The Regulatory Quality and ESG Model at World Level

Costantiello, Alberto and Leogrande, Angelo

LUM University Giuseppe Degennaro, LUM Enterprise s.r.l.

14 March 2023

Alberto Costantiello[1]*, Angelo Leogrande[2]*°
*LUM University Giuseppe Degennaro, Casamassima, Bari, Puglia, Italy, EU
°LUM Enterprise s.r.l., Casamassima, Bari, Puglia, Italy, EU

The Regulatory Quality and ESG Model at World Level

Abstract

In this article, we analyse the determinants of Regulatory Quality-RQ for 193 countries in the period 2011-2020. We use a database from ESG-Environment Social Governance of the World Bank. We apply OLS, Panel Data with Fixed Effects and Panel Data with Random Effects. We found that the variables that have the most positive impact on RQ, among others, are "*GHG Net Emission*", "*Mean Drought Index*", and "*Heat Index*". We also found that the variables that have the most negative impact on RQ are among others "*Renewable Energy Consumption*", "*Voice and Accountability*" and "*Rule of Law*". Furthermore, we have applied the k-Means algorithm optimized with the Elbow Method and we find the presence of five clusters. In adjunct, we confront eight machine learning algorithms to predict the value of RQ and we found that the best predictor is Polynomial Regression. The predictive level of RQ for the analysed countries is expected to diminish of -1,29%. In the end, we present a network analysis with the Euclidean distance and we found the presence of a structure of seven networks using augmented data.

1. Introduction-Research Question

In this article, we estimate the level of RQ i.e., the perception of the ability of governments to promote the development of the private sector. The level of RQ as an index varies in a range between -2.5 to 2.5. Specifically, we analysed the relationship between RQ and a set of indicators related to the World Bank's ESG. In particular, RQ is an indicator which is part of the governance section and which has been analysed in its relationships with other variables relating to the environment and the social dimensions. The ESG model has been proposed as a tool for achieving sustainability.

In fact, although the orientation towards the market society and the development of the private sector may seem trivial, we are witnessing a retreat of the private sector following a series of crises that have occurred recently. Covid-19, the Russo-Ukrainian war, inflation, the energy crisis, have once again placed the role of the state and the public economy at the centre, even in Western societies inspired by Anglo-Saxon capitalism. This succession of adverse macro-phenomena has in fact considerably weakened businesses, especially small and medium-sized enterprises, compressed the income of workers and families, and reduced life expectancy together with the size of the share capital of the population.

---

[1] Professor of Economics at LUM University Giuseppe Degennaro. Email: costntiello@lum.it. Strada Statale 100 km 18, Casamassima, Bari, Puglia, Italia.
[2] Professor of Economics at LUM University Giuseppe Degennaro and Researcher at LUM Enterprise s.r.l. Email: leogrande.cultore@lum.it, Strada Statale 100 km 18, Casamassima, Bari, Puglia, Italia.

However, the Western capitalist system needs to invest in the private sector, as the private sector provides important products, services and jobs that are essential for the development of economic, political, and social systems, also in the sense of sustainability. In fact, if it is true that access to the energy transition follows the trend of the Environmental Kuznets Curve, then it is necessary to further strengthen the private sector to ensure that the conditions are created for accessing the green economy. Hence the need to focus on a set of elements that are not only aimed at a governance dimension, and which are instead also able to grasp aspects relating to the environment and the social dimension. No less important is also the question of social participation in political and democratic issues. In fact, countries that have high levels of RQ, i.e., Western countries, also experience a set of limitations in accessing democracy, as evidenced by growing inequality, abstentionism and violent phenomena such as the assault on the Capitol Hill in the US of the 6 January 2021.

It is therefore necessary to find a new sustainable balance between social, environmental and governance issues, and aim at strengthening private production that has been put to the test by the succession of adverse macro-economic phenomena.

The article continues as follows: the second paragraph contains an analysis of the literature, the third presents the econometric model, the fourth shows the cluster analysis, the fifth analyses the prediction with machine learning algorithms, the sixth implements the network analysis, the seventh concludes. The appendix presents supplementary statistics, metrics and methodologies.

2. Literature Review

In the following part we present a brief literature review, just to introduce the topic. In general, we have verified that RQ has positive effects on economic growth, economic development, financial development, energetic transition, and environmental sustainability.

RQ has no meaning in promoting economic growth in Middle East and Northern African-MENA countries [1]. RQ has a relevant role in promoting financial institutions in African countries [2], [3], [4]. There is a positive relationship between RQ and environmental degradation in Sub-Saharan African countries [5]. RQ has a positive impact in reducing CO_2 emissions in Brazil, Russia, India, China, and South Africa, i.e. BRICS countries, in the long run [6]. RQ has a relevant role in Brazil even if not all the laws are effectively implemented in the legal system [7]. RQ has a negative impact on economic development in the short run and a positive one in the long run in the Economic Community of Western African States-ECOWAS [8], [9]. RQ has a negative impact on the inverse relationship between non-renewable energy and life expectancy in African countries [10]. RQ is positively associated to the adoption of renewable energies in a panel of 85 countries [11]. RQ has a positive effect in boosting the contribution of Foreign Direct Investments-FDI on the exports of high tech products in developing countries [12]. Historical, institutional and democratic factors can explain the heterogeneity in terms of RQ among European countries [13]. RQ positively affect tourism in India [14]. RQ has a positive impact in promoting the economic performance either in oil either in non-oil developing countries [15]. RQ positively affect the stock market performance in a composite set of 23 countries [16]. Countries with higher levels of RQ recovery faster in case of financial distress [17]. There is a positive relationship between RQ and the ability of multi-Latinas to produce quality accounting reports in the period 2014-2020 for a sample of 77 corporations [18]. RQ promotes financial inclusion and inclusive growth in Nigeria [19]. RQ is associated to a reduction in infant and maternal mortality in Sub Saharan Africa [20]. RQ is an essential tool to promote an increase in per capita income in 35 European countries [21]. RQ has a positive effect in boosting the finance-growth nexus [22]. The low level of RQ in Pakistan is negatively associated to banking financial stability [23]. RQ improves environmental sustainability in a set of 177 countries [24]. RQ has a negative effect in attracting Chinese FDI in Africa [25]. RQ has a positive impact on the reduction of electricity

prices in Europe [26]. There is a positive relationship between RQ and Initial Public Offerings-IPOs in Pakistan [27].

In synthesis, we can see that there are positive effects that RQ produces on economic performance and environmental sustainability. Either developed countries either developing countries should create the conditions to improve the level of RQ. The orientation toward private property, economic freedom and the liberalization of private sector have positive on the economic and social development of developed and developing countries.

Synthesis of the Literature Review by Main Themes	
RQ , Economic Growth and Development	[1], [8], [12], [15], [21], [4], [25]
RQ, Financial Sector and Financial Markets	[2], [3], [16], [17], [22], [9], [23], [27]
RQ, Environment and Energy	[5], [6] , [10], [11], [24], [26]
Miscellaneous	[7], [13], [14], [18]
RQ, Social and Demographic Issues	[19], [20]

3. The Econometric Model for the Estimation of the Value of Regulatory Quality

We have estimated the level of Regulatory Quality in 193 countries in the period 2010-2021 using a set of econometric techniques i.e. Panel Data with Fixed Effects, Panel Data with Random Effects, Pooled OLS. Specifically we have estimated the following equation:

$$
\begin{aligned}
RegulatoryQuality_{it} \\
&= \alpha + \beta_1(AdjustedSavingsNaturalResourcesDepletion)_t \\
&+ \beta_2(AnnualizedAverageGrowthRateInPerCapitaRealSurveyMeanConsumptionOrIncome)_{it} \\
&+ \beta_3(EnergyIntensityLevelofPrimaryEnergy)_{it} + \beta_4(EnergyUse)_{it} \\
&+ \beta_5(FertilityRateTotal)_{it} + \beta_6(ForestArea)_{it} + \beta_7(GHGNetEmissions)_{it} \\
&+ \beta_8(HeatIndex35)_{it} + \beta_9(MeanDroughtIndex)_{it} + \beta_{10}(MortalityRate)_{it} \\
&+ \beta_{11}(NitrousOxideEmissions)_{it} \\
&+ \beta_{12}(PeopleUsingSafelyManagedDrinkingWaterServices)_{it} \\
&+ \beta_{13}(RenewableElectricityOutput)_{it} + \beta_{14}(RenewableEnergyConsumption)_{it} \\
&+ \beta_{15}(ResearchAndDevelopmentExpenditure)_{it} + \beta_{16}(RuleofLawEstimate)_{it} \\
&+ \beta_{17}(SchoolEnrollmentPrimaryandSecondary)_{it} \\
&+ \beta_{18}(StrengthofLegalRightsIndex)_{it} + \beta_{19}(VoiceAndAccountabilityEstimate)_{it}
\end{aligned}
$$

$$t = [2011; 2020]; i = 193$$

We find that the level of Regulatory Quality is positively associated to the following variables i.e.:

- *GHG net emissions/removas by LUCF:* It is a variable that takes the net emissions of GHG as a reference point considered as net changes of the levels of greenhouse gases in the atmosphere. Countries that have the most the levels of RQ are also the countries that have the greatest levels of GHG. In fact, since these are industrialized western countries, they have high levels of GHG emissions. Since RQ allows to enhance the private sector, it follows that these countries have a more solid industrial system with the development of and industrial system that have a negative impact for the environment. In addition, the countries that have

larger levels of RQ have also greater GHG emissions following the greater distribution of polluting cars and means of transport. It follows that the set of industrial production activity and population consumption models in western countries tends to generate growth in terms of GHG. The green oriented policies that most countries have embraced should reduce the level of GHG.

- *Mean Drought Index:* it is a measure of drought. Countries that have larger levels of RQ also tend to have greater drought levels. However, the growth of drought is a generalized phenomenon connected to the climate change. It is very difficult to evaluate whether the green oriented economic policies that have been designed by Western countries are able to introduce changes in terms of reversal of the phenomenon of drought. However, the reduction of rains, the retreat of glaciers in Europe poses problems both to agriculture, and industry and the population in general. It is very probable that in the future the phenomenon of drought will be even more relevant worldwide by decreeing a condition of difficulty of the countries that could generate food famine and economic and financial crises.

- *Heat Index 35:* is an indicator that considers the average number of days per with a temperature above 35 Celsius degrees. There is a positive relationship between the RQ and the Heat Index 35. It follows that the western countries with high per capita income, which are the same that have high levels of RQ, experience a growing temperature. The number of days in which the temperature grows above 35 degrees tends to increase in countries with high RQ levels. This condition is serious as it involves growth in energy expenditure for air conditioners, with a further aggravation of polluting emissions, a growth in energy consumption and the worsening of global climatic condition. The positive relationship between RQ and Heat Index 35 suggests the urgency of a legislation sensitive to the environmental question in high-income-income countries to counter the adverse effect of the climate change.

- *School Enrolment primary and secondary, gender parity index:* is an indicator that takes into consideration the ratio between girls and boys enrolled in both public and private primary and secondary schools. There is a positive relationship between the RQ and the value of gender equality in primary and secondary schools. Hence the consideration that the countries that have a higher RQ also have the possibility of experiencing greater gender parity. The presence of legislation in favour of the private sector is not only an economic fact, but also have social effects promoting the civil emancipation of female students and workers. In fact, the promotion of the private economy leads to a greater presence of women in the labour market, and therefore society accepts more easily that women can study and train to actively participate in the production of added value at a national level. It follows that even the primary and secondary education sectors are involved in the process of women's emancipation by offering training not only oriented towards work but also towards citizenship, social activism and civil protagonism.

- *Research and Development Expenditure % of GDP:* is a variable that considers spending on research and development as a percentage of GDP. This indicator takes into account either the capital expenditures either the current expenditures in four sectors i.e. : private for-profit sector, government, public education, and private non-profit. Expenditure on Research and Development covers basic research, applied research and experimental development. There is a positive relationship between the value of R&D expenditures and RQ. Indeed, countries that have high RQ levels also tend to have a more entrepreneurially active private sector. To be able to compete, companies need to invest in research and development to produce new goods and services. Furthermore, since many of the countries that have high levels of RQ are also

democratic countries, it follows that also the public sector and the non-profit sector, as well as the education sector, are engaged in research and development, to offer new services and products to citizens. This demand for research and development by the private, public and non-profit sectors generates a growth in R&D expenditure as a percentage of GDP, which leads countries leading in RQ to also be world leaders in science and technology.

- *Annualized Average Growth in per capita real survey mean consumption or income, total population:* is a variable that considers the average growth rate of consumption of the population. The rate is considered per capita in relation to the real income of the population. The data is acquired through sample surveys on households relating to income distribution over five-year periods. Average consumption or per capita income is measured on the basis of 2017 PPP purchasing power parity. There is a positive relationship between countries that have high levels of RQ and countries that have high levels of consumption based on per capita income growth rates. This condition derives from the fact that the countries that have high levels of RQ are also countries that have high levels of per capita income, where the labour force is larger, and household consumption tends to grow either in connection with GDP growth either in application of redistributive policies. Therefore, the promotion of a legislation favourable to the private sector increases the possibility of households to consume and raises the standard of living of the population.

- *Forest Area as percentage of land area:* is a variable that considers the forest area without considering the trees that are planted for agricultural production, the trees in parks and urban gardens. There is a positive relationship between the RQ value and the value of forest areas not dedicated to agriculture. This structure is mainly due to the presence among the top countries in terms of RQ of some countries such as Finland, which has an amount of forest areas equal to 73.72%, Sweden with a corresponding value of 68.69%. But, we also have to consider that the average coefficient of the regression is equal to 0,079903 i.e. a value close to zero. This means that even if there is positive relationship between RQ and the degree of forest area as percentage of land, it is a value that is closed to zero.

- *Energy intensity level of primary energy:* is a variable that considers the relationship between energy supply and gross domestic product at purchasing power parity. It is a measure that calculates the relationship between the energy consumed and the gross domestic product. If the ratio grows, it means that an increasing value of energy is required to produce a certain amount of output. Conversely, if the value decreases, it means that fewer energy resources can be used to produce a certain amount of energy. Countries that have an increasing level of RQ also have an increasing level of energy use per amount of value added produced. This positive relationship is because countries that have high levels of RQ are also countries that have highly evolved industrial systems that require the use of large energy sources. Furthermore, they are also countries in which the service sector plays a significant role that is generally located in densely populated areas with a great consumption of energy.

- *Adjusted savings natural resources depletion:* is a variable that calculates the value of the depletion of natural resources, i.e. forests, mineral resources and energy. There is a positive relationship between countries that have high levels of RQ and countries that have high levels of natural resource depletion. This relationship is because the countries that have high levels of RQ are also the countries that exploit their territory more intensely from the point of view of natural resources. This trend obviously highlights the inefficiency of the economic policies put in place to combat climate change, at present. However, it is highly probable that the positive effects of environmental economic policies will occur over a long period of time without considering highly improbable phenomena that could reduce the probability of a real

energy transition such as, for example, in the case of conflict, famine or decreases in the international trading. However, this report highlights how difficult it is at present to refer to the energy transition that has taken place in upper-middle income countries.

- *People using safely managed drinking services as percentage of population:* is a variable that considers the percentage of people who drink potable water from improved sources. Improved sources include piped water, boreholes, protected wells, protected springs, packaged water. There is a positive relationship between the percentage of the population drinking potable water from improved sources and RQ. This relationship may be because in countries with a high RQ, there are also more evolved markets, and companies, both public and private, operating in the extraction and distribution of water. This condition makes it possible to increase the percentage of the population that has access to water. However, from a strictly metric point of view, it is necessary to consider that the average of the value estimated with the econometric models for the variable analysed is equal to 0.015 units. This is a small value, close to zero. It therefore follows that the relationship is weakly positive on average and that it could easily change in the future in the presence of even marginal modifications in the markets for water extraction, processing and distribution.

- *Mortality rate under-5*: is an indicator that considers the probability in 1,000 that a new-born will die before reaching the age of five. There is a positive relationship between this indicator and the RQ value. However, it is necessary to consider that the average value deriving from the application of the econometric models tested for the variable of interest is equal to 0.001477. This is evidently a positive value, however close to zero. Therefore, it might be correct to refer to a weak positive relationship between the two variables or to a potential neutrality. In fact, since the countries that have a high level of RQ are also the countries that have the highest levels of health services, it follows that the presence of a positive relationship between the RQ and infant mortality under five has low credibility. However, the metric analysis in this case suggests that the relationship between the two variable is close to zero.

- *Fertility Rate Total:* is a rate that considers the number of children that would be born to a woman if she lived to the end of her childbearing years and gave birth according to average fertility rates calculated at country level. There is a positive relationship between the value of the total fertility rate and the RQ value at the country level. However, also in this case, as in the previous one, the average value deriving from the analysis of the various econometric models proposed is low and basically equal to zero, i.e.: 0.001201. In fact, the countries that have a high RQ, i.e. the Western countries, also have a low birth rate, with a demographic balance in the balance in many countries. Furthermore, very often in countries with a high RQ it is immigrants who keep the birth rate high. However, in the proposed variable it is not possible to distinguish between the birth rate of immigrants and the birth rate of natives. In this sense, therefore, it should be emphasized that this relationship is weakly positive and not perfectly verified for many countries with a high RQ in the western world.

- *Nitrous Oxide Emissions:* Nitrous oxide emissions are emissions from the combustion of agricultural biomass, industrial activities and livestock management. There is a positive relationship between the nitrous oxide value and RQ. This relationship is because countries with a high RQ are also countries in which a series of activities are widely spread, such as, for example, breeding and the combustion of agricultural biomass, as well as industrial emissions. However, the mean value of the econometric relationship estimated through a set of models is very small and equal to an amount of 0.001201. That is, although this relationship is significant in terms of p-value, it turns out to be substantially very close to zero from a quantitative point of view.

We also find that the level of Regulatory Quality is negatively associate to the following variables:

- *Energy Use:* is a variable that takes into consideration the value of energy consumption with respect to the development of production, household consumption and transport systems. However, energy consumption does not depend only on demand, as it is also sensitive to the price of energy and a series of climatic, geographical and economic factors. Energy consumption tends to be growing either in low middle income either high-income countries. The growth in energy consumption and the growth in energy prices has prompted many governments to consider energy economic policies as strategic with respect to industry and households welfare. Energy efficiency makes it possible to reduce emissions and improve energy security. There is a negative relationship between countries that have high RQ levels and countries that have a high level of energy use. This condition is because countries that have high levels of RQ also have more efficient energy markets in terms of both production and distribution and also have available technologies that can allow the application of energy savings. Furthermore, countries that have a high RQ, also thanks to the development of the private sector, offer their customers, be they households or businesses, a set of alternative options relating to the possibility of sourcing energy at affordable prices.

- *Strength of legal rights index:* measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and creditors and thereby facilitate lending. The index ranges from zero to 12, with higher scores indicating these laws are better designed to expand access to credit. There is a negative relationship between the RQ value and the value of the legal rights index. This indication indicates that in countries with a high level of RQ there are no excessively favourable laws towards creditors. This condition may seem paradoxical. However, it is the improvement in the condition of the debtors that has allowed the development of the credit system. A legislation more favourable to debtors can promote deeper culture of risk in business and economic organizations. Countries that have too strict legislation on debtors can inhibit the ability of economic operators to invest in business activity. In this case, the insolvent debtors could look with concern at the consequences of a failure to repay the loan with a reduction in the investment in risk capital and in the business activity. The market society is based not only on easier access to credit but also on the tolerance of the failures of entrepreneurs and companies.

- *Renewable Electricity Output:* is the share of electricity generated by renewable energy plants in the total electricity generated by all types of plants. There is a negative relationship between the RQ value and the value of renewable electricity output. This relationship indicates that countries that have high RQ levels have low levels of renewable energy output. In fact, the percentage of renewable energy output tends to be high for countries with low per capita income, especially African countries, which also have a low level of institutional quality. There are however exceptions. In fact, Norway, Switzerland, Austria and Iceland have high levels of both RQ and of renewable electricity outputs thanks to the use of hydroelectric and geothermal energy. The other high-middle-income countries that also have high levels of RQ instead tend to have a low value of renewable electricity output and consume an energy mix characterized by high levels of non-renewable energy such as coal and oil. However, it is probable that with the change in environmental policies at a global level and the introduction of new technologies for the production of renewables, there will be a shift in the relationship between RQ and renewables.

- *Renewable energy consumption:* is the share of renewable energy in the total final energy consumption. It should be considered that there is a negative relationship between the

consumption of renewable energy and the global RQ value. This condition is due, as in the case of the previous point, to the fact that countries with high per capita incomes, which are also countries with high RQ levels, tend to consume low values of renewable energy compared to countries low per capita income. Economic growth is an energy-intensive process, which requires the use and consumption of large quantities of energy. Since energy efficiency and the continuity of renewables tends to be variable, then countries with high per capita incomes use energy mixes in which the non-renewable energy component is significant. It is probable that the change of technologies that are available for the production of renewable energy together with the investment in research and development for sustainable energies could lead in the future to a change in the relationship between RQ and consumption of renewable energy worldwide.

- *Voice and Accountability:* captures perceptions of the extent to which a country's citizens are able to participate in the selection of their government, as well as freedom of expression, freedom of association and freedom of the media. There is an inverse relationship between the Voice and Accountability value and the RQ value. This relationship may appear counterfactual considering that almost all countries that have high levels of RQ are also democratic countries and therefore should allow a high level of Voice and Accountability. There are many countries which, although having high levels of RQ, have low levels in terms of Voice and Accountability with for example Singapore with respective values of 2.23 and -0.13, United States with .145 and 0.90, Israel with 0.68 and 1.20, United Arab Emirates with -1.19 and 1.0, and Qatar with -1.17 and 0.86. It therefore follows that the relationship between RQ and democratic participation can be paradoxical, and even have negative values, such as those indicated in the econometric analysis considered.

- *Rule of Law:* captures perceptions of the extent to which officers trust and respect society's rules, and in particular the quality of contract enforcement, property rights, police and courts, as well as the likelihood of crime and violence. There is a negative relationship between the rule of law value and the RQ value. This is certainly a counterfactual result since generally the two elements should be closely connected. However, the value of the relationship turns out to be negative both by controlling for the Random Effects, for the Fixed Effects and for the Pooled OLS.

Average Value of the Coefficients with Fixed Effects, Random Effects and Pooled OLS.	
Variable	**Average**
GHG net emissions/removals by LUCF (Mt of CO2 equivalent)	452202
Mean Drought Index (projected change, unitless)	328289
Heat Index 35 (projected change in days)	205502
School enrolment, primary and secondary (gross), gender parity index (GPI)	0,34279
Research and development expenditure (% of GDP)	0,261392
Annualized average growth rate in per capita real survey mean consumption or income, total population (%)	0,241382
Forest area (% of land area)	0,079903
Energy intensity level of primary energy (MJ/$2011 PPP GDP)	0,078297
Adjusted savings: natural resources depletion (% of GNI)	0,05399
People using safely managed drinking water services (% of population)	0,015007
Mortality rate, under-5 (per 1,000 live births)	0,001477
Fertility rate, total (births per woman)	0,001201

Nitrous oxide emissions (metric tons of CO2 equivalent per capita)	0,000119
Energy use (kg of oil equivalent per capita)	-6,8E-05
Strength of legal rights index (0=weak to 12=strong)	-0,00372
Renewable electricity output (% of total electricity output)	-0,00469
Renewable energy consumption (% of total final energy consumption)	-0,00873
Voice and Accountability: Estimate	-0,02077
Rule of Law: Estimate	-0,55617

4. Rankings and Clusterization with the k-Means Algorithm Optimized with the Elbow Method

There is a great heterogeneity among countries for the level of RQ. The top ten countries in 2021 are: Singapore with a level of RQ equal to 2,2310 followed by Luxembourg with 1.9152, Finland with 1.89, Australia with a level of 1.83, Denmark with 1.80, New Zealand with 1.80, Netherlands with 1.75, Sweden with 1.75, Switzerland with 1.73, Norway with a level of 1.63. In the middle of the ranking there are the following countries i.e. Turkiye with a level of -0.0819, Trinidad and Tobago with -0.0854, Brazil with -0.1108, Morocco -0.1217, Vanuatu with -0.1228, Samoa with a level of -0.1668, Bosnia and Herzegovina with a level of -0.1786, Ghana with a level of -0.2003, Paraguay with a level of -0.2077, Mongolia with a level of -0.2086, Mexico with a level of -0.2307. In the final part of the ranking there are the following countries i.e. Iran with -1.6223, Syrian Arab Republic with -1.6289, Equatorial Guinea with -1.7128, Somalia with -1.8172, Libya with -1,9512, South Sudan with -1.9846, Yemen with -2.0079, Turkmenistan with -2.0188, Venezuela RB with a level of -2.1957, Eritrea with -2.2687, North Korea with -2.3274. Only 84 countries over 191 have a positive value of RQ. This means that the vast majority of countries i.e. the 53% of world countries have negative values of RQ i.e. miss an institutional and legal framework able to promote the development of the private sector. This result counterfactual since it contrast with the idea of diffusion of capitalism and market society as a unique institutional framework for the global economy. There more than 100 countries in the world economy that have a legislative order that is inefficient in promoting the private sector and property rights.
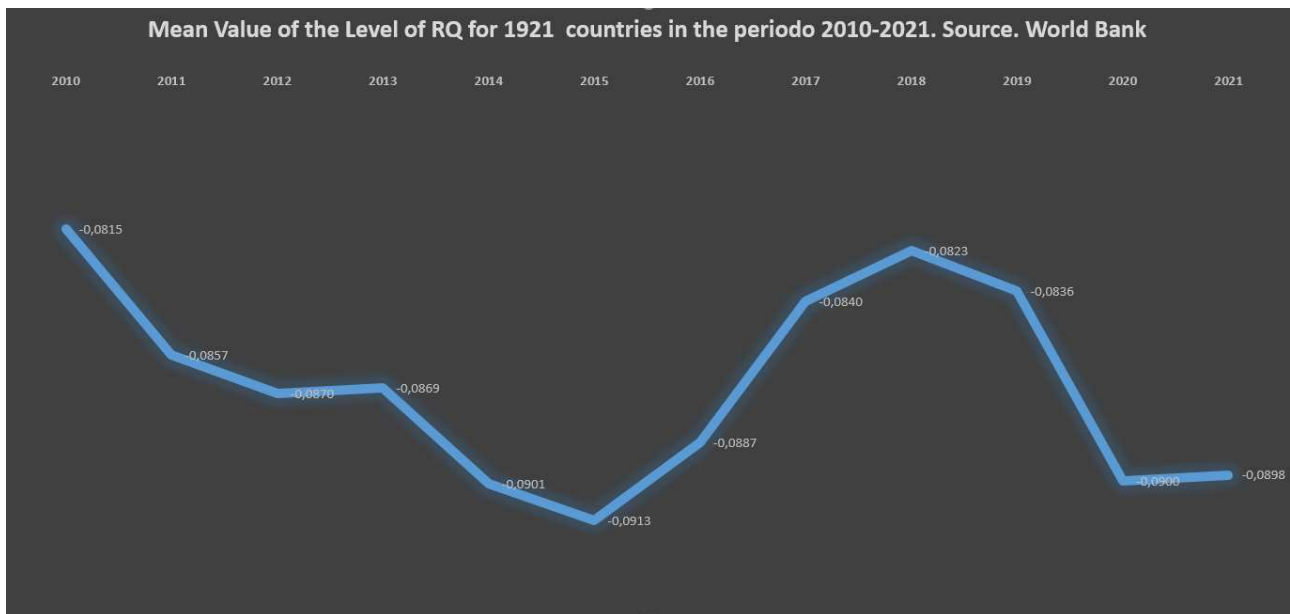
Figure 1. Mean value of RQ for 191 countries in the period 2010-2021.

If we consider the percentage variation of RQ in the period 2010-2021 we can see that the first ten countries are: United Arab Emirates with a level of RQ equal to +218.27% equal to 0.70 units, the El Salvador with a level of RQ equal to +201.97% equal to -0.68 units, Indonesia with a level of +178.29% equal of 0.68, Uganda with a level of +136.86% equal to -0.28 units, Saudi Arabia with a level of +110.26% equal to 0.18 units, Fiji with a value of +99.20% equal to 0.56 units, Vanuatu with a level of +84.29% equal to 0.66 units, India with a value of +80.80% equal to 0.33 units, Georgia with a level of +80.78% equal to 0.47 units, North Macedonia with a level of +75.42% equal to 0.18 units. In the middle of the ranking there are Denmark with a percentage variation of -3.47% equal to -0.07 units, followed by Ireland with -3.47% equal to -0.06 units, and Micronesia Fed. Sts equal to -4.24% equal to -0.03 units, Eritrea with a level of -4.88% equal to -0.11 units, followed by Zambia with a level of -5.34% equal to -0.03 units, Suriname with a level of -5.61% equal to -0.04 units, France with a level of -5.69% equal to -0.08 units, Algeria with -5.98% equal to -0.07 units, Chad with a level of -6.88% equal to -0.07 units, Benin with a level of RQ of -7.40% equal to -0.03 units, Iraq with a level of RQ of -8.05% equal to -0.08 units. In the final part of the ranking we find Serbia with a level of -179,39%, followed by Seychelles with -211.47% equal to 0.04 units, Yemen Rep. with -226.08% equal to -1.39 units, Kenya with -226.56% equal to -0.31 units, Egypt Arab Republic with a level of -243.22% equal to -0.36 units, Mexico with -247.58% equal to -0.39 units, Cabo Verde with -286.86% equal to 0.42 units, Tunisia with -345.03% equal to -0.30 units, Ghana with a level of -473.97% equal to -0.25 units, Lebanon with -4056.57% equal to -0.91 units, Montenegro with a level of 6037.36% equal to 0.44 units.
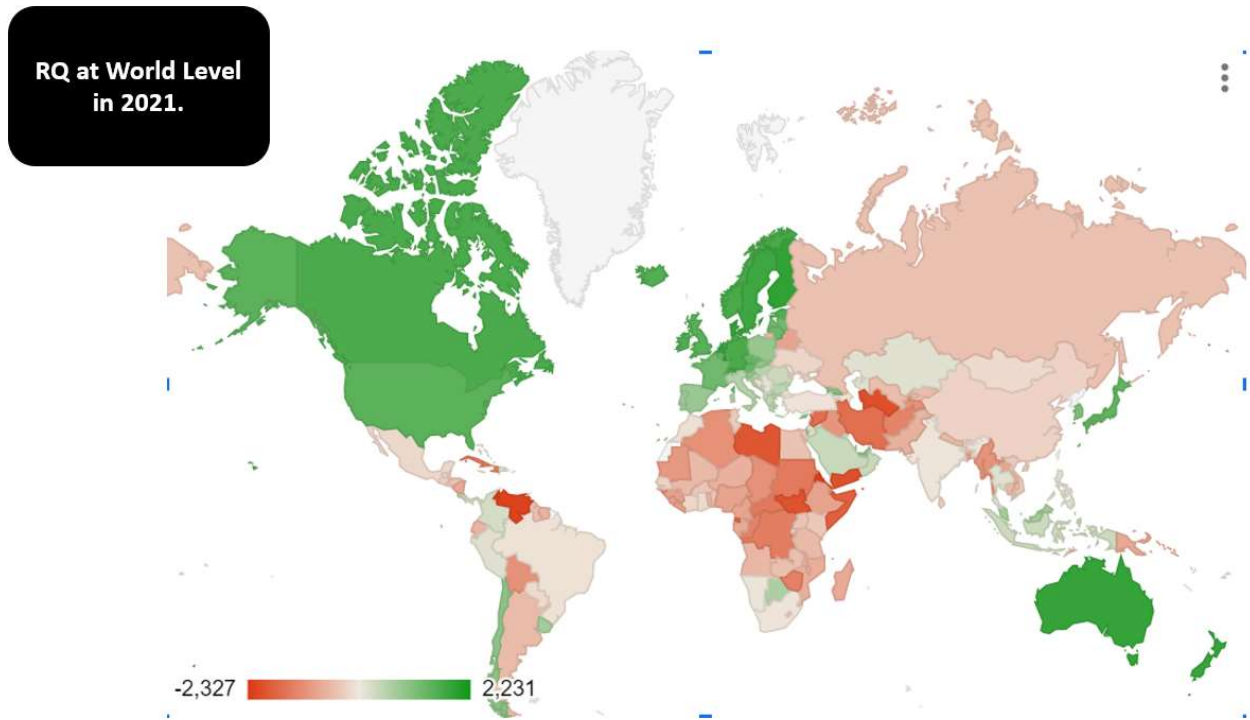
Figure 2. The map of RQ at world level.

If we consider the mean value for 191 countries in the period 2010-2021 we can verify a worsening of the level of RQ in the period 2018-2021. The reduction of the level of RQ started before Covid-19 in 2018 and continued in the period 2020-2021. The level of RQ in 2021 during the Covid-19 pandemic reached a low level close to the absolute minimum of the entire period that was -0.093 in 2015. This result is coherent with the choices of many governments to improve the public spending and increase the public control on the private market.

Furthermore we have applied an unsupervised machine learning technique to verify the presence of clusters among the data i.e. k-Means algorithms optimized with the Elbow Method. We find the presence of five clusters as follows:

- Cluster 1: Haiti, Yemen Rep., Myanmar, Comoros, Guinea-Bissau, Afghanistan, Algeria, Central African Republic, Uzbekistan, Congo rep., South Sudan, Iran, Syrian Arab Republic, Congo Dem. Rep., North Korea, Cuba, Sudan, Libya, Venezuela, Somalia, Zimbabwe, Eritrea, Turkmenistan, Equatorial Guinea;
- Cluster 2: Italy, Uruguay, Slovenia, Hungary, Botswana, Qatar, Portugal, Malaysia, Bahrain, Bulgaria, Costa Rica, Georgia, St. Kittis and Nevis, Slovak Republic, Romania, United Arab Emirates, Brunei Darussalam, Span, Poland, Barbados, Antigua and Barbuda, Panama, Peru, Mauritius, Oman, Greece, South Korea, Cyprus, Latvia, Croatia, North Macedonia, Lithuania;
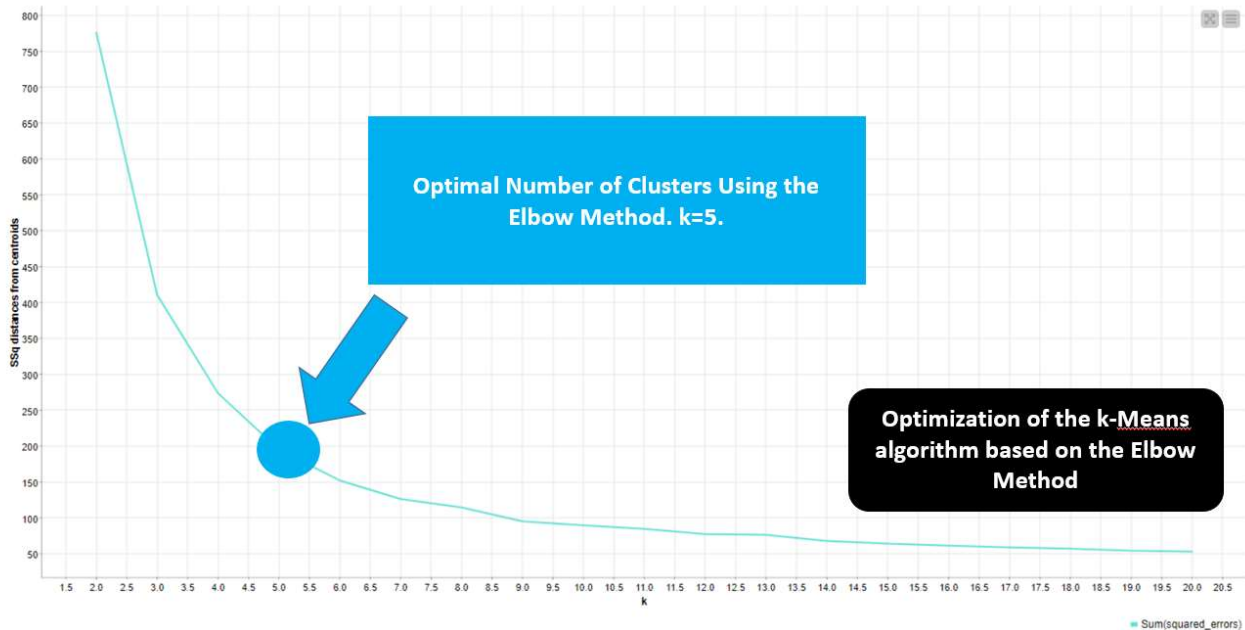
Figure 3. Optimal number of clusters using the Elbow Method. The number of k is equal to 5.

- Cluster 3: Nepal, Mauritania, Togo, Lao DPR, Malawi, Cameroon, Sierra Leone, Sao Tome and Principe, Nigeria, Bangladesh, Madagascar, Pakistan, Niger, Djibouti, Timor-Leste, Guinea, Gabon, Angola, Burundi, Ecuador, Tuvalu, Suriname, Micronesia Fed Sts., Bhutan, Liberia, Solomon Islands, Mozambique, Mali, Guyana, Papua New Guinea, Ethiopia, Argentina, Egypt Arab Rep., Kiribati, Cote d'Ivoire, Nauru, Zambia, Belarus, Tajikistan, Lesotho, Gambia The, Vietnam, Cambodia, Tanzania, Palau, Vanuatu, Belize, Benin, Nicaragua, Tonga, Marshall Islands, Iraq, Chad, Maldives, Ukraine, Russian Federation.
- Cluster 4: Dominican Republic, Moldova, Seychelles, Bosnia and Herzegovina, Rwanda, Ghana, Kuwait, Cabo Verde, Brazil, Serbia, Saudi Arabia, Philippines, Morocco, Namibia, Thailand, Sri Lanka, Indonesia, Grenada, Jamaica, Kazakhstan, El Salvador, Mongolia, Senegal, Samoa, Jordan, Paraguay, Trinidad and Tobago, Guatemala, China, Mexico, Uganda, South Africa, Dominica, Montenegro, the Bahamas, Fiji, Albania, Turkiye, Armenia, Kenya, Armenia, Kenya, Tunisia, Lebanon, Burkina Faso, Eswatini, India, Azerbaijan, Kyrgyz Republic, Honduras, Colombia, St. Vincent and the Grenadines, St. Lucia;
- Cluster 5: Canada, Switzerland, Germany, Norway, United Kingdom, Luxembourg, Australia, Ireland, Sweden, Finland, Netherlands, Denmark, Estonia, New Zealand, Liechtenstein, Austria, Singapore, United States, Chile, Belgium, Israel, Iceland, Malta, Japan, Andorra, France, Czechia.

As we can see, as a general overview there is a positive relationship between RQ, market societies, democracies, per capita income, and the level of wellbeing of the population. However, we do not check for causal relationships. We can only observe that for countries that have high levels of per capital income, that are democracies and that recognize the freedoms and rights of the minorities, there is also a higher level of RQ. Essentially RQ coincides with the western civilization in the Anglo-Saxon, Scandinavian, European and Japanese-Korean version. This means that there is a great possibility that the development of a RQ framework is the result of a certain cultural approach to the institutional building and to the relationship between political freedom, economic freedom and civil rights.
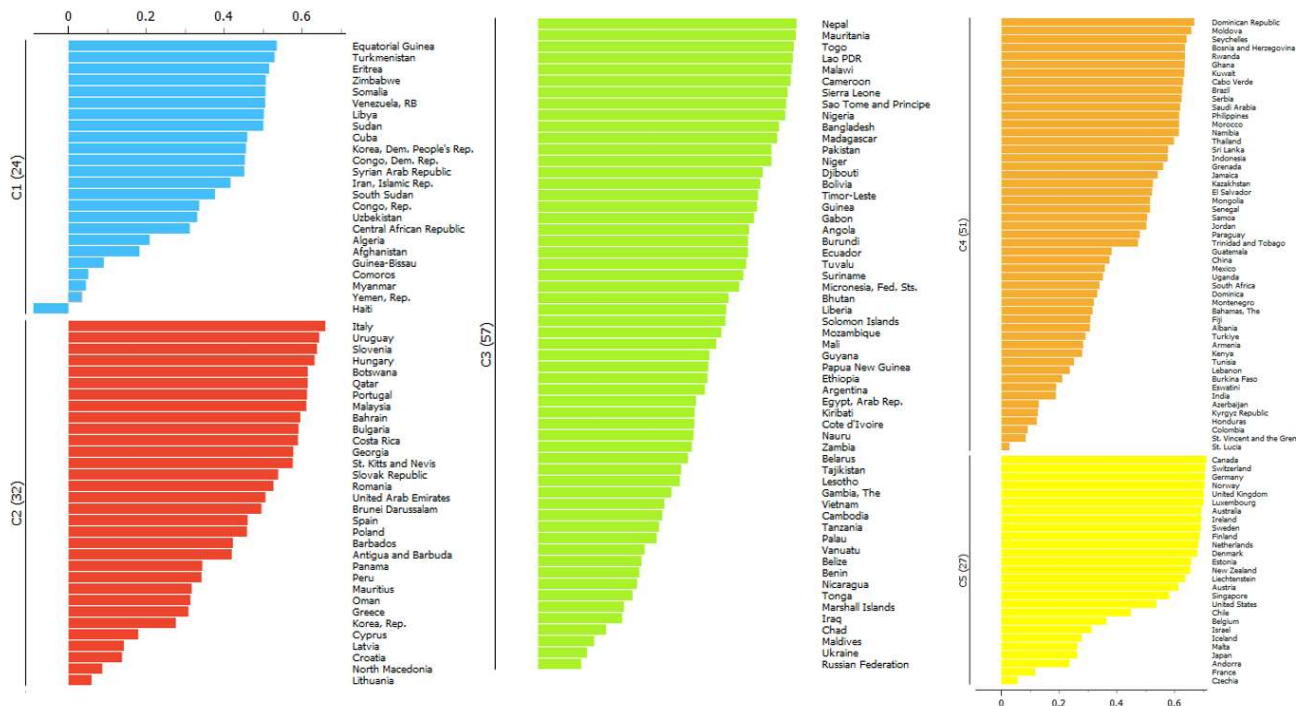
Figure 4. Clusterization with the k-Means algorithm optimized with the Elbow Method with the indication of the Silhouette Coefficient.

If we consider the level of median of clusters we find the following order i.e.: C5=1.5591>C2=0.7225>C4=-0.0596>C3=-0.7619>C1=-1.4779. In the C5 there are countries that have a highest level of per capita income. The vast majority of countries in C5 are European countries and in general western countries. In C5, there is also a subset of countries with high per capita income such as Andorra, Singapore, Liechtenstein, Luxembourg, Switzerland, Ireland that have developed a specifically legal order that is favourable to the development of the private sector. RQ can be considered as the output of a set of elements that capture the ability of a country to promote either political either economic freedom i.e. a mix of market society and democracy. In this sense we propose a confrontation between RQ and the Index of Economic Freedom-IEF. The index of Economic Freedom is realized by the Heritage Foundation. An index varies in a range between 0 and 100. The IEF considers at country level the following macro-variables i.e. "Rule of Law", "Government Size", "Regulatory Efficiency" and "Market Openness". We can express the definition of Index of Economic Freedom in the following form:

$$IndexOfEconomicFreedom = f(RuleOfLaw; GovernmentSize; RegulatoryEfficiency; MarketOpenness)$$

Due to this characteristic, the IEF is able to represent either democratic issues either the presence of a pro-market society at country level. We found that there is a positive relationship between RQ and IEF for countries in C5. Specifically, we find that the top countries for RQ also have highest values of IEF. For example, Singapore as a RQ of 2.23 and an IEF of 89.70, the same value for New Zealand are 1.80 and 83.90, Australia 1.83 and 82.40, Switzerland with 1.73 and 81.90, Ireland with 1.56 and 81.40 and United Kingdom with 1.45 and 78.40. The positive relationship between RQ and IEF shows that the ability of countries to orient the institutional framework towards the development of the private sectors is not independent from the level of democracy and the degree of economic freedom. Economic freedom is a synthesis between democracy and the market society oriented to entrepreneurship, innovation and property rights. Furthermore, economic freedoms and rights have a

special role in promoting either democracy either the production of value added in a market society creating the conditions for the empowerment of individuals, groups and communities.
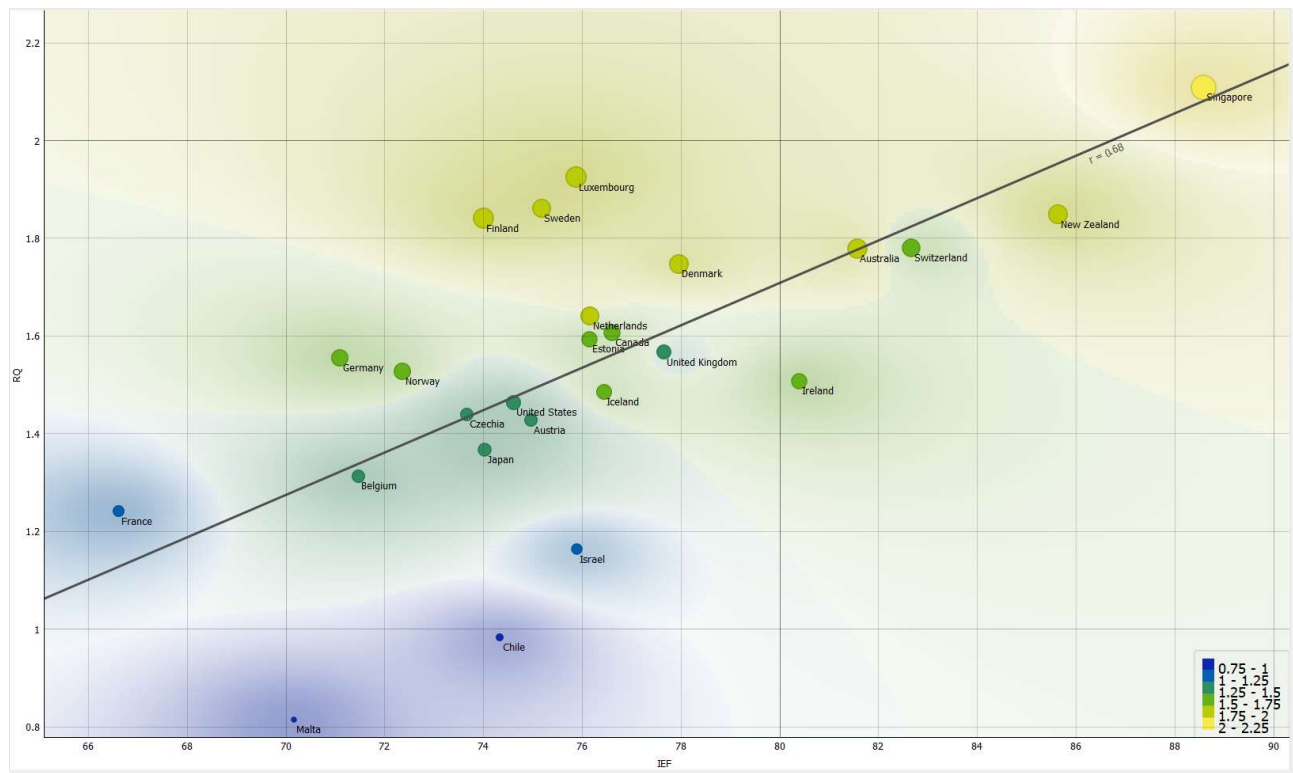
Figure 5. The positive relationship between RQ and IEF for countries in C5.

If we consider the relationship between RQ and IEF for the year 2021 for countries in C2, we can find that there is a positive connection. The increase in the level of economic freedom is positively associated to the improvement of RQ at national level for the countries in C2. Countries in C2 are in large part European Countries with a middle level of per capita income. Furthermore, there are also other countries that are heterogeneous in the sense of geography among which there is a sub-group of central and southern American countries such as: Uruguay, Peru, Panama and Costa Rica. In addition, other countries have not any geographical connection i.e. Botswana, Oman and South Korea. In these countries, the increase in the level of economic freedom is positively associated to an increase in the RQ i.e. an improvement in the ability to generate a political and institutional framework that is favourable to the private sector and the empowerment of the market society. We have to consider that the countries in the C2 are essentially democratic states. This means that for countries that have a middle income per capita, and that are already functioning democracies, there is a chance to improve the level of RQ and economic freedom in the same set of policies. But, it is largely possible that the presence of a culture that is essentially oriented towards democracy can boost the ability to generate institutional reforms that can deepen economic freedoms.
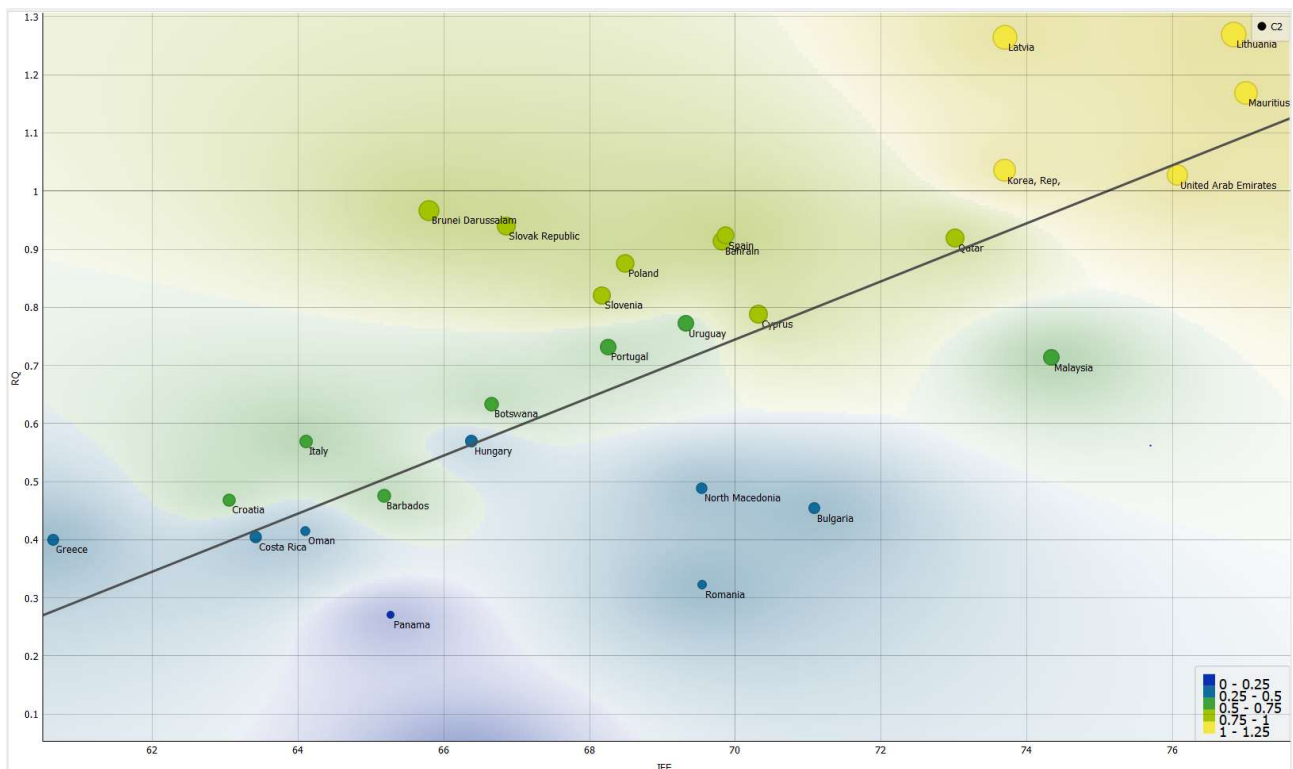
Figure 6. Relationship between RQ and IEF in C2.

Similar results hold in the relationship between RQ and IEF for the other clusters as showed in the appendix. This means that essentially countries that develop deeper economic freedom also tend to develop an orientation toward the market society generating a positive effect in promoting property rights.

5. Machine Learning and Predictions for the Prediction of the Future Value of RQ

In the following part we propose a confrontation among eight different machine learning algorithm for the prediction of the future value of RQ. The 70% of the data have been used as learning rate for the algorithms, while the remaining 30% are used for the prediction. The performance of algorithms is evaluated through the maximization of R-squared and the minimization of Mean Squared Error, Root Mean Squared Error, Mean Absolute Error. We found the following order of algorithms in terms of performance:

- Polynomial Regression with a payoff equal to 5;
- Linear Regression with a payoff equal to 7;
- Random Forest Regression with a payoff equal to 12;
- Simple Regression Tree with a payoff equal to 16;
- Gradient Boosted Tree with a payoff equal to 20;
- ANN-MLP with a payoff equal to 29;
- Tree Ensemble Regression with a payoff equal to 29;
- PNN-Probabilistic Neural Network with a payoff equal to 30.

Polynomial Regression is the best predictive algorithm based on the minimization of the statistical errors and the maximization of R-Squared.
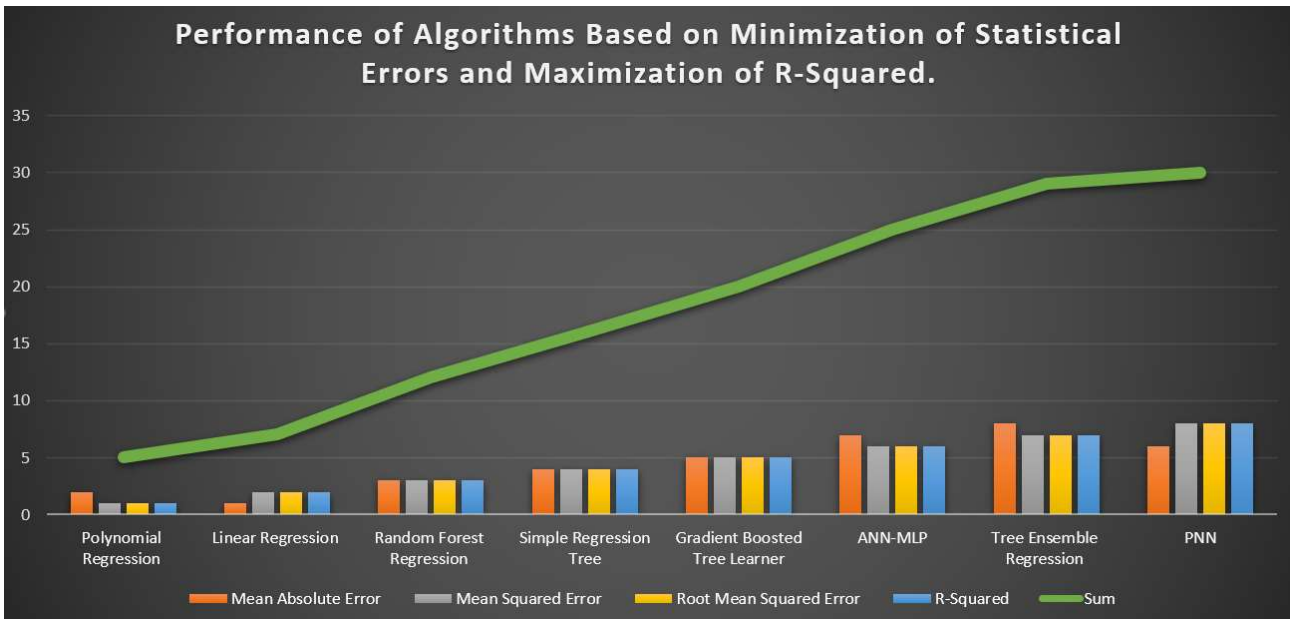
Figure 7. Performance of Algorithms Based on Minimization of Statistical Errors and Maximization of R-Squared.

Through the application of the Polynomial Regression, we found that 17 countries are "winners" in the sense that they experiment an increase of the predicted value of RQ, while, on the contrary, there are 37 countries that are "losers" i.e. countries that have a negative predictive value in terms of RQ. Among the winners, the best ten performers are: Iran with +53,15, Myanmar +41,58%, Kyrgyz Republic with 17,11%, Malta with 17,02%, Papua New Guinea with 13,92%, Italy with 11,08%, Ethiopia with +10,15%, Guinea Bissau with 8,17%, Bulgaria with 5,97%, Tunisia with 5,69%. Among the losers, the top performers are: Bahrain with -17,00%, Costa Rica with 13,42%, India -10,51%, Azerbaijan -9,63%, Fiji with -8,78%, Vanuatu with -8,72%, Bangladesh -8,02%, Georgia -7,36%, Singapore -7,30%, Luxembourg -7,02%. If we take the average value of the countries for which we have the prediction, we found that the level of RQ is expected to reduce of -1,29%.
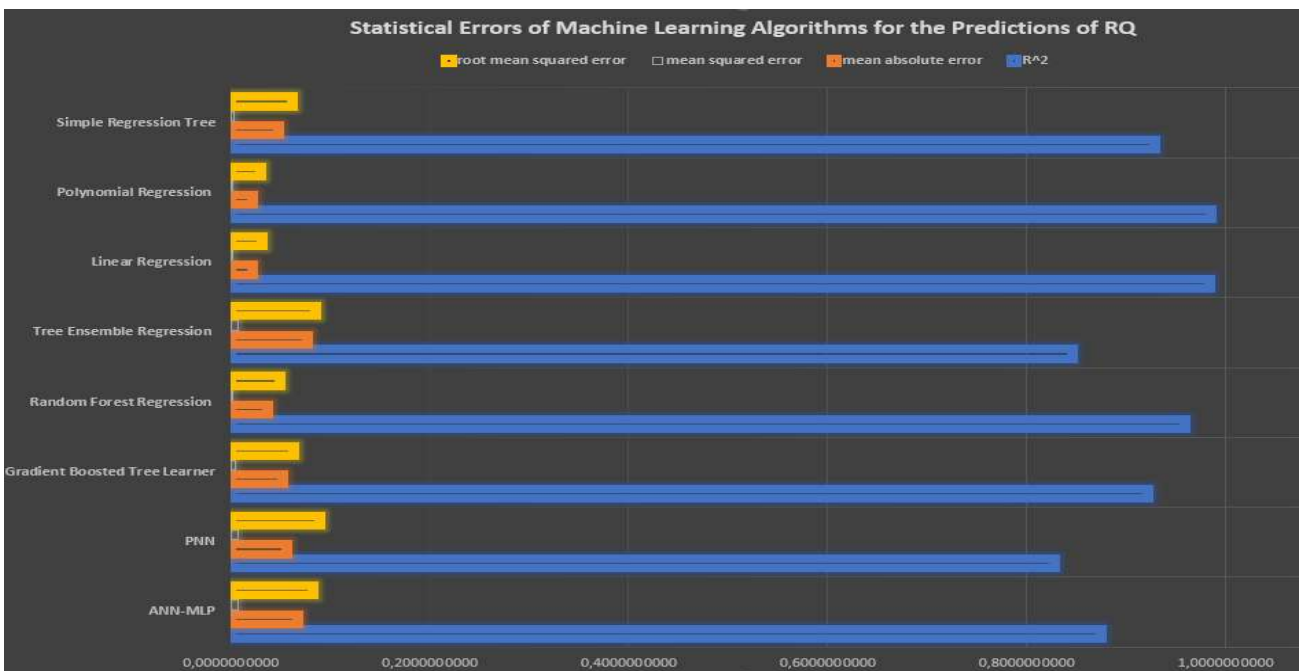
Figure 8. Statistical Errors of Machine Learning for the Prediction of the Future Level of RQ with the indication of R-squared.

16

6. Network Analysis with Predicted Values in the Application of the Euclidean Distance

We apply the Euclidean distance in a network analysis framework to find the presence of connection among the countries with the estimated values generated in application of the Polynomial Regression. Network analysis does not determine causal relationships among the values of RQ in the analyzed countries. However, it implies the presence of similar characteristics in the historical dataset augmented with the predicted data. Our analysis led us to the identification of a set of six complex network structures and a simplified network structure.

There is a network structure composed as follows:

- Bahrain has a connection with Costa Rica in the amount of 0.35 units;
- Costa Rica has a connection with Bahrain with an amount of 0.35 units, with Bulgaria with an amount of 0.3 units, and with Antigua and Barbuda with an amount of 0.35 units;
- Bulgaria has a connection with Costa Rica amounting to 0.3 units;
- Antigua and Barbuda have a connection with Costa Rica in the amount of 0.35 units and with Croatia in the amount of 0.38 units;
- Croatia has a connection with Antigua and Barbuda in the amount of 0.38 units, with North Macedonia in the amount of 0.34 units and with Vincent and the Grenadines in the amount of 0.31 units;
- North Macedonia has a connection with Croatia amounting to 0.34 units and with Vincent and the Grenadines amounting to 0.31 units;
- St. Vincent and the Grenadines have a connection with North Macedonia for the amount of 0.3 units, with Croatia for the amount of 0.31 units and with Armenia for the amount of 0.24 units;
- Armenia has a connection with St. Vincent and the Grenadines for the amount of 0.24 units and with Jamaica for the amount of 0.32 units;
- Jamaica has a connection with Armenia amounting to 0.32 units and with Saudi Arabia amounting to 0.32 units.

There is a complex network structure between the following countries namely:

- Estonia has a connection with Ireland in the amount of 0.29 units and with Germany in the amount of 0.3 units;
- Ireland has a connection with Estonia in the amount of 0.29 units and with Germany in the amount of 0.23 units;
- Germany has a connection with Estonia for 0.3 units and with Ireland for 0.23 units.

There is a complex network structure between the following countries namely:

- Sao Tome and Principe has a connection with Algeria for an amount of 0.15 units, with Cameroon for an amount of 0.23 units with Bangladesh for an amount of 0.2 units;
- Algeria has a connection with Sao Tome and Principe for an amount of 0.15 units, with Cameroon for an amount of 0.31 units and with Bangladesh for an amount of 0.31 units;
- Cameroon has a connection with Sao Tome and Principe for a value of 0.23 units, with Algeria for an amount of 0.31 units and with Bangladesh for an amount of 0.14 units;

- Bangladesh has a connection with Sao Tome and Principe for the amount of 0.2 units, with Algeria for the amount of 0.31 units and with Cameroon for the amount of 0.14 units and with Ethiopia for an amount of 0.3;
- Ethiopia have a connection with Bangladesh equal to an amount of 0.3 units, with Iraq an amount of 0.36 units, with Chad an amount of 0.37 units;
- Chad has a connection with Ethiopia in the amount of 0.37 units, with Iraq in the amount of 0.25 and with Guinea Bissau in the amount of 0.3 units;
- Guinea Bissau has a connection with Chad in the amount of 0.3 units and with Iraq in the amount of 0.33 units;
- Iraq has a connection with Guinea Bissau amounting to 0.33 units, with Chad amounting to 0.25 units and with Ethiopia amounting to 0.36 units.

There is a complex network structure between the following countries namely:

- Senegal has a connection with Paraguay in the amount of 0.23 units;
- Paraguay has a connection with Senegal in the amount of 0.23 units, with Azerbaijan in the amount of 0.36 units, and with India in the amount of 0.35 units;
- Azerbaijan has a connection with Paraguay in the amount of 0.36 units and with India in the amount of 0.25 units;
- India has a connection with Paraguay amounting to 0.35 units and with Azerbaijan amounting to 0.25 units.

There is a complex network structure made up of the following countries:

- Turkmenistan has a connection with Somalia in the amount of 0.36 units, and with Eritrea in the amount of 0.32 units;
- Eritrea has a connection with Turkmenistan in the amount of 0.32 units and with Somalia in the amount of 0.38 units;
- Somalia has a connection with Eritrea amounting to 0.38 units and with Turkmenistan amounting to 0.36 units.
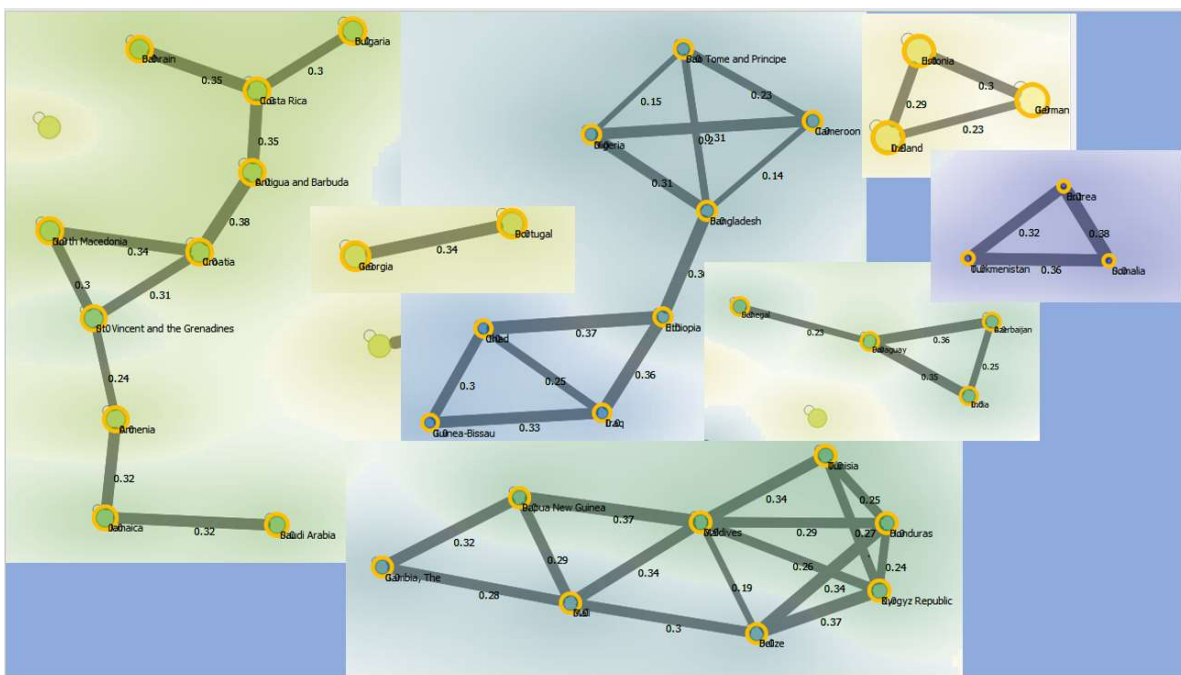

Figure 9. Structures of Network Analysis with the Euclidean distance.

18

There is a complex network structure composed as follows:

- The Gambia has a connection with Papua New Guinea equal to an amount of 0.32 units and with Mali for an amount of 0.28 units;
- Papua New Guinea has a connection with Gambia for the amount of 0.32 units with Mali for the amount of 0.29 units and with the Maldives for the amount of 0.37 units;
- Maldives has a connection with Papua New Guinea equal to 0.37 units, with Mali with an amount of 0.34 units with Belize equal to 0.19 units, with Kyrgyz Republic with an amount of 0.34, with Honduras for an amount of 0.29 units and with Tunisia for an amount of 0.34 units;
- Tunisia has a connection with Maldives amounting to 0.34 units with Kyrgyz Republic amounting to 0.27 units and with Honduras amounting to 0.25 units;
- Honduras has a connection with Tunisia for an amount of 0.25 units, with the Maldives for an amount of 0.29 units, with Belize for an amount of 0.34 units, and with Kyrgyz Republic for an amount by 0.24 units;
- Kyrgyz Republic has a connection with Tunisia for the amount of 0.27 units, with Honduras for the amount of 0.24 units, with Belize for the amount of 0.37 units and with the Maldives for the amount of 0.26 units;
- Belize has a connection Maldives amounting to 0.19 units with Honduras amounting to 0.34 units, Kyrgyz Republic having 0.37 units to Mali amounting to 0.3 unit;
- Mali has connections with Gambia amounting to 0.38 units, with Papua New Guinea amounting to 0.29 units, with Maldives amounting to 0.34 units and with Belize amounting to by 0.3 units.

There is also a simplified network structure as indicated below, namely:

- Georgia and Portugal have a connection amounting to 0.34 units.

The application of a network analysis shows the effects of propagation among countries of the increase of RQ in one country. For example, if we consider one of the most connected countries, i.e. Maldives, we can find that the increase-or decrease- in RQ has positive-or negative-effects on Papua New Guinea, Mali, Belize, Kyrgyz Republic, Honduras, and Tunisia. Again, we have to underline the fact that there are not causal relationships but they simply identify a series of connections that represents some similarities in the data of analyzed countries.

7. Conclusions

In the article we conducted an analysis of RQ with respect to a set of variables from the World Bank's ESG dataset. The results show that the countries that have high levels of RQ are also countries that suffer for environmental issues with the growth of GHG Emissions, the increase of drought and temperatures. Furthermore, the fact of developing RQ does not sufficiently help countries in the transition to the use of renewable energy, despite the privatization of energy markets, and the development of technologies for energy sustainability. Finally, contrary to current opinion, RQ is negatively associated both with the exercise of civil and political rights and also with the rule of law. A complex picture therefore emerges. Certainly, the development of the market and the private sector is a precious ally for the implementation of technologies that can guide the economy towards environmental sustainability. In addition, the private sector offers many jobs that help workers and families to access better life opportunities by overcoming poverty and social inequality. However,

evidently the development of RQ is not sufficient to guarantee the application of ESG models. Furthermore, the private sector has been hit, worldwide, by a set of adverse factors of a macro-economic nature, which have reduced the productivity of companies, disrupted supply chains and cracked trade relations among countries. While on the one hand the growth of companies and the market would be desirable from an ESG perspective, on the other hand macro-economic fragility is causing investment to retreat and could delay the processes of energy transition, social inclusion and good governance.

8. List of Abbreviations

List of Abbreviations	
RQ	Regulatory Quality
ESG	Environmental, Social and Governance
C1	Cluster 1
C2	Cluster 2
C3	Cluster 3
C4	Cluster 4
C5	Cluster 5
IEF	Index of Economic Freedom
GDP	Gross Domestic Product
FDI	Foreign Direct Investments
ECOWAS	Economic Community of Western African States
BRICS	Brazil, Russia, India, China, and South Africa
MENA	Middle East and Northern African

9. Declarations

10. References

[1] M. A. Destek, F. Adedoyin, F. V. Bekun e S. Aydin, «Converting a resource curse into a resource blessing: The function of institutional quality with different dimensions,» *Resources Policy,* n. 103234, p. 80, 2023.

[2] B. Sanga e M. Aziakpono, «The effect of institutional factors on financial deepening: Evidence from 50 African countries,» *Journal of Business and Socio-Economic Development,* 2022.

[3] R. Abaidoo e E. K. Agyapong, «Financial development and institutional quality among emerging economies,» *Journal of Economics and Development,* 2022.

[4] J. O. Afolabi, «The Impact of Governance on Economic Development in West Africa: A system GMM dynamic panel approach,» *Acta Universitatis Danubius. Œconomica,* vol. 15, n. 3, pp. 217-231, 2019.

[5] C. E. Yameogo, J. A. Omojolaibi e R. O. Dauda, «Economic globalisation, institutions and environmental quality in Sub-Saharan Africa,» *Research in Globalization,* vol. 3, n. 100035, 2021.

[6] F. F. Adedoyin, M. I. Gumede, F. V. Bekun, M. U. Etokakpan e D. Balsalobre-Lorente, «Modelling coal rent, economic growth and CO2 emissions: does regulatory quality matter in BRICS economies?,» *Science of the Total Environment,* vol. 710, n. 136284, 2020.

[7] M. Abreu, I. Soares e S. Silva, «Governance quality and environmental policy on emergent, resource-rich economies: The case of Brazil,» *Energy Reports,* vol. 8, pp. 70-75, 2022.

[8] H. O. R. Ogwuru, D. O. Okolie e J. I. Okolie, «Economic openness, institutional quality and per capita income: Evidence from the Economic Community of West African States (ECOWAS),» *Research Papers in Economics and Finance,* vol. 6, n. 2, pp. 50-67, 2022.

[9] F. Li, M. Appiah e B. Korankye, «Financial development and economic sustainability in ECOWAS countries: The role of institutional quality,» *ETIKONOMI,* vol. 19, n. 1, pp. 41-50, 2020.

[10] R. L. Ibrahim e K. B. Ajide, «The role of income level and institutional quality in the non-renewable energy consumption and life expectancy nexus: evidence from selected oil-producing economies in Africa,» *OPEC Energy Review,* vol. 45, n. 3, pp. 341-364, 2021.

[11] F. Yahya e M. Rafiq, «Unraveling the contemporary drivers of renewable energy consumption: Evidence from regime types,» *Environmental Progress & Sustainable Energy,* vol. 5, n. 13178., p. 38, 2019.

[12] S. ÖZSOY, «The impact of foreign direct investment on export of high-technology products: The role of financial development and regulatory quality,» *Balıkesir Üniversitesi Sosyal Bilimler Enstitüsü Dergisi,* vol. 23, n. 44, pp. 959-975, 2020.

[13] A. Stojkov e F. Besimi, «Rule of Law and Regulatory Quality in Central, Eastern and South Eastern Europe During the Transition».

[14] R. Mushtaq, A. A. Thoker e A. A. Bhat, «Does institutional quality affect tourism demand? Evidence from India,» *Journal of Hospitality and Tourism Insights,* vol. 4, n. 5, pp. 622-638, 2021.

[15] R. RANJPOUR, A. KAZEROONI, M. B. BEHESHTI e A. GHORBANI, «STUDYING THE WEIGHT IMPORTANCE OF THE GOVERNMENT EFFECTIVENESS AND REGULATORY QUALITY AS COMPONENTS OF GOVERNANCE IN INFLUENCING THE ECONOMIC PERFORMANCE OF DEVELOPING COUNTRIES (COMPARATIVE COMPARISON OF OIL AND NON-OIL DEVELOPING COUNTRIES),» *Journal of Critical Reviews,* vol. 7, n. 1, 2020.

[16] I. Boadi e H. Amegbe, «The link between quality of governance and stock market performance: International level evidence,» *European Journal of Government and Economics,* vol. 6, n. 1, pp. 78-101, 2017.

[17] F. Curti e A. Mihov, «Fraud recovery and the quality of country governance,» *Journal of Banking & Finance,* vol. 87, pp. 446-461, 2018.

[18] D. A. Correa-Mejía, «Impact of corporate governance and institutional context on multilatinas' reporting quality,» *Corporate Governance: The International Journal of Business in Society,* 2022.

[19] R. O. Raji, «Testing the Relationship between Financial Inclusion, Institutional Quality and Inclusive Growth for Nigeria,» *Daengku: Journal of Humanities and Social Sciences Innovation,* vol. 1, n. 1, pp. 18-28, 2021.

[20] C. O. Iheonu, S. A. Agbutun, C. M. Omenihu, G. I. Ihedimma e V. N. Osuagwu, «The impact of governance quality on mortality rates in sub Saharan Africa,» *African Population Studies,* vol. 33, n. 1, 2019.

[21] L. Glawe e H. Wagner, «The role of institutional quality for economic growth in Europe,» *SSRN ,* n. 3375215, 2019.

[22] C. C. Lee, G. Olasehinde-Williams e I. Olanipekun, «Financial systems, regulatory quality, and economic growth,» *The Journal of International Trade & Economic Development,* vol. 30, n. 2, pp. 246-274, 2021.

[23] H. W. Kamran, S. B. bin Mohamed Arshad e A. Omran, « Country governance, market concentration and financial market dynamics for banks stability in Pakistan,» *Research in World Economy,* vol. 10, n. 2, pp. 136-146, 2019.

[24] S. Handoyo e F. K. Fitriyah, «Control of corruption, regulatory quality, political stability and environmental sustainability: a cross-national analysis,» *Journal of Accounting Auditing and Business,* vol. 1, n. 2, pp. 28-38, 2018.

[25] S. Shan, Z. Lin, Y. Li e Y. Zeng, «Attracting Chinese FDI in Africa: The role of natural resources, market size and institutional quality,» *Critical perspectives on international business,* 2018.

[26] A. Kaller, S. Bielen e W. Marneffe, « The impact of regulatory quality and corruption on residential electricity prices in the context of electricity market reforms,» *Energy Policy,* vol. 123, pp. 514-524, 2018.

[27] W. Mehmood, R. Mohd-Rashid, A. H. Ahmad e A. H. Tajuddin, «IPO initial return in Pakistan: Influence of country-level institutional quality,» *South Asian Journal of Business Studies,* 2021.

11. Appendix

Econometric Model to Estimate the Value of Regulatory Quality		

y	A55	*Regulatory Quality*
x_1	A3	*Adjusted savings: natural resources depletion (% of GNI)*
x_2	A8	*Annualized average growth rate in per capita real survey mean consumption or income, total population (%)*
x_3	A18	*Energy intensity level of primary energy (MJ/$2011 PPP GDP)*
x_4	A19	*Energy use (kg of oil equivalent per capita)*
x_5	A20	*Fertility rate, total (births per woman)*
x_6	A22	*Forest area (% of land area)*
x_7	A25	*GHG net emissions/removals by LUCF (Mt of CO2 equivalent)*
x_8	A29	*Heat Index 35 (projected change in days)*
x_9	A38	*Mean Drought Index (projected change, unitless)*
x_{10}	A40	*Mortality rate, under-5 (per 1,000 live births)*
x_{11}	A42	*Nitrous oxide emissions (metric tons of CO2 equivalent per capita)*
x_{12}	A44	*People using safely managed drinking water services (% of population)*
x_{13}	A56	*Renewable electricity output (% of total electricity output)*
x_{14}	A57	*Renewable energy consumption (% of total final energy consumption)*
x_{15}	A58	*Research and development expenditure (% of GDP)*
x_{16}	A59	*Rule of Law: Estimate*
x_{17}	A61	*School enrollment, primary and secondary (gross), gender parity index (GPI)*
x_{18}	A63	*Strength of legal rights index (0=weak to 12=strong)*
x_{19}	A67	*Voice and Accountability: Estimate*

Fixed-effects, using 1930 observations				
Included 193 cross-sectional units				
Time-series length = 10				
Dependent variable: A55				
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−6.80863	0.671195	−10.14	<0.0001	***
A3	0.0493771	0.0113790	4.339	<0.0001	***
A8	0.159605	0.0325540	4.903	<0.0001	***
A18	0.0667865	0.00321599	20.77	<0.0001	***
A19	−6.81686e-05	2.33296e-05	−2.922	0.0035	***
A20	0.00139789	0.000172332	8.112	<0.0001	***
A22	0.182940	0.0216880	8.435	<0.0001	***
A25	4.70067	0.186900	25.15	<0.0001	***

A29	2.35390	0.0991927	23.73	<0.0001	***
A38	30.6816	2.56390	11.97	<0.0001	***
A40	0.00159721	5.48937e-05	29.10	<0.0001	***
A42	0.000109709	9.42060e-06	11.65	<0.0001	***
A44	0.0114121	0.00133440	8.552	<0.0001	***
A56	−0.00545194	0.00169749	−3.212	0.0013	***
A57	−0.00987582	0.00225754	−4.375	<0.0001	***
A58	0.261720	0.0813550	3.217	0.0013	***
A59	−0.632026	0.0251321	−25.15	<0.0001	***
A61	0.405291	0.0288846	14.03	<0.0001	***
A63	−0.00564257	0.000459479	−12.28	<0.0001	***
A67	−0.473416	0.0926774	−5.108	<0.0001	***

Mean dependent var	0.909885	S.D. dependent var	9.130740
Sum squared resid	3871.433	S.E. of regression	1.501151
LSDV R-squared	0.975927	Within R-squared	0.853979
LSDV F(211, 1718)	330.0886	P-value(F)	0.000000
Log-likelihood	−3410.292	Akaike criterion	7244.585
Schwarz criterion	8424.423	Hannan-Quinn	7678.578
rho	−0.285492	Durbin-Watson	2.460710

Joint test on named regressors -

 Test statistic: F(19, 1718) = 528.812

 with p-value = P(F(19, 1718) > 528.812) = 0

Test for differing group intercepts -

 Null hypothesis: The groups have a common intercept

 Test statistic: F(192, 1718) = 6.56537

 with p-value = P(F(192, 1718) > 6.56537) = 1.76928e-108

Actual and fitted A55
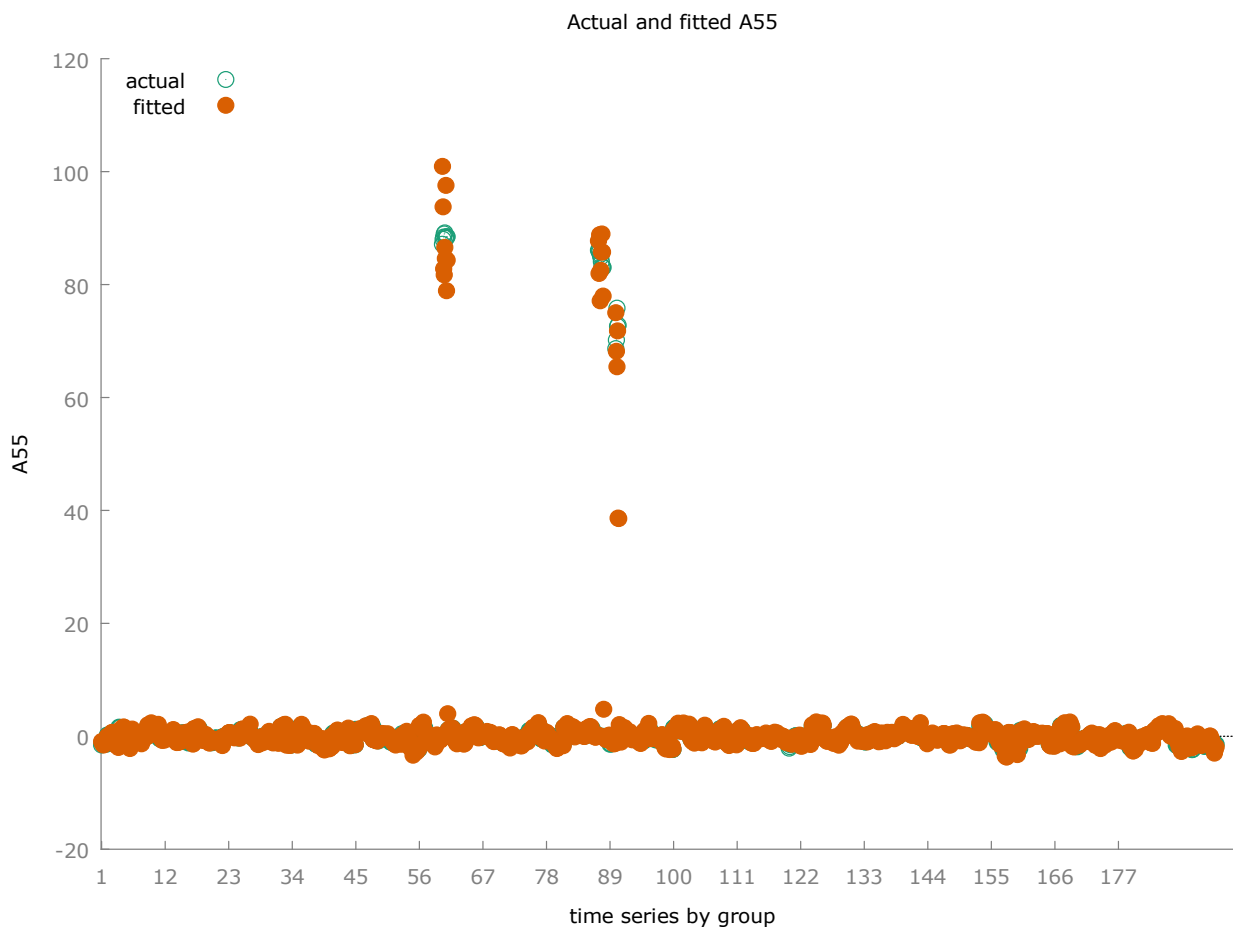
	Coefficient	Std. Error	z	p-value	
		Random-effects (GLS), using 1930 observations			
		Using Nerlove's transformation			
		Included 193 cross-sectional units			
		Time-series length = 10			
		Dependent variable: A55			
const	−3.04605	0.535881	−5.684	<0.0001	***
A3	0.0588496	0.0108366	5.431	<0.0001	***
A8	0.242582	0.0295391	8.212	<0.0001	***
A18	0.0765258	0.00281520	27.18	<0.0001	***
A19	−7.41586e-05	2.25470e-05	−3.289	0.0010	***
A20	0.00122736	0.000164722	7.451	<0.0001	***
A22	0.0601350	0.0123763	4.859	<0.0001	***
A25	4.86007	0.177420	27.39	<0.0001	***
A29	2.27903	0.0953228	23.91	<0.0001	***
A38	36.2901	2.28357	15.89	<0.0001	***

25

A40	0.00154137	5.22898e-05	29.48	<0.0001	***
A42	0.000126329	8.82890e-06	14.31	<0.0001	***
A44	0.0169024	0.00105183	16.07	<0.0001	***
A56	−0.00515810	0.00164107	−3.143	0.0017	***
A57	−0.00935402	0.00216682	−4.317	<0.0001	***
A58	0.209746	0.0773039	2.713	0.0067	***
A59	−0.583255	0.0228707	−25.50	<0.0001	***
A61	0.316728	0.0232097	13.65	<0.0001	***
A63	−0.00421252	0.000392716	−10.73	<0.0001	***
A67	−0.251586	0.0845652	−2.975	0.0029	***

Mean dependent var	0.909885	S.D. dependent var	9.130740
Sum squared resid	16057.77	S.E. of regression	2.898760
Log-likelihood	−4783.071	Akaike criterion	9606.142
Schwarz criterion	9717.447	Hannan-Quinn	9647.084
rho	−0.285492	Durbin-Watson	2.460710

'Between' variance = 25.106

'Within' variance = 2.00592

theta used for quasi-demeaning = 0.910969

Joint test on named regressors -

Asymptotic test statistic: Chi-square(19) = 11122.4

with p-value = 0

Breusch-Pagan test -

Null hypothesis: Variance of the unit-specific error = 0

Asymptotic test statistic: Chi-square(1) = 209.475

with p-value = 1.78842e-47

Hausman test -

Null hypothesis: GLS estimates are consistent

Asymptotic test statistic: Chi-square(19) = 84.0967

with p-value = 3.62174e-10

Actual and fitted A55
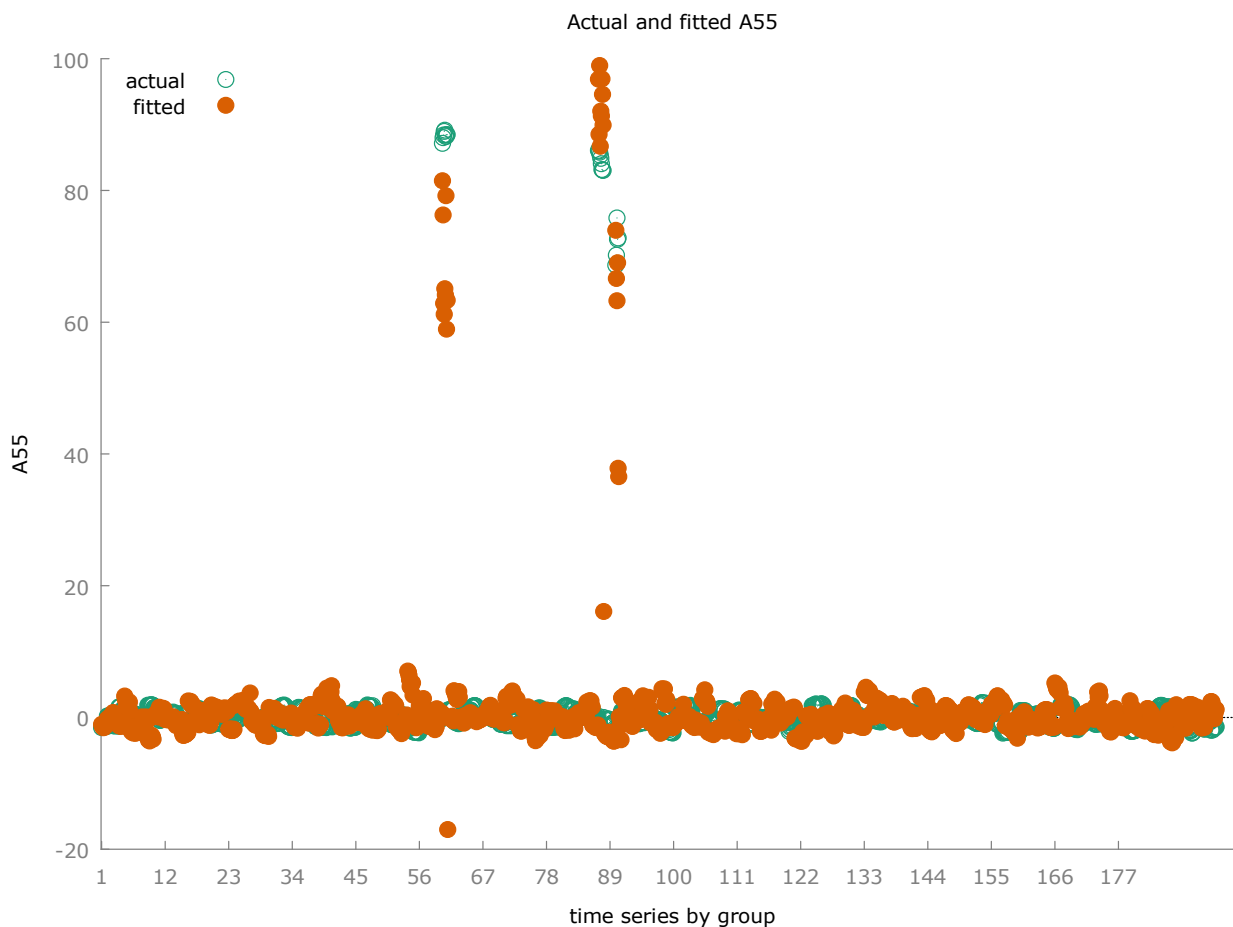
	Pooled OLS, using 1930 observations
	Included 193 cross-sectional units
	Time-series length = 10
	Dependent variable: A55

	Coefficient	Std. Error	t-ratio	p-value	
const	−1.15866	0.0913888	−12.68	<0.0001	***
A3	0.0537446	0.00831782	6.461	<0.0001	***
A8	0.321959	0.0337360	9.543	<0.0001	***
A18	0.0915778	0.00313273	29.23	<0.0001	***
A19	−6.25063e-05	2.40161e-05	−2.603	0.0093	***
A20	0.000976609	0.000196901	4.960	<0.0001	***
A22	−0.00336700	0.00187179	−1.799	0.0722	*
A25	4.00533	0.195159	20.52	<0.0001	***
A29	1.53212	0.107622	14.24	<0.0001	***
A38	31.5149	1.88046	16.76	<0.0001	***
A40	0.00129145	6.28822e-05	20.54	<0.0001	***
A42	0.000119891	1.05822e-05	11.33	<0.0001	***

A44	0.0167064	0.000833370	20.05	<0.0001	***
A56	−0.00344708	0.00175677	−1.962	0.0499	**
A57	−0.00697072	0.00179044	−3.893	0.0001	***
A58	0.312711	0.0624635	5.006	<0.0001	***
A59	−0.453224	0.0239284	−18.94	<0.0001	***
A61	0.306351	0.0128202	23.90	<0.0001	***
A63	−0.00129131	0.000296473	−4.356	<0.0001	***
A67	0.662681	0.0499730	13.26	<0.0001	***

Mean dependent var	0.909885	S.D. dependent var	9.130740
Sum squared resid	6712.025	S.E. of regression	1.874606
R-squared	0.958264	Adjusted R-squared	0.957849
F(19, 1910)	2308.105	P-value(F)	0.000000
Log-likelihood	−3941.309	Akaike criterion	7922.618
Schwarz criterion	8033.923	Hannan-Quinn	7963.560
rho	0.121039	Durbin-Watson	1.613038

Actual and fitted A55
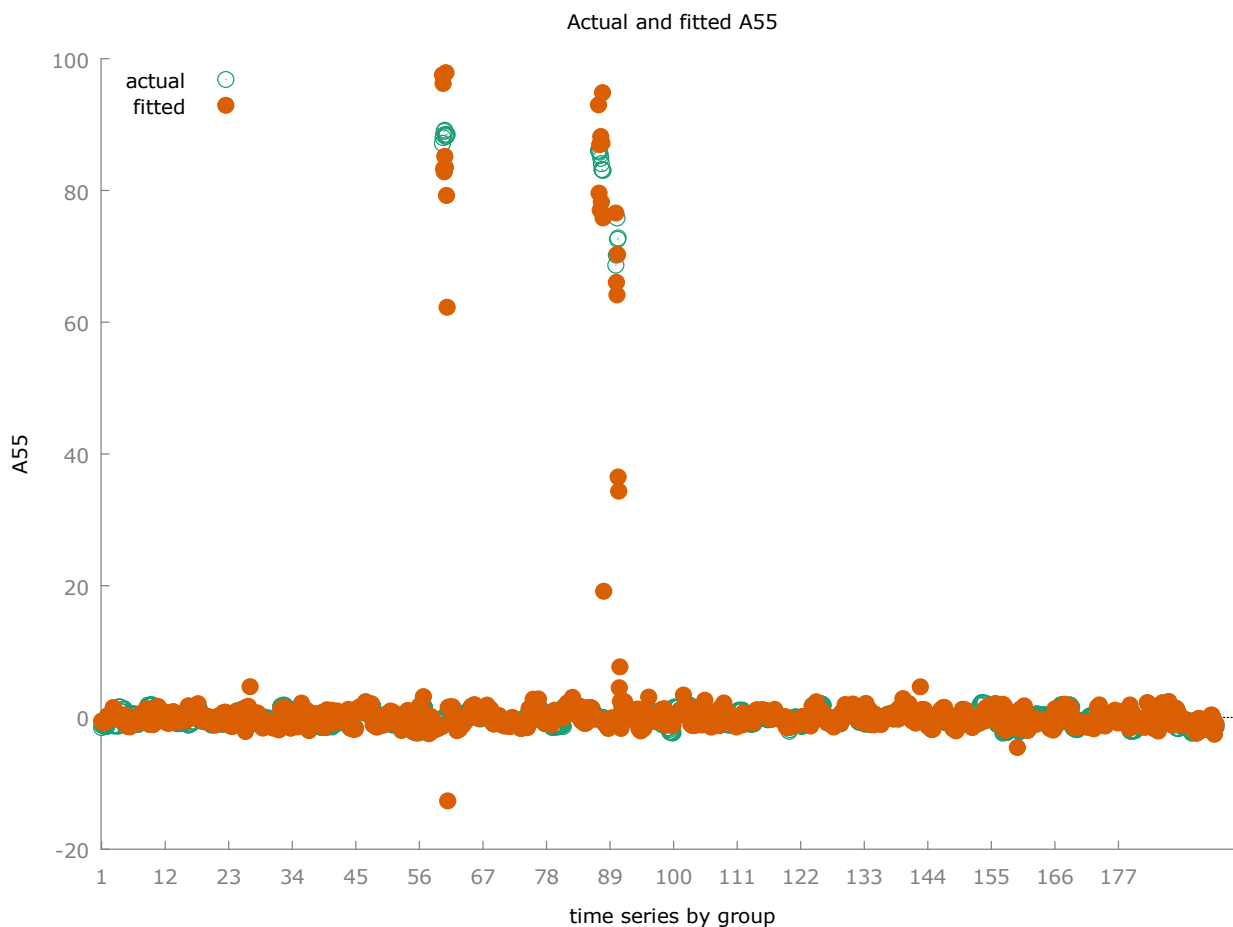
List of Variables of the Econometric Model. Source World Bank	
Variable	*Description*
Regulatory Quality	Regulatory Quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. The variable change in a range between -2.5 and +2.5.
Adjusted savings: natural resources depletion	Natural resource depletion is the sum of net forest depletion, energy depletion, and mineral depletion. Net forest depletion is unit resource rents times the excess of roundwood harvest over natural growth. Energy depletion is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas. Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate.

Annualized average growth rate in per capita real survey mean consumption or income, total population (%)	The growth rate in the welfare aggregate of the total population is computed as the annualized average growth rate in per capita real consumption or income of the total population in the income distribution in a country from household surveys over a roughly 5-year period. Mean per capita real consumption or income is measured at 2017 Purchasing Power Parity (PPP) using the Poverty and Inequality Platform (http://www.pip.worldbank.org). For some countries means are not reported due to grouped and/or confidential data. The annualized growth rate is computed as (Mean in final year/Mean in initial year)^(1/(Final year - Initial year)) - 1. The reference year is the year in which the underlying household survey data was collected. In cases for which the data collection period bridged two calendar years, the first year in which data were collected is reported. The initial year refers to the nearest survey collected 5 years before the most recent survey available, only surveys collected between 3 and 7 years before the most recent survey are considered. The coverage and quality of the 2017 PPP price data for Iraq and most other North African and Middle Eastern countries were hindered by the exceptional period of instability they faced at the time of the 2017 exercise of the International Comparison Program. See the Poverty and Inequality Platform for detailed explanations.
Energy intensity level of primary energy	Energy intensity level of primary energy is the ratio between energy supply and gross domestic product measured at purchasing power parity. Energy intensity is an indication of how much energy is used to produce one unit of economic output. Lower ratio indicates that less energy is used to produce one unit of output.
Energy use (kg of oil equivalent per capita)	In developing economies growth in energy use is closely related to growth in the modern sectors - industry, motorized transport, and urban areas - but energy use also reflects climatic, geographic, and economic factors (such as the relative price of energy). Energy use has been growing rapidly in low- and middle-income economies, but high-income economies still use almost five times as much energy on a per capita basis. Governments in many countries are increasingly aware of the urgent need to make better use of the world's energy resources. Improved energy efficiency is often the most economic and readily available means of improving energy security and reducing greenhouse gas emissions.
Fertility rate, total (births per woman)	Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year.
Forest area (% of land area)	Forest area is land under natural or planted stands of trees of at least 5 meters in situ, whether productive or not, and excludes tree stands in agricultural production systems (for example, in fruit plantations and agroforestry systems) and trees in urban parks and gardens.

GHG net emissions/removals by LUCF (Mt of CO2 equivalent)	GHG net emissions/removals by LUCF refers to changes in atmospheric levels of all greenhouse gases attributable to forest and land-use change activities, including but not limited to (1) emissions and removals of CO2 from decreases or increases in biomass stocks due to forest management, logging, fuelwood collection, etc.; (2) conversion of existing forests and natural grasslands to other land uses; (3) removal of CO2 from the abandonment of formerly managed lands (e.g. croplands and pastures); and (4) emissions and removals of CO2 in soil associated with land-use change and management. For Annex-I countries under the UNFCCC, these data are drawn from the annual GHG inventories submitted to the UNFCCC by each country; for non-Annex-I countries, data are drawn from the most recently submitted National Communication where available. Because of differences in reporting years and methodologies, these data are not generally considered comparable across countries. Data are in million metric tons.
Heat Index 35 (projected change in days)	Total count of days per year where the daily mean Heat Index rose above 35°C. A Heat Index is a measure of how hot it feels once humidity is factored in with air temperature.
Mean Drought Index (projected change, unitless)	Total count of days per year where the daily mean Heat Index rose above 35°C. A Heat Index is a measure of how hot it feels once humidity is factored in with air temperature.
Mortality rate, under-5 (per 1,000 live births)	Under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year.
Nitrous oxide emissions (metric tons of CO2 equivalent per capita)	Nitrous oxide emissions are emissions from agricultural biomass burning, industrial activities, and livestock management.
People using safely managed drinking water services (% of population)	The percentage of people using drinking water from an improved source that is accessible on premises, available when needed and free from faecal and priority chemical contamination. Improved water sources include piped water, boreholes or tubewells, protected dug wells, protected springs, and packaged or delivered water.
Renewable electricity output (% of total electricity output)	Renewable electricity is the share of electrity generated by renewable power plants in total electricity generated by all types of plants.
Renewable energy consumption (% of total final energy consumption)	Renewable energy consumption is the share of renewables energy in total final energy consumption.

Research and development expenditure (% of GDP)	Gross domestic expenditures on research and development (R&D), expressed as a percent of GDP. They include both capital and current expenditures in the four main sectors: Business enterprise, Government, Higher education and Private non-profit. R&D covers basic research, applied research, and experimental development.
Rule of Law: Estimate	Rule of Law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.
School enrollment, primary and secondary (gross), gender parity index (GPI)	Gender parity index for gross enrollment ratio in primary and secondary education is the ratio of girls to boys enrolled at primary and secondary levels in public and private schools.
Strength of legal rights index (0=weak to 12=strong)	Strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The index ranges from 0 to 12, with higher scores indicating that these laws are better designed to expand access to credit.
Voice and Accountability: Estimate	Voice and Accountability captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Standard error indicates the precision of the estimate of governance. Larger values of the standard error indicate less precise estimates. A 90 percent confidence interval for the governance estimate is given by the estimate +/- 1.64 times the standard error.

Appendix 3-Ranking of Countries for the Level of RQ in 2021

Ranking of Countries for the Level of RQ in 2021. Source WB					
Rank	Country Name	2021	Rank	Country Name	2021
1	Singapore	2.231	97	Ghana	-0.2003
2	Luxembourg	1.9152	98	Paraguay	-0.2077
3	Finland	1.8981	99	Mongolia	-0.2086
4	Australia	1.8387	100	Mexico	-0.2307
5	Denmark	1.8088	101	Cote d'Ivoire	-0.2564
6	New Zealand	1.8082	102	Ukraine	-0.2782
7	Netherlands	1.7526	103	Tonga	-0.2789
8	Sweden	1.7526	104	Senegal	-0.3121
9	Switzerland	1.7329	105	China	-0.3133
10	Norway	1.6354	106	Guatemala	-0.3152
11	Germany	1.6315	107	El Salvador	-0.3441
12	Canada	1.6172	108	Bhutan	-0.3688
13	Ireland	1.5622	109	Sri Lanka	-0.37
14	Estonia	1.5591	110	Tuvalu	-0.3761

15	Liechtenstein	1.5353	111	Tunisia	-0.3885
16	Iceland	1.5347	112	Vietnam	-0.3982
17	United Kingdom	1.4656	113	Belize	-0.4152
18	United States	1.4517	114	Benin	-0.4315
19	Japan	1.3759	115	Kenya	-0.4454
20	Andorra	1.3625	116	Burkina Faso	-0.4669
21	Austria	1.3487	117	Uganda	-0.4769
22	Czechia	1.3485	118	Kiribati	-0.4826
23	Belgium	1.3425	119	Egypt. Arab Rep.	-0.5066
24	Lithuania	1.2769	120	Guyana	-0.5193
25	France	1.2356	121	Honduras	-0.522
26	Latvia	1.2235	122	Maldives	-0.5228
27	Israel	1.209	123	Russian Federation	-0.5298
28	Mauritius	1.1672	124	Zambia	-0.5529
29	Korea. Rep.	1.0995	125	Kyrgyz Republic	-0.5776
30	Georgia	1.0605	126	Uzbekistan	-0.5812
31	United Arab Emirates	1.0139	127	Eswatini	-0.5826
32	Brunei Darussalam	0.9934	128	Nepal	-0.6167
33	Chile	0.9534	129	Argentina	-0.6181
34	Slovak Republic	0.8742	130	Mali	-0.6216
35	Qatar	0.8635	131	Tanzania	-0.6268
36	Cyprus	0.859	132	Togo	-0.6333
37	Bahrain	0.8491	133	Cambodia	-0.6442
38	Poland	0.84	134	Angola	-0.6626
39	Slovenia	0.8343	135	Ecuador	-0.7028
40	Malta	0.8137	136	Suriname	-0.705
41	Spain	0.811	137	Pakistan	-0.7316
42	Portugal	0.7361	138	Lesotho	-0.7372
43	Uruguay	0.7226	139	Niger	-0.7455
44	Malaysia	0.7224	140	Mozambique	-0.7783
45	Botswana	0.6142	141	Malawi	-0.786
46	Barbados	0.5605	142	Micronesia. Fed. Sts.	-0.786
47	St. Kitts and Nevis	0.5524	143	Timor-Leste	-0.7867
48	Italy	0.5452	144	Gabon	-0.808
49	Croatia	0.502	145	Madagascar	-0.8201
50	Hungary	0.4962	146	Papua New Guinea	-0.8347
51	Costa Rica	0.4564	147	Nicaragua	-0.8359
52	Bulgaria	0.4483	148	Bangladesh	-0.8457
53	Greece	0.4417	149	Solomon Islands	-0.8631
54	Montenegro	0.4306	150	Djibouti	-0.8691
55	North Macedonia	0.4167	151	Gambia. The	-0.8733
56	Antigua and Barbuda	0.3904	152	Lebanon	-0.8828
57	Nauru	0.3896	153	Lao PDR	-0.8875
58	St. Lucia	0.3744	154	Belarus	-0.9192
59	St. Vincent and the Grenadines	0.3359	155	Cameroon	-0.9227
60	Saudi Arabia	0.3357	156	Ethiopia	-0.9281
61	Oman	0.3298	157	Sao Tome and Principe	-0.9299

62	*Romania*	0.309	158	*Nigeria*	-0.9326
63	*Indonesia*	0.2982	159	*Liberia*	-0.9502
64	*Grenada*	0.2919	160	*Guinea*	-0.9643
65	*Dominica*	0.2836	161	*Sierra Leone*	-0.9649
66	*Cabo Verde*	0.2736	162	*Burundi*	-0.9843
67	*Colombia*	0.2201	163	*Mauritania*	-1.0552
68	*Jamaica*	0.1958	164	*Marshall Islands*	-1.1065
69	*Albania*	0.1928	165	*Iraq*	-1.1122
70	*Palau*	0.1927	166	*Tajikistan*	-1.1258
71	*Panama*	0.1926	167	*Myanmar*	-1.1309
72	*Kuwait*	0.1748	168	*Bolivia*	-1.1539
73	*Jordan*	0.1507	169	*Chad*	-1.155
74	*Armenia*	0.1452	170	*Algeria*	-1.1709
75	*Thailand*	0.0941	171	*Comoros*	-1.2475
76	*Kazakhstan*	0.0899	172	*Guinea-Bissau*	-1.2583
77	*Dominican Republic*	0.0891	173	*Haiti*	-1.3187
78	*Peru*	0.0826	174	*Afghanistan*	-1.338
79	*Philippines*	0.0765	175	*Congo. Rep.*	-1.3546
80	*Rwanda*	0.071	176	*Zimbabwe*	-1.3725
81	*Bahamas. The*	0.0641	177	*Congo. Dem. Rep.*	-1.4229
82	*Serbia*	0.0521	178	*Cuba*	-1.4434
83	*Seychelles*	0.0197	179	*Sudan*	-1.4654
84	*Moldova*	0.0139	180	*Central African Republic*	-1.4903
85	*Fiji*	-0.005	181	*Iran. Islamic Rep.*	-1.6223
86	*Namibia*	-0.005	182	*Syrian Arab Republic*	-1.6289
87	*Azerbaijan*	-0.06	183	*Equatorial Guinea*	-1.7128
88	*South Africa*	-0.073	184	*Somalia*	-1.8172
89	*India*	-0.079	185	*Libya*	-1.9512
90	*Turkiye*	-0.082	186	*South Sudan*	-1.9846
91	*Trinidad and Tobago*	-0.085	187	*Yemen. Rep.*	-2.0079
92	*Brazil*	-0.111	188	*Turkmenistan*	-2.0188
93	*Morocco*	-0.122	189	*Venezuela. RB*	-2.1957
94	*Vanuatu*	-0.123	190	*Eritrea*	-2.2687
95	*Samoa*	-0.167	191	*Korea. Dem. People's Rep.*	-2.3274
96	*Bosnia and Herzegovina*	-0.179			

Appendix 5-Ranking of Countries for level of percentage variation of RQ in the period 2010-2021

Ranking of Countries for RQ Percentage Variation between 2010-2021					
Rank	Country Name	2010	2021	Var Ass	Var per
1	United Arab Emirates	0.32	1.01	0.70	218.27
2	El Salvador	0.34	-0.34	-0.68	201.97
3	Indonesia	-0.38	0.30	0.68	178.29
4	Uganda	-0.20	-0.48	-0.28	136.86
5	Saudi Arabia	0.16	0.34	0.18	110.26

6	Fiji	-0.56	0.00	0.56	99.20
7	Vanuatu	-0.78	-0.12	0.66	84.29
8	India	-0.41	-0.08	0.33	80.80
9	Georgia	0.59	1.06	0.47	80.78
10	North Macedonia	0.24	0.42	0.18	75.42
11	Cote d'Ivoire	-0.93	-0.26	0.67	72.31
12	Tuvalu	-1.15	-0.38	0.78	67.38
13	Iceland	0.92	1.53	0.61	66.70
14	Kiribati	-1.32	-0.48	0.84	63.39
15	Uzbekistan	-1.54	-0.58	0.96	62.17
16	Thailand	0.06	0.09	0.03	52.30
17	Tonga	-0.58	-0.28	0.30	51.87
18	Myanmar	-2.24	-1.13	1.11	49.62
19	Mauritius	0.80	1.17	0.37	45.54
20	Qatar	0.60	0.86	0.27	44.73
21	Paraguay	-0.36	-0.21	0.15	42.56
22	Colombia	0.16	0.22	0.06	39.95
23	Ukraine	-0.45	-0.28	0.18	38.79
24	Samoa	-0.27	-0.17	0.10	38.07
25	Angola	-1.06	-0.66	0.40	37.50
26	Ecuador	-1.12	-0.70	0.42	37.48
27	Vietnam	-0.63	-0.40	0.23	36.99
28	Japan	1.02	1.38	0.36	35.34
29	Lithuania	0.96	1.28	0.32	32.99
30	Latvia	0.93	1.22	0.30	31.77
31	Zimbabwe	-2.00	-1.37	0.63	31.44
32	Timor-Leste	-1.11	-0.79	0.32	29.16
33	Togo	-0.89	-0.63	0.25	28.63
34	Solomon Islands	-1.20	-0.86	0.34	28.22
35	Singapore	1.78	2.23	0.45	25.09
36	Belarus	-1.19	-0.92	0.27	22.64
37	Somalia	-2.30	-1.82	0.48	21.03
38	Uruguay	0.60	0.72	0.12	20.57
39	Korea. Rep.	0.92	1.10	0.18	19.73
40	Bahrain	0.71	0.85	0.14	19.25
41	Mongolia	-0.26	-0.21	0.05	19.17
42	Nepal	-0.76	-0.62	0.15	19.04
43	Malaysia	0.61	0.72	0.11	18.18
44	Lesotho	-0.63	-0.74	-0.11	16.99
45	Argentina	-0.74	-0.62	0.13	16.80
46	Luxembourg	1.67	1.92	0.24	14.42
47	Guyana	-0.61	-0.52	0.09	14.21
48	Cuba	-1.67	-1.44	0.23	13.67
49	Lao PDR	-1.02	-0.89	0.13	12.65

50	Estonia	1.39	1.56	0.17	12.31
51	Burundi	-1.12	-0.98	0.14	12.30
52	Afghanistan	-1.52	-1.34	0.18	11.77
53	Barbados	0.51	0.56	0.06	10.84
54	Comoros	-1.40	-1.25	0.15	10.63
55	Marshall Islands	-1.24	-1.11	0.13	10.54
56	Kuwait	0.16	0.17	0.02	10.36
57	Slovenia	0.76	0.83	0.08	9.87
58	Guinea	-1.06	-0.96	0.10	9.02
59	Liberia	-1.04	-0.95	0.09	8.65
60	Australia	1.70	1.84	0.14	8.42
61	Norway	1.51	1.64	0.12	8.16
62	Congo. Dem. Rep.	-1.55	-1.42	0.13	8.09
63	St. Lucia	0.35	0.37	0.03	7.73
64	Grenada	0.27	0.29	0.02	7.22
65	Austria	1.45	1.35	-0.10	7.02
66	Switzerland	1.62	1.73	0.11	6.91
67	Botswana	0.58	0.61	0.04	6.20
68	Sweden	1.66	1.75	0.10	5.82
69	Iran. Islamic Rep.	-1.71	-1.62	0.09	5.09
70	Korea. Dem. People's Rep.	-2.45	-2.33	0.12	4.83
71	Belgium	1.28	1.34	0.06	4.65
72	Canada	1.69	1.62	-0.08	4.50
73	St. Vincent and the Grenadines	0.32	0.34	0.01	4.43
74	Czechia	1.30	1.35	0.05	3.95
75	Germany	1.57	1.63	0.06	3.87
76	Croatia	0.49	0.50	0.01	2.56
77	Portugal	0.72	0.74	0.02	2.53
78	China	-0.32	-0.31	0.01	2.38
79	Turkmenistan	-2.06	-2.02	0.04	2.07
80	Senegal	-0.32	-0.31	0.01	1.74
81	Netherlands	1.73	1.75	0.02	1.36
82	Finland	1.87	1.90	0.03	1.33
83	Liechtenstein	1.53	1.54	0.01	0.66
84	United States	1.44	1.45	0.01	0.55
85	New Zealand	1.81	1.81	0.00	-0.23
86	Israel	1.21	1.21	-0.01	-0.48
87	Bangladesh	-0.86	-0.85	0.01	-1.39
88	Morocco	-0.12	-0.12	0.00	-1.81
89	Andorra	1.39	1.36	-0.03	-1.94
90	Denmark	1.87	1.81	-0.07	-3.47
91	Ireland	1.62	1.56	-0.06	-3.47
92	Micronesia. Fed. Sts.	-0.75	-0.79	-0.03	-4.24
93	Eritrea	-2.16	-2.27	-0.11	-4.88

94	Zambia	-0.52	-0.55	-0.03	-5.34
95	Suriname	-0.67	-0.71	-0.04	-5.61
96	France	1.31	1.24	-0.08	-5.69
97	Algeria	-1.10	-1.17	-0.07	-5.98
98	Chad	-1.08	-1.16	-0.07	-6.88
99	Benin	-0.40	-0.43	-0.03	-7.40
100	Iraq	-1.03	-1.11	-0.08	-8.05
101	Congo. Rep.	-1.25	-1.35	-0.10	-8.18
102	Sao Tome and Principe	-0.85	-0.93	-0.08	-8.80
103	Sudan	-1.34	-1.47	-0.12	-8.96
104	Ethiopia	-0.85	-0.93	-0.08	-9.43
105	Brunei Darussalam	1.11	0.99	-0.12	-10.35
106	Equatorial Guinea	-1.55	-1.71	-0.16	-10.61
107	Tajikistan	-1.01	-1.13	-0.12	-11.43
108	Guinea-Bissau	-1.12	-1.26	-0.14	-11.98
109	Slovak Republic	1.00	0.87	-0.13	-12.51
110	United Kingdom	1.73	1.47	-0.27	-15.31
111	Jamaica	0.23	0.20	-0.04	-16.28
112	Albania	0.23	0.19	-0.04	-17.37
113	Poland	1.02	0.84	-0.18	-17.90
114	Dominica	0.35	0.28	-0.06	-18.42
115	Pakistan	-0.61	-0.73	-0.12	-19.28
116	Costa Rica	0.59	0.46	-0.13	-22.12
117	Cameroon	-0.75	-0.92	-0.17	-22.54
118	Malawi	-0.64	-0.79	-0.15	-23.30
119	Belize	-0.34	-0.42	-0.08	-23.71
120	Mauritania	-0.84	-1.06	-0.21	-25.17
121	Nigeria	-0.74	-0.93	-0.19	-25.44
122	Oman	0.44	0.33	-0.11	-25.52
123	Sierra Leone	-0.76	-0.96	-0.20	-26.84
124	Central African Republic	-1.16	-1.49	-0.33	-28.15
125	Haiti	-1.03	-1.32	-0.29	-28.25
126	Mali	-0.48	-0.62	-0.14	-28.51
127	Djibouti	-0.68	-0.87	-0.19	-28.51
128	Spain	1.16	0.81	-0.35	-29.98
129	Cambodia	-0.49	-0.64	-0.15	-31.20
130	Greece	0.64	0.44	-0.20	-31.29
131	Niger	-0.56	-0.75	-0.18	-32.04
132	Chile	1.42	0.95	-0.46	-32.63
133	Bulgaria	0.68	0.45	-0.23	-34.11
134	Jordan	0.23	0.15	-0.08	-34.37
135	Madagascar	-0.61	-0.82	-0.22	-35.43
136	Tanzania	-0.46	-0.63	-0.16	-35.57
137	Maldives	-0.38	-0.52	-0.14	-36.13

138	Italy	0.89	0.55	-0.35	-39.04
139	Antigua and Barbuda	0.64	0.39	-0.25	-39.28
140	Cyprus	1.42	0.86	-0.56	-39.55
141	Venezuela. RB	-1.56	-2.20	-0.63	-40.47
142	Malta	1.43	0.81	-0.62	-43.04
143	Bolivia	-0.80	-1.15	-0.36	-44.73
144	Armenia	0.27	0.15	-0.12	-46.03
145	Papua New Guinea	-0.57	-0.83	-0.27	-46.54
146	Eswatini	-0.40	-0.58	-0.19	-46.85
147	Sri Lanka	-0.25	-0.37	-0.12	-49.06
148	Bosnia and Herzegovina	-0.12	-0.18	-0.06	-49.51
149	Libya	-1.30	-1.95	-0.65	-50.29
150	Hungary	1.01	0.50	-0.52	-51.09
151	St. Kitts and Nevis	1.14	0.55	-0.59	-51.56
152	Romania	0.67	0.31	-0.36	-54.05
153	Panama	0.47	0.19	-0.28	-59.21
154	Bhutan	-1.16	-0.37	0.79	-68.18
155	Russian Federation	-0.31	-0.53	-0.22	-70.63
156	Mozambique	-0.45	-0.78	-0.33	-71.65
157	Peru	0.39	0.08	-0.31	-78.97
158	Gambia. The	-0.48	-0.87	-0.39	-81.73
159	Guatemala	-0.17	-0.32	-0.14	-83.00
160	Azerbaijan	-0.39	-0.06	0.33	-84.82
161	Gabon	-0.44	-0.81	-0.37	-85.53
162	Bahamas. The	0.55	0.06	-0.49	-88.32
163	Syrian Arab Republic	-0.86	-1.63	-0.77	-90.45
164	Namibia	0.21	0.00	-0.22	-102.18
165	Moldova	-0.13	0.01	0.15	-110.49
166	Honduras	-0.25	-0.52	-0.28	-111.69
167	Trinidad and Tobago	0.54	-0.09	-0.63	-115.83
168	South Africa	0.45	-0.07	-0.52	-116.42
169	Kyrgyz Republic	-0.26	-0.58	-0.32	-120.98
170	Palau	-0.87	0.19	1.07	-122.07
171	Burkina Faso	-0.21	-0.47	-0.26	-124.09
172	Turkiye	0.31	-0.08	-0.40	-126.17
173	Rwanda	-0.24	0.07	0.31	-129.60
174	Kazakhstan	-0.28	0.09	0.37	-131.75
175	Philippines	-0.22	0.08	0.29	-135.52
176	Nauru	-1.05	0.39	1.44	-137.22
177	Brazil	0.25	-0.11	-0.36	-144.93
178	Nicaragua	-0.30	-0.84	-0.53	-176.44
179	Dominican Republic	-0.12	0.09	0.21	-176.81
180	Serbia	-0.07	0.05	0.12	-179.39
181	Seychelles	-0.02	0.02	0.04	-211.47

| 182	Yemen. Rep.	-0.62	-2.01	-1.39	-226.08
183	Kenya	-0.14	-0.45	-0.31	-226.56
184	Egypt. Arab Rep.	-0.15	-0.51	-0.36	-243.22
185	Mexico	0.16	-0.23	-0.39	-247.58
186	Cabo Verde	-0.15	0.27	0.42	-286.86
187	Tunisia	-0.09	-0.39	-0.30	-345.03
188	Ghana	0.05	-0.20	-0.25	-473.97
189	Lebanon	0.02	-0.88	-0.91	-4056.57
190	Montenegro	-0.01	0.43	0.44	-6037.36

Appendix 6- Graphical Results of the Clusterization with the application of the k-Means algorithm optimized with the Elbow Method
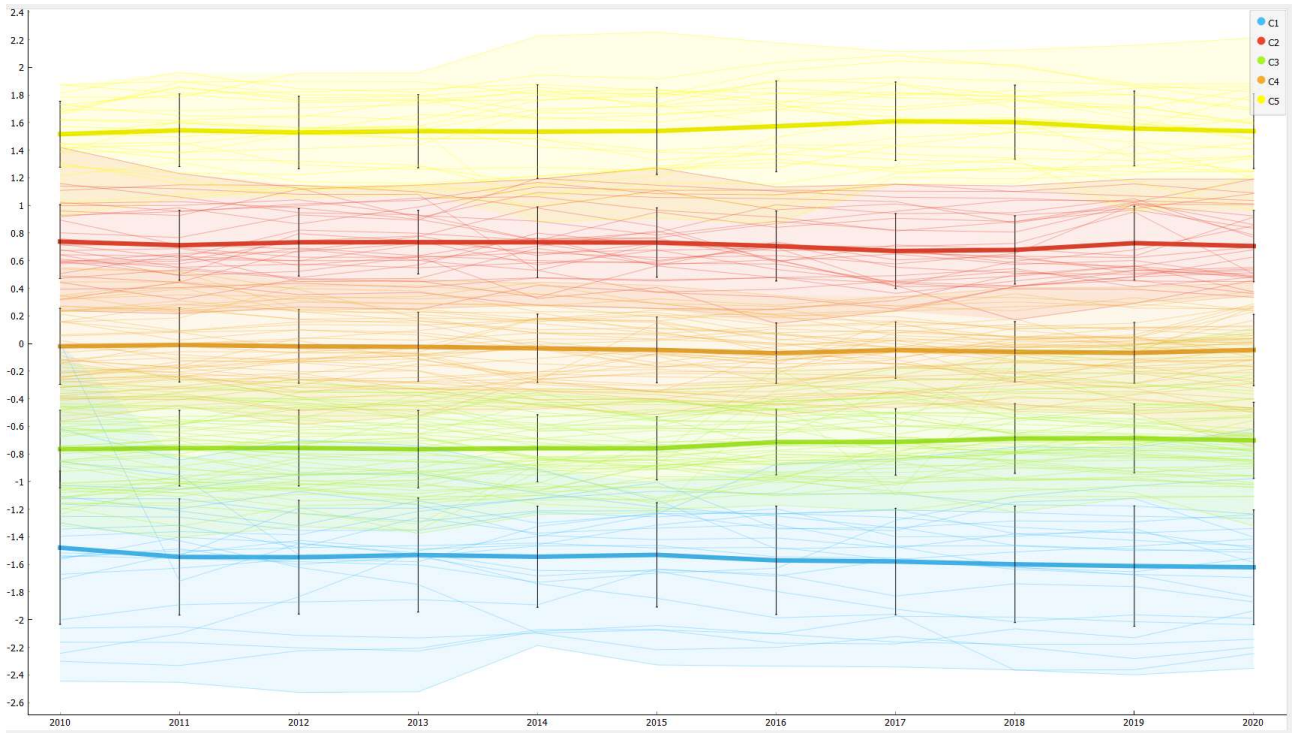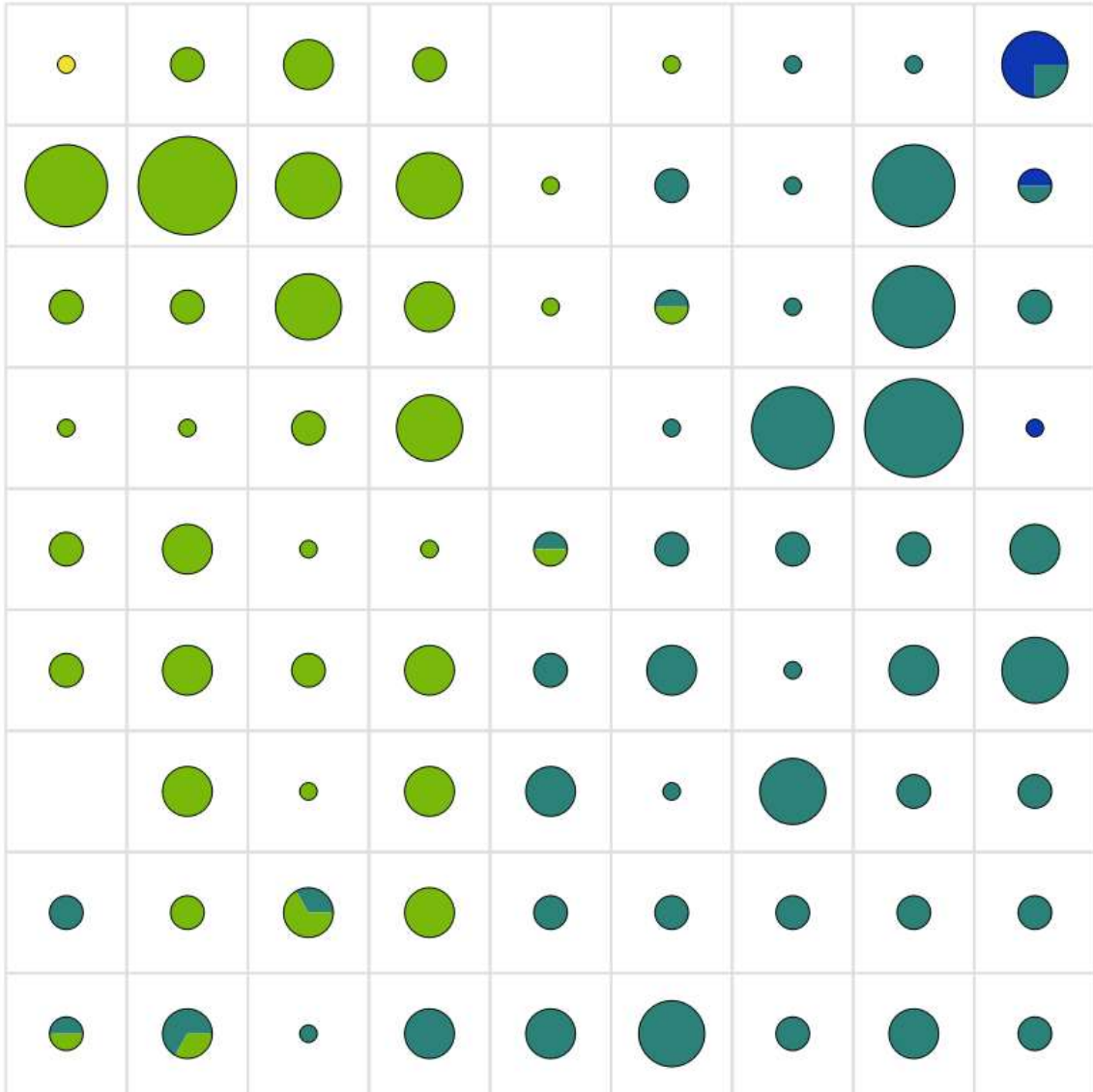
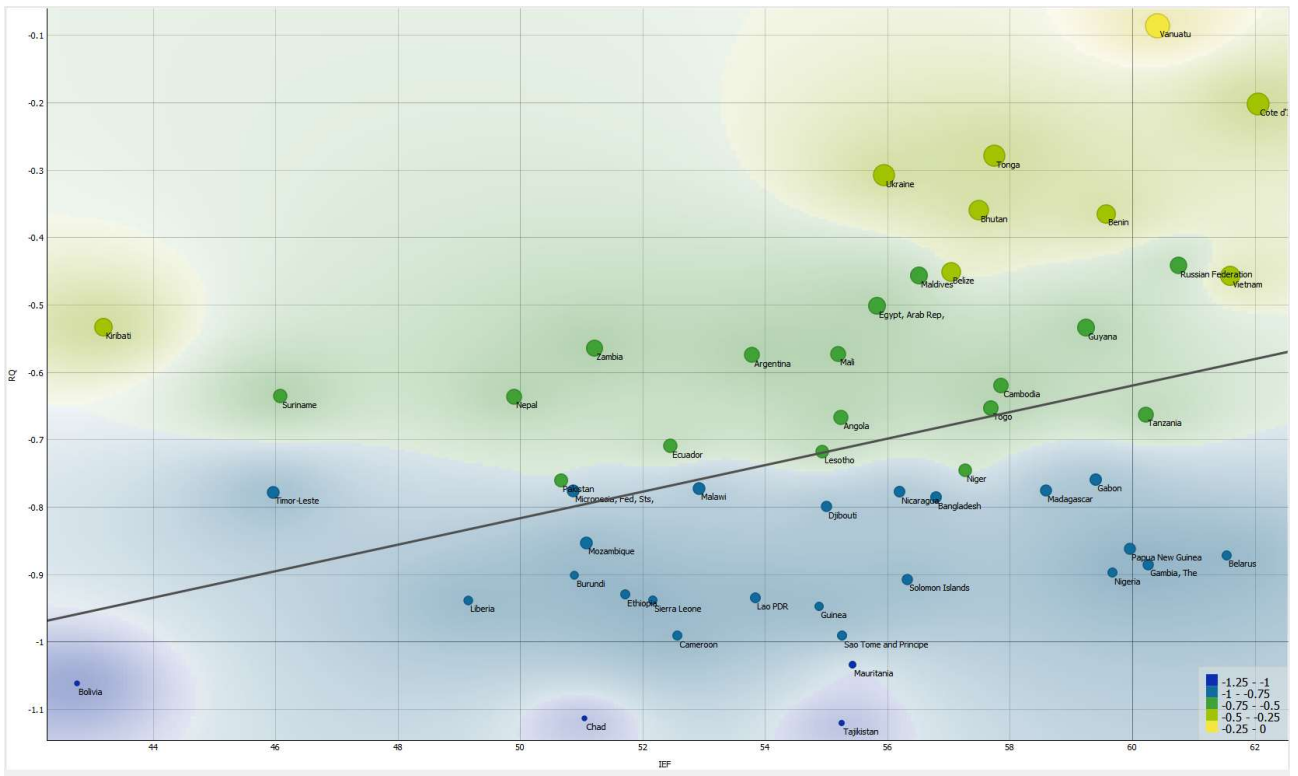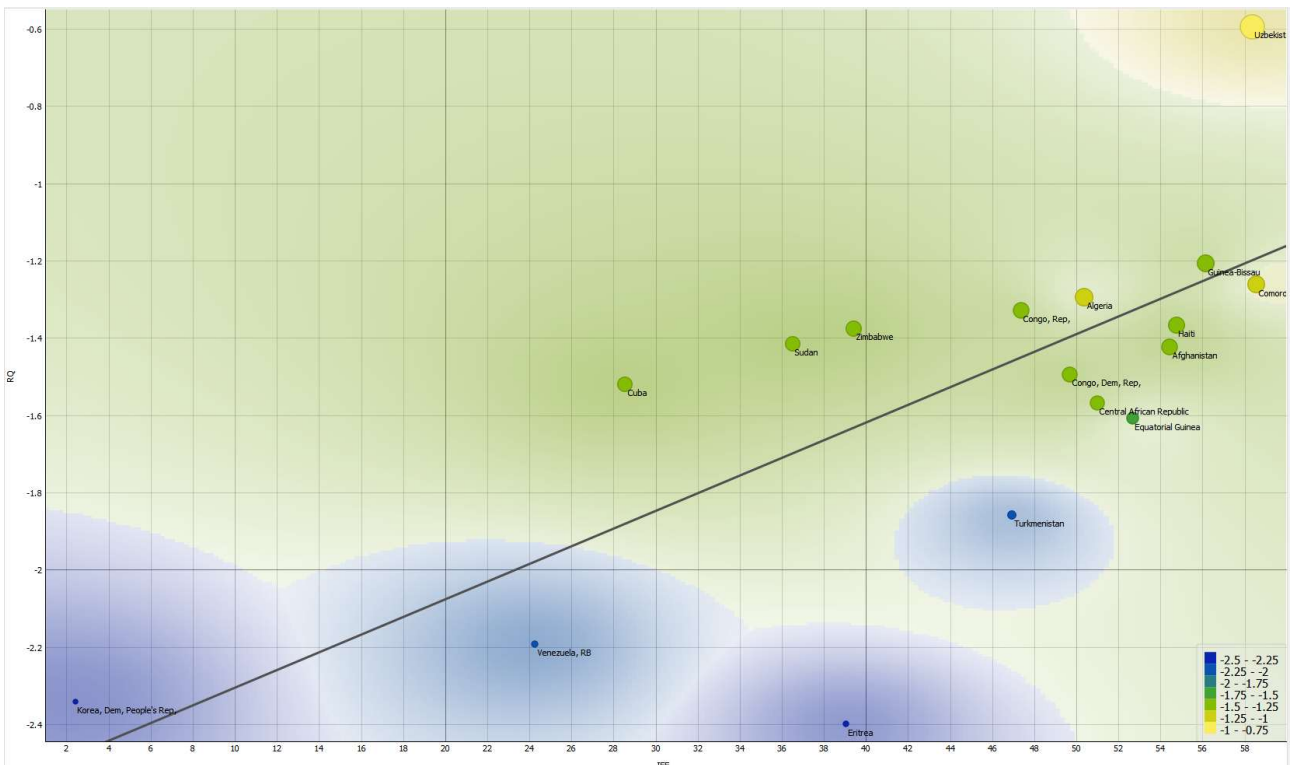■ < -2   ■ -2 - 0   ■ 0 - 2   ■ ≥ 2
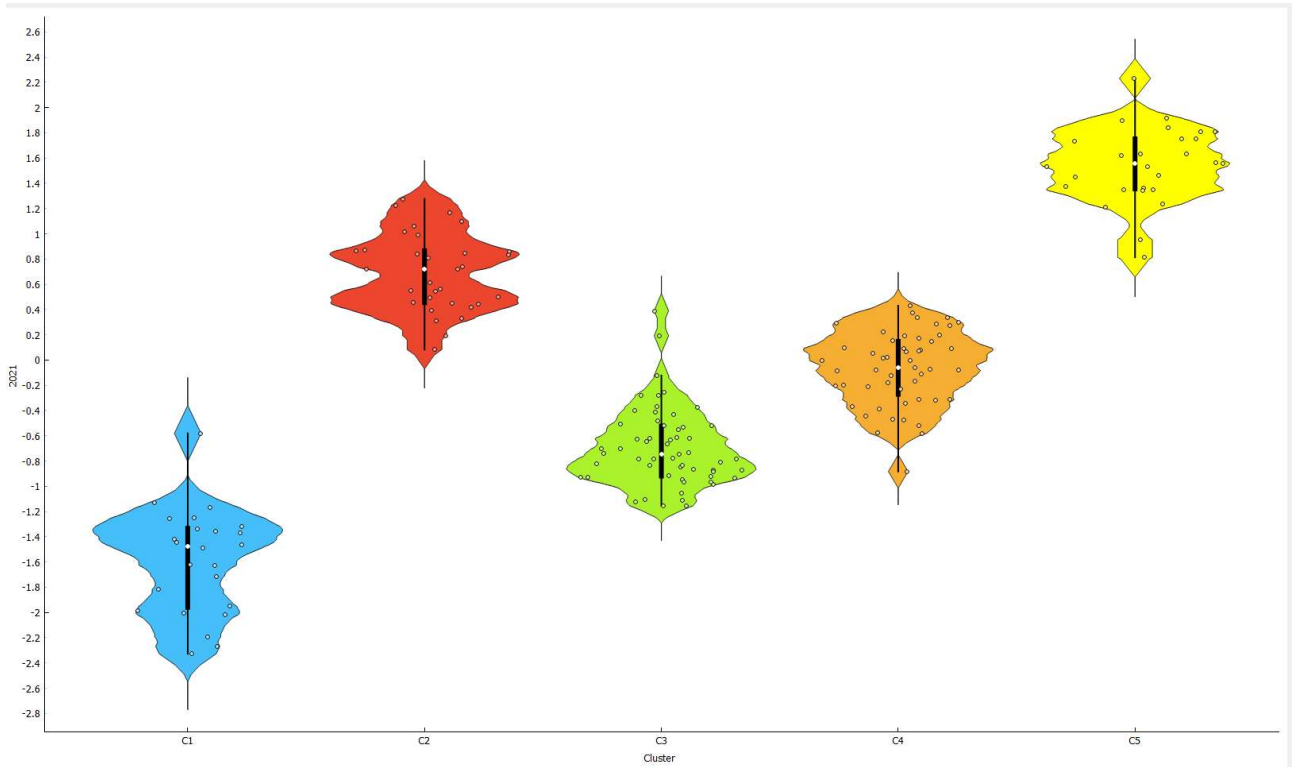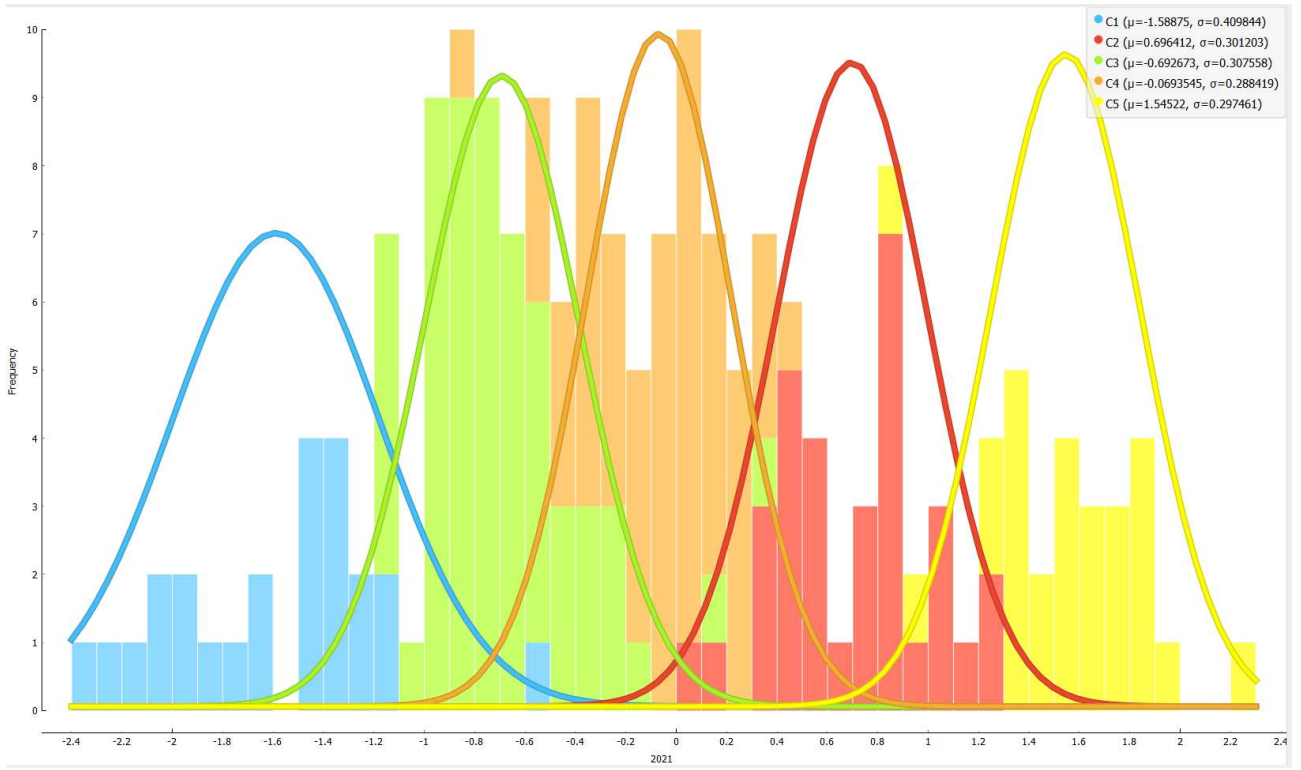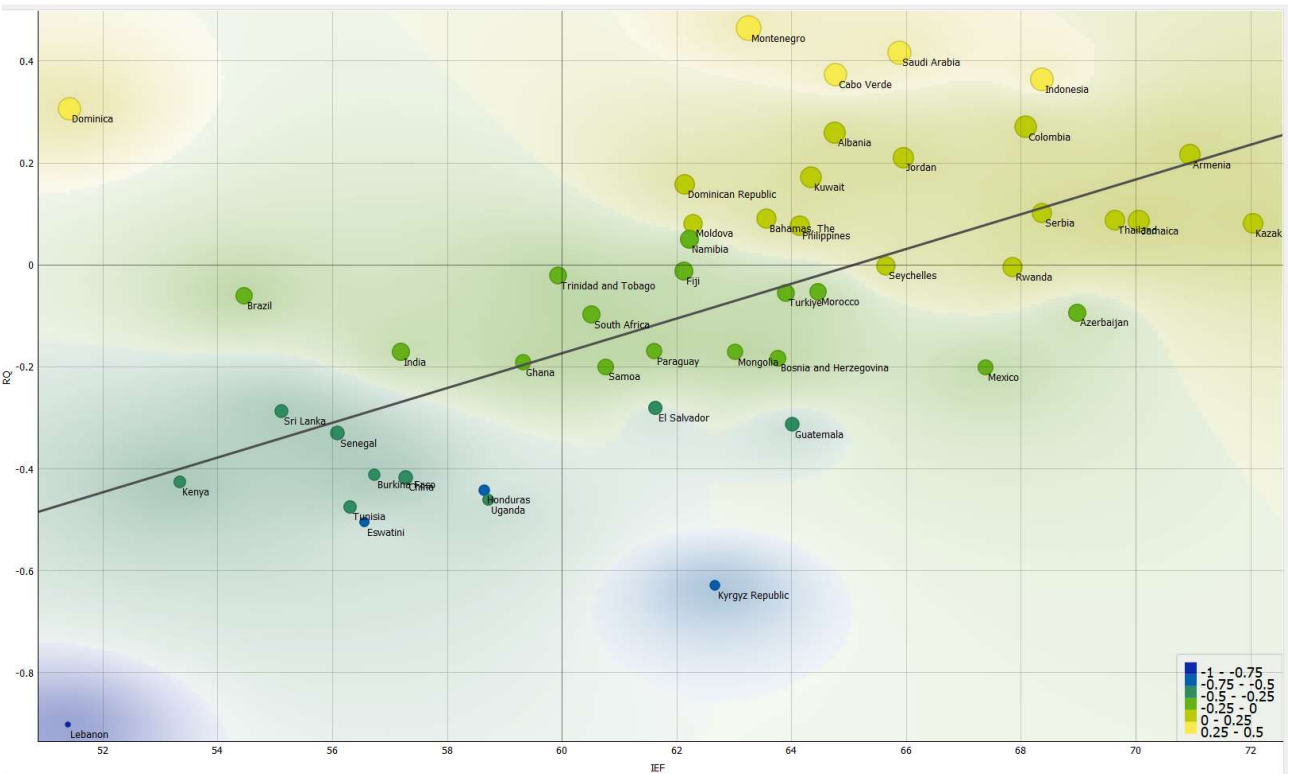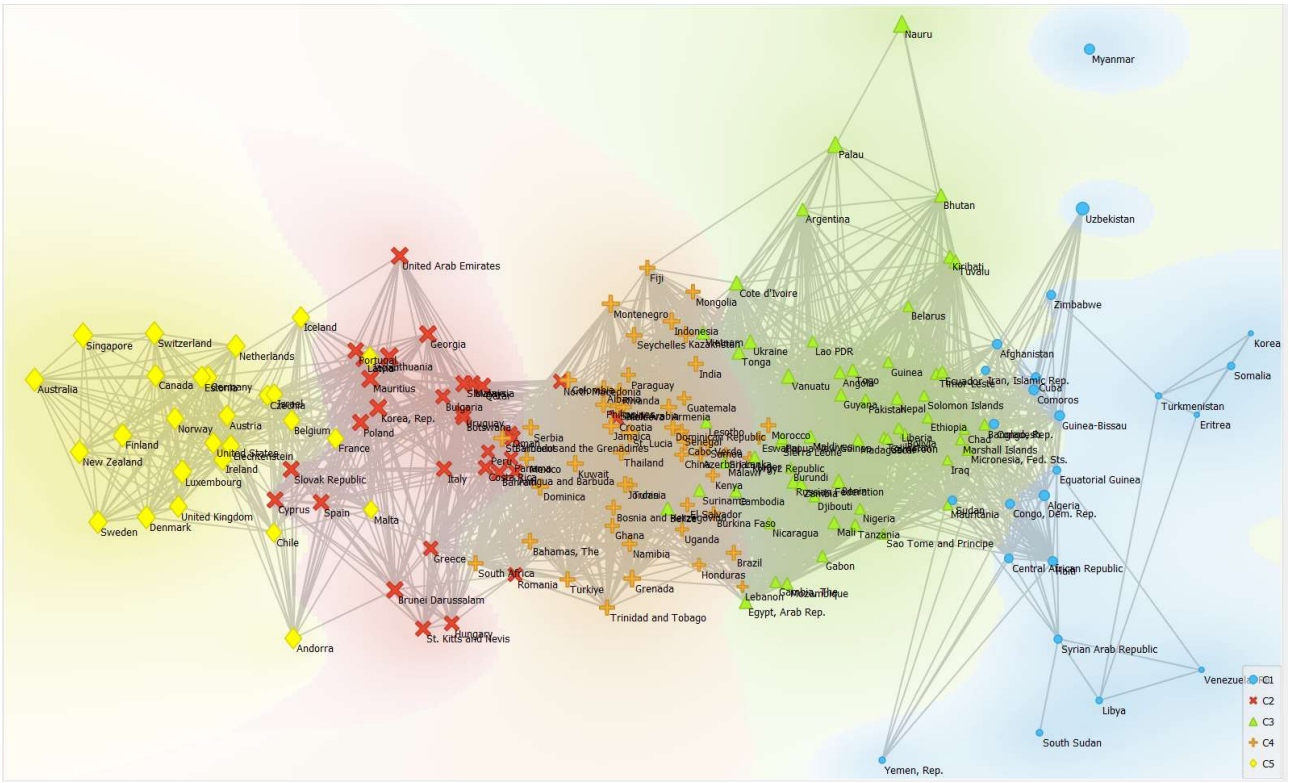
Relationship between RQ and IEF in C4.

Relationship between RQ and IEF for C3.

Relationship between RQ and IEF in C1.

Excel Reader — Node 102
Normalizer — Node 39
Column Filter — Node 42
Partitioning — Node 45
Tree Ensemble Learner (Regression) — Node 47
Tree Ensemble Predictor (Regression) — Node 48
Normalizer — Node 46
Numeric Scorer — Node 41

Excel Reader — Node 103
Normalizer — Node 49
Column Filter — Node 55
Partitioning — Node 56
Linear Regression Learner — Node 57
Regression Predictor — Node 58
Normalizer — Node 52
Numeric Scorer — Node 50

Excel Reader — Node 104
Normalizer — Node 65
Column Filter — Node 59
Partitioning — Node 60
Polynomial Regression Learner — Node 67
Regression Predictor — Node 61
Normalizer — Node 63
Numeric Scorer — Node 66

Excel Reader — Node 105
Normalizer — Node 75
Column Filter — Node 74
Partitioning — Node 72
Simple Regression Tree Learner — Node 77
Simple Regression Tree Predictor — Node 78
Normalizer — Node 71
Numeric Scorer — Node 68