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Application of Systemic Geopolitical Analysis: The Compound Geopolitical Indicator of the Energy Reserves and their Distribution in the Geopolitical Complex of the Arctic Ocean

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Abstract: Due to ice melting, the energy reserves in the Arctic Ocean have become accessible. Therefore, with reference to the climatic changes that have been taking place in recent years, the aim of this paper is to analyze the reallocation of power in the geopolitical complex of the Arctic Ocean, through the context of the distribution, availability and development of the energy reserves in the area. That includes the study of the energy dividends of the Arctic Ocean's coastal states as well as the strategic and political importance of the geopolitical complex of the research, in terms of energy.

Introduction

The 1/4 of the world's remaining natural gas reserves is located north of the Arctic Circle and specifically off the coast, in the continental shelf of the Arctic Ocean, whose share is claimed by the coastal states of the Arctic Ocean (Emerson, et al., 2012). According to the U.S. Geological Survey (2018), 2/3 of unexplored Arctic gas is located in four areas and most of these deposits belong to Russia: The Southern Sea Kara (39%), the northern and southern basin of Barents and the Alaska platform. According to the study of the US Geological Survey (2018), the Arctic Subsoil contains:

1. 15% of the world's oil and gas reserves,
2. 83 billion barrels of crude oil,
3. 1.55 quadrillion million cubic meters of natural gas,
4. Ores and Gems.

Arctic may also hide 3-4% of the hydrocarbon deposits that remain unrevealed to the world (Arctic Climate Impact Assessment- ACIA, 2013). Alaska is recognized as the richest geographic area in terms of oil, as it is estimated to contain 22 to 256 billion barrels in its subsoil (Arctic Climate Impact Assessment- ACIA, 2013). Arctic's natural resources, and especially hydrocarbons, are one of the major reasons for increasing the interest of the States in the region and a major factor in shaping Arctic geopolitics (U.S. Geological Survey-USGS, 2018). The US Geological Survey has triggered coastal States to take the necessary steps to ensure the maximum potential for exploitation of stocks at the bottom of the Arctic Ocean (Joung, 2012).

On the other hand, the climate in the Arctic, even if it has become smoother, certainly raises the cost and the risk for any business activity and the creation of infrastructures for the exploitation of the Arctic Area (Arctic Monitoring and Assessment Programme, 2013). The main argument of the research is that the shrinking ice cap will lead to the further development of the huge untapped resources which exist in the continental shelf of the Arctic Ocean (Bird, et al., 2008). Also, in order to be able to exploit the hydrocarbon deposits, the Arctic Ocean's coastal states should extend their borders beyond the 200

nautical miles, in accordance with the law of the sea (International Boundaries Research Unit: Centre for Borders Research, 2015).

Although Arctic hydrocarbons are considered costly because of the specificity of the Arctic environment, they are nevertheless a credible alternative and strong negotiating capacity with OPEC (U.S. Geological Survey- USGS, 2018). The need of new technology for pumping into deep water and the resistance of ice flows, favors more Russia as the waters in the North Sea are relatively shallow and have huge sedimentary basins (U.S. Geological Survey- USGS, 2018) (Kelman, 2017).

As Regards the technology which is used for mining in Arctic, it separated in two categories: Mobiles in lower part supported and floating platforms and stable production structures used exclusively for growth wells (World Ocean Review, 2014). The factors which need to be taken into account in the process of selecting the Arctic extraction method are: the depth of the water, the period of extraction as the Arctic prevails long periods of darkness and very low temperatures (Pilisi, et al., 2011) (Maritime Connector, 2018).

In the case of the Arctic region, the most useful technologies are the jack-up rigs, the semisubmersible rigs and the drill ships. However, a variety of reasons make difficult to extract the oil and gas reserves in the Arctic Ocean. One of the most important reasons is the ecological factor. Several times during the process of extraction of small and large enterprises, leaks can occur even in cases of explosions (Eden, et al., 1981). As is reasonably expected, any explosion or leakage causes environmental disasters, for example air, sea and land contamination (Arctic Monitoring and Assessment Programme- an Arctic Council Working Group, 2018).

This may have repercussions on the food chain and consequently the relations of Arctic countries are going to be affected as competition between them and native peoples will increase (Le Billon, 2001) (Arctic Monitoring and Assessment Programme- an Arctic Council Working Group, 2018). In addition to the above mentioned, concerning the transportation of oil and gas, there is a high risk concerning the accidents and in the case of pipeline transport, as well (O' Rourke, 2018)(Stephens & VanderZwaag, 2014).

The thickness of the ice cover has reduced over the past three decades and it has resulted in additional severe wave actions within the Beaufort and Chukchi Seas throughout

the open water season because it permits wind to travel over larger open water areas (Henderson & Loe, 2014). This will have an effect on vessel and general operations performance (Henderson & Loe, 2014) (Arctic Monitoring and Assessment Programme- an Arctic Council Working Group, 2018). Nevertheless, the presence of the USA in the Arctic Ocean is important as in recent years has been trying to take advantage of the economic benefits created by melting ice in the Arctic (Coffey & Kochis, 2016).

As far as Norway is concerned, its objective is clear and concerns the development of oil and gas in the region, because hydrocarbons are the means by which the country can be economically improved and thus help the welfare of its citizens (Norwegian Ministry of Foreign Affairs, 2014). Denmark projects its power in the Arctic Ocean, through Greenland and among the areas of interest of Denmark's foreign policy is energy (Boersma & Foley, 2014). Finally, Canada focus on the aspect that the shrinking ice cap gives the opportunity to study and exploit new resources, increases traffic in the region and brings about economic gains, even if these events are responsible for possible conflicts between States and give incentives for the bloom and spread illegal activities (Eurasia Group, 2000) (Global Affairs Canada, 2017).

1.1 Methodological remarks on Systemic Geopolitical Analysis

The analysis should be based on the geographic dimension of the topic and therefore, systemic geopolitical analysis is the tool which is going to be used for the analysis so as to produce the geopolitical model of redistribution of power (Mazis, 2002) (Mazis, 2012) (Domatioti, 2017, pp. 9-11). As regards to above mentioned, this research attempts to address the emerging geopolitical reality in the Arctic, approaching the economic and/or energy dividends in the Arctic energy reserves of the Arctic Ocean's coastal states that are possible to affect the shift of power in the geopolitical complex under study.

The geopolitical factor of reallocation of power in this research is the geo-climatic change that causes the ice-melting in the Arctic region. As a result, the geostrategic competition of the coastal states in the Arctic Ocean has been rise. The two (2) sub-systems of the Arctic Circle complex are the following two:

1. The Arctic Ocean coastal states of NATO: USA, Canada, Norway, Denmark
2. The Russian Federation

By defining the super systemic operators, these are the two subsystems mentioned above. Moreover, the super systemic operators include countries which are participating as observers in the Arctic Council: EU members, China, India, Japan, Korea, Singapore, and United Kingdom. It should also be mentioned that states such as the USA and Russia Federation are usually super systemic operators for other complexes, but in this case they are elements of the geopolitical complex under study (Domatioti, 2017, pp. 33-34). Hence, the countries forming the geopolitical complex of the research are: Russian Federation, Canada, Denmark (Greenland), the United States of America and Norway.

The reason for which the Russian Federation is placed in the second subsystem is because Russia contains the largest part of the Arctic's energy reserves, as well as there is a significant presence of Russian companies in this region (Radwal, 2014). By defining super system operators, these are the two sub-systems mentioned above. Analyzing the geopolitical complex, the following singularity is emphasized: the classical ones super systemic poles, representing state actors (states), are elements of it under complex / system screening. That is, states like the US and Russia, which usually consisted of super systemic poles for other complexes, in the case under consideration are elements of the complex under consideration. Therefore, it is methodological rectangles also belong to system component subsystems (Domatioti, 2017).

The geopolitical pillars of power in which the action and function of geopolitical factor is analyzed are: the economic pillar of power and the geopolitical pillar of politics. The economic pillar of power refers on claims and the interests of the states which forms the geopolitical complex of Arctic Ocean for the energy stocks of Hydrocarbons and of Natural Gas, as and for the way transfer of stock through new transit routes that creates the phenomenon of ice melting. The geopolitical indicators used are the following:

- Oil reserves (thousand million barrels)
- Oil production (thousand barrels/per day)
- Natural Gas production (billion cubic meters)

For the geopolitical pillar of politics has selected for analysis the Geopolitical ratio of Government Effectiveness concerning energy policies related to the development of hydrocarbons in the Arctic. The geopolitical pillar of policy is chosen as it is important to

highlight the policies implemented by each country separately and the political relations created between the countries concerned.

1.2 Research constraints

The constraints of the research are the following:

1. The phrase "of the Arctic Circle" can be read in two ways: first may mean the Arctic Ocean coastal Arctic countries and secondly, the international antagonisms recorded and crossed in the Arctic Circle or centered on the Arctic Circle. This research studies exclusively the first case.
2. The geopolitical factor, the melting of the ice, is taken for granted after numerous valid researches that confirms the phenomenon. However, it is stressed that the research it deals exclusively with the redistribution of power, which is the result the dramatic change of the frozen surface. Therefore, it does not come in in the scientific debate on climate change and, more generally, on the reasons that cause this particular natural phenomenon.
3. States participating in the Arctic Council as "observers" may form a geopolitical subsystem. However, this study does not consider it as the limits of the research are limited. This study focuses geographically on coastal only in the Arctic Ocean States.
4. In this research the geopolitical pillars of politics and economy are examined, without this signifying that the pillars of security/defense and culture/information are less important.
5. The data collected exclusively from Open data sources.

2.1 Analysis of the economic geopolitical pillar of power.

This chapter will make the analysis of geopolitical indicators for the pillars of the economy and policy. For the economic pillar as has been said in the previous chapter, the following geopolitical indicators have been selected for consideration:

- Proved Oil reserves (thousand million barrels)
- Oil exports (thousand barrels /per day)

- Proved Natural Gas reserves(trillion cubic feet)
- Natural Gas exports (cubic metres)

Subsystem	USA, Canada, Denmark, Norway				Russian Federation			
Geopolitical Indicator	Proved Oil reserves	Oil exports	Proved Natural Gas reserves	Natural Gas exports	Proved Oil reserves	Oil exports	Proved Natural Gas reserves	Natural Gas exports
2014	234.3	4,069.38	480.31	229,688	103.2	4,437.33	1,688	35.0
2015	228	4,085.57	514.06	245,146	102.4	5,220.39	1,688.23	35.0
2016	228.6	4,823.7	447.14	264,643	106.2	4,983.10	1,688.23	34.8
2017	227.2	5,588.63	465.41	299,102	106.3	4,057.66	1,688.23	38.9
2018	238	7,002.25	574.45	304,840	106.2	5,664.12	1,688.23	38.9

To calculate a composite index from individual indicators described by numerical values, it is necessary that all data be expressed on a common basis to make them comparable. The method by which we bring our data into a common basis is called "normalization" and is a process of data transformation, in which numerical values are replaced with other, "more appropriate", so that the ratios become Comparable.

With the method of normalization *of minimum-maximum*, transform the numeric values so that they range within a certain range of values, of our preference. If we consider a set of values of a Ratio, where its largest value is maxA and its smallest value is minA, we can transform all values within a new range with a lower limit of the new_minA and upper limit of the new_maxA according to the relationship below. Where x is the numeric value of the index and where x ' is the value that we receive after the transformation.

$$x' = \frac{x - min_A}{max_A - min_A}(new\_max_A - new\_min_A) + new\_min_A$$

Where:

- min_A: The minimum value from the system data set for a pointer
- max_A: The maximum value from the system data set for a pointer
- new_{min_A}: The new minimum value in the period decided by the analyst
- new_{max_A}: The new maximum value in the period decided by the analyst

The price range that the analyst chooses to work on in this case is the interval [0.1]. So, for the above formula we know:

- $new\_min_A = 0$
- $new\_max_A = 1$

So, the type of minimum-maximum normalization is significantly simplified:

$$x' = \frac{x - min_A}{max_A - min_A}$$

The above indicators are then listed for the performance data for each individual country that make up the geopolitical complex. The time range ranges from 2014-2017. After the prices have been transformed and the indicators have become comparable, we calculate the performance of each pillar. For the calculation of the power supply it is proposed to add the individual indicators with weighting factors, which arise based on the judgement of the analyst. It is important to mention that the sum of all gravity factors should be the unit.

The first subsystem as mentioned in the previous chapter consists of: USA, Canada, Norway, Denmark.

- For the USA, the following elements are presented

Geopolitical indicator	Proved Oil reserves (thousand million barrels)	Oil exports(thousand barrels/per day)	Proved Natural Gas reserves(trillion cubic feet)	Natural Gas exports (cubic metres)
2014	55.0	441.68	338.26	42,876
2015	48.0	392.48	368.70	50,502
2016	50.0	441.65	307.73	66,133
2017	50.0	1,514.68	322.23	89,703
2018	61.2	2,511.06	438.46	102,125

- For the proved oil reserves index we have :

Max	172.2
Min	0.4

From the formula resolution we have:

2014: $\frac{55.0-0.4}{172.2-0.4} = 0.31$

2015: $\frac{48.0-0.4}{172.2-0.4} = 0.27$

2016: $\frac{50.0-0.4}{172.2-0.4} = 0.28$

2017: $\frac{50.0-0.4}{172.2-0.4} = 0.28$

2018: $\frac{61.2-0.4}{172.2-0.4}$ =0.35

- For the oil exports index, we have:

Max	5,664.12
Min	51.35

From the formula resolution we have:

2014: $\frac{441,68-51.35}{5,664.12-51.35} = 0.070$

2015: $\frac{392,48-51,35}{5,664.12-51.35} = 0.060$

2016: $\frac{441.5-51.35}{5,664.12-51.35} = 0.069$

2017: $\frac{1,514.68-51.35}{5,664.12-51.35} = 0.26$

2018: $\frac{2,511.86-51.35}{5,664.12-51.35} = 0.43$

For the proved Natural Gas reserves:

Max	1,688.23
Min	0.45

2014: $\frac{338.26-0.45}{1,688.23-0.45} = 0.23$

2015: $\frac{368.70-0.45}{1,688.23-0.45} = 0.21$

2016: $\frac{307.73-0.45}{1,688.23-0.45} = 0.18$

2017: $\frac{322.23-0.45}{1,688.23-0.45} = 0.19$

2018: $\frac{438.46-0.45}{1,688.23-0.45} = 0.26$

For the Natural Gas exports:

Max	251,295.227
Min	1,538.000

2014: $\frac{42,876-1,538}{251,295.227-1,538} = 0.16$

2015: $\frac{50,502-1,538}{251,295.227-1,538} = 0.19$

2016: $\frac{66,133-1,538}{251,295.227-1,538} = 0.25$

2017: $\frac{89,703-1,538}{251,295.227-1,538} = 0.35$

2018:$\frac{102,125-1,538}{251,295.227} = 0.40$

Therefore, the transformed data for the USA is as follows:

Year	Proved Oil reserves (thousand million barrels)	Oil exports (thousand barrels /per day)	Proved Natural Gas reserves (trillion cubic feet)	Natural Gas exports (cubic metres)
2014	0.31	0.070	0.23	0.16
2015	0.27	0.060	0.21	0.19
2016	0.28	0.069	0.18	0.25
2017	0.28	0.26	0.19	0.35
2018	0.35	0.43	0.26	0.40

2.2 Power Performance of the economic pillar.

For this case, the analyst decides that in the single performance of the pillar each indicator participates with the following importance:

a) Proved Oil reserves (thousand million barrels): 30% or 0.3
b) Oil production (thousand barrels/per day) 20% or 0.2
c) Proved Natural Gas reserves (trillion cubic feet) 30% or 0.3
d) Natural Gas exports (cubic metres) 20% or 0.2

Therefore, the Power Performance of the economic pillar for the specific years is the following:

2014=0.31*0.3+0.070*0.2+0.23*0.3+0.16*0.2=0.208

2015=0.27*0.3+0.060*0.2+0.21*0.3+0.19*0.2=0.194

2016=0.28*0.3+0.069*0.2+0.18*0.3+0.25*0.2=0.201

2017=0.28*0.3+0.26*0.2+0.19*0.3+0.35*0.2=0.263

2018=0.35*0.3+0.43*0.2+0.26*0.3+0.40*0.2=0.349

Year	Power Performance of Economic Pillar
2014	0.208
2015	0.194
2016	0.201
2017	0.263
2018	0.349

- For Canada

Geopolitical Indicator	Proved Oil reserves (thousand million barrels)	Oil exports (thousand barrels /per day)	Proved Natural Gas reserves (trillion cubic feet)	Natural Gas exports (cubic metres)
2014	172.2	2,262.11	66,72	77,968
2015	171.5	2,378.61	71,79	78,253
2016	170.6	2,898.07	70,48	82,023
2017	168.9	2,688.39	77,07	84,679
2018	167.8	3,294.39	72,60	80,216

For the proved Oil reserves index:

Max	172.2
Min	0.4

Based on the formula we have:

2014: $\frac{172.2-0,4}{172.2-0,4} = 1$

2015: $\frac{171.5-0,4}{172.2-0,4} = 0.99$

2016: $\frac{170.6-0.4}{172.2-0.4} = 0.98$

2017: $\frac{168.9-0.4}{172.2-0.4} = 0.98$

2018: $\frac{167.8-0.4}{172.2-0.4} = 0.97$

For the oil exports (thousand barrels/per day):

Max	5,664.12
Min	51.35

2014: $\frac{2,262.11-51.35}{5,664.12-51.35} = 0.39$

2015: $\frac{2,378.61-51.35}{5,664.12-51.35} = 0.43$

2016: $\frac{2,898.07-51.35}{5,664.12-51.35} = 0.50$

2017: $\frac{2,688.39-51.35}{5,664.12-51.35} = 0.46$

2018: $\frac{3,294.39-51.35}{5,664.12-51.35} = 0.57$

For proved Natural Gas reserves (trillion cubic feet):

Max	1,688.23
Min	0.45

2014: $\frac{66.72-0.45}{1,688.23-0.45} = 0.040$

2015: $\frac{71.79-0.45}{1,688.23-0.45} = 0.042$

2016: $\frac{70.48-0.45}{1,688.23-0.45} = 0.041$

2017: $\frac{77.07-0.45}{1,688.23-0.45} = 0.045$

2018: $\frac{72.60-0.45}{1,688.23-0.45} = 0.042$

For Natural Gas exports:

Max	251,295.227
Min	1,538

2014: $\frac{77,968-1,538}{251,295.227-1,538} = 0.30$

2015: $\frac{78,253-1,538}{251,295.227-1,538} = 0.31$

2016: $\frac{82,023-1,538}{251,295.227-1,538} = 0.32$

2017: $\frac{84,679-1,538}{251,295.227-1,538} = 0.33$

2018: $\frac{80,216-1,538}{251,295.227-1,538} = 0.31$

The transformed data for Canada is as follows:

Year	Proved Oil reserves (thousand million barrels)	Oil exports (thousand barrels/per day)	Proved Natural Gas reserves (trillion cubic feet)	Natural Gas exports (cubic metres)
2014	1	0.39	0.040	0.30
2015	0.99	0.43	0.042	0.31
2016	0.98	0.50	0.041	0.32
2017	0.98	0.46	0.045	0.33
2018	0.97	0.57	0.042	0.31

Power Performance of Economic Pillar

2014=1*0.3+0.39*0.2+0.040*0.3+0.30*0.2=0.45

2015=0.99*0.3+0.43*0.2+0.042*0.3+0.31*0.2=0.46

2016=0.98*0.3+0.50*0.2+0.041*0.3+0.32*0.2=0.47

2017=0.98*0.3+0.46*0.2+0.045*0.3+0.33*0.2=0.46

2018=0.97*0.3+0.57*0.2+0.042*0.3+0.31*0.2=0.48

Year	Power Performance of Economic Pillar
2014	0.45
2015	0.46
2016	0.47
2017	0.46
2018	0.48

- For Norway

Geopolitical indicators	Oil reserves (thousand million barrels)	Oil exports (thousand barrels/per day)	Proved Natural Gas reserves (trillion cubic feet)	Natural Gas exports (cubic metres)
2014	6.5	1,236.02	73.81	106,759
2015	8.0	1,258.61	72.36	114,200
2016	7.6	1,432.63	67.87	114,373
2017	7.9	1,300.45	65.54	122,485
2018	8.6	1,144.97	62.94	120,961

For the index of oil reserves

Max	172.2
Min	0.4

2014: $\frac{6.5-0.4}{172.2-0.4} = 0.03$

2015: $\frac{8.0-0.4}{172.2-0.4} = 0.044$

2016: $\frac{7.6-0.4}{172.2-0.4} = 0.041$

2017: $\frac{7.9-0.4}{172.2-0.4} = 0.043$

2018: $\frac{8.6-0.4}{172.2-0.4} = 0.047$

For the index of oil exports (thousand barrels/per day)

Max	5,664.12
Min	51.35

2014: $\frac{1,236.02-51.34}{5,664.12-51.35} = 0.21$

2015: $\frac{1,258.61-51.35}{5,664.12-51.35} = 0.21$

2016: $\frac{1,432.63-51.35}{5,664.13-51.35} = 0.24$

2017: $\frac{1,300.45-51.35}{5,664.12-51.35} = 0.22$

2018: $\frac{1,144.97-51.35}{5,664.12-51.35} = 0.19$

For Proved Natural Gas reserves (trillion cubic feet):

Max	1,688.23
Min	0.45

2014: $\frac{73.81-0.45}{1,668.23-0.45} = 0.043$

2015: $\frac{72.76-0.45}{1,688.23-0.45} = 0.042$

2016: $\frac{67.87-0.45}{1,668.23-0.45} = 0.040$

2017: $\frac{65.54-0.45}{1,688.23-0.45} = 0.038$

2018: $\frac{62.94-0.45}{1,688.23-0.45} = 0.037$

For Natural Gas exports:

Max	251,295.227
Min	1,538

2014: $\frac{106,759-1,538}{251,295.227-1,538} = 0.42$

2015: $\frac{114,200-1,538}{251,295.227-1,538} = 0.45$

2016: $\frac{114,373-1,538}{251,295.227-1,538} = 0.45$

2017: $\frac{122,485-1,538}{251,295.227-1,538} = 0.48$

2018: $\frac{120,961-1,538}{251,295.227-1,538} = 0.47$

The transformed data for Norway is as follows:

Year	Proved Oil reserves (thousand million barrels)	Oil production exports barrels/per day)	Proved Natural Gas reserves (trillion cubic feet)	Natural Gas exports (cubic metres)
2014	0.03	0.21	0.043	0.42
2015	0.044	0.21	0.042	0.45
2016	0.041	0.24	0.040	0.45
2017	0.043	0.22	0.038	0.48
2018	0.047	0.19	0.037	0.47

Calculation of Power Performance

2014=0.03*0.3+0.21*0.2+0.043*0.3+0.42*0.2=0.147

2015=0.044*0.3+0.21*0.2+0.042*0.3+0.45*0.2=0.149

2016=0.041*0.3+0.24*0.2+0.040*0.3+0.45*0.2=0.162

2017=0.043*0.3+0.22*0.2+0.038*0.3+0.48*0.2=0.164

2018=0.047*0.3+0.19*0.2+0.037*0.3+0.47*0.2=0.157

Year	Power Performance of Economic Pillar
2014	0.147
2015	0.149
2016	0.162
2017	0.164
2018	0.157

- For Denmark

Geopolitical indicators	Oil reserves (thousand million barrels)	Oil exports(thousand barrels/per day)	Proved Natural Gas reserves (billion cubic feet)	Natural Gas exports (cubic metres)
2014	0.6	129.75	1.52	2,085
2015	0.5	55.87	1.21	2,191
2016	0.4	51.35	1.06	2,114
2017	0.4	85.11	0.57	2,235
2018	0.4	51.83	0.45	1,538

For the proved oil reserves index:

Max	172.2
Min	0.4

2014: $\frac{0.6-0.4}{172.2-0.4} = 0.001$

2015: $\frac{0.5-0.4}{172.2-0.4} = 0.0005$

2016: $\frac{0.4-0.4}{172.2-0.4} = 0$

2017: $\frac{0.4-0.4}{172.2-0.4} = 0$

2018: $\frac{0.4-0.4}{172.2-0.4} = 0$

For the oil exports index

Max	5,664.12
Min	51.35

2014: $\frac{129.57-51.35}{5{,}664.12-51.35} = 0.01$

2015: $\frac{55.87-51.35}{5{,}664.12-51.35} = 0.0008$

2016: $\frac{51.35-51.35}{5{,}664.12-51.35} = 0$

2017: $\frac{85.11-51.35}{5{,}664.12-51.35} = 0.006$

2018: $\frac{51.83-51.35}{5,664.12-51.35} = 0.00008$

For proved Natural Gas reserves (trillion cubic feet):

Max	1,688.23
Min	0.45

2014: $\frac{1.52-0.45}{1,688.23-0.45} = 0.0006$

2015: $\frac{1.21-0.45}{1,688.23-0.45} = 0.0004$

2016: $\frac{1.06-0.45}{1,688.23-0.45} = 0.0003$

2017: $\frac{0.57-0.45}{1,688.23-0.45} = 0.000007$

2018: $\frac{0.45-0.45}{1,688.23-0.45} = 0$

For Natural Gas exports (cubic metres):

Max	251,295.227
Min	1,538

2014: $\frac{2,085-1,538}{251,295.227-1,538} = 0.0021$

2015: $\frac{2,191-1,538}{251,295.227-1,538} = 0.0026$

2016: $\frac{2,114-1,538}{251,295.227-1,538} = 0.0023$

2017: $\frac{2,235-1,538}{251,295.227-1,538} = 0.0028$

2018: $\frac{1,538-1,538}{251,295.227-1,538} = 0$

The transformed data for Denmark is as follows:

Year	Proved Oil reserves (thousand million barrels)	Oil exports(thousand barrels/per day)	Proved Natural Gas reserves (trillion cubic feet)	Natural Gas exports (cubic metres)
2014	0.001	0.001	0.0006	0.0021
2015	0.0005	0.0008	0.0004	0.0026
2016	0	0	0.0003	0.0023
2017	0	0.006	0.00007	0.0028
2018	0	0.00008	0	0

Calculation of Power Performance

2014=0.001*0.3+0.001*0.2+0.0006*0.3+0.0021*0.2=0.0011

2015=0.0005*0.3+0.0008*0.2+0.0004*0.3+0.0026*0.2=0.0009

2016=0*0.3+0*0.2+0.0003*0.3+0.0023*0.2=0.0005

2017=0*0.3+0*0.006*0.2+0.00007*0.3+0.0028*0.2=0.0017

2018=0*0.3+0.00008*0.2+0*0.3+0*0.2=0.00001

Year	Power Performance of Economic Pillar
2014	0.0011
2015	0.0009
2016	0.0005
2017	0.00017
2018	0.00001

- Russian Federation

Geopolitical Indicator	Oil reserves (thousand million barrels)	Oil production (thousand barrels/per day)	Proved Natural Gas reserves (billion cubic feet)	Natural Gas exports (cubic metres)
2014	103.2	10860	1,688	193,900
2015	102.4	11009	1,688.23	197,740
2016	106.2	11269	1,668.23	208,040
2017	106.3	11257	1,688.23	228,320
2018	106.2	11438	1,688.23	251,295

For the proved oil reserves index:

Max	172.2
Min	0.4

2014: $\frac{103.2-0.4}{172.2-0.4} = 0.598$

2015: $\frac{102.4-0.4}{172.2-0.4} = 0.593$

2016: $\frac{106.2-0.4}{172.2-0.4} = 0.615$

2017: $\frac{106.3-0.4}{172.2-0.4} = 0.616$

2018: $\frac{106.2-0.4}{172.2-0.4} = 0.615$

For the oil exports index:

Max	5,664.12
Min	51.35

2014: $\frac{4,437.33-51.35}{5,664.12-51.35} = 0.78$

2015 $\frac{5,220.39-51.35}{5,664.12-51.35} = 0.92$

2016: $\frac{4,983.10-51.35}{5,664.12-51.35} = 0.87$

2017: $\frac{4,057.66-51.35}{5,664.12-51.35} = 0.71$

2018: $\frac{5,664.12-51.35}{5,664.12-51.35} = 1$

For Proved Natural Gas reserves (trillion cubic feet):

Max	1,688.23
Min	0.45

2014: $\frac{1,688-0.45}{1,688.23-0.45} = 0.99$

2015: $\frac{1,688.23-0.45}{1,688.23-0.45} = 1$

2016: $\frac{1,688.23-0.45}{1,688.23-0.45} = 1$

2017: $\frac{1,688.23-0.45}{1,688.23-0.45} = 1$

2018: $\frac{1,688.23-0.45}{1,688.23-0.45} = 1$

For Natural Gas exports (cubic metres):

Max	1,538
Min	251,295.227

2014: $\frac{193,900-1,538}{251,295.227-1,538} = 0.77$

2015: $\frac{197,740-1,538}{251,295.227-1,538} = 0.78$

2016: $\frac{208,040-1,538}{251,295.227-1,538} = 0.82$

2017: $\frac{228,320-1,538}{251,295.227-1,538} = 0.90$

2018: $\frac{251,295.227-1,538}{251,295.227-1,538} = 1$

The transformed data for the Russian Federation is as follows:

Year	Proved Oil reserves (thousand million barrels)	Oil exports (thousand barrels/per day)	Proved Natural Gas reserves (trillion cubic feet)	Natural Gas exports (cubic metres)
2014	0.598	0.78	0.99	0.77
2015	0.593	0.92	1	0.78
2016	0.615	0.87	1	0.82
2017	0.616	0.71	1	0.90
2018	0.615	1	1	1

Calculation of Power Performance

2014=0.598*0.3+0.78-0.2+0.99*0.3+0.77*0.2=0.78

2015=0.593*0.3+0.92*0.2+1*0.3+0.78*0.2=0.81

2016=0.615*0.3+0.87*0.2+1*0.3+0.82*0.2=0,82

2017=0.616*0.3+0.71*0.2+1*0.3+0.90*0.2=0.80

2018=0.615*0.3+1*0.2+1*0.3+1*0.2=0.88

Year	Power Performance of Economic Pillar
2014	0.78
2015	0.81
2016	0,82
2017	0.80
2018	0.88

3.1 Analysis of the geopolitical pillar of Politics

For the Pillar of Policy has selected for analysis the Geopolitical ratio of government effectiveness concerning energy policies related to the development of hydrocarbons in the Arctic.

For the first subsystem of the Arctic complex (USA, Canada, Norway, and Denmark) the elements of the specific ratio listed in continue:

For the USA

Geopolitical indicator	Government effectiveness(estimation)
2014	1.5
2015	1.5
2016	1.5
2017	1.6
2018	1.6

Max	2.03
Min	-0.2

2014:$\frac{1.5-(-0.2)}{2.03-(-0.2)} = 0.76$

2015: $\frac{1.5-(-0.2)}{2.03-(-0.2)} = 0.76$

2016: $\frac{1.5-(-0.2)}{2.03-(-0.2)} = 0.76$

2017:$\frac{1.6-(-0.2)}{2.03-(0.2)}$ =0.80

2018$\frac{1.6-(-0.2)}{2.03-(-0.2)} = 0.80$

The transformed data for USA:

Year	Government effectiveness (estimation)
2014	0.76
2015	0.76
2016	0.76
2017	0.80
2018	0.80

3.2 Power Performance of the geopolitical pillar of Politics

For this case, the analyst decides that in the single performance of the pillar each indicator participates with the following importance

- **Government Effectiveness (estimation): 100% or 1**

Because we have only on Indicator for the Political Pillar the results of the Power of Performance are the same with the transformed data for each country

Year	Power of Performance
2014	0.76
2015	0.76
2016	0.76
2017	0.80
2018	0.80

For Canada

Geopolitical indicator	Government effectiveness (estimation)
2014	1.8
2015	1.8
2016	1.8
2017	1.9
2018	1.9

2014: $\frac{1.8-(-0.2)}{2.03-(-0.2)} = 0.89$

2015: $\frac{1.8-(-0.2)}{2.03-(-0.2)} = 0.89$

2016: $\frac{1.8-(-0.2)}{2.03-(-0.2)} = 0.89$

2017: $\frac{1.9-(-0.2)}{2.03-(-0.2)} = 0.94$

2018$\frac{1.9-(-0.2)}{2.03-(-0.2)} = 0.94$

The transformed data for Canada:

Geopolitical Indicator	Government effectiveness (estimation)
2014	0.89
2015	0.89
2016	0.89
2017	0.94
2018	0.94

Year	Power of Performance
2014	0.89
2015	0.89
2016	0.89
2017	0.94
2018	0.94

For Norway

Geopolitical Indicator	Government effectiveness (estimation)
2014	1.8
2015	1.9
2016	1.9
2017	2.0
2018	2.03

2014: $\frac{1.8-(-0.2)}{2.03-(-0.2)} = 0.89$

2015: $\frac{1.90-(-0.2)}{2.03-(-0.2)} = 0.94$

2016: $\frac{1.90-(-0.2)}{2.03-(-0.2)} = 0.94$

2017: $\frac{2.0-(-0.2)}{2.03-(-0.2)} = 0.98$

2018:$\frac{2.03-(-0.2)}{2.03-(-0.2)} = 1$

The transformed data for Norway:

Geopolitical Indicator	Government effectiveness (estimation)
2014	0.89
2015	0.94
2016	0.94
2017	0.98

Calculation of Power of Performance:

Year	Power of Performance
2014	0.89
2015	0.94
2016	0.94
2017	0.98
2018	1

For Denmark

Geopolitical Indicator	Government effectiveness (estimation)
2014	1.8
2015	1.8
2016	1.9
2017	1.8
2018	1.85

2014: $\frac{1.8-(-0.2)}{2.03-(-0.2)}$=0.89

2015:$\frac{1.8-(-0.2)}{2.03-(-0.2)} = 0.89$

2016: $\frac{1.9-(-0.2)}{2.03-(-0.2)} = 0.94$

2017: $\frac{1.8-(-0.2)}{2.03-(-0.2)} = 0.89$

2018: $\frac{1.85-(-0.2)}{2.03-(-0.2)} = 0.91$

The transformed data for Denmark

Geopolitical Indicator	**Government effectiveness (estimation)**
2014	0.89
2015	0.89
2016	0.94
2017	0.89
2018	0.91

Calculation of Power of Performance:

Year	**Power of Performance**
2014	0.89
2015	0.89
2016	0.94
2017	0.89
2018	0.91

For the second subsystem of the Arctic Complex (Russian Federation) the data for the indicator of government effectiveness concerning energy policies related to the development of hydrocarbons in the Arctic, are the following:

Russian Federation

Geopolitical Indicator	Government effectiveness (estimation)
2014	-0.1
2015	-0.2
2016	-0.2
2017	-0.1
2018	-0.15

2014: $\frac{0.1-(-0.2)}{2.03-(-0.2)} = 0.13$

2015: $\frac{0.2-(-0.2)}{2.03-(-0.2)} = 0.18$

2016: $\frac{0.2-(-0.2)}{2.03-(-0.2)} = 0.18$

2017: $\frac{0.1-(-0.2)}{2.03-(-0.2)} = 0.13$

2018: $\frac{0.15-(-0.2)}{2.03-(-0.2)} = 0.15$

The transformed data for the Russian Federation

Geopolitical Indicator	Government effectiveness (estimation)
2014	0.13
2015	0.18
2016	0.18
2017	0.13
2018	0.15

Calculation of Power of Performance:

Year	Power of Performance
2014	0.13
2015	0.18
2016	0.18
2017	0.13
2018	0.15

4. The Redistribution of Power in the geopolitical system.

4.1 Prediction of redistribution of power using minimal quadratic method.

The Minimal Quadratic method is used when we want to relate / describe two variables using a theoretical equation. This equation can have different forms, such as linear, parabolic, exponential, etc. In the context of this study, we will deal with linear equations, which have the form Y = α+ βX and where:

- X, Y: the two variables
- β: the slope of the line
- α: steadily

The purpose of the method is to determine optimally parameters (α) and (β), so that our data is adequately described. The way this is achieved is through minimizing the sum of the squares of the deviations, between the actual data and the corresponding which are represented on the straight or else the error between the real and the calculated from the straight, price. Therefore, the α, β values are calculated from the following formulas:

$$\alpha = \bar{Y} - \frac{S_{xy}}{S_{xx}}\bar{X}$$

$$\beta = \frac{S_{xy}}{S_{xx}}$$

Όπου:

$\bar{X}$: the average of the X variable

$\bar{Y}$: the average of the Y variable

$$S_{xx}: \sum_{i=1}^{n} (x_i - \bar{x})^2$$

$$S_{xy}: \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})$$

Using the line equation, we can predict the future values of a numeric marker. Caution, however, should be given as the above equation calculates the linear trend over time. The trend may be upward, downward or rarely neutral.

4.2 Apply to Case Study- Prediction with the Minimum Quadrant Method of Power Performance of each country.

X: years reported performance

Y: the performance of the index

Therefore, for the Power Performance of Economic Pillar for USA, we have:

Years (variable X)	**Power Performance (variable Y)**
2014	0.208
2015	0.194
2016	0.201
2017	0.263
2018	0.349

Then, we calculate the average value for each of the X and Y variables.

$$\bar{X} = \frac{2014 + 2015 + 2016 + 2017 + 2018}{5} = 2016$$

$$\bar{Y} = \frac{0.208 + 0.194 + 0.201 + 0.263 + 0.349}{5} = 0.243$$

Then we will subtract the average we found from each of its values variable X and Y, respectively.

For Variable X: $X_{2014} - \bar{X} = 2014 - 2016 = -2$

$X_{2015} - \bar{X} = 2015 - 2016 = -1$

$X_{2016} - \bar{X} = 2016 - 2016 = 0$

$X_{2017} - \bar{X} = 2017 - 2016 = 1$

$X_{2018} - \bar{X} = 2018 - 2016 = 2$

For Variable Y: $Y_{2014} - \bar{Y} = 0.208 - 0.243 = -0{,}035$

$Y_{2015} - \bar{Y} = 0.194 - 0{,}243 = -0.049$

$Y_{2016} - \bar{Y} = 0.201 - 0.243 = -0.042$

$Y_{2017} - \bar{Y} = 0.263 - 0.243 = 0.02$

$Y_{2018} - \bar{Y} = 0.349 - 0.243 = 0{,}106$

Then we have to calculate the $(X - \bar{X})^2$ for each year:

2014:$(-2)^2 = 4$

2015: $(-1)^2 = 1$

2016: $(0)^2 = 0$

2017: $(1)^2 = 1$

2018:$(2)^2 = 4$

$S_{xx} = 4 + 1 + 0 + 1 + 4 = 10$

Then we calculate the $(X - \bar{X})(Y - \bar{Y})$

2014:(-2) *(-0.035) =0.07

2015: (-1) *(-0.049)=0.049

2016:0*(-0.042)=0

2017: 1*(0.02)=0.02

2018:2*0.106=0.212

$S_{xy} = 0{,}084 + 0.015 + 0 - 0.013 + 0.196 = 0.282$

Years (X)	Power of Performance	$X - \overline{X}$	$Y - \overline{Y}$	$(X - \overline{X})^2$	$(X - \overline{X})(Y - \overline{Y})$
2014	0.208	-2	-0,035	4	0.07
2015	0.194	-1	-0,049	1	0.049
2016	0.201	0	-0.042	0	0
2017	0.263	1	0.02	1	0.02
2018	0.349	2	0.106	4	0.212
				$S_{xx} = 10$	$S_{xy} = 0.351$

$\alpha = 0{,}243 - 2016\left(\frac{0.351}{10}\right) = -70.5186$

$\beta = \frac{0.351}{10} = 0{,}0351$

$Y = -70.5186 + 0{,}0351X$

For 2019: Y=-70.5186+0.0351*2019=0.3483

For 2020: Y=-70.5186+0.0351*2020=0.3834

For 2021: Y=-70.5186+0.0351*2021=0.4185

For 2022: Y=-70.5186+0.0351*2022=0.4536

Following the same procedure, for Canada we have:

Years(X)	Power Performance(Y)	$X-\overline{X}$	$Y-\overline{Y}$	$(X-\overline{X})^2$	$(X-\overline{X})(Y-\overline{Y})$
2014	0.45	-2	-0.014	4	0.018
2015	0.46	-1	-0.004	1	0.004
2016	0.47	0	0.006	0	0
2017	0.46	1	-0.004	1	-0.004
2018	0.48	2	0.016	4	0.032
$\overline{X}=2016$	$\overline{Y}$ =0.464			$S_{XX}=10$	$S_{xy}=0.05$

α=0,464-2016(0.005)= -9.16

β=$\frac{0,05}{10}=0.005$

So, we have: Y=-9.16+0.005*X

The prediction for 2019 for Canada is: Y=-9.16+0.005*2019=0.935

The prediction for 2020 for Canada is: Y=-9.16+0.005*2020=0.940

The prediction for 2021 for Canada is: Y=-9.16+0.005*2021=0.945

The prediction for 2022 for Canada is: Y=-9.16+0.005*2022=0.950

For Norway:

Years (X)	Power Performance(Y)	$X-\overline{X}$	$Y-\overline{Y}$	$(X-\overline{X})^2$	$(X-\overline{X})(Y-\overline{Y})$
2014	0.147	-2	-0.0088	4	0.0176
2015	0.149	-1	-0.0068	1	0.0068
2016	0.162	0	0.0062	0	0
2017	0.164	1	0.0082	1	0.0082
2018	0.157	2	0.0012	4	0.0024
$\overline{X}=2016$	$\overline{Y}=0.1558$			$S_{xx}=10$	$S_{xy}=0.035$

α=0,1558-2016*0.0035=-6.9002

β=$\frac{0.035}{10} = 0.0035$

Y=-6.9002+0.0035*X

The estimation for 2019 for Norway is: Y=-6.9002+0.0035*2019=0.1663

The estimation for 2020 for Norway is: Y=-6.9002+0.0035*2020=0.1698

The estimation for 2021 for Norway is: Y=-6.9002+0.0035*2021=0.1733

The estimation for 2022 for Norway is: Y=-6.9002+0.0035*2022=0.1768

For Denmark:

Years (X)	**Power Performance (Y)**	$\boldsymbol{X - \overline{X}}$	$\boldsymbol{Y - \overline{Y}}$	$(\boldsymbol{X - \overline{X}})^2$	**(**X-$\boldsymbol{\overline{X}}$$\boldsymbol{(Y - \overline{Y})}$
2014	0.0011	-2	0.000564	4	-0.001128
2015	0.0009	-1	0.000364	1	-0.000364
2016	0.0005	0	-0.000036	0	0
2017	0.00017	1	-0.000366	1	-0.000366
2018	0.00001	2	-0.000526	4	-0.001052
$\boldsymbol{\overline{X} = 2016}$	$\overline{Y} = 0.000536$			$S_{xx} = 10$	$S_{xy} = -0.00291$

α= 0,000536-2016(-0.000291)=0.587

β=$-\frac{0.00291}{10}$= - 0.000291

For Denmark we have: Y=0.587-0.000291*X

The estimation for 2019 is: Y=0.587-0.000291*2019= -0.000529

The estimation for 2020 is: Y=0.587-0.000291*2020= -0.000820

The estimation for 2021 is: Y=0.587-0.000291*2021= -0.001111

The estimation for 2022 is: Y=0.587-0.000291*2022= -0.001402

For Russia Federation:

Years (X)	Power Performance (Y)	$\boldsymbol{X-\overline{X}}$	$\boldsymbol{Y-\overline{Y}}$	$\boldsymbol{(X-\overline{X})^2}$	**(**X-$\boldsymbol{\overline{X}}$)$\boldsymbol{(Y-\overline{Y})}$
2014	0.78	-2	-0.086	4	0.172
2015	0.81	-1	-0.056	1	0.056
2016	1.06	0	0.194	0	0
2017	0.80	1	-0.066	1	-0.066
2018	0.88	2	0.014	4	0.028
$\boldsymbol{\overline{X}=2016}$	$\overline{Y}=0.866$			S_{xx}=10	$S_{xy}=0.19$

α= 0.866-2016*0.019=-37.438

β=$\frac{0,19}{10}=0.019$

Y=-37.438+0.019*X

The estimation for 2019 for Russian Federation is: Y=-37.4385+0.019*2019=0.923

The estimation for 2020 for Russian Federation is: Y=-37.4385+0.019*2020=0.942

The estimation for 2021 for Russian Federation is: Y=-37.4385+0.019*2021=0.961

The estimation for 2022 for Russian Federation is: Y=-37.4385+0.019*2022=0.980

- **Use of Minimum Quadrant Method of Power Performance of Political Pillar**

The Power Performance of Political Pillar of USA:

Years (Variable X)	Power Performance (Variable Y)
2014	0.76
2015	0.76
2016	0.76
2017	0.80
2018	0.80

$$\bar{X} = \frac{2014 + 2015 + 2016 + 2017 + 2018}{5} = 2016$$

$$\bar{Y} = \frac{0.76 + 0.76 + 0.76 + 0.80 + 0.80}{5} = 0.776$$

Then we will subtract the average we found from each of its values variable X and Y, respectively

For Variable X: $X_{2014} - \bar{X} = 2014 - 2016 = -2$

$X_{2015} - \bar{X} = 2015 - 2016 = -1$

$X_{2016} - \bar{X} = 2016 - 2016 = 0$

$X_{2017} - \bar{X} = 2017 - 2016 = 1$

$X_{2018} - \bar{X} = 2018 - 2016 = 2$

For Variable Y: $Y_{2014} - \bar{Y} = 0.76 - 0.776 = -0.016$

$Y_{2015} - \bar{Y} = 0.76 - 0.776 = -0.016$

$Y_{2016} - \bar{Y} = 0.76 - 0.776 = -0.016$

$Y_{2017} - \bar{Y} = 0.80 - 0.776 = 0.024$

$Y_{2018} - \bar{Y} = 0.80 - 0.776 = 0.024$

Then we have to calculate the $(X - \bar{X})^2$ for each year:

2014: $(-2)^2$=4

2015: $(-1)^2$=1

2016: $(0)^2 = 0$

2017: $(1)^2 = 1$

2018: $(2)^2 = 4$

$S_{xx} = 4 + 1 + 0 + 1 + 4 = 10$

Then we calculate the (X$-\bar{X}$)$(Y - \bar{Y})$ for each year:

2014: (-2) *(-0.016) =0.032

2015: (-1) *(-0.016) =0.016

2016: (0) * (-0.016) =0

2017: (1) *(0.024) =0.024

2018: 2*0.024=0.048

$S_{xy} = 0.032 + 0.016 + 0 + 0.024 + 0.048 = 0.12$

Years (X)	**Power of Performance (Y)**	$X - \bar{X}$	$Y - \bar{Y}$	$(X - \bar{X})^2$	$(X - \bar{X})(Y - \bar{Y})$
2014	0.76	-2	-0.016	4	0.032
2015	0.76	-1	-0.016	1	0.016
2016	0.76	0	-0.016	0	0
2017	0.80	1	0.024	1	0.024
2018	0.80	2	0.024	4	0.048
$\bar{X} = 2016$	$\bar{Y} = 0{,}776$			$S_{xx} = 10$	$S_{xy} = 0.12$

α=0,776-2016*0.012=-23,416

$\beta=\frac{0,12}{10}=0,012$

Y=-23.416+0.012*X

For the estimation for 2019 we have: Y=-23.416+0.012*2019= 0.812

For the estimation for 2020 we have: Y=-23.416+0.012*2020= 0.824

For the estimation for 2021 we have: Y=-23.416+0.012*2021= 0.836

For the estimation for 2022 we have: Y=-23.416+0.012*2022= 0.848

For Canada

Years (X)	Power Performance (Y)	$X-\overline{X}$	$Y-\overline{Y}$	$(X-\overline{X})^2$	$(X-\overline{X})(Y-\overline{Y})$
2014	0.89	-2	-0.02	4	0.04
2015	0.89	-1	-0.02	1	0.02
2016	0.89	0	-0.02	0	0
2017	0.94	1	0.03	1	0.03
2018	0.94	2	0.03	4	0.06
$\overline{X}=2016$	$\overline{Y}=0.91$			$S_{xx}=10$	$S_{xy}=0.15$

α= 0.91-2016*0.015=-29.33

$\beta=\frac{0,15}{10}=0,015$

Y=-29.33+0.015*X

The estimation for 2019 is: Y=-29.33+0.015*2019=0.955

The estimation for 2020 is: Y=-29.33+0.015*2020=0.970

The estimation for 2021 is: Y=-29.33+0.015*2021=0.985

The estimation for 2022 is: Y=-29.33+0.015*2022=1.000

For Norway

Years(X)	Power Performance (Y)	$X-\overline{X}$	$Y-\overline{Y}$	$(X-\overline{X})^2$	$(X-\overline{X})(Y-\overline{Y})$
2014	0.89	-2	-0.6	4	1.2
2015	0.94	-1	-0.1	1	0.1
2016	0.94	0	-0.1	0	-0.1
2017	0.98	1	0.3	1	0.3
2018	1	2	0.5	4	1
$\overline{X}=2016$	$\overline{Y}$ =0.95			$S_{xx}=10$	$S_{xy}=2.5$

α=0.95-2016*0.25=-503.05

$\beta=\frac{2.5}{10}=0{,}25$

Y=-503.05+0.25*X

The estimation for 2019 is: Y=-503.05+0.25*2019=1.70

The estimation for 2020 is: Y=-503.05+0.25*2020=1.95

The estimation for 2021 is: Y=-503.05+0.25*2021=2.20

The estimation for 2022 is: Y=-503.05+0.25*2022=2.45

For Denmark:

Years (X)	Power Performance (Y)	$X-\overline{X}$	$Y-\overline{Y}$	$(X-\overline{X})^2$	$(X-\overline{X})(Y-\overline{Y})$
2014	0.89	-2	-0.014	4	0.028
2015	0.89	-1	-0.014	1	0.014
2016	0.94	0	0.036	0	0
2017	0.89	1	-0.014	1	-0.014
2018	0.91	2	0.006	4	0.012
$\overline{X}=2016$	$\overline{Y}=0.904$			$S_{xx}=10$	$S_{xy}=0.040$

α= 0,904-2016*0.004=-7.16

β=$\frac{0,040}{10}=0,004$

Y=-7.16+0.004*X

The estimation for 2019 is: Y=-7.16+0.004*2019=0.916

The estimation for 2020 is: Y=-7.16+0.004*2020=0.920

The estimation for 2021 is: Y=-7.16+0.004*2021=0.924

The estimation for 2022 is: Y=-7.16+0.004*2022=0.928

For the Russian Federation

Years (X)	Power Performance (Y)	$X - \bar{X}$	$Y - \bar{Y}$	$(X - \bar{X})^2$	$(X - \bar{X})(Y - \bar{Y})$
2014	0.13	-2	-0.024	4	0,048
2015	0.18	-1	0,026	1	0.026
2016	0.18	0	0,026	0	0
2017	0.13	1	-0.024	1	-0.024
2018	0.15	2	-0.004	4	-0.008
$\bar{X} = 2016$	$\bar{Y} = 0.154$			$S_{xx} = 10$	$S_{xy} = 0.042$

α=0,154-2016*0.0042=-8.31

β=$\frac{0.042}{10} = 0.0042$

Y=-8.31+0.0042*X

The estimation for 2019 is: y=-8.31+2019*0.0042=0.1698

The estimation for 2020 is: y=-8.31+2020*0.0042=0.1740

The estimation for 2021 is: y=-8.31+2021*0.0042=0.1782

The estimation for 2022 is: y=-8.31+2022*0.0042=0.1824

4.3 Prediction of the redistribution of power using Time Series (Balanced Moving Average)

Time series measure the dependence of a future value of a size, from its previous values in the past. One of the most commonly used methods is the Balanced Moving Average, which is used to perform predictions based on previous time periods, the number of which is defined by the analyst.

Prediction errors are directly related to the number of periods chosen by the analyst. Generally, as the number decreases, so decreases the error in prediction; however, what also increases is sensitivity to random fluctuations and extreme values.

More specifically, if we define:

t: the present period

N: the number of periods chosen by the analyst

P: the period for which the forecast is carried out

A: the indicator values for a specific period

n: the gravity factors matched by the analyst in each period then:

$$\Pi_{t+1} = (n_tA_t+n_{t-1}A_{t-1}+\ldots+n_{t-N+1}A_{t-N+1})/N$$

The name of the method includes the term moving because the periods included in the calculation of the prediction are continuously updated, so the final number of periods remains constant. One of the major advantages is that it enables the analyst to match gravity factors in previous periods, thus allowing very rapid incorporation of new information.

Making a prediction presupposes that the analyst initially must define:

1. The time horizon for which he carries out the forecast.
2. the number of previous periods on which the prediction will be based
3. The gravity factors attributed to each of the previous periods, depending on their significance.

In order to make a prediction we add the sum products of weights and values of the previous periods and divide these by the number of previous periods.

For our case, the forecast for 2019 and so on until 2022, will be based on five (5) previous periods. The gravity factors will be attributed to the periods, in a way that gives greater value to the periods closer to the present year. If N is the number of periods used for the prediction, then the gravity factors for each one of the periods are presented below:

- Weight 0.5 to period N-1.

- Weight 0.25 to period N-2.

- Weight 0.15 to period N-3.

- Weight 0.05 to period N-4.

- Weight 0.05 to period N-5.

The Power Performance of Economic Pillar of USA:

Years	Power Performance
2014	0.208
2015	0.194
2016	0.201
2017	0.263
2018	0.349

For the year 2019 the prediction for USA shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.349+0.25*0.263+0.15*0.201+0.05*0.194+0.05*0.208 = **0.290**

The same applies for the other predictions:

P2020 = 0.5*0.290+0.25*0.349+0.15*0.263+0.05*0.201+0.05*0.194 = **0.291**

P2021 = 0.5*0.291+0.25*0.290+0.15*0.349+0.05*0.263+0.05*0.201 = **0.294**

P2022 = 0.5*0.294+0.25*0.291+0.15*0.290+0.05*0.349+0.05*0.263 = **0.294**

For Canada:

Years	**Power Performance**
2014	0.45
2015	0.46
2016	0.47
2017	0.46
2018	0.48

For the year 2019 the prediction for Canada shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.48+0.25*0.46+0.15*0.47+0.05*0.46+0.05*0.45 = **0.471**

The same applies for the other predictions:

P2020 = 0.5*0.471+0.25*0.48+0.15*0.46+0.05*0.47+0.05*0.46 = **0.471**

P2021 = 0.5*0.471+0.25*0.471+0.15*0.48+0.05*0.46+0.05*0.47 = **0.4717**

P2022 = 0.5*0.4717+0.25*0.471+0.15*0.471+0.05*0.48+0.05*0.46 = **0.4712**

For Norway:

Years	Power Performance
2014	0.147
2015	0.149
2016	0.162
2017	0.164
2018	0.157

For the year 2019 the prediction for Norway shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.157+0.25*0.164+0.15*0.162+0.05*0.149+0.05*0.147 = **0.1586**

The same applies for the other predictions:

P2020 = 0.5*0.1586+0.25*0.157+0.15*0.164+0.05*0.162+0.05*0.149= **0.1587**

P2021 = 0.5*0.1587+0.25*0.1586+0.15*0.157+0.05*0.164+0.05*0.162 = **0.1588**

P2022 = 0.5*0.1588+0.25*0.1587+0.15*0.1586+0.05*0.157+0.05*0.164 = **0.1589**

For Denmark:

Years	Power Performance
2014	0.0011
2015	0.0009
2016	0.0005
2017	0.00017
2018	0.00001

For the year 2019 the prediction for Denmark shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.00001+0.25*0.00017+0.15*0.0005+0.05*0.0009+0.05*0.0011 = **0.00022**

The same applies for the other predictions:

P2020 = 0.5*0.00022+0.25*0.00001+0.15*0.00017+0.05*0.0005+0.05*0.0009 = **0.0002**

P2021 = 0.5*0.0002+0.25*0.00022+0.15*0.00001+0.05*0.00017+0.05*0.0005 = **0.00019**

P2022 = 0.5*0.00019+0.25*0.0002+0.15*0.00022+0.05*0.00001+0.05*0.00017 = **0.00019**

For Russian Federation:

Years	Power Performance
2014	0.78
2015	0.81
2016	0.82
2017	0.8
2018	0.88

For the year 2019 the prediction for Russian Federation shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.88+0.25*0.8+0.15*0.82+0.05*0.81+0.05*0.78 = **0.8425**

The same applies for the other predictions:

P2020 = 0.5*0.8425+0.25*0.88-2+0.15*0.8+0.05*0.82+0.05*0.81 = **0.8427**

P2021 = 0.5*0.8427+0.25*0.8425-2+0.15*0.88+0.05*0.8+0.05*0.82 = **0.845**

P2022 = 0.5*0.845+0.25*0.8427-2+0.15*0.8425+0.05*0.88+0.05*0.8 = **0.843**

The Power Performance of Political Pillar of USA:

Years	Power Performance
2014	0.76
2015	0.76
2016	0.76
2017	0.8
2018	0.8

For the year 2019 the prediction for USA shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.8+0.25*0.8+0.15*0.76+0.05*0.76+0.05*0.76 = **0.790**

The same applies for the other predictions:

P2020 = 0.5*0.790+0.25*0.8+0.15*0.8+0.05*0.76+0.05*0.76 = **0.791**

P2021 = 0.5*0.791+0.25*0.790+0.15*0.8+0.05*0.8+0.05*0.76 = **0.791**

P2022 = 0.5*0.791+0.25*0.791+0.15*0.790+0.05*0.8+0.05*0.8 = **0.792**

For Canada:

Years	Power Performance
2014	0.89
2015	0.89
2016	0.89
2017	0.94
2018	0.94

For the year 2019 the prediction for Canada shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.94+0.25*0.94+0.15*0.89+0.05*0.89+0.05*0.89 = **0.927**

The same applies for the other predictions:

P2020 = 0.5*0.927+0.25*0.94+0.15*0.94+0.05*0.89+0.05*0.89 = **0.928**

P2021 = 0.5*0.928+0.25*0.927+0.15*0.94+0.05*0.94+0.05*0.89 = **0.928**

P2022 = 0.5*0.928+0.25*0.928+0.15*0.927+0.05*0.94+0.05*0.94 = **0.929**

For Norway:

Years	Power Performance
2014	0.89
2015	0.94
2016	0.94
2017	0.98
2018	1

For the year 2019 the prediction for Norway shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*1 +0.25*0.98+0.15*0.94+0.05*0.94+0.05*0.89 = **0.977**

The same applies for the other predictions:

P2020 = 0.5*0.977+0.25*1+0.15*0.98+0.05*0.94+0.05*0.94= **0.979**

P2021 = 0.5*0.979+0.25*0.977+0.15*1+0.05*0.98+0.05*0.94 = **0.980**

P2022 = 0.5*0.980+0.25*0.979+0.15*0.977+0.05*1+0.05*0.98 = **0.981**

For Denmark:

Years	Power Performance
2014	0.89
2015	0.89
2016	0.94
2017	0.89
2018	0.91

For the year 2019 the prediction for Denmark shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.91+0.25*0.89+0.15*0.94+0.05*0.89+0.05*0.89 = **0.9075**

The same applies for the other predictions:

P2020 = 0.5*0.9075+0.25*0.91+0.15*0.89+0.05*0.94+0.05*0.89 = **0.9062**

P2021 = 0.5*0.9062+0.25*0.9075+0.15*0.91+0.05*0.89+0.05*0.94 = **0.908**

P2022 = 0.5*0.908+0.25*0.9062+0.15*0.9075+0.05*0.91+0.05*0.89 = **0.906**

For Russian Federation:

Years	Power Performance
2014	0.13
2015	0.18
2016	0.18
2017	0.13
2018	0.15

For the year 2019 the prediction for Russian Federation shall be based on years 2018, 2017, 2016, 2015 and 2014 and according to the gravity factors attributed by the analyst:

P2019 = 0.5*0.15+0.25*0.13+0.15*0.18+0.05*0.18+0.05*0.13 = **0.15**

The same applies for the other predictions:

P2020 = 0.5*0.15+0.25*0.15+0.15*0.13+0.05*0.18+0.05*0.18 = **0.15**

P2021 = 0.5*0.15+0.25*0.15+0.15*0.15+0.05*0.13+0.05*0.18 = **0.15**

P2022 = 0.5*0.15+0.25*0.15+0.15*0.15+0.05*0.15+0.05*0.13 = **0.14**

5. Comparison and calculation of overall system power performance

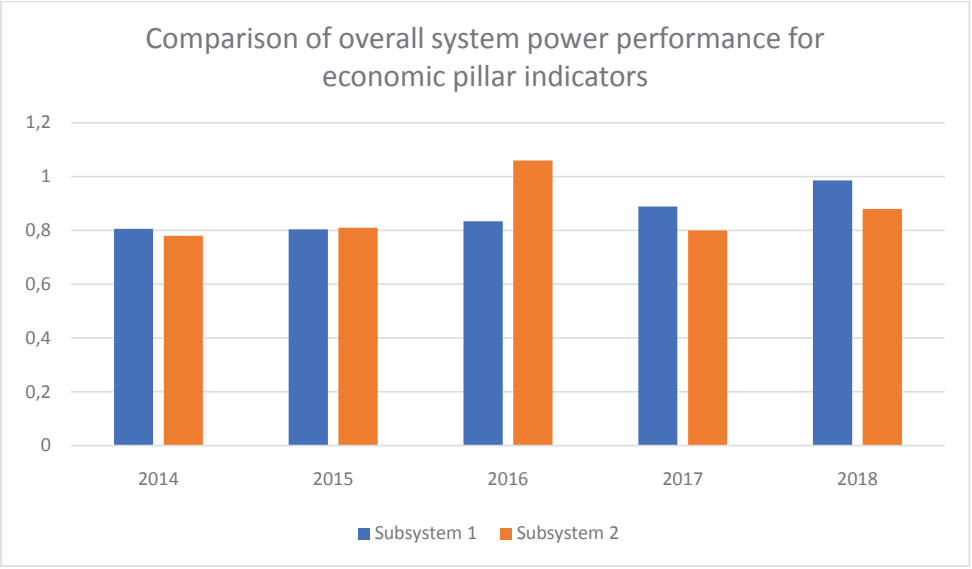
5.1 Implementation in the scheme for the economic geopolitical pillar indicators

From the numbers resulting from the analysis of the data and from the forecasts for the overall power performance of the subsystems, we obtain a global picture of the geographical system identified in the context of the Geopolitical complex. However, each subsystem interacts with the rest within the system, based on specific interests. In fact, the interests which define and influence the above interactions are characterized by very high complexity and variability. For this reason, we are making certain assumptions, with a view to simplifying the computational model, as well as the faster calculation – export of information.

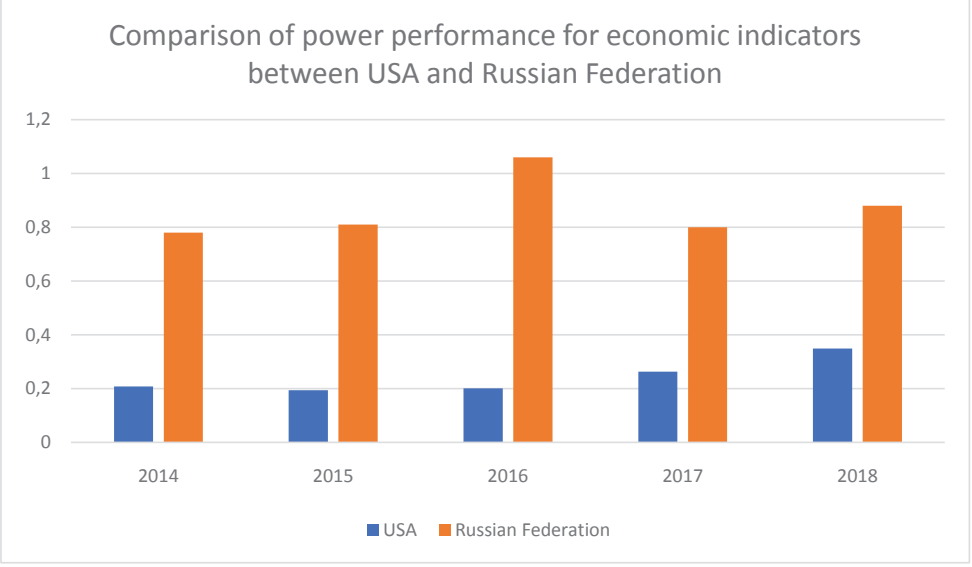
This assumption is that the coastal States of the Arctic Ocean (USA, Canada, Norway and Denmark) are the first subsystem as has been clarified in previous chapters. The second subsystem is the Russian Federation. So, by summing up the individual performance of the countries of the economic pillar, we:

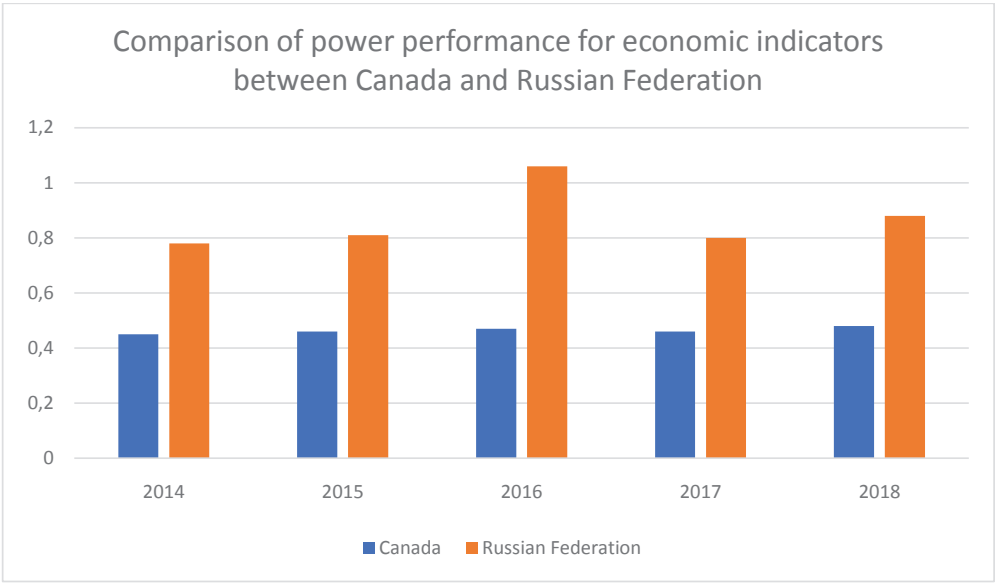
Year	USA	Canada	Norway	Denmark	1st Subsystem
2014	0.208	0.45	0.147	0.0011	0.8061
2015	0.194	0.46	0.149	0.0009	0.8039
2016	0.201	0.47	0.162	0.0005	0.8335
2017	0.263	0.46	0.164	0.00017	0.88717
2018	0.349	0.48	0.157	0.00001	0.98601

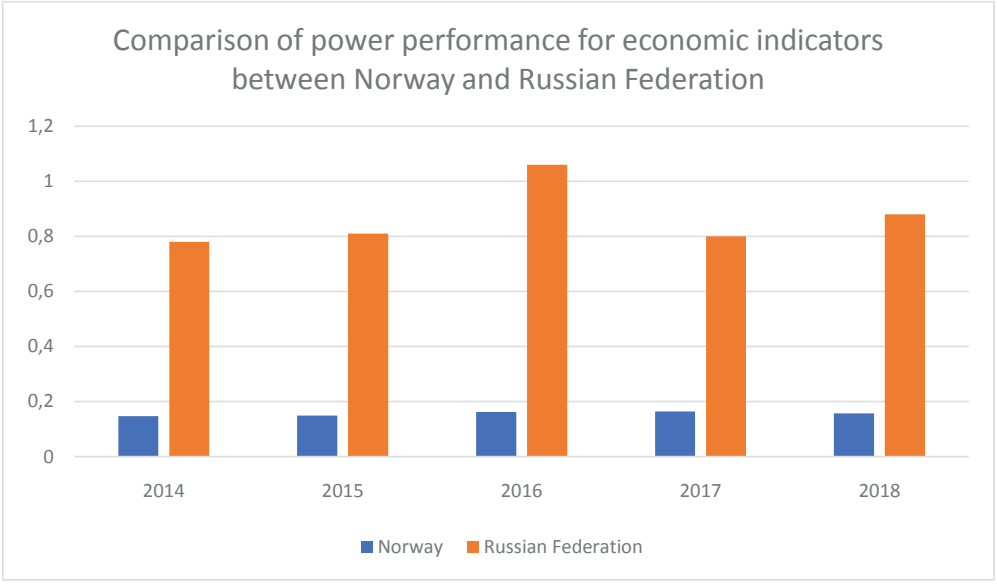
Year	Russian Federation	2nd Subsystem
2014	0.78	0.78
2015	0.81	0.81
2016	1.06	1.06
2017	0.80	0.80
2018	0.88	0.88

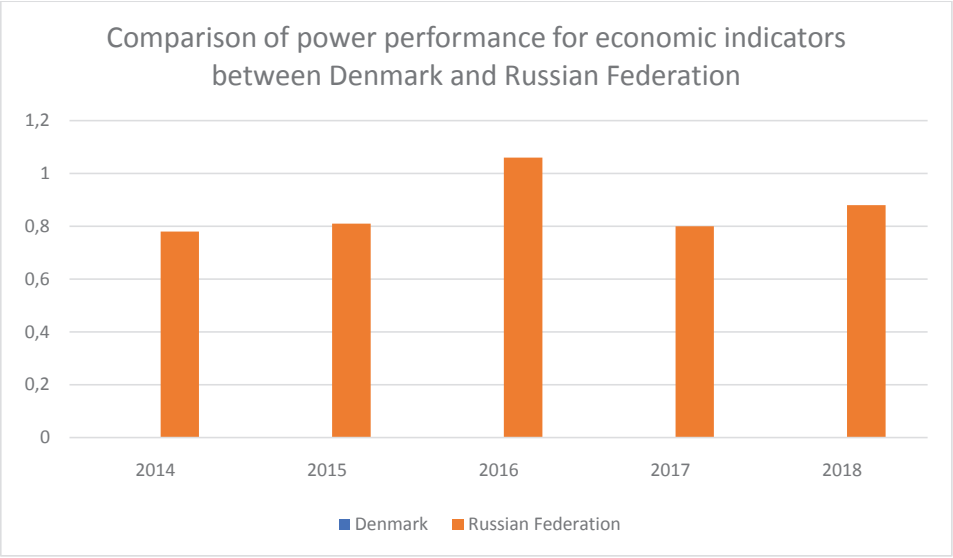


It is clear that the above tables indicate that the 1st Subsystem (USA, Canada, Norway, and Denmark) Overrides in the economic pillar against the 2nd Subsystem (Russian Federation.




Comparison of power performance for economic indicators between Canada and Russian Federation
1,2
1
0,8
0,6
0,4
0,2
0
2014
2015
2016
2017
2018
Canada
Russian Federation


Comparison of power performance for economic indicators between Norway and Russian Federation
1,2
1
0,8
0,6
0,4
0,2
0
2014
2015
2016
2017
2018
Norway
Russian Federation

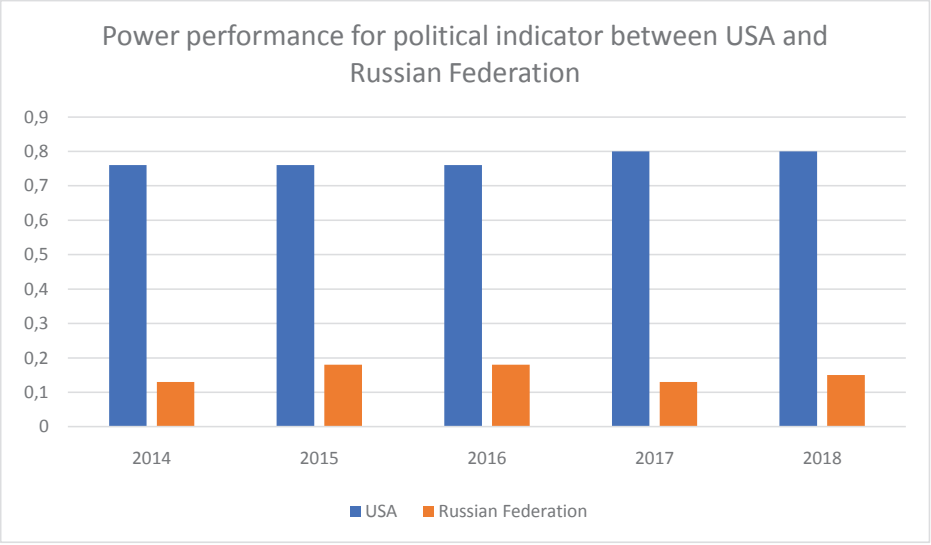


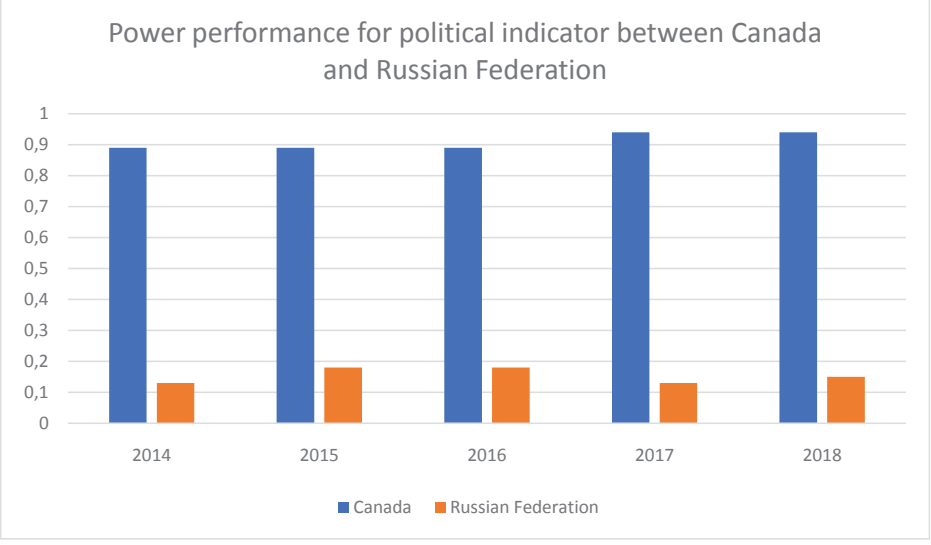
As can be concluded from the above diagrams, in terms of economic indicators, Russian Federation excels for each country separately but also for comparing the two subsystems on the basis of the Results Observe that there is an upward trend of indicators over time.

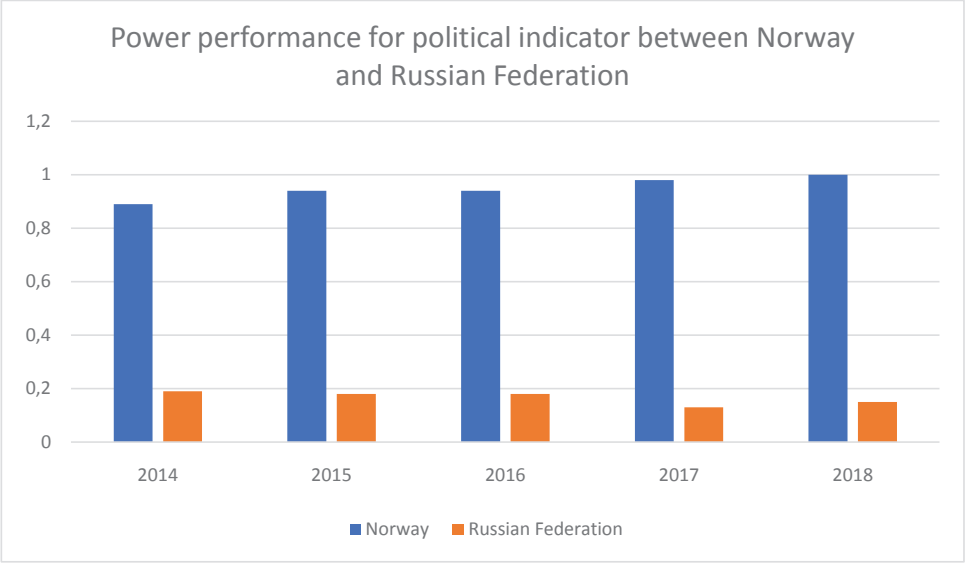
5.2 Implementation of the geopolitical Pillar of Politics index.

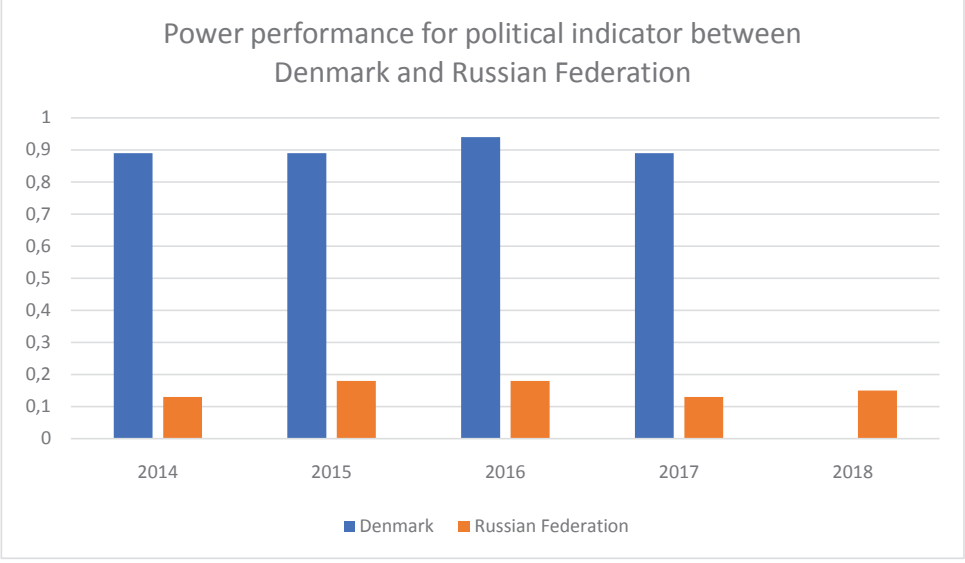
Year	USA	Canada	Norway	Denmark	1st Subsystem
2014	0.76	0.89	0.89	0.89	3.43
2015	0.76	0.89	0.94	0.89	3.48
2016	0.76	0.89	0.94	0.94	3.53
2017	0.80	0.94	0.98	0.89	3.61
2018	0.80	0.94	1	0.91	3.65

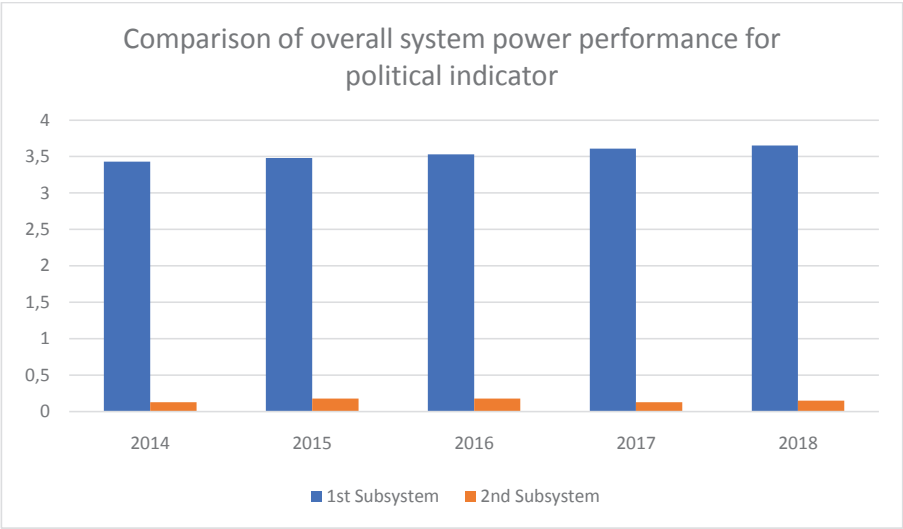
Year	Russian Federation	2nd Subsystem
2014	0.13	0.13
2015	0.18	0.18
2016	0.18	0.18
2017	0.13	0.13
2018	0.15	0.15






Power performance for political indicator between Norway and Russian Federation
1,2
1
0,8
0,6
0,4
0,2
0
2014
2015
2016
2017
2018
Norway
Russian Federation


Power performance for political indicator between Denmark and Russian Federation
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
2014
2015
2016
2017
2018
Denmark
Russian Federation



As shown in the above tables it appears that the 1st Subsystem takes precedence over the 2nd Subsystem As far as the pillar of politics is concerned. In this context, additional policies may arise at the level of the geo-strategic choices for each interested party.

The above systemic Geopolitical Analysis in the Arctic Ocean System and with planned the Economic and Political Pillar took into account the above-mentioned conditions, that is:

- As far as the pillar of the economy is concerned, there were several indicators that could be analyzed, but the main purpose was to give an overview explaining the need for the coastal States of the Arctic Circle for the energy reserves that exist in the area.
- For the Pillar of Policy, chosen the index government effectiveness concerning energy policies related to the development of hydrocarbons in the Arctic, in order to stress how important is for each country, the preoccupation of with the Energy reserves of Arctic.

Under these conditions and with the quantification described, we end up with conclusion that the balance of power, and therefore its distribution in the Arctic System Ocean, goes for the benefit of the 1st Subsystem (USA, Canada, Norway, and Denmark).

But as far as, the comparison of power performance for economic indicators between Russian Federation and separately every Country of the 1st Subsystem (Canada, USA, Norway, and Denmark), we have the following indications:

- Between Russian Federation and USA , we can see that both countries are located in the same levels and only for year 2018 , USA is in a little above level from Russian Federation.
- For Russian Federation and Canada, the power performance for Russian Federation is totally higher than Canada.
- For Russian Federation and Norway and Denmark, we can see that the power performance for Russian Federation is tremendously in high level in comparison with the two other countries.

As far as, the comparison of power performance for political indicator between Russian Federation and separately every Country of the 1st Subsystem, we have the according indications:

- For every Country, the Power performance for the political indicator is very high in comparison with the power performance of Russian Federation.

Conclusion

Summarizing the above mentioned, some important conclusions/remarks concerning the reallocation of power in the geopolitical complex as well as the two geopolitical sub-systems are:

1. Given the environmental developments, due to global warming, involving the melting of ice in the Arctic, opportunities are being created for the exploitation of natural resources. On the one hand, there is Russia which wants to play a dominant role, and this is because it wants the energy it provides to be moved by its national companies. On the other hand, the western countries do not hesitate, nor do they always have a cold conflict with each other on the issue of hydrocarbon extraction, because, even though they belong to the Western

Coalition, they make the survival of their state their primary concern. In the international system through the principle of self-help. For this reason, they wish to extract the hydrocarbons, as energy is a very important coefficient of power, which can make a state strong on the international stage, capable of putting the remaining states in power balance with them in the Arctic subsystem.

2. The Arctic environment is subject to substantial changes due to climate change in the region. This change is a key factor in the Arctic environment and sets a very large percentage of any international developments in the region. But the Arctic states, in addition to the challenges, see new opportunities emerging through the change in the Arctic's natural environment. For example, the existence of oil in the Arctic has been known for many years, but not the stocks (number of barrels) at the bottom of the Arctic Ocean.
3. The publication of the research of the U.S. Geological Survey, which characterized the Arctic Ocean as one of the largest in volume oil reserves, unexplored areas of the planet, caused the immediate reaction of the Arctic States and non-Arctic agents wishing to participate in the developments and take advantage of the exploitation of the resources of the Arctic bottom. Climate change seems to have a positive effect on the plans of the Arctic states since the melting of the ice makes it easier, feasible and perhaps less costly the process of oil and gas extraction in the Arctic Ocean.
4. The research showed clearly that the reallocation of power is for Russia. Most of the Arctic Ocean is provided to Russia, which claims 1.2 million square kilometers. Arctic is an area that has been employed, employing and will continue to employ more, especially in the coming years. The geopolitical turmoil will continue as the power vector is for Russia.

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