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Evaluation of the impacts of selected socio-economic factors on healthcare quality at the country level and possible implications to COVID-19

Master's thesis

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TARTU 2020

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Allowed for defence on ……..

(date)

I have written this master's thesis independently. All viewpoints of other authors, literary sources, and data from elsewhere used for the writing of this paper have been referenced.

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Abstract

The aim of this thesis is to define the socio-economic factors at the country-level that have an impact on healthcare quality which is measured by the health care index offered by the Legatum Institute, to analyze the effects of these indicators using the data from the 77 countries and to discuss the findings on the real case of "COVID-19". In the study, 8 indicators were defined, which are "Patient Satisfaction", "Current Health Expenditure", "The Number of Beds", "The Number of Doctors", "ICT Development Index", "The Burden of Government Regulations", "Population", "Research and Development". In order to analyze the relationship between the indicators and healthcare quality, hypotheses derived from literature analysis were tested with OLS (Ordinary Least Squares) multiple linear regression method. While the results of analysis supported the predicted effects of all indicators on the healthcare quality, "The Number of Doctors", and "Research and Development" demonstrated insignificant conclusions on the index.

Keywords: Healthcare Index, Healthcare Quality, Patient Satisfaction, Legatum Institute, COVID-19

Acknowledgment

I want to express my heartfelt appreciation to my supervisor, and Head of the School of Business and Economics, professor Kadri Ukrainski who has consistent support to me during the whole thesis writing process including idea generation, aim specifications, modeling the thesis and structuring the paper. I am also thankful to the program director of Innovation and Technology Management, Dr. Mustafa Hakan Eratalay for his irreplaceable guidance and invaluable directions that he gave me in all the cases when I had problems with the studies during 2 years of study and thesis project. Furthermore, I would also like to express my gratitude to Diana Gabrielyan for providing worthwhile feedback for the improvement of my work with her valuable suggestions. I would also wish my eternal appreciation to the Indrek Seppo who is R-guru in Estonia for all the practical knowledge in data analysis he provided me during my studies.

I additionally want to show my endless gratitude to my family members for their continuous mental support, motivation and eternal belief in me. Especially, special thanks go to my mother for her contribution to my thesis with proofreading the work consistently in all different stages of the process. Additionally, I want to demonstrate my sincere thanks to the Sanan Abdullayev and Hagigat Hasanova who were always there with their precious support to me in our late-night discussions about the thesis project and motivating me when I have all kind of difficulties about the process.

Finally, an equal amount of gratitude goes to all the authors of the scientific papers which I got inspiration and precious information for improving the topic and scale of the thesis.

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Introduction

“To Err is Human” - a report shared by the Institute of Medicine (US) found out that every year more than 98000 people die from medical errors in health institutions. This founding increases the importance of questioning the quality of the services provided by health care organizations (Committee on Quality of Health Care in America, 2000, p. 1). Health care is the prevention, identification, medication, and other necessary actions taken for the treatment of medical injuries for improving the person's wellbeing. According to Institute of Medicine, healthcare quality is "the degree to which health care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge." (AHRQ, 2018) For the prevention of deaths resulting from medical errors, it is crucial for governments to improve the quality of healthcare which leads to a safe and healthy nation. In order to find the gaps and improve the quality of healthcare services provided in the country, governments need to be well informed about the current quality of the healthcare system. These improvements are one of the best tools for governments to increase the overall living standards of the nations. Additional to the improvement of quality of healthcare, knowing the current level of healthcare services is pivotal for the improvement of other socio-economic factors.

In order to evaluate the quality of healthcare, one of the accepted measures is the healthcare index introduced by Legatum Institute, (2017, p. 55) in the research defined as Legatum Prosperity Index[1]. The Legatum Institute is a London based organization which analyzes the journey of countries from poverty to prosperity with defining the current situation in the regions and promoting policies for improvement. Thus, the Legatum Institute identified nine pillars which take countries to prosperity. One of them is “Health Pillar”, which is the measurement of the healthcare quality in the defined territories and demonstrates the level of the health sector at the country level. The Institute collected the data from the 149 countries for eleven years and interpret the role of health quality in the path to or from the prosperity of the countries. (Legatum Institute, 2017)

[1] *Legatum Prosperity Index* (2019) “is a tool for transformation, offering a unique insight into how prosperity is forming and changing across the world”.

The problem of "healthcare quality measurement" has been addressed by a number of researchers from different aspects. The most studied topics were about the effects of several socio-economic factors on the investigation of patient satisfaction and in the estimation of the life-expectancy at birth which will be discussed in the literature review in a more detailed way. While most of the papers studied the impacts of the socio-economic factors on the mentioned directions, there is a gap in the literature about the analysis of the quality of healthcare with the possible effects of socio-economic factors on it (Asandului et al., 2014; Stefko et al., 2019; Xesfingi & Vozikis, 2016). The findings of this thesis will help the further investigations which aims the improvement of the healthcare policies to ameliorate the effectiveness and parallelly efficiency of healthcare systems. Moreover, nowadays, the global pandemic COVID-19[2] is one of the most contemporary topics studied in the healthcare industry, but the scale of the papers does not cover COVID-19 and its relationship with healthcare quality in a profound manner.

This thesis aims to analyze the effects of socio-economic factors that have a role on the determination of healthcare quality at the country level. The novelty of the paper is defining the impacts of the factors on healthcare quality which is measured by the index offered by the Legatum Institute elucidated above. Moreover, the model offered by the thesis will include the variables which are found relevant after the analysis of previous literature. Predicted effects of the indicators will be tested with the data of 2017 collected among 77 countries all over the world including countries from the European Union, Great 20, Africa, Asia, South America and so on. Final focus of the paper is the possible implications of the results to the analysis of COVID-19, which also brings novelty to the literature with the discussion of the topic. As a result of the literature reviews, hypotheses will be derived for each of the affecting socio-economic factors which are discussed in the literature. In order to test the impacts of this indicators on healthcare quality, these hypothesis will be tested at the 1 %, 5 % and 10 % significance level on the collected data. While testing the presumed effects of the indicators, OLS (Ordinary Least Square) Multiple Regression method will be used in the study. The method of the testing will be divided into several stages; if any of the variables

[2] Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. (World Health Organization, 2020)

show insignificant results, these variables will be eliminated from the model and regression will be repeated.

The remaining paper is organized as follows: The introduction is followed with the literature review part in which healthcare quality is discussed from different perspectives and includes hypotheses derivation about different indicators which have proved impact on healthcare quality. The next section, called Data and Methodology, includes the description of data about the dependent and independent variables, and the sources of the collected data. After the data part, the model is described with the explanation of the reasons of the selected variables and summary of descriptive statistics. Following the model, methods used for the analysis and the results of the regression is discussed. In the end, the paper is concluded with the discussion of the findings from the analysis, limitations of the study and further implications for the future research.

Literature Review and Hypothesis Deviation

The healthcare quality has various definitions for the different stakeholders which include patients, policymakers, managers, and staff of healthcare organizations. In general understanding, healthcare quality is the fulfilling expectations of the stakeholders with the provision of efficient and effective healthcare services with considering the updated clinical guidelines and standards for increasing satisfaction (Mohammad Mosadeghrad, 2013). In the modern health sector, the quality of healthcare is given more importance than the quantity of the patients treated in a day. The Agency for Healthcare Research and Quality (AHRQ) sets the quality of healthcare as “doing the right thing for the right patient, at the right time, in the right way to achieve the best possible results.” (Ladak et al., 2007). In order to achieve higher quality in healthcare provision, healthcare organizations should make sure the minimum instances of harm are happening during the delivery process which leads to safer healthcare service. Moreover, due to Institute of Medicine (US) Committee on Quality of Health Care in America (2000), one of the accepted descriptions of healthcare quality is defined as "the degree to which health care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge".

First and foremost, patient-centeredness as a dimension has valuable implications to the quality of health care system. In literature, patient-centered service provision is defined as the attention to the preferences, values and choices of patients about health status (Bardes, 2012). Including patients to the evaluation process of the health care can open rooms for opportunities for the policymakers while implementing projects to improve the quality of healthcare. In his research, Jayadevappa (2017) concluded that the patient-centered approach should be embraced by the healthcare organizations as it has effective positive results on the quality of care. Patient centeredness plays important role in Legatum Institute[3] as the outcomes of the index identified by society itself. Being an inseparable part of health care quality measurement, outcomes were calculated based on the "feeling of joy" and "feeling of sadness and worry" indicators. (2017). Furthermore, patient safety in the context of health care is defined as preventing injuries happening as a result of the medical care provided by the health organizations. AHRQ (2018) Patient Safety Network Website defines the patient safety as "freedom from accidental or preventable injuries produced by medical care". This factor is an inseparable part of provision of health care. In the report of the Institute of Medicine (US) Committee on Quality of Health Care in America (2001), it is concluded that for reaching the maximum healthcare service quality, the main step is ensuring the safety of the medical services.

It is always discussed in the literature that healthcare quality has strong correlation with patient satisfaction. In recent years it has caught the attention of the researchers as perception of the patients has a crucial role in the determination of the service level (Abbasi-Moghaddam et al., 2019). Stefko et al. (2019) took the data published by Numbeo[4] (2020) to measure the effects of indicators on the patient satisfaction in selected OECD[5] countries. Health care organizations understand the importance of improving healthcare quality level in order to keep patient loyalty at high levels. So investigation of patient satisfaction is important for policy makers and hospital managers for achieving efficiency and to keep service quality at high levels (Alrubaiee & Alkaa'ida, 2011).

[3] The Legatum Institute (2019) is a London-based think-tank with a global vision: to see all people lifted out of poverty.
[4] Numbeo (2020) is the world's largest cost of living database.
[5] The Organisation for Economic Co-operation and Development (OECD, 2020) is an international organisation that works to build better policies for better lives.

On the contrary side, researchers argue that, the measurement of the patient satisfaction can be biased as a result of some individual factors such as socio-demographic factors which affects patients' perceptions (Naidu, 2009). While some factors have impact positively on the perceptions and satisfaction level, others have negative influence and creates bias in the evaluation process. For example, education is one of the factors that has impact on the patient satisfaction evaluation. Miller & Tucker (2011) discuss this factor in their study and conclude that more educated patients are more inclined to be satisfied from the services of the healthcare system. Another factor that affects the patient satisfaction is the income level of the patients. It has revealed that people who have higher income are more attentive to the quality of the healthcare system and satisfying them is more difficult compared with the people with lower-income. The possible reason is that people with low-income are more concerned about the costs of the services of the healthcare system rather than the quality of services (Mummalaneni & Gopalakrishna, 1995).

Another common measure of healthcare quality is waiting times which was defined as part of timeliness which is a dimension of achieving a high quality healthcare system. The importance of this factor for the healthcare quality measurement is supported with "responsiveness (waitings) in medical institutions" indicator of Numbeo health care index. McMullen & Netland (2013) discussed the relationship between waiting times and the patient satisfaction and found out that there is a significant correlation between them regardless of the cost of the service.

Hypothesis 1: The patient satisfaction has a significant effect on the quality of healthcare.

Demographics of population defines another factor which has direct impacts on the healthcare quality index is the spending on the health care services. As the age level of the population in the country increases, it leads to rising costs spending on the treatment of the patients. This relationship is explained by Zhang & Imai (2007) with the high costs of long-term care which is needed by mostly old patients and the increased probability of having severe complications. It supports the idea of the consideration of the health care expenditures as part of GDP to the measuring indicators of the healthcare quality index. Moreover, one of the indicators of the healthcare quality by Legatum is the Illness and Risk factors which is the measurement of the adult diabetes rate or quality-adjusted life years. Therefore, age

distribution of population is significantly impactful in the measurement of the Illness and Risk factors. (Legatum Institute, 2017)

Although it is important to know the effects of healthcare expenditure on the quality, effectiveness and efficiency of the spending on health care services should also be taken into consideration, which have an important role in the improvements of healthcare quality. The AHRQ (2018) defines the effective healthcare provision with the usage of the best choices of the drugs, equipment which have better outcomes compared with the alternatives and accepts effectiveness as the factor which can be taken into consideration by the policymakers and healthcare professionals while defining the healthcare quality. Sower et al. (2001) investigates the dimensions of service quality for hospitals and found out that effectiveness of spendings is one of the most crucial factors in the improvement of the healthcare quality process. Next to effectiveness, the efficiency is the aspect which is discussed and compared in every topic of healthcare literature (Lo Storto & Goncharuk, 2017). Efficiency has been studied in the investigations done about the quality of healthcare also and found out that it has an important role while determining the quality of medical services. Palmer & Torgerson (1999) defined the efficiency in health care context as the usage of the resources available for getting the maximum value for the money. It measures the efficient usage of the input factors which are the medical equipment, the expenditure to the health care services, or the number of staff to get the highest level of outcomes which are measured by the amount of treated patients with the means of quality indicators such as waiting time. Valdmanis et al. (2008) studied the effects of the inefficiencies in the health care service provision in 34 states and came to the conclusion that efficiency has an inevitable role in the outputs of the process.

Hypothesis 2: Current Health Expenditure as a percentage of GDP has a significant effect on the quality of healthcare.

Equipment for modern diagnosis and treatment is suggested as a variable in order to identify the effect of the number of available equipment on healthcare quality. This can be supported by the research articles done by Xesfingi & Vozikis (2016) and Asandului et al. (2014). The importance of the equipment and modern diagnosis in the healthcare quality supports the idea that governments should allocate sufficient level of resources to Research and Development

of the up-to-date tools. In their study, the Institute of Medicine Committee on Health Research Committee and the Privacy of Health Information supported the idea that investing in Research and Development has a positive effect on the improvements of the equipment used in healthcare (Nass et al., 2009). As the number of medical equipment increases, the waiting time of the service receivers significantly decreases which positively affects the healthcare quality. This highlights the logic behind the usage of variable "Responsiveness (waiting) in the medical institutions" in the calculations of the model by Numbeo (2017). The rapid spread of the coronavirus COVID-19 pandemic proved the importance of the speed in completing examination and reports, which was chosen as the variable of Numbeo model. The countries which allocated more resources for the detection tools of the virus which includes instant tests have more success rates in the prevention of the spread (WHO[6], 2020).

Hypothesis 3: Number of beds has a significant effect on the quality of healthcare.

Hypothesis 4: Research and Development as a percentage of GDP has a significant effect on the quality of healthcare.

The skill and competency of medical staff was identified by the range of literature as one of the determinants of the quality of health care services and it includes the professional knowledge, background, years of experience, number of failure instances of the health care providers which is an important factor for the effective care provision (Bosley & Dale, 2008). The number of the physicians is an input factor which has a contribution to the quality of healthcare as a dimension and is an important indicator which measures healthcare quality. Haberfelde et al. (2005) studied the relationship between the number of the nurses and the patient safety events and found out that when the amount of nurses increases the patient safety and efficiency of the process increases. However, it can lead to increases in the expenses of healthcare and it will cause inefficiency problems. In their research, Deily and McKay (2006) found out that there is a negative relationship between the efficiency and the increase in the number of staff. Xesfingi & Vozikis (2016) defined the association between the number of nurses and physicians per 100000 inhabitants and patient satisfaction and healthcare quality.

Hypothesis 5: Number of doctors has a significant effect on the quality of healthcare.

[6] WHO - World Health Organisation.

Burden of government regulations is discussed by several researches and should not be disregarded while literature analysis. According to Oseran et al., (2018), one of the main problems that healthcare institutions face while improving their healthcare quality is the regulations by the government. These institutions often need to reorganize the work they do in order to comply with the requirements of the government.

Hypothesis 6: The burden of government regulations has a significant effect on the quality of healthcare.

The young part of the population are seeking more innovative and patient-centered provision. This includes the implementation of the new information and communication technologies to the healthcare services which is measured with ICT Development index. Moret et al. (2007) argued this view also and claimed that the young expect more involvement to the decision making process and evaluate healthcare quality with this measurement. Having experienced the advancements in the fields of technologies, the health system benefits its alterations as other industries. Obviously, the ramifications might either be positive or negative depending on the implementation patterns. Chandra & Skinner (2012) emphasize that in case of the appropriate application of the technology on healthcare in the USA, they achieved dramatic positive changes in the healthcare index of the country due to their rising survival rates.

Hypothesis 7: ICT Development Index has a significant effect on the quality of healthcare.

As discussed in the previous literature, the demographics of the population is crucial for the measuring quality of the health care system. Equity is one of the factors that should be taken into consideration while measuring effects of expenditure on healthcare systems which is deeply affected by the number of population. In this context the equitability means "Health Equity" or "Equity in Health" and implies that ideally everyone should have a fair opportunity to attain their full health potential and no one should be disadvantaged from achieving this potential." (*WHO | Health Equity*, n.d.). Mayberry et al. (2006) argues that inequalities in the health care have destructive effects on the quality of healthcare in the countries. Therefore, the amount of the population is one of the important variables that has an effect on the quality of healthcare. It determines the equitability of the health care facilities as discussed in the paper of Culyer (2015).

Hypothesis 8: Population of country has significant effect on the quality of healthcare.

Figure 1. Healthcare quality and affecting socio-economic factors

Source: Derived from literature review.

One of the recent topics discussed in the literature of the health care is the COVID-19 which is also known as Coronavirus. It started from the Wuhan, China, spread to other regions of the world and endanger the healthcare systems of the countries. The research done by the Buja et al. (2020), concluded that socio-economic factors and the quality of healthcare system plays a crucial role in the estimated effects of COVID-19 consequences. One of the prevention methods of the pandemic spread is testing the maximum amount of people (WHO, 2020). Lai et al. (2020) made an investigation on the possible patterns between the healthcare quality and pandemic spread. They claim that the number of cases keep growing in the countries which has higher quality of healthcare while countries with low quality of healthcare report less cases. The explained reason is Healthcare Access and Quality Index (HAQ-Index)[7] which measures health-system characteristics and the reasoning was that countries with better HAQ-Index make more tests and detect more cases. It helps them to slow the speed of the spread while in the countries with less HAQ-Index active cases

[7] The *Healthcare Access and Quality* (HAQ) Index is measured on a scale from 0 (worst) to 100 (best) based on death rates from 32 causes of death that could be avoided by timely and effective medical care (also known as 'amenable mortality'). (2015)

remained undetected. These conclusions supports that the quality of healthcare and socio-economic factors have effects on the spread of the COVID-19.

Data and Methodology

Data

In order to analyse the hypotheses derived in the literature, data is collected from different sources about the indicators. Based on the research question, the paper is going to identify the effects of the variables which are *patient satisfaction, health care expenditure, number of hospital beds per 1000 inhabitants, number of doctors per 1000 inhabitants, the ICT Development Index of countries, the burden of government regulations, population in millions and research and development expenditures as a percentage of GDP*. All the data about the variables was collected at the country level for 77 countries[8], including counties from European Union, Great 20, Africa, Asia and South America. The data for testing the effects of the offered variables was collected from different resources such as Global Health Observatory`s data repositories[9], World Bank databases[10] and other global indexes.

As it is discussed the dependant variable of the research paper is Health Care Index which is taken from "health pillar" of the Legatum Institute (2017). The data is collected from the ranking of the countries in the eleventh edition of The Legatum Prosperity Index (Legatum Institute, 2017). It ranges in between [0:100] and gives information about 149 countries all over the world. While it includes data about 149 countries, only 77 countries have been chosen for the analysis and the rationale of doing it was the lack of the data of other independent variables in the sources where data was retrieved.

[8] Argentina, Australia, Austria, Bangladesh, Belarus, Belgium, Bosnia and Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Estonia Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Jordan, Kuwait, Lebanon, Lithuania, Malaysia, Malta, Mexico, Morocco, Netherlands, New Zealand, Nigeria, North Macedonia, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Vietnam.

[9] The (GHO, 2020), Global Health Observatory data repository is WHO`s gateway to health-related statistics for its 194 Member States.

[10] At the World Bank, the Development Data Group coordinates statistical and data work and maintains a number of macro, financial and sector databases.

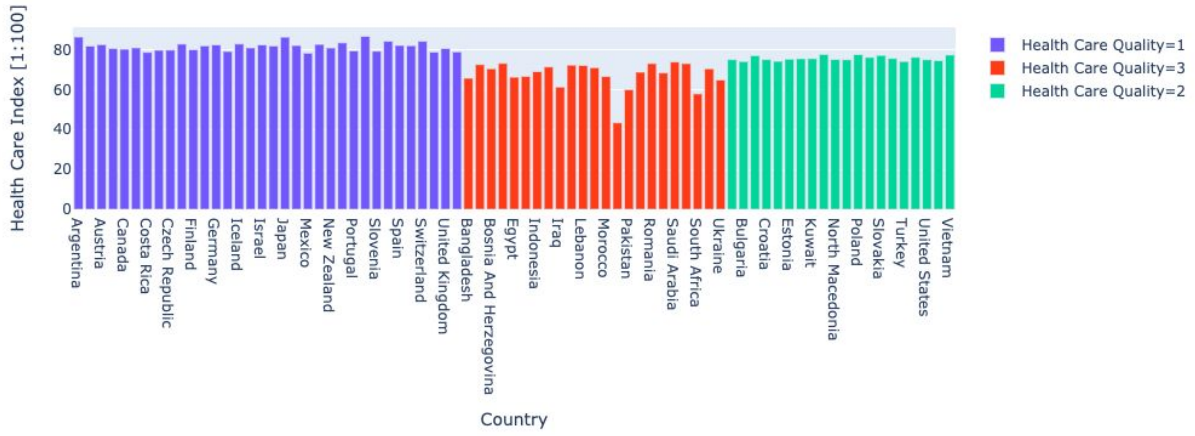

Figure 2. Classification countries based on their healthcare quality.

According to Figure 2, the countries which are visualized with blue color are the countries which have a high level of the healthcare quality with the index value more than 78. The countries which are described with green color are the ones which have a middle level of healthcare quality and range between [74:78]. Finally, the ones which have quality index ranged between [0:74] are the countries which have low levels of healthcare and filled with red color.

As a main reference for the Patient Satisfaction indicator the Health Care Index by Numbeo (2017) was taken, which measures the quality of the health with the patient satisfaction levels in the different countries. As all of the factors in the healthcare index by Numbeo are evaluated by the patients themselves from all over the world (patient-reported), the results are highly relied on the perception of the patients. The data was collected by the visitors of the Numbeo (2020) website based on their experiences in the health care organizations. The survey was conducted in the scale [-2, 2], in which -2 strongly disagree, while +2 is agree. The kind of survey is similar to the governmental surveys like the World Health Organisation conducts. In order to avoid spam, the company used median value. For better visibility the scale of this variable is in [0:100] range. In the measurement of the patient satisfaction, Numbeo takes into account the statistics from 80 countries. The values of the variable distributed normally.

For the second independent variable which is Current Health Expenditure (CHE) as percentage of gross domestic product (GDP) (%) the data is extracted from the databases of

the World Health Organization. The measurement indicates the share of GDP which is spended for health related issues and demonstrates the attention to the health industry relatively to the whole economy. It ranges in between [0:100] and its unit of measurement is percentage (WHO, 2017a).

The next independent variable is number of hospital beds per population (1000 inhabitants) which is the number of hospital beds which are available in all of the medical organizations. The data is collected from the Global Health Observatory databases of World Health Organisation (WHO, 2017b). The aggregation method of the data is weighted average per 1000 inhabitants and updated annually. For example, in Estonia this index is 5 which means there are 5 hospital beds for 1000 people in the country.

Doctors per population (1000 inhabitants) is the next index that is included in the model and the data about this variable is collected from the World Health Organization's Global Health Workforce Statistics, OECD. The data is calculated annually and with a weighted average. The WHO defines the minimum range for this variable as 2.5 medical employees per 1000 people for provision of decent level of health care. For example, in Lithuania it is 4.3 per 1000 people which means there are 4.3 physicians for the 1000 people in the country. (World Bank, 2018a)

The next variable is ICT Development index which is an annual measurement for comparison of the development in information and communication technology (ICT) in the countries. The data is extracted from the official website of the ICT index. The data about this index is collected since 2009, ranges in [0:10] and includes 11 indicators to measure the index. (*ITU | Global ICT Development Index*, 2017)

The burden of government regulation is included in the model and defined as the level of hardness for the implication of policies and their compliance with the governmental administrative requirements (e.g., permits, regulations, reporting). The indicator ranges in between [1:7], in which 1 means extremely hard, while 7 means not hard at all to implement improvements. The data is extracted from the database of the World Bank which was categorized by countries (World Bank, 2018c).

Population in millions is another independent variable that is included in the model as a factor influencing healthcare quality. The data is collected from the website of the Geoba.se[11] about the amount of the population in 77 countries in 2017 (Geoba, 2018).

The last factor included to the model is Research and Development expenditure as a percentage of GDP. The gross domestic expenditures spended on the Research and Development is expressed as the percentage share of GDP and ranges between [0:100]. The index includes the spendings from the businesses, government organizations, education organizations and private non-profit organizations. It is calculated annually and with the weighted average method (World Bank, 2018b).

Model

In order to analyze the relationship between the indicators and healthcare quality, OLS (ordinary least squares) multiple linear regression method has been used. The method estimates the parameters in the model with minimizing the sum of squared residuals. The result of this regression is a line which demonstrate the relationship between independent and dependent variables. Multiple linear regression also known as multiple regression is a method to estimate the values of dependent variable using the estimation of independent variables. For getting predicted values, the collected data is analyzed and visualised in the R and Python statistical programming languages.

By taking into consideration the various aspects of the research, the economic models are described in the following way:

$$y = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8) \quad (1)$$

In the equation (1), y is the Health Care Index, x_1 is Patient Satisfaction , x_2 Current health expenditure (CHE) as percentage of gross domestic product (GDP) (%), x_3 is the number of hospital beds per population (1000 inhabitants), x_4 is the number of doctors per population (1000 inhabitants), x_5 is the ICT Development Index per country, x_6 is the burden of government regulation, x_7 is the population of the country (in millions), x_8 is the research and development expenditure as a percentage of GDP.

[11] http://www.geoba.se/index.php

The econometric style of the model are as the following:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + u \quad (2)$$

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + u \quad (3)$$

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + u \quad (4)$$

Subsequently, the reasons are discussed why those variables are included in the empirical part in order to depict the impact of them on the healthcare quality index for the research below:

The first variable is patient satisfaction which is the estimation of satisfaction from medical services which includes the quality of staff in healthcare organizations, tools used in service provision and cost. Due to Numbeo (2017) the inputs that are used in the calculation of the health care index are skill and competency of medical staff, speed in completing examination and reports, equipment for modern diagnosis and treatment, accuracy and completeness in filling out reports, friendliness and courtesy of the staff, responsiveness (waitings) in medical institutions, convenience of location. Since it includes information from various aspects of the healthcare system, the determination of this metric can open up the opportunities for the countries which have the goal of ensuring the healthcare quality efficiency and patient satisfaction.

Next variable is current health expenditure (CHE) as percentage of gross domestic product (GDP) (%). In their analysis Asandului et al. (2014) discuss that combined government and private spending as the percentage of GDP has a significant effect on health care. A relevant study of Xesfingi & Vozikis (2016) supports the idea that there is a strong relationship between CHE and the condition of health care services. When the amount of money spent by the government to the improvement of the healthcare system which includes preventative actions, public health services, compulsory health insurance and health administration increases, it has a positive impact on the healthcare quality index.

Number of hospital beds per population (1000 inhabitants) is another country-level variable that is included in the model. The total hospital beds are the sum of the number of hospital beds in all the health organizations that are prepared and available at the care of the coming patients and it is directly related to the health care index which is the measurement of the healthcare quality. Du (2017) supported in his paper that the total number of hospital beds is a key indicator for the quality of healthcare services.

Number of doctors per population (1000 inhabitants) is included in the model which has an influence on the healthcare quality index. Although Numbeo (2017) considers the skills and competences of the doctors it does not count the amount of the healthcare staff which provides medical services. "The number of staff is defined as the people who have a degree in medicine at university level (proved by an adequate diploma) and who is licensed to practice; interns and resident physicians (with an adequate diploma and providing services under the supervision of other medical doctors during their postgraduate internship or residency in a healthcare facility); salaried and self-employed physicians delivering services irrespectively of the place of service provision; foreign physicians licensed to practice and actively practicing in the country" (*Foreign-Trained Doctors*, 2008). When there is a shortage of the healthcare staff, the speed, and efficiency of the service level decrease which leads to decreased patient satisfaction and low level of the quality of the service (Asandului et al., 2014).

The ICT Development Index (IDI) is a measure published by the United Nations International Telecommunication Union since 2009 and used to compare the developments in the ICT indicators in the countries. It is one of the tools used in the improvement process in healthcare management to upgrade the quality and productivity of the services. It is included in the model, because inclusion of this tool to the process increases the chance of getting better outcomes from the policy improvements (Bhattacherjee & Fitzgerald, 2012). From the perspective of Miller & Tucker (2011) electronic medical records (EMRs), which is an example of ICT solutions, eases fast and punctual access to patient data. Possessing that records accurately and within a short duration enables treating people much more effectively. They also experienced a drastic change in the number of mortality and all of these factors shows a unrejectable impact on the improvement of healthcare.

In comparison with other sectors, it is more challenging and harder to implement or make changes due to its burden of regulation in the healthcare industry which is another variable included in the model. Conover (2004) notes that the special case from the USA, which is applicable to other countries as well, that the healthcare system failed in a myriad of cases owing to the difficulty of healthcare regulations, and by altering that system to more friendly one they achieved to experience the improvements in the healthcare system. Moreover, Herzlinger (2006) writes that the regulations in the health sector are strictly implemented and restricted seriously in order to prevent fraudulent and incompetent suppliers. It is acknowledged that applying those regulations possesses a crucial positive impact, nonetheless, since these regulations are quite tough they also encounter a negative situation which signifies that the sector needs to adjust a few changes. Fernando Cembranelli (2012) remarks government regulations of health care are able sometimes to aid the healthcare system ("orphan drug" laws provide incentives to companies that develop treatments for rare diseases) and sometimes hinder it. A company with a new health care idea should also be aware that regulators, to demonstrate their value to the public, may ripple their muscles occasionally by tightly interpreting ambiguous rules or punishing a hapless innovator. Therefore, I inserted that variable to the econometric model to analyze the effect of this on healthcare.

Weinberger et al. (2017) increase with population size, and possess positive effects on the healthcare system (positive feedback) as well as costs in terms of negatively affecting the provision of ecosystem services. When the population is increasing then its implementation is getting more challenging due to the difficulty of delivering the effective healthcare system all over the country. Thus, it is crucial to insert this as a variable to my econometric model in order to analyze more efficiently.

Research and development in healthcare aims to achieve a better quality of the services and improve patient experience. Moreover, the more attention paid to research and development of medical services, the more efficiency is achieved in the service provision which proves the importance of including this variable to the model. In their paper, Vera & Salge (2011) come to the conclusion that there is a positive correlation between the R&D and clinical performance. As a result of research and development, new methods and techniques are

identified, however only finding out new methods is not enough for the improvement. The implementation and adoption of innovation successfully is inevitable for success of research and development. In the detailed description of the data about the dependent and independent variables are summarized with statistical measurements. Starting from the Health Care Index which is a dependent variable in our model, Table 1 displays that the maximum value is 86.63 and minimum value is 43.35 in the rage of [0:100]. Moreover, the mean value is ~75.79 which indicates that on average countries have the value of healthcare quality equal to 75.79. The standard deviation of the health care index is 7.22 which shows how much the index values of countries differ from the mean value.

Table 1.Descriptive statistics of the dataset

Statistic	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Health Care Index [1:100]	*75.793*	*7.221*	*43.350*	*72.980*	*80.860*	*86.630*
Patient Satisfaction [1:100]	*64.742*	*10.473*	*36.900*	*57.600*	*71.920*	*83.200*
Current Health Expenditure (% of GDP)	*7.225*	*2.720*	*1.200*	*5.200*	*9.100*	*17.100*
Number of Hospital Beds (for 1000 inhabitants)	*3.795*	*2.652*	*0*	*1.9*	*5*	*13*
Number of Physicians/Doctors (for 1000 inhabitants)	*2.595*	*1.316*	*0*	*1.5*	*3.6*	*5*
ICT Development Index (0-10)	*6.673*	*1.594*	*2.420*	*5.615*	*7.915*	*8.980*
The Burden of Government Regulations (1-7)	*3.385*	*0.848*	*1.650*	*2.780*	*4.050*	*5.610*
Population (millions)	*79.221*	*215.486*	*0*	*6*	*66*	*1,379*
Research and Development (% of GDP)	*1.312*	*1.064*	*0.040*	*0.532*	*1.905*	*4.550*

Patient satisfaction which is the first independent variable in our mode, has the mean value of ~64.74 which indicates that on average patients satisfaction level from the medical services in included 77 counties is 64.74 in the range of [0:100]. Additionally, the maximum patient satisfaction level detected in the data is 83.20 and the minimum value is 36.90 in the dataset.

The deviation of the patient satisfaction levels of the countries from the mean value is ~10.47.

Current health expenditure as the percentage of GDP has the mean value of ~ 7.22 which means selected counties spend on average 7.22% of their GDP to the healthcare sector. In the range of [0:100], the maximum percentage that the countries separate for their healthcare is 17.10 % and the minimum is 1.20 % of their GDP. The results show that the defined deviation from the mean value of the health expenditures as percentage of GDP is about 2.72.

Number of hospital beds included in the model as the indicator that has effect on the measurement of the quality of healthcare. On average, in the countries there are ~3.79 hospital beds per 1000 habitants. The values deviate from the mean value approximately 2.65 hospital beds. The maximum amount of the hospital beds observed in the dataset is 13.40 and the minimum amount is 0.50.

Next independent variable is the number of physicians/doctors for 1000 habitants. As a result of analysis of the dataset on average in countries there are 2.59 doctors per 1000 people. The number of doctors deviate from the mean is 1.31. The maximum number of doctors in the countries is 5.40 and the minimum number is 0. ICT development index which ranges between [0:10] has the minimum amount of 2.42 which is observed in Pakistan and the maximum of 8.98 in Iceland. On average countries have ICT development index of 6.67 and the indexes deviate from the mean in the amount of 1.59. Subsequent independent variable which is the burden of government regulation ranges between [1:7] in the dataset. The country which has the highest burden of government regulation is Singapore with the value of 5.61. On the other hand, the minimum value of government burden is observed in Venezuela with the value of 1.65. On average countries have the burden of government regulations equal to 3.38 with standard deviation of 0.84. Population variable as indicated above represents the number of the people in the countries and shown in millions. On average there are ~79.2 million people in the countries with a standard deviation of 215.4. The minimum number of people is observed in Iceland and the maximum amount is 1379 in China.

Finally, the Research and Development index is one of the factors that has relation with the quality of healthcare and identified as percentage of the GDP spent to the research and

development. On average counties spent 1.31 percent of their GDP to the research and development. The maximum amount of spending done to the research and development is monitored in South Korea with the percentage of 4.55 while the minimum spending is in Iraq with 0.04 percent of their GDP.

Results

For analysing the effects of the independent variables on the dependent variable, the multiple linear regression method used. The results shown in Table 2 describe the significance of the effects of independent variables on the dependent variable, which is Health Quality Index.

Table 2. Regression Results

	Dependent variable:		
	Health Care Index		
	(1)	(2)	(3)
Patient Satisfaction	*0.141***	*0.141***	*0.199****
	(0.057)	*(0.056)*	*(0.059)*
Current Health Expenditure	*-0.378*	*-0.383*	
	(0.279)	*(0.268)*	
Number of Hospital Beds	*0.513***	*0.517***	*0.248*
	(0.240)	*(0.233)*	*(0.273)*
Number of Physicians/Doctors	*-0.038*		
	(0.537)		
ICT Development Index	*3.365****	*3.348****	*2.946****
	(0.613)	*(0.556)*	*(0.427)*
The Burden of Government Regulations	*-1.287**	*-1.281**	*-0.645*
	(0.694)	*(0.682)*	*(0.709)*
Population	*0.003*	*0.003*	
	(0.002)	*(0.002)*	
Research and Development	*0.907*	*0.908*	
	(0.698)	*(0.692)*	
Constant	*52.379****	*52.427****	*46.416****
	(4.561)	*(4.471)*	*(3.686)*
Observations	*66*	*66*	*73*
R2	*0.677*	*0.677*	*0.608*
Adjusted R2	*0.632*	*0.638*	*0.585*
Residual Std. Error	*3.605 (df = 57)*	*3.574 (df = 58)*	*4.571 (df = 68)*
F Statistic	*14.945**** *(df = 8; 57)*	*17.378**** *(df = 7; 58)*	*26.410**** *(df = 4; 68)*
Note:		*p<0.1; **p<0.05; ***p<0.01	

According to the results coming from the Table 2, the decision about the hypotheses derived from the literature review are determined. Table 3 describes the H_0 and H_a for the hypotheses and taking information from the Table 2, it shows the rejection decision of the H_0 for each indicator.

Table 3. Hypothesis testing.

Statement and Description	H_0/H_a	Significance	Reject
1. *The patient satisfaction has significant effect on the quality of healthcare.*	H_0: $\beta_1 = 0$ H_a: $\beta_1 \neq 0$	5%	rejected
2. *Current Health Expenditure as a percentage of GDP has significant effect on the quality of healthcare*.	H_0: $\beta_2 = 0$ H_a: $\beta_2 \neq 0$	10%	not rejected
3. *Number of beds has significant effect on the quality of healthcare.*	H_0: $\beta_3 = 0$ H_a: $\beta_3 \neq 0$	5%	rejected
4. *Research and Development as a percentage of GDP has significant effect on the quality of healthcare.*	H_0: $\beta_4 = 0$ H_a: $\beta_4 \neq 0$	10%	not rejected
5. *Number of doctors has significant effect on the quality of healthcare.*	H_0: $\beta_5 = 0$ H_a: $\beta_5 \neq 0$	10%	not rejected
6. *The burden of government regulations has significant effect on the quality of healthcare.*	H_0: $\beta_6 = 0$ H_a: $\beta_6 \neq 0$	10%	rejected
7. *ICT Development Index has significant effect on the quality of healthcare.*	H_0: $\beta_7 = 0$ H_a: $\beta_7 \neq 0$	1%	rejected
8. *Population of country has significant effect on the quality of healthcare.*	H_0: $\beta_8 = 0$ H_a: $\beta_8 \neq 0$	10%	not rejected

Starting from the first variable which is patient satisfaction, the results of regression indicate that the variable is significant at 5% significance level. The interpretation for this result is an additional unit increase in patient satisfaction leads to 0.141 unit increase in Health Care Index. Thus, the hypothesis 1 is rejected and the results verify that there is a positive relationship between the patient satisfaction and Health Care Index. The next variable is current healthcare expenditure as a percentage of GDP. Although the early hypothesis was

that it has a positive effect on healthcare quality and it was supported by the early studies done by researchers, the results show that healthcare expenditures are significant at the determined significance level. Therefore, there is not enough support to reject H_0 that current healthcare expenditure as a percentage of GDP have effect on healthcare quality. Moreover, number of hospital beds have a positive influence on the Health Quality Index as the result of the regression, so we can reject the null hypothesis that number hospital beds does not have an effect on the healthcare quality and a unit increase in the number of hospital beds leads to a 0.513 unit increase in the dependent variable.

Number of physicians/nurses shows unexpected results than the derived hypothesis. In spite of the fact that in literature the positive effect of this variable was supported by a number of researches, our results show that there is not any significant relationship between these variables. Therefore, we do not have enough support to reject H_0 which indicated that number of beds does not have significant effect on the quality of healthcare.

ICT Development Index is the independent variable of our model, which shows the most significance in the results, so its effect on the Health Care Index is significant at even 1 percent significance level which gives us enough support to reject H_0 which specified that ICT Development Index does not have impact on the dependent variable. The interpretation for this variable is a unit increase in the ICT index results in 3.365 unit increase in healthcare quality. The Burden of Government Regulations is another independent variable, which has negative association with the Health Care Index and it is significant at 10 percent significance level. Although it is not as significant as previous variables it provides us enough support to reject H_0. A unit increase in the Burden of Government Regulations results in 1.287 unit decrease in the Health Care Index. Population is next variable of the regression which found insignificant according to the table 2, and it does not provide enough support for us to reject the null hypothesis about this variable.

Last but not least, expenditure spend on Research and Development was expected to have a significant impact on the healthcare quality, however, the results do not show significance between the dependent variable and Research and Development. Thus, we failed to reject H_0 which indicated that spending on Research and Development does not have effect on Healthcare Quality.

The R^2 of this model is 0.677 which shows the goodness of fit of the model and can be interpreted as 67.7 % of the variability in the Health Care Index is explained by the model. Additionally, adding the penalty of the new variables, adjusted R^2 shows that 63.2 % of the variability of Health Care Index is explained with the model. Although the data was collected over 77 countries, 11 countries contained data with N/A s in their instances and this weakness will be discussed in the limitation of the research part in the following sections.

As it is observed from the discussed model, the number of physicians/ nurses does not have a significant effect on the Health Care Index. Thus, this variable is emitted from the model and the regression was runned again. As a result, the number observations and R square stayed the same. However, the adjusted R square has increased which means this model is better fit relative to the previous one and the dependent variable is explained better with the independent variables in the second model.

For making the results more accurate, third regression has been run in which current healthcare expenditure as a percentage of GDP, number of physicians/nurses, population and research and development spending as a percentage of GDP were removed from the model. The results of the third model shows that the number of observations increased because of the removal of variables, which had N/A in their datasets. However, the decline is observed in the fitting of the mode, so the R squared and Adjusted R squared decreased. In the result of analysis of these three models, the best fit is observed when the number of physicians/nurses is removed from the model.

Discussion

Healthcare sector is one of the most important and “painful” parts of the economy (Stefko et al., 2019). The latest events and spread of the pandemic from China to all over the world, affected the economies of the countries and the lifestyle of the citizens considerably. The current situation of the world proved that the quality of healthcare systems are not ready for such medical problems (World Health Organization, 2020).

Based on the result, which was extracted from our model, the significance of the relationship between healthcare quality and the number of hospital beds has been proved. Moreover, the recent events and reports about the Covid19 showed the importance of the

amount of hospital beds on the speed of recovery process of the patients (Remuzzi & Remuzzi, 2020). The equity of healthcare is also the factor that should be taken into consideration at this point. In the literature and hypothesis deviation part, it was discussed that the equal distribution of the medical services leads to equal access of patients to the facilities. It can be concluded that, as equal distribution of amount of the hospital beds is included to the medical services led to the increased healthcare quality.

The studies analyzed in the literature review suggested that there is a positive association between the Research and Developments and healthcare quality. However, our results show that there is not a significant relationship between these variables. The possible reason for this result is the inefficient usage of the resources. Remuzzi & Remuzzi (2020) did research on how the efficiency of the resource spent is important for the current health care of the World, while it is fighting with the pandemic of COVID-19. It means countries should be careful while making decisions about dedication of the resources to the health care sector, especially while investing in research and development. Therefore, it is possible that the governments allocate sufficient resources to research and development; however, these resources are not used efficiently and cause insignificant relationships between these factors (Malpani, 2008).

The literature review of the paper supports the correlation between the number of professionals in the health sector and healthcare quality. In contrast, our model summarised that, there is no significant correlation between healthcare quality and number of physicians per capita. Watson & McGrail (2009) supports the idea that the number of the healthcare staff does not have any relationship with the quality of the healthcare in their study. The result can be also related to the situation that is happening in the world; as a result of the increases in the number of cases of coronavirus, countries gather all of the human resources in medical sector; they call the retired doctors back to the job, and students of the medical institutions are hired as the doctors or as volunteers to the hospitals (McArdle, 2020). However this does not significantly impact the speed of the pandemic and proves that increase in the amount of the doctors does not lead to the improvement of the quality in the healthcare systems (Tanne et al., 2020). The possible reason is that the COVID-19 proved that people should have quite good immune systems in order to recover. In the instructions provided by the WHO for ceasing the spread of virus, the main recommendation is self-isolation for the group of

people who have weak immune system, because they are the main risk group in the society (*WHO, (2019).Pdf*, n.d.). Moreover, as discussed in the literature by Bosley & Dale (2008), the skills and competencies of the doctors are very significant determinant of the healthcare quality, so not the quantity of the staff but the quality of the physicians/nurses such as the educational level and professional background of the doctors is more important in the predicted relationship.

The results of the regression showed the most significant relationship between the dependent and independent variables was observed in the ICT development index and this conclusion was also supported by the literature. In a digitized world, the effects of the information and communication technologies in all the sectors is undeniable and it is obvious that it should have a significant effect on healthcare quality in a positive way. This factor not only has important effects on the dependent variable, but also on the tracking of the other variables. For example, information and communication tools can be used to track the patient satisfaction which is another independent variable of the healthcare index. Furthermore, the role of the ICT in the treatment of the COVID-19 is undeniable. In their study, Okereafor & Olajide Adebola (2020) and Zaman et al. (2020) discussed the potential benefits of implementing ICT solutions to healthcare and came to the conclusion that it has a huge impact in the process of "war" with the pandemic.

Limitations of the Study

During the data collection process, several limitations were observed. The most common limitation in the data collection process is the lack of the information about the countries. For example, the database about research and development expenditure (% of GDP) does not contain information about Venezuela, Ecuador, Lebanon, Morocco and some other countries. Moreover, in the database where the information about the number of hospital beds per 1000 inhabitants is shared, updated information was missed. For example, although the numbers about most of the countries are from 2017, in some countries numbers are extracted from the last updated dates because of the lack of updates. Another limitation is the lack of literature and data on COVID-19, thus although the findings of the analysis can be applied to the further investigations. Lack of the previous research about the pandemic prevented the desired implementations of derived results.

Conclusion

This paper studied the potential effects of the socio-economic factors on healthcare quality measured with the Health Care Index. The analysis has been done over the 77 counties and with the data of 2017 and some key findings are identified. The results concluded that the healthcare quality is significantly affected by the ICT Development Index, Patient Satisfaction, Number of Hospital Beds per 1000 habitants, and the burden of Government Regulations. Among the other variables, Current Healthcare Expenditure, Population, Number of Physicians/Nurses per 1000 habitants , and Research and Development does not show significant relationship with the Health Care Index. All the results and findings are discussed with the real case of spread of COVID-19 coronavirus and its treatment process.

The findings of the study give motivation for further research. The possible research topics of future studies can focus on the impacts of spending to the Research and Development and the efficiency level of its allocation. Moreover, the study showed unexpected results on the relationship between the healthcare quality and Current Healthcare Expenditure, number of doctors and spending on the research and development. Further researches can dive deeper to these aspects of the healthcare, for example, current healthcare expenditures can be researched with seperated into 2 sources: private and public spendings. Another possible research topic is adding the metrics measuring knowledge and skills of the staff in the hospitals and then see the relationship between the healthcare quality and number of physicians. Finally, this study analyzed the effects of these indicators only on the Legatum Index, further researches can make comparative analysis and see the results of these indicators over the other indexes which can be a measurement of the healthcare quality such as Healthcare Access and Quality Index (HAQ Index).

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Appendices

Appendix A: Data Overview

Table A1. Overview of Data

Name	Definition	Measure Unit	Source
Indexes			
Health Care Index	Measurement of the healthcare quality in the defined territories	[0:100]	The Legatum Prosperity Index
Patient Satisfaction	Patient satisfaction levels in the different countries	[0:100]	Numbeo
Current Health Expenditure	Monetary resources dedicated to the Health Sector	[0:100]	WHO
Number of Hospital Beds	The number of hospital beds which are available in all of the medical organizations	Amount per 1000 inhabitants	WHO
Number of Physicians/Doctors	The number of doctors which are available in all of the medical organizations	Amount per 1000 inhabitants	WHO, Global Health Workforce Statistics, OECD.
ICT Development Index	An annual measurement for comparison of the development in information and communication technology (ICT) in the countries	[0:10]	Official website of the ICT index

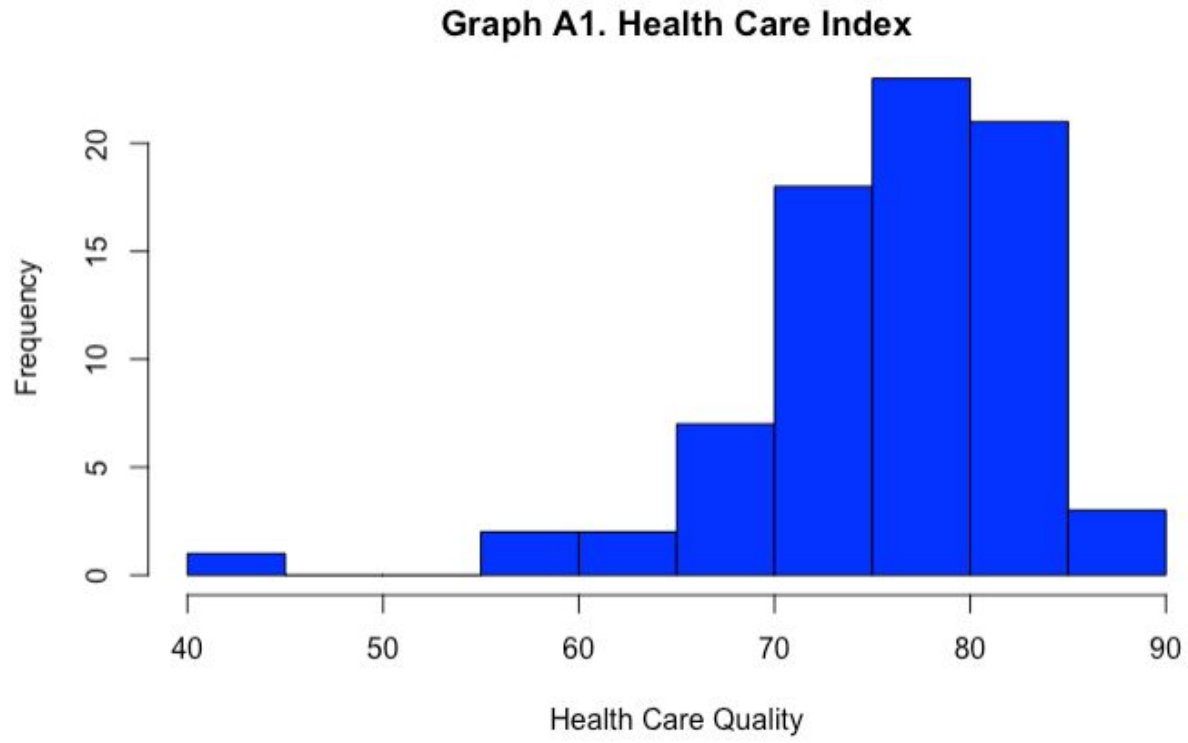
The Burden of Government Regulations	Implication of policies and their compliance with the governmental administrative requirements	[1:7]	World Bank
Population	Number of people living in the selected country	In millions	Geoba.se
Research and Development	Gross domestic expenditures spended on the Research and Development	[0:100]	World Bank

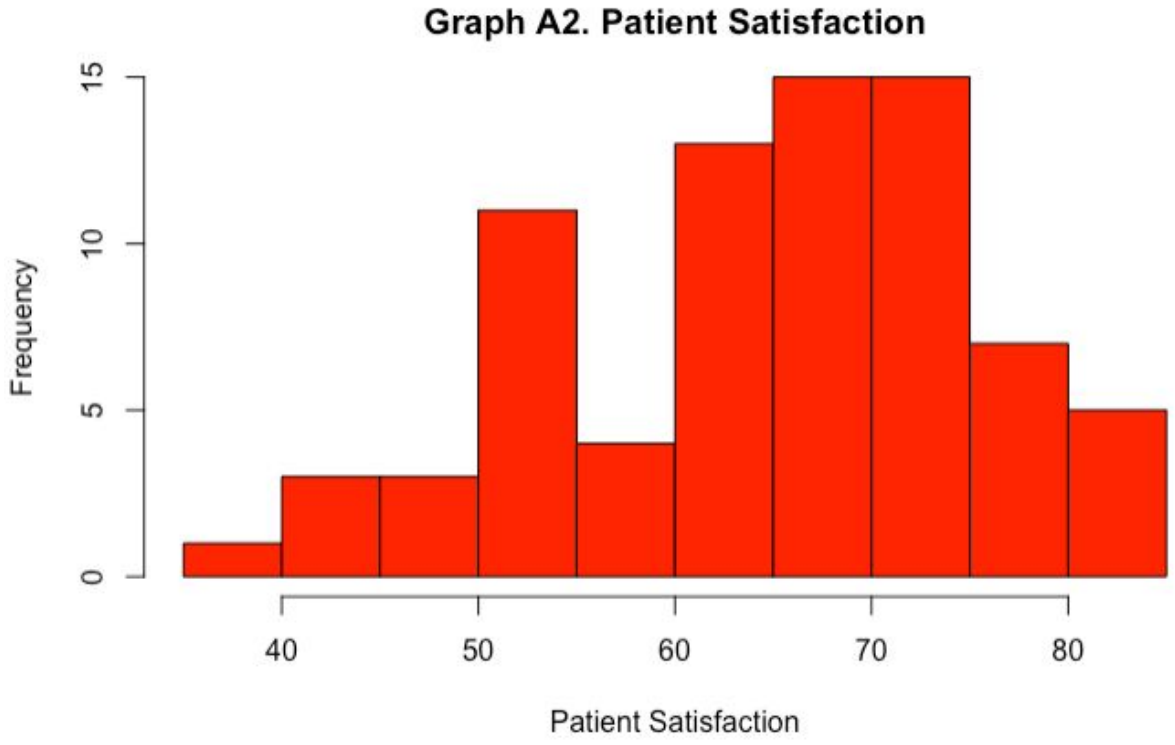
Appendix B: Correlation Matrix

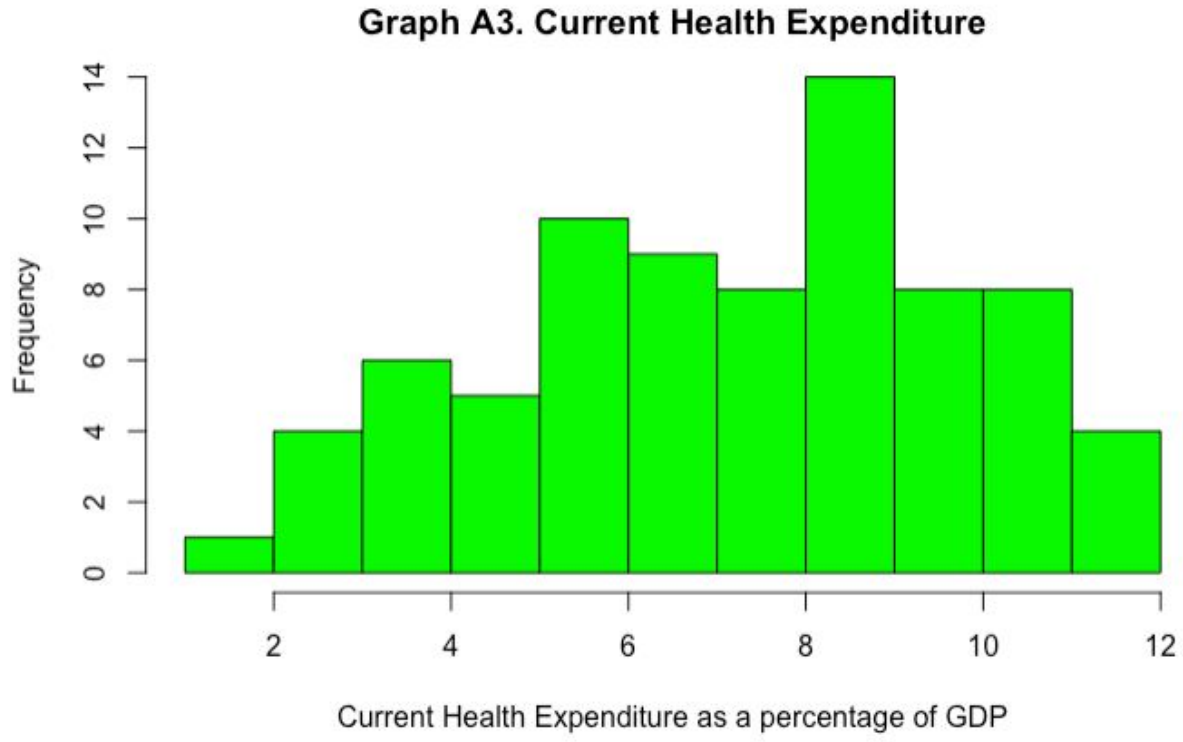
Table A2. Correlation Matrix

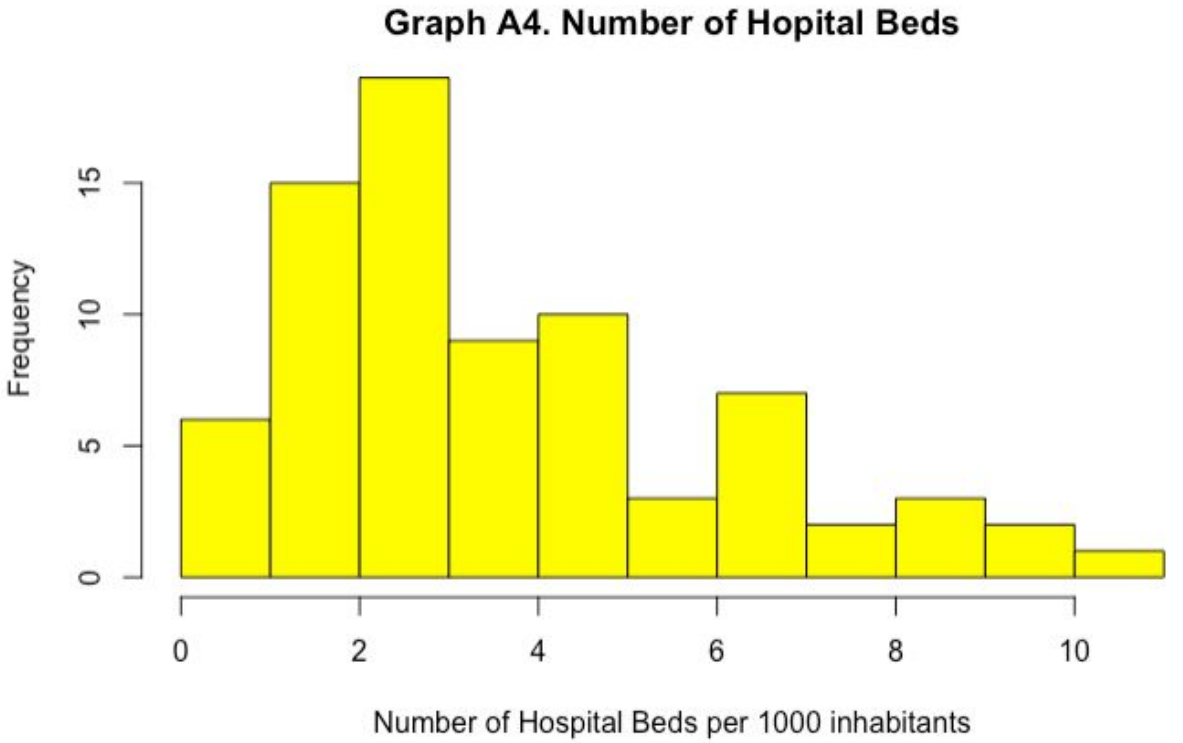
	hecareind	ptsf	che	beds	doctors	ict	gogreg	pop	rnd
hecareind	1	0.569	0.509	0.306	0.569			-0.153	
ptsf	0.569	1	0.473	0.242	0.385			-0.032	
che	0.509	0.473	1	0.379	0.643			-0.218	
beds	0.306	0.242	0.379	1	0.554			-0.133	
doctors	0.569	0.385	0.643	0.554	1			-0.261	
ict						1			
gogreg							1		
pop	-0.153	-0.032	-0.218	-0.133	-0.261			1	
rnd									1

Appendix C: Histogram of the indicators.

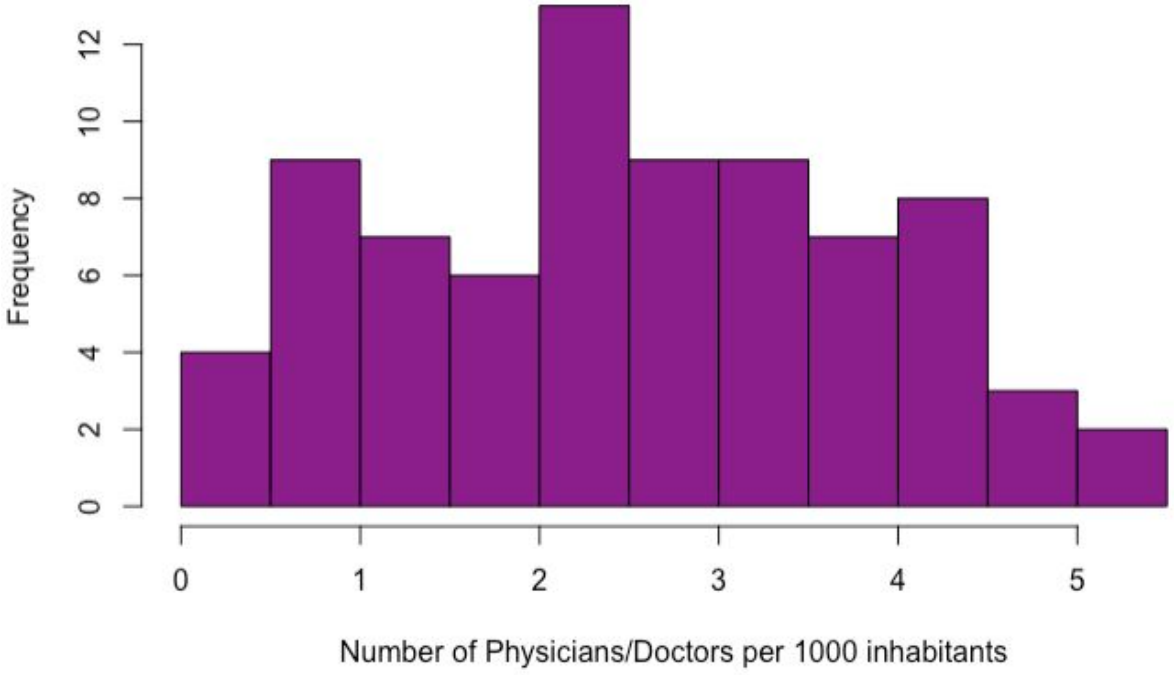




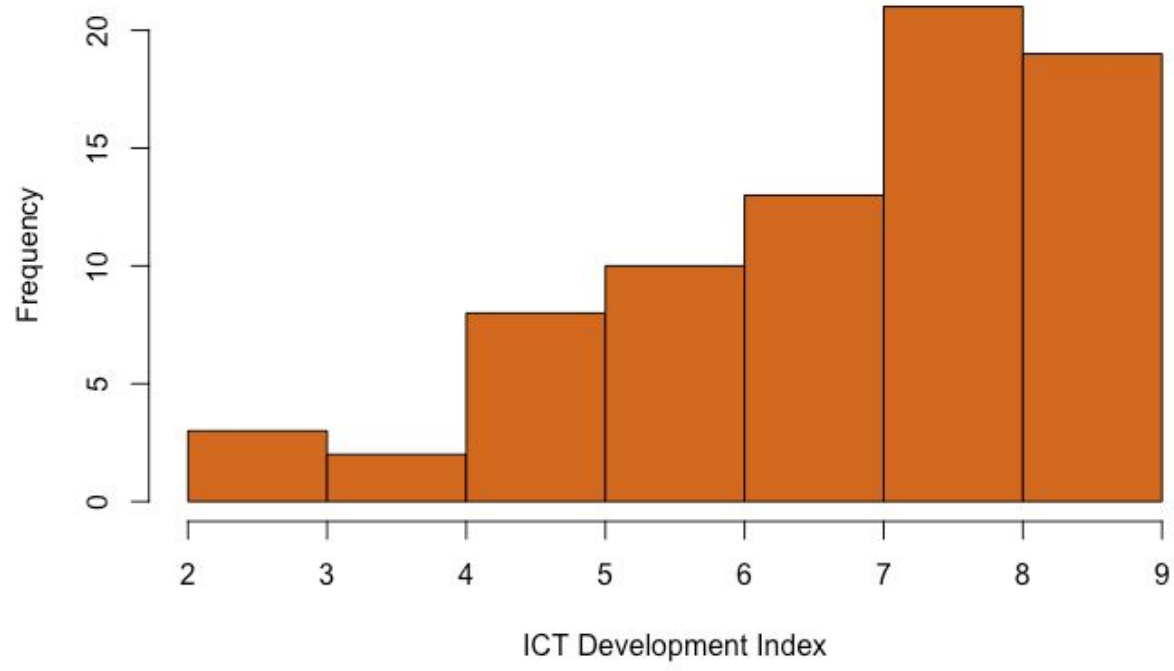

Graph A3. Current Health Expenditure
Frequency
0
2
4
6
8
10
12
14
2
4
6
8
10
12
Current Health Expenditure as a percentage of GDP

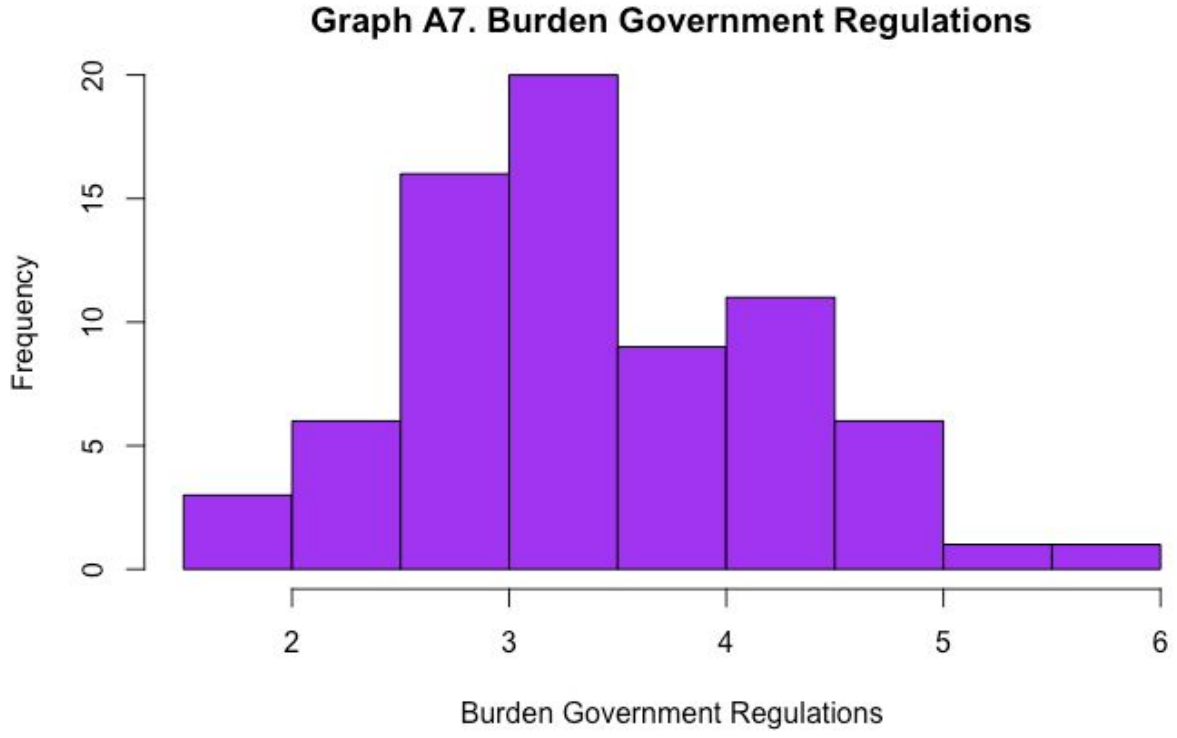

Graph A4. Number of Hopital Beds
Frequency
0
5
10
15
0
2
4
6
8
10
Number of Hospital Beds per 1000 inhabitants

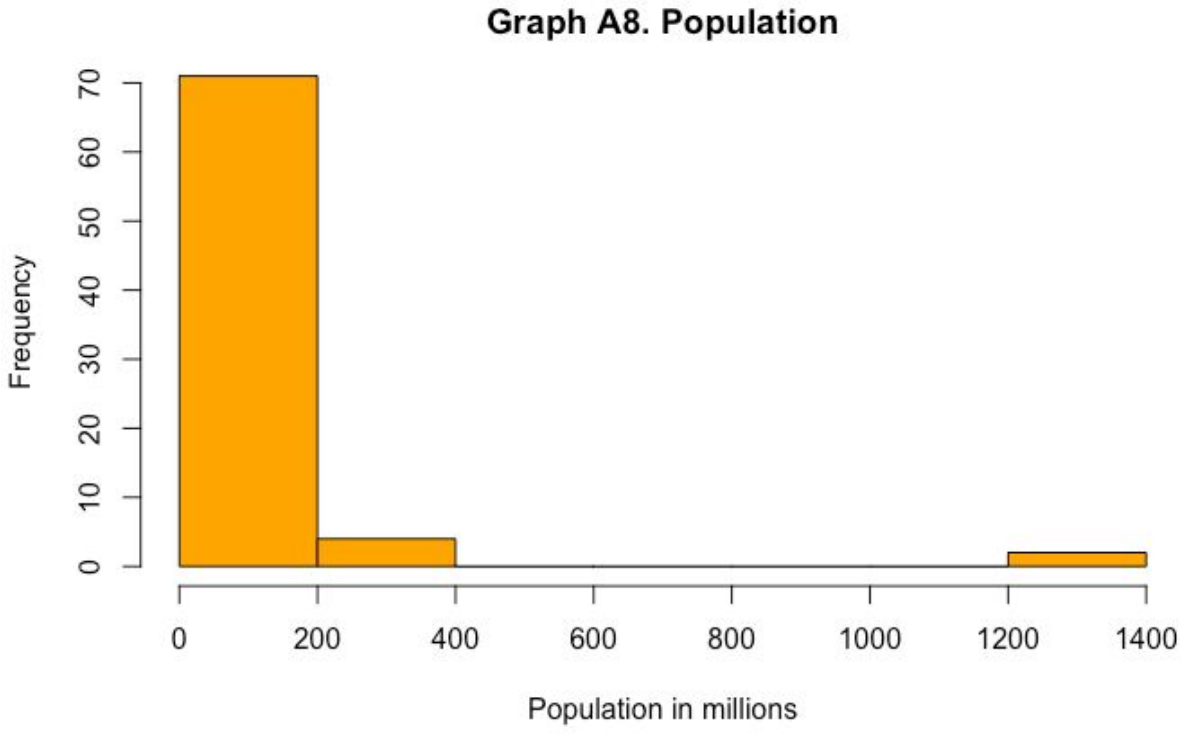
Graph A5. Number of Physicians/Doctors

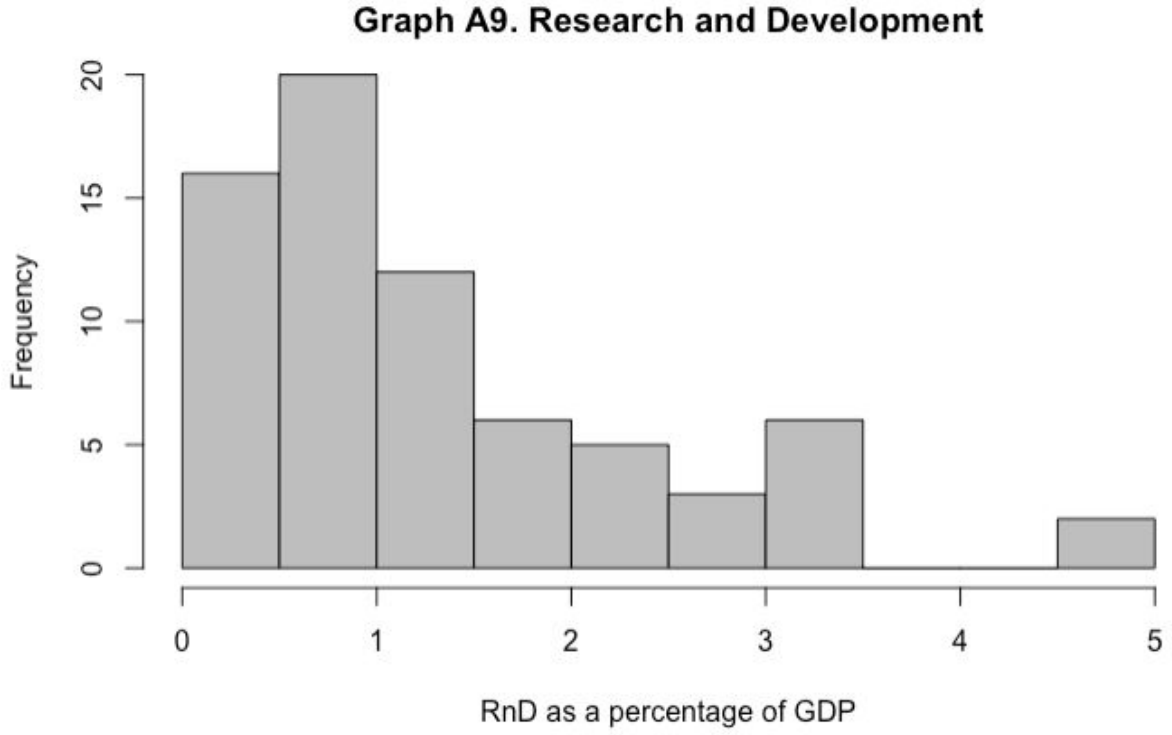


Graph A6. Information and Communication Technologies




Graph A7. Burden Government Regulations
Frequency
0
5
10
15
20
2
3
4
5
6
Burden Government Regulations


Graph A8. Population
Frequency
0
10
20
30
40
50
60
70
0
200
400
600
800
1000
1200
1400
Population in millions


Graph A9. Research and Development
Frequency
0
5
10
15
20
0
1
2
3
4
5
RnD as a percentage of GDP

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