next step in econometrical verification is heteroskedasticity test. For its purpose was applied White's test.

Table 4-10 Heteroscedasticity test Norway

p-value	Comparison	Level of significance
p = 0.248808	0.248808 > 0.05	α = 0.05

Source: author's calculation in GRETL

There is homoscedasticity in the model at the level of significance $\alpha = 0.05$.

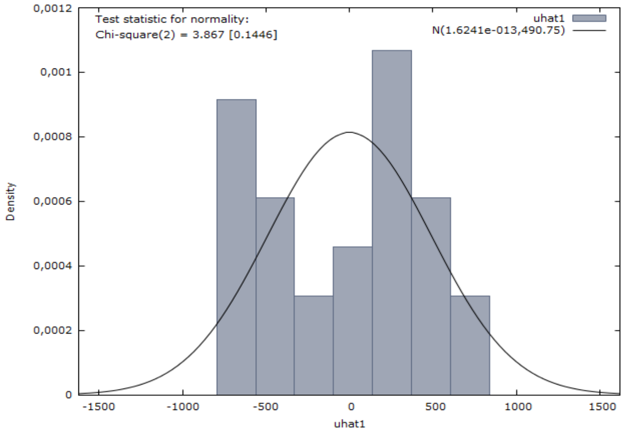
After verification of homoskedasticity in the model the next step of testing residuals is normality test.

Table 4-11 Normality test Norway

p-value	Comparison	Level of significance
p = 0.14461	0.14461 > 0.05	α = 0.05

Source: author's calculation in GRETL

Figure 15 Normality of residual Norway



Source: GRETL's output

Residuals of the model are normally distributed

4.1.4 Discussion of the results

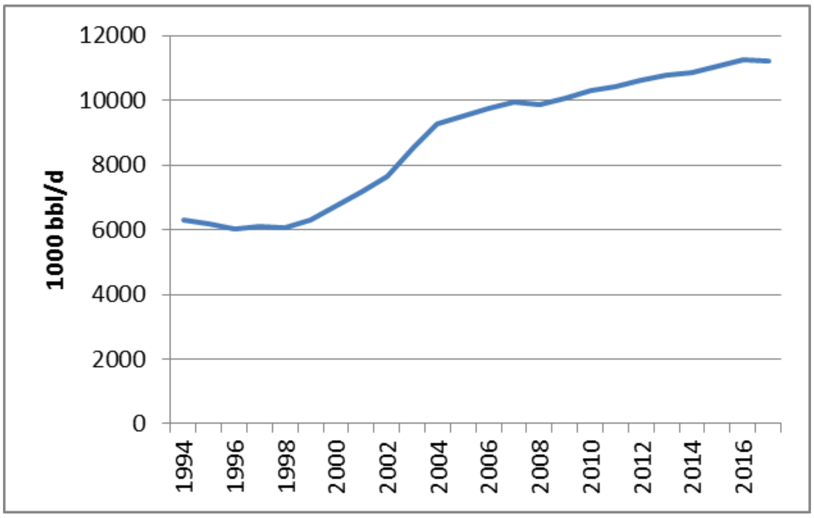
Crude oil production in Norway was analysed in accordance with the goals of the practical part. First, it was described how the various factors influence crude oil production in the country. It was also presented their level of importance, current trends and future perspectives. Second, based on the assumption of dependency crude oil production on certain factors (GDP per Capita, inflation rate, exchange rate, crude oil WTI Futures) it was created a regression model. The model was analysed using OLSM, statistical and econometrical verification. Based on the mentioned methods the model itself was confirmed to be statistically significant and allowed to explain the relationship between variables. There were also identified variables (macroeconomic indicators) playing crucial role in explaining crude oil production trend in Norway – GDP per Capita and inflation rate.

4.2 Overview of the crude oil production in Russia

History of the crude oil in Russia started in the 19th century and had an intense developing during the 20th century. The political regime and economic situation has changed many times from the Russian Empire (until 1917) to the Union of Soviet Socialist Republic (until 1991) and finally Russian Federation. One of the most important factors for the country that has stayed unchanged is the crude oil.

The production of the crude oil started in Baku in 1846. In the beginning of the 20th century the Russian Empire shared about 30% of the exporting crude oil in the world. All the dramatic changes in the country (Revolution, Civil War, nationalisation, both World Wars) reduced production significantly. After the situation within the country was stabilised new oil fields were discovered in Caucasus and Caspian regions, in Ural and Siberia. The Soviet Union increased its export to world market and it can be seen as another reason for the foundation of OPEC. In the 1980s the crude oil industry faced a decline due to a lack of investment. In the early years of the Russian Federation the crude oil production decreased again. The following strategy was implemented in order to stabilise the industry – demonopolisation and privatisation. These starteges helped to stabalise the crude oil production and even increase its volume.[62]

Figure 16 Annual Crude oil production (1000 bbl/d) 1994-2017 Russia



Source: data available from https://www.eia.gov/beta/international/data/russia, created by author

Nowadays, Russia is one of the crude oil net exporting countries with 5 116 000 bbl/day (the 2nd country in the world). According to the data of crude oil proved reserves Norway is on the 8st position in the world with 80 000 000 000 bbl.[63] Among the largest oil companies today are Rosneft (50% of the state ownership), Lukoil (non-state company), Gazprom Neft (subsidary of Gazprom – appr. 50% of the state ownership), Surgutneftegaz

[62] EGOROV B., Black gold: How the Russian oil industry was born, [online], 2017, Available from https://www.rbth.com/business/326217-black-gold-how-russian-oil

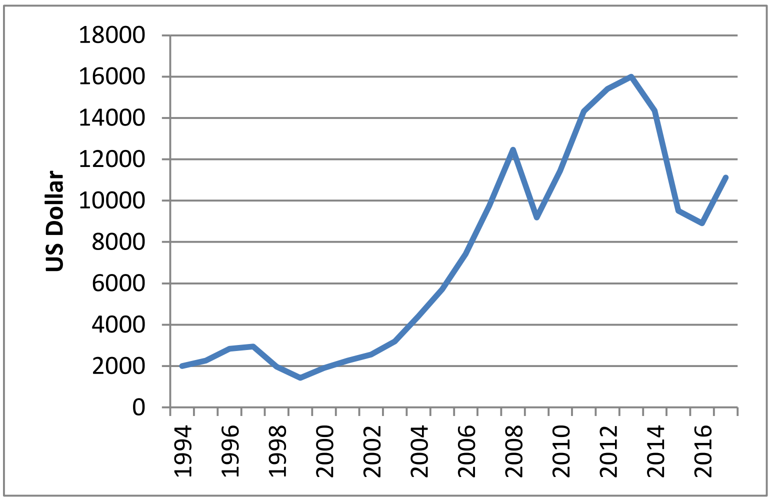
[63] Central Intelligence Agency, Crude oil Exports and Proved reserves, [online], Available from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2242rank.html

and Tatneft. All of them are integrated oil companies which means they provide the full cycle of operations with oil from exploration, production and exporting.[64]

Typically, in the oil-exporting countries revenue from the crude oil is directed into economy and leads to a fiscal expansion. As the largest Russian oil companies are controlled by the state the process of such transferring happens in Russia. In this case the model is a part of fiscal policy and influences the whole domestic economy. Like many others large oil-exporting countries Russia founded a fund based on the crude oil revenue – the Oil Stabilisation Fund (OSF) in 2004. The main purpose of the OSF was the financing the country's budget when the crude oil price is lower than reference price. It was also used for covering the Pension Fund deficit. Lately, in 2008 the OSF was split into Reserve Fund (stabilisation function of the budget deficit and a Future Generation (saving function). Ten years later, in 2018 due to the negative economic effect caused by international sanctions those two funds were merged into one again.[65]

The fall of the USSR and instability of a new political system the Russian economy reflected with a recession.

Figure 17 GDP per Capita (US Dollar) 1994-2017 Russia



Source: data available from https://countryeconomy.com/gdp/russia, created by author

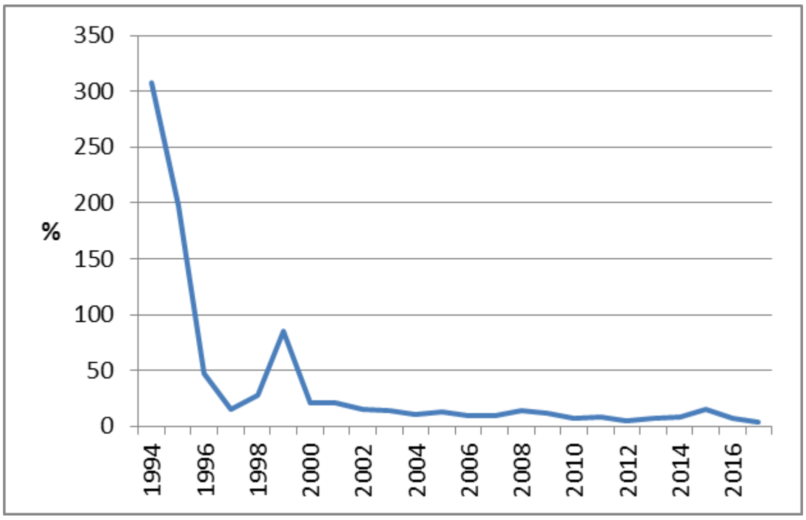
[64] CARPENTER J.W., The 5 biggest Russian Oil Companies, [online], 2015, Available from https://www.investopedia.com/articles/markets/100515/5-biggest-russian-oil-companies.asp

[65] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

All macroeconomic indicators were low including GDP per Capita (Figure 17). It has been slightly growing from 1994 until the Asian financial Crises. The declining trend was reversed during the period of high crude oil prices but then again started to decline after implemented financial and political sanctions against Russia.[66]

The inflation rate in Russia increased dramatically during the transition process in economy at the beginning of 1990s and also after the Asian Financial crisis in 1998. It reacted with a significant growth due to the Global Financial crisis and sanctions.[67]

Figure 18 Inflation rate (%) 1994-2017 Russia



Source: data available from https://www.imf.org/external/datamapper/, created by author

While facing an inflation pressure on the fiscal policy, the exchange rate regimes were constrained to maintain a proper monetary policy. As an net-exporting crude oil country Russia has a strong orientation on the US Dollar (the currency for trading oil).[68]

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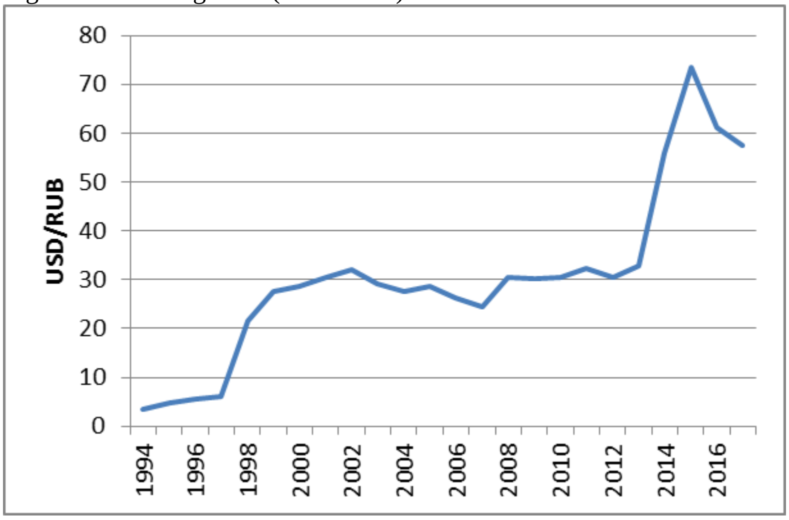
[66] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

[67] ALEGRE J.G., GURTNER F., STURM M., Fiscal policy challenges in oil-exporting countries, [online], 2009, Available from http://www.ecb.europa.eu

[68] STANLEY R., Russia and others joint OPEC: Coordinated push to cut oil output, [online], 2016, Available from https://www.nytimes.com/2016/12/10/business/russia-opec-saudi-arabia-cut-oil-output.html

Figure 19 Exchange rate (USD/RUB) 1994-2017 Russia



Source: data available from https://www.investing.com/currencies/usd-rub-historical-data, created by author

Russia a member of the World Petroleun Council (WPC). On the domestic level oil industry regulates by Ministry of Energy, Ministry of Natural Resources and Ecology, Federal Agency for Subsoil Use. Even though officially Russia is a non-OPEC counrty it has agreed with OPEC's initiative about cutting of the crude oil production in 2017.[69]

Russia has a great potential in the renewable energy production and using because of the size, climate and geographical diversity. It would be very beneficial from both economic and environment points of view. Unfortunately this unique potential is not being utilised enough and at all. Both production and consumption are at the low level (Figure 6). Among all kinds of renewable energy sources only hydropower has been developed enough. But there is still a big and unused capacity. There is a whole area for the future development through the scientific research, implementation on domestic and international levels. Russia has all the important pre-conditions for developing renewable energy industry.[70]

According to the Russian Constitution environmental policy the regulation is combined on the government and regional levels. There are two main federal laws which regulate environmental protection including the crude oil production (Environmental

[69] STANLEY R., Russia and others joint OPEC: Coordinated push to cut oil output, [online], 2016, Available from https://www.nytimes.com/2016/12/10/business/russia-opec-saudi-arabia-cut-oil-output.html

[70] Øverland I. KjÆrnetH., Russian Renewable Energy: The Potential for International Cooperation, 2009, p.149

protection and Environment Expert Review). Based on the Environmental Protection law (2001) every company which can create any environmental impact is required to obtain a permit for its activities. At the same time its possible pollution or emission is regulated by tariffs and in case of a higher environmental impact a company is required to settle a higher payment. This is so called "pay-to-pollute" principle. The Russian government also requires oil companies to utilise the associated petroleum gas by themselves (95%).[71]

4.2.1 Formulation of an econometric model

Based on the preliminary described factors and their influential level on the crude oil production in Russia, following indicators are chosen to create a regression model: annual GDP, GDP per Capita, exchange rate, inflation rate, crude oil WTI futures. All this indicators are independent variables and, together with annual crude oil production as a dependent variable, create the model which will be analysed.

This created model can be transformed into function according to the equation (2) and formulated as: crude oil production in Norway can be explained by annual GDP, GDP per Capita, exchange rate, inflation rate, crude oil WTI futures.

Crude oil Production = f (GDP; GDP per Capita; Exchange rate; inflation rate; WTI futures)

For the better representation of information all variables were transformed into shorter notation. This form of variables was used as input data for GRETL software.

Table 4-12 Declaration of variables Russia

	Description	**Type**	**Units**
y	The annual crude oil production	Endogenous (dependent)	1000 bbl/d
$\mathbf{x_1}$	Annual GDP	Exogenous (explanatory)	bil $
$\mathbf{x_2}$	GDP per Capita	Exogenous (explanatory)	$
$\mathbf{x_3}$	Exchange rate	Exogenous (explanatory)	USD/RUB
$\mathbf{x_4}$	Inflation rate	Exogenous (explanatory)	%
$\mathbf{x_5}$	Crude oil WTI futures	Exogenous (explanatory)	$

Source: created by author

[71] JOSEFSON J., RROTAR A., Oil and Gas Regulation in the Russian Federation: overview, [online], 2018, Available from https://uk.practicallaw.thomsonreuters.com

According to the equation (3) the regression model represents connection between given dependent variable and all explanatory variables as followed:

$$y = \gamma_0 + \gamma_1 x_{1t} + \gamma_2 x_{2t} + \gamma_3 x_{3t} + \gamma_4 x_{4t} + \gamma_5 x_{5t} + u_t \qquad (7)$$

As the starting point of regression model analysis the descriptive statistics for all variables is done. It allows getting basic raw information about input data. For each variable it includes mean, median, minimum and maximum values, standard deviation.

Table 4-13 Descriptive statistics Russia

Observations 1994-2017					
Variable	**Mean**	**Median**	**Minimum**	**Maximum**	**Std. Dev.**
y	8827.3	9621.5	6017.0	11250.	1964.3
x_1	1039.9	942.10	210.49	2297.1	714.35
x2	7224.7	6567.5	1433.0	15997.	5002.2
x3	30.500	29.778	3.5850	73.596	17.403
x4	36.758	13.200	3.7000	307.60	70.551
x5	49.969	44.025	12.050	98.830	29.132

Source: author’s calculation in GRETL

Before the model estimation and quantification of its parameters, correlation matrix has to be done to check the presence of multicollinearity between explanatory variables.

Table 4-14 Correlation matrix Russia

Observations 1994-2017 (5% critical value two-tailed = 0.4044 for n = 24)					
x_1	**x_2**	**x_3**	**x_4**	**x_5**	
1.0000	<u>1.0000</u>	0.5095	-0.4255	<u>0.8377</u>	**x_1**
	1.0000	0.5096	-0.4270	<u>0.8393</u>	**x_2**
		1.0000	-0.5099	0.2830	**x_3**
			1.0000	-0.4306	**x_4**
				1.0000	**x_5**

Source: author’s calculation in GRETL

Correlation between three independent variables is considered to be a strong multicollinearity when its absolute value is more than 0.8. There is a strong multicollinearity between three pairs of variables:

- $\rho_{x1;x2}$ = 1.0000 > 0.8
- $\rho_{x1;x5}$ = 0.8377 > 0.8
- $\rho_{x2;x5}$ = 0.8393 > 0.8

For the purpose of the following calculations multicollinearity was solved as:

- ✓ the data for variable x_5 was transformed by using the method of the 1st difference (a new time series for variable x_5 was created, each of a new observation is difference between a current value and a previous value, can be also described as $x_{5t} – x_{5(t-1)}$)
- ✓ variable x_1 was excluded from the analysis since it may be represented by related variable x_2 due to the similar specifics both of them

The new correlation matrix is the following.

Table 4-15 Correlation matrix (transformed) Russia

Observations 1995 - 2017 (5% critical value two-tailed = 0.4132 for n = 23)				
x_2	**x_3**	**x_4**	**d_x_5**	
1.0000	0.4740	-0.4368	-0.2100	**x_2**
	1.0000	-0.4426	-0.1928	**x_3**
		1.0000	0.0318	**x_4**
			1.0000	**d_x_5**

Source: author's calculation in GRETL

Based on the outcome data from the new correlation matrix the problem of existed multicollinearity was successfully solved. The next step of the regression model analysing (estimation of the parameters) can be provided.

4.2.2 Model estimation using OLSM

Estimation of the model is made using OLS method to obtain information which is used for the further model's testing and verification.

Table 4-16 OLS Russia

Observations 1995 - 2017 (T = 23); dependent variable y					
	Coefficient	**Std. Error**	**t-ratio**	**p-value**	
const	5582.70	407.808	13.69	<0.0001	***
x_2	0.259384	0.0326033	7.956	<0.0001	***
x_3	46.8876	9.66764	4.850	0.0001	***
x_4	−3.92241	3.81509	−1.028	0.3175	
d_x_5	18.5482	6.98207	2.657	0.0161	**

Source: author’s calculation in GRETL

Table 4-17 OLS Russia (continuation of table 4-17)

Mean dependent var	8936.913	**S.D. dependent var**	1932.036
Sum squared resid	7249040	**S.E. of regression**	634.6057
R-squared	0.911727	**Adjusted R-squared**	0.892111
F(4, 23)	46.47827	**P-value(F)**	3.00e-09
Log-likelihood	−178.2358	**Akaike criterion**	366.4715
Schwarz criterion	372.1490	**Hannan-Quinn**	367.8994
rho	0.619055	**Durbin-Watson**	0.724304

Source: author’s calculation in GRETL

Regarding to previously described process of eliminating multicollinearity from the model the original formula of regression (3) has been transformed into:

$$y = \gamma_0 + \gamma_2 x_{2t} + \gamma_3 x_{3t} + \gamma_4 x_{4t} + \gamma_{d5} x d_{d5t} + u_t \quad (8)$$

After the substitution of coefficients obtained from the software into the equation (8) the final regression model equation:

$$y = 5582.7 + 0.259384x_{2t} + 46.8876x_{3t} - 3.92241x_{4t} + 18.5482x_{d5t} + u_t \quad (9)$$

4.2.3 Model verification

Results obtained from GRETL using output data of OLS method are crucial for analysing. Further, the model is verified with economic, statistical and econometrical approaches.

Economic verification of the model

Based on the results obtained from OLSM, individual coefficients of the parameters can be explained as a connection between that explanatory variable and dependent variable.

- If GDP per Capita increases by 1$, then Annual Crude Oil Production increases by 259.4 (bbl/d); ceteris paribus
- If Exchange Rate increases by 1, then Annual Crude Oil Production increases by 46.9 (thds. bbl/d); ceteris paribus
- If Inflation Rate increases by 1 p.p., then Annual Crude Oil Production decreases by 3922 (bbl/d); ceteris paribus
- If Crude Oil WTI Futures increases by 1$, then Annual Crude Oil Production increases by 18.6 (thds. bbl/d); ceteris paribus

Statistical verification of the model

Coefficient of determination R^2 is the degree of conformity between the estimated model and data and the first indication of whether the chosen model is successful in explaining y variation.[72]

In the given model according to OLSM outcome $R^2 = 0.911727$. It means that 91% of the variation y (crude oil production) is explained by regressors x_{it}. On the other hand 9% of information remains unexplained.

As already mentioned, coefficient of determination is a preliminary tool for evaluation of a model. For the purpose of testing overall significance of the model is used F-test.

Table 4-18 F-test Russia

p-value of F-test	Comparison	Level of significance
$p = 3.00e-09$	$3.00e-09 < 0.05$	$\alpha = 0.05$

Source: author's calculation in GRETL

The overall model is statistically significant at the level of significance $\alpha = 0.05$.

[72] DEVORE, J. L., Probability and Statistics for Engineering and the Sciences, 2011, p. 580.

The next test for evaluation of the model is t-test which examines whether or not an individual estimated parameter is significant.

Table 4-19 t-test ($\alpha = 0.05$) Russia

	x_2	x_3	x_4	d_x_5
t-value	7.956	4.85	$\lvert -1.028 \rvert$	2.657
$t_{\alpha(n-p-1)}$	2.101	2.101	2.101	2.101
Conclusion	H_1	H_1	H_0	H_1

Source: author's calculation in GRETL

Individual parameter x_4 is not statistically significant at the level of significance $\alpha = 0.5$. Individual parameters x_2, x_3, d_x_5 are statistically significant at the level of significance $\alpha = 0.5$.

Econometrical verification of the model

The final econometrical verification provides additional information for making more accurate conclusion. Three tests are completed: autocorrelation test, heteroskedasticity test and test for normality of residual.

For the purpose of autocorrelation testing was applied Breusch-Godfrey test. Based on the calculations in GRETL the following results were obtained.

Table 4-20 Autocorrelation test Russia

p-value	Comparison	α
p = 0.000354	0.000354 < 0.05	0.05

Source: author's calculation in GRETL

There is an autocorrelation of residuals of data in the model at the level of significance $\alpha = 0.05$.

The next step in econometrical verification is heteroskedasticity test. For its purpose was applied White's test.

Table 4-21 Heteroskedasticity test Russia

p-value	Comparison	Level of significance
p = 0.422603	0.2422603 > 0.05	α = 0.05

Source: author's calculation in GRETL

There is homoscedasticity in the model at the level of significance α = 0.05.

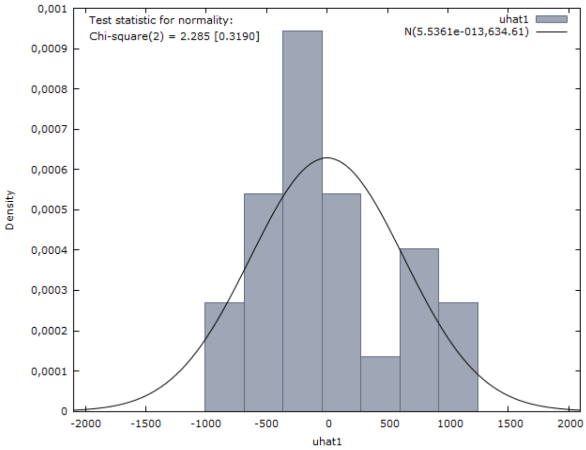
After verification of homoskedasticity in the model the next step of testing residuals is normality test.

Table 4-22 Normality test Russia

p-value	Comparison	Level of significance
p = 0.31903	0.31903 > 0.05	α = 0.05

Source: author's calculation in GRETL

Figure 20 Normality of residual Russia



Source: GRETL's output

Residuals of the model are normally distributed.

4.2.4 Discussion of the results

Crude oil production in Russia was analysed in accordance with the goals of the practical part. First, it was described how the various factors influence crude oil production in the country. It was also presented their level of importance, current trends and future perspectives. Second, based on the assumption of dependency crude oil production on certain factors (GDP per Capita, inflation rate, exchange rate, crude oil WTI Futures) it was created a regression model. The model was analysed using OLSM. Economic, statistical and econometrical verifications were applied. Based on the mentioned methods the model itself was confirmed to be statistically significant and allowed to explain the relationship between variables. There were also identified variables (macroeconomic indicators) playing crucial role in explaining crude oil production trend in Russia – GDP per Capita, exchange rate and crude oil WTI futures.

5 Conclusion

The main aim of the present bachelor thesis is to define major developmental trends in global crude oil production, to investigate main factors affecting crude oil production in Norway and Russia and to identify links connecting selected macroeconomic indicators with the production of crude oil. To explain the developmental trends in production of crude oil in selected countries there were used the same macroeconomic factors. The structure of created models consisted of dependent variable (crude oil production) and explanatory variables (GDP per Capita, inflation rate, exchange rate and crude oil WTI futures). Both models were estimated with the use of OLS method, which helped to identify the relationship between variables. Economic verification allowed quantifying relationship between crude oil production and chosen macroeconomic factors. Statistical verification tested the overall significance of the model and individual estimated parameters. Econometrical verification was presented by autocorrelation test, heteroskedasticity test and normality of residual test. Both models were confirmed to be statistically significant, nevertheless it turned out that the chosen macroeconomic factors explain the crude oil Norway and Russia differently. They almost perfectly explained crude oil production in Russia (the model was determined on 91% and only 9% of information remained unexplained). However, for explaining Norwegian crude oil production those factors are not sufficient (the model determined only 38% and 62% of information remained unexplained). It means that developmental patterns in Norway and Russia are different. As it was described there are certain concerns about Norway's economy dependency on crude oil production. There is a tendency in Norway to diversify its export production activities and to rely less on the crude oil production so the volume of production tends to decrease. It can be explained using the tested model output: with an increase in two significant factors (GDP per Capita, inflation rate) crude oil production decreases. At the same time there are also concerns about crude oil dependency of Russian's economy. Despite this fact the volume of crude oil production increased during the last 25 years. The relationship between significant factors (GDP per Capita, exchange rate, crude oil WTI futures) and crude oil production is directly proportional. Crude oil production in Russia is still sensitive to these variables and any increase in those factors causes an increase in production as well.

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7 Appendix

Table 7-1Data for the practical part for Norway 1989-2017

Year	Annual GDP (in billions $)	GDP per Capita ($)	USD/NOK (December to December)	Inflation rate (p.p.)	The Annual Crude oil Production (1000 bbl/d)	Crude Oil WTI Futures (December to December, $)
1989	102,634	24245	6,595	4,5	1570	21,82
1990	119,791	28187	5,8825	4,1	1725	28,44
1991	121,872	28514	5,9725	3,4	1962	19,12
1992	130,838	30433	6,95	2,3	2225	19,5
1993	120,579	27881	7,5338	2,3	2385	14,17
1994	127,132	29236	6,7634	1,4	2700	17,76
1995	152,028	34789	6,3444	2,5	2910	19,55
1996	163,517	37225	6,4418	1,3	3241	25,92
1997	161,354	36561	7,3742	2,6	3290	17,64
1998	154,165	34717	7,6325	2,3	3147	12,05
1999	162,287	36279	8,0176	2,4	3148	25,6
2000	171,315	38063	8,7707	3,1	3354	26,8
2001	174,004	38502	8,9474	3	3422	19,84
2002	195,419	42975	6,93	1,3	3341	31,2
2003	228,752	50023	6,6718	2,5	3272	32,52
2004	264,356	57479	6,0795	0,5	3196	43,45
2005	308,722	66653	6,745	1,5	2978	61,04
2006	345,423	73937	6,2366	2,3	2786	61,05
2007	401,085	84946	5,4362	0,7	2564	95,98
2008	462,552	96626	6,9566	3,8	2464	44,6
2009	386,62	79836	5,7956	2,2	2352	79,36
2010	429,131	87432	5,8243	2,4	2145	91,38
2011	498,831	100307	5,992	1,3	2051	98,83
2012	510,229	101273	5,5665	0,7	1927	91,82
2013	523,502	102722	6,0683	2,1	1848	98,42
2014	499,339	96838	7,474	2	1897	53,27
2015	386,663	74281	8,8423	2,2	1957	37,04
2016	371,075	70652	8,6395	3,6	2004	53,72
2017	400	75534	8,2095	1,9	1979	60,42

Source: data available from https://www.eia.gov/beta/international/data, https://www.imf.org/external/datamapper, https://www.investing.com/currencies/usd-nok-historical-data, https://countryeconomy.com/gdp/norway, https://countryeconomy.com/gdp/norway, https://www.investing.com/commodities/crude-oil-historical-data, created by author

Table 7-2 Data for the practical part for Russia 1994-2017

Year	Annual GDP (in billions $)	GDP per Capita ($)	USD/RUB	The Annual Inflation (%)	The Annual Petroleum Production (1000 bbl/d)	Crude Oil WTI Futures (December to December, $)
1994	297,487	2004	3,585	307,6	6307	17,76
1995	336,82	2271	4,665	197,5	6172	19,55
1996	420,966	2843	5,589	47,7	6017	25,92
1997	435,112	2944	5,998	14,8	6101	17,64
1998	291,23	1976	21,55	27,7	6070	12,05
1999	210,492	1433	27,55	85,7	6312	25,6
2000	279,033	1906	28,541	20,8	6723	26,8
2001	329,407	2259	30,495	21,5	7159	19,84
2002	371,213	2557	31,95	15,8	7658	31,2
2003	462,332	3198	29,242	13,7	8534	32,52
2004	634,944	4408	27,72	10,9	9273	43,45
2005	820,568	5714	28,741	12,7	9511	61,04
2006	1063,64	7421	26,326	9,7	9732	61,05
2007	1396,475	9755	24,579	9	9938	95,98
2008	1784,514	12472	30,535	14,1	9875	44,6
2009	1313,681	9181	30,314	11,7	10049	79,36
2010	1638,463	11445	30,577	6,9	10290	91,38
2011	2051,657	14321	32,204	8,4	10412	98,83
2012	2210,255	15411	30,558	5,1	10600	91,82
2013	2297,125	15997	32,895	6,8	10768	98,42
2014	2063,663	14355	55,9077	7,8	10856	53,27
2015	1368,402	9510	73,5963	15,5	11039	37,04
2016	1281,286	8900	61,273	7,1	11250	53,72
2017	1600	11112	57,6114	3,7	11210	60,42

Source: data available from https://www.investing.com/commodities/crude-oil-historical-data, https://countryeconomy.com/gdp/russia, https://countryeconomy.com/gdppercapita/russia, https://www.investing.com/currencies/usd-rub-historical-data, https://www.eia.gov/beta/international/data/browser/, https://www.imf.org/external/datamapper/, created by author