World Development Indicators: Discovering high-weighting factors for the economic growth of Bulgaria, Czech Republic and Romania

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Abstract: Background: Economists have created various measures to assess the development of a nation or a country. The ability of people to make extended democratic choices, having variety of employment opportunities, access to high quality education and healthcare facilities, as well as clean and safe physical environment defines the level of economic progress in different countries.

Objectives: The aim of this paper is to discover the key determinants of economic growth of part of the lower developed territorial district, namely for the three countries Bulgaria, Romania and Czech Republic.

Methods: In this research we use data from the World Bank representing a set of the world development indicators. Three Eastern European countries, part of the European union, including Bulgaria, Romania and Czech Republic are investigated in the study. Random forest technique is used to identify the features' importance. Linear regression is applied next to select the most relevant factors related to the GDP growth among the selected countries.

Results: The results point out that the most important indicators for the economic development differ on country level. Some of the strongest predictors are level of employment, production, level of urbanization, communication and computer service import, percentage of merchandise import and commercial service export.

Conclusion: The conducted analysis reveals that the three countries should use their strengths and pay more attention on improving work and operational environment, using new technologies and ensuring high-quality of goods and services. Working together with the other European countries, they might lend each other a hand and grow economically as part of the European union.

Keywords: Economic Development; Economic Growth; GDP; Eastern European Countries, Covid-19 pandemic

JEL: O01, O04

Introduction:

Economic growth is a function of many economic indicators and represents the aggregate production and quality of life of any nation. It indicates the capacity of public goods and services for a time of period. The economic growth reveals a continuous process that follows a certain trend and reflects to the changes that have arisen from different economic circumstances.

It is observed that in comparison with part of the European union, where there is a concentration of countries with well-functioning economies, the eastern region shows lower values of the main indicators for economic growth.

The aim of this paper is to discover the key determinants of economic growth of part of this territorial district, namely for the three countries Bulgaria, Romania and Czech Republic. Additional aim of this research is the creation of predictive model for the economic growth of the selected countries.

The subject of the research are indicators for development of the European countries included in the data, provided by the World Bank about world development indicators. To achieve the formulated goal, three countries, including Bulgaria, Romania and Czech Republic, are selected for the analyses. The observations period, used for testing the different models is 20 years (2000-2020).

The literature presents various factors that affect the economic growth of the countries: human development index, political stability, gross domestic product (GDP), industrialization, and freedom, science-technology-innovations, human capital, stock market activity, foreign direct investment, CO_2 emissions, ICT development, levels of urbanization, technology and tertiary education, institutions, tourism, energy consumption, export expansion, mobile telecommunications, agricultural productivity and income inequality.

Most researchers report that these factors are usually interacting with each other.

According to the World Population Review (2021), a developed country is a sovereign state with a developed economy and technologically advanced infrastructure compared to other nations. The review reveals several factors that determine whether a country is developed, such as the Human Development Index, political stability, gross domestic product (GDP), industrialization, and freedom. Countries that are not quite yet developed are called developing countries. The Human Development Index (HDI) is developed by the United Nations to measure human development in a country. It is quantified by looking at a country's human development, such as education, health, and life expectancy.

Al-mutawkkil et al. (2009) show in their research that information and communication technology (ICT) development is a main growth factor of many countries.

Senera & Sarıdoğan (2011) point out that countries which have science-technology-innovation oriented global strategies have sustainable competitiveness and long run growth. According to their research, time and country factors are also very significant for the country-level analysis.

Another study of Lam & Shiu (2010) examines the impact of mobile telecommunications on economic growth. The results indicate that there is a bidirectional relationship between real gross domestic product (GDP) and telecommunications development for European and high-income countries.

Another research (Chakraborty, 2004) reveals that human capital drives economic growth. Moreover, high mortality societies do not grow fast since shorter lifespans discourage savings and reduce returns on investments like education, which is related to development traps. High mortality in poor countries is also connected with widespread poverty and inadequate living conditions.

Another study (Carp, 2011) reported that emerging stock markets have a key role in the international economy, and their effects on economic growth can be transmitted to the real sector through their specific channels: liquidity, market capitalization, risk sharing and diversification. In general, there is a strong correlation between economic development and stock market activity, because stock markets allow people, firms and institutions to invest their savings in productive activities (Forti et al., 2011). Moreover, investment in stocks is a form of long-term saving that is invested directly in production activity.

Several researches (Borensztein et al., 1998; Findlay,1978; Wang, 1990) point out the role of foreign direct investment in the technological progress of developing countries. Borensztein et al. (1998) find out that foreign direct investment (FDI) is contributing relatively more to growth than domestic investment. However, their results suggest that the higher productivity of FDI holds only when the host country has a minimum threshold stock of human capital. The authors conclude that FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host economy.

Arouri et al. (2012) investigate the relationship between carbon dioxide emissions, energy consumption and economic growth in for 12 Middle East and North African Countries for a period of 24 years. The authors show that GDP exhibits a quadratic relationship with CO_2 emissions for the region, using annual data from World Bank Development Indicators (WDI).

According to Eggoh et al. (2011) increasing energy consumption increases growth, and vice versa and this applies for both energy exporters and importers. The authors also point out that there is a difference in the cointegration relationship when country groups are considered.

Knox (2020) reports that levels of urbanization are closely correlated with levels of economic development, because urbanization involves a complex set of economic, demographic, social, cultural, technological, and environmental processes. Another study on this topic (Nguyen & Nguyen, 2018) concludes that there is at least a causal relationship between urbanization and economic growth and urbanization positively impacts economic

growth. However, the relationship between urbanization and economic growth is non-linear. The study shows that urbanization has the potential to accelerate the economic growth, and this potential depends on the establishment of favorable institutions and investments in appropriate public infrastructure.

A number of empirical researches examine the relationship between tourism development and economic growth (Oh, 2005; Nissan et al., 2011; Rasool et al., 2021; Selimi et al., 2017, Soukiazis and Proença, 2008). Rasool et al. (2021) conclude that the causality between inbound tourism and economic growth is bi-directional. Soukiazis and Proença (2008) report that tourism contributes to economic growth and development of countries, and improves the life standard, thus promoting a process of regional convergence and stimulating domestic demand.

Another research (Kavoussi, 1984) investigates the relationship between export expansion and economic growth using data for observation period of 18 years. It shows that in both low- and middle-income countries, export expansion is associated with better economic performance and that an important reason of this relationship is the desirable impact of exports on total factor productivity.

Another research (Matsuyama, 1992) finds significant relationship between agricultural productivity and economic growth. For the closed economy case, the model predicts a positive link between agricultural productivity and economic growth, while, for the small open economy case, it predicts a negative link. The authors conclude that the openness of an economy should be an important factor when planning development strategy and predicting growth performance.

The study of Shin (2012) investigates the effect of income inequality on economic growth. The author concludes that both positive and negative effects are possible – that is, higher inequality can retard growth in the early stage of economic development and can encourage growth in a near steady state.

1. Material and methods

1.1. Data sources

This research uses widely use statistical data for world development indicators (WDI) and time series from the World Bank on the following topic areas: Agriculture & Rural Development, Aid Effectiveness, Climate Change, Economic Policy & External Debt, Education, Energy & Mining, Environment, Financial Sector, Gender, Health, Infrastructure, Labor & Social Protection, Poverty, Private Sector, Public Sector, Science & Technology, Social Development and Urban Development. The World Development Indicators is a compilation of relevant, high-quality, and internationally comparable statistics about global development and fight against poverty.

1.2. Study design and participants

This is an intertemporal cross-country research. The world development indicators data are used to define the relationship between different factors and economic growth. The research focuses on three European countries, namely Bulgaria, Romania and Czech Republic, which are part of the lower developed region of Europe. These three countries are interesting to be investigated, because two of them (Bulgaria and Romania) show the lowest values of the indicators for economic growth, and the third one show significantly better socio-economic factors and can be used as a benchmark in order to make the comparisons of the main determinants of economic growth.

1.3. Data extraction and data preparation

For the purposes of the research, we use the most recent dataset for WDI, consisting of 641 indicators for European countries. The data are pre-downloaded in .csv format and imported into R software. For the aim of the analysis, only variables with low percentage of missing observations are selected. For a clearer idea of the missing values, a summary of the information contained in the data set is created, with the number of missing observations and their percentage in relation to the total number of observations.

Analyses are conducted for representativeness of the differences between the more and the less developed countries in Europe in terms of different indicators for economic growth.

Data transformations and selection of predictive variables are done based on literature review for the most important indicators for economic growth. Additional selection of variables is done based on and features' importance results from decision tree and random forest algorithms. The observation period selected for testing the models is 20 years (2000-2020).

1.4. Economic growth

Gross Domestic product (GDP) measures the economic state of a country, and therefore predicting GDP is important to make policy-decisions concerning the economy. For our research, the chosen target variable is the numerical indicator **"GDP per capita growth (annual percentage)"**. This feature possesses values in the range from -6.032 to 11.144 for all the EU region from the 20 years period (2000-2020). Each selected country in our study has different variation of this indicator due to the specifics of inner national economic processes. In Czech Republic the range of the target variable varies from -5.199 to 6.478, while in Bulgaria the values fluctuate from -2.750 to 8.278. In Romania highest variation between the minimum and maximum value for this characteristic is observed: from -4.727 to 11.144.

1.5. Covariates

Binning is one of the techniques performed at the level of data preparation in our research to reduce the effects of minor observation errors and accomplish small bins with representative values of our explanatory features. Some of the numeric characteristics in the dataset like "Communications, computer, etc. (% of service imports, BoP)" and "Air transport,

registered carrier departures worldwide" have been binned into values from 1 to 4 based on their quartile values.

1.6. Statistical analysis

Decision tree algorithms are applied in order the best predictors of our target feature to be found. Random Forest technique is used to identify the variables' importance. Linear regression technique is used to find linear dependance between our response variable "GDP per capita growth (annual percentage)" and the important predictors for each of the three countries, pointed out in the results from the tree-based algorithms. Each explanatory characteristic is observed for statistical significance in the model. R software is used for all analyses.

The formula of the regression model represents the equation between the dependent variable and uncorrelated explanatory characteristics for each of the country:

GDP per capita growth (annual %) for Czech Republic (Linear Regression model) =

β_0 *(Intercept)* + β_1 Changes in inventories (current LCU) +
β_2 Food imports (% of merchandise imports +
β_3 Fuel imports (% of merchandise imports) +
β_4 Unemployment with basic education (% of total labor force with basic education) + *e*

GDP per capita growth (annual %) for Bulgaria (Linear Regression model) =

β_0 *(Intercept)* + β_1 Birth rate, crude (per 1,000 people) +
β_2 Commercial service exports (current US$) +
β_3 Communications, computer, etc. (% of service exports, BoP) +
β_4 Fuel imports (% of merchandise imports)
β_5 Net financial account (BoP, current US$) + *e*

GDP per capita growth (annual %) for Romania (Linear Regression model) =

β_0 *(Intercept)* + β_1 Age dependency ratio (% of working-age population) +
β_2 Air transport, registered carrier departures worldwide +
β_3 Communications, computer, etc. (% of service exports, BoP) +
β_4 Employment in industry (% of total employment) (modeled ILO estimate) +
β_5 Net financial account (BoP, current US$) + e

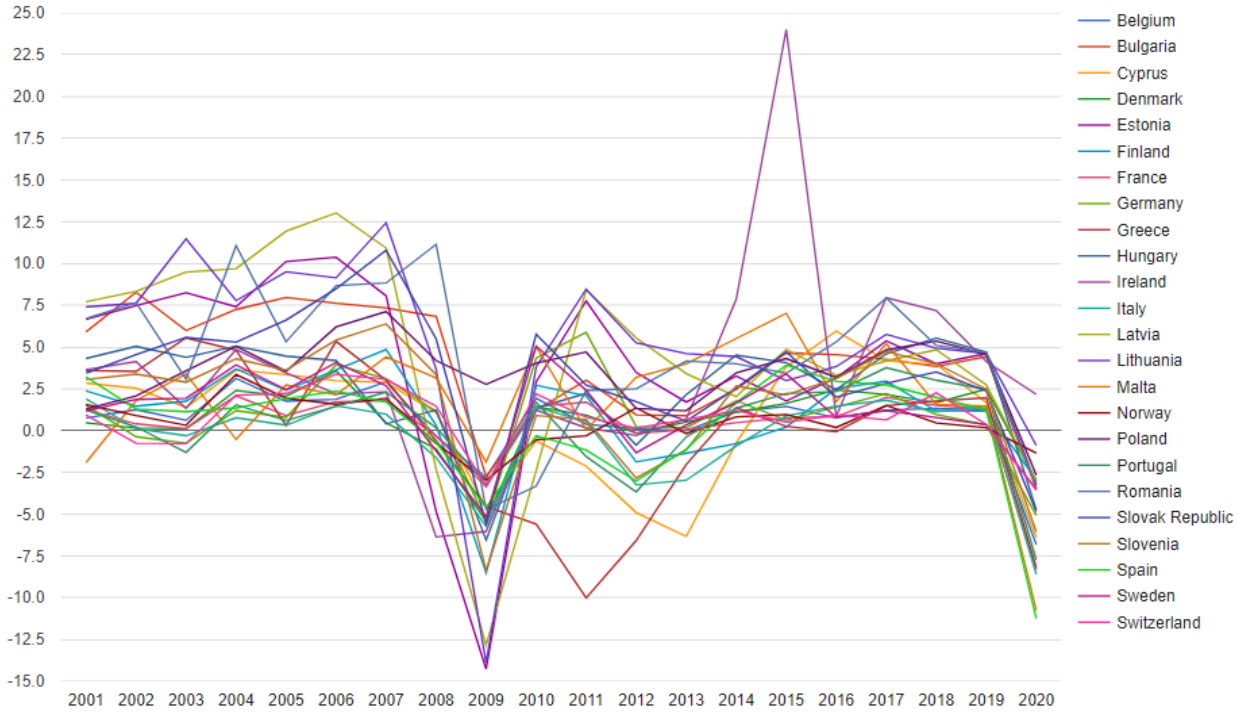
Each vector (β) from the equation brings a score which impact in our explanatory regression model for each observation or each cohort (calendar year).

2. Results

2.1. Sample overview and demographics

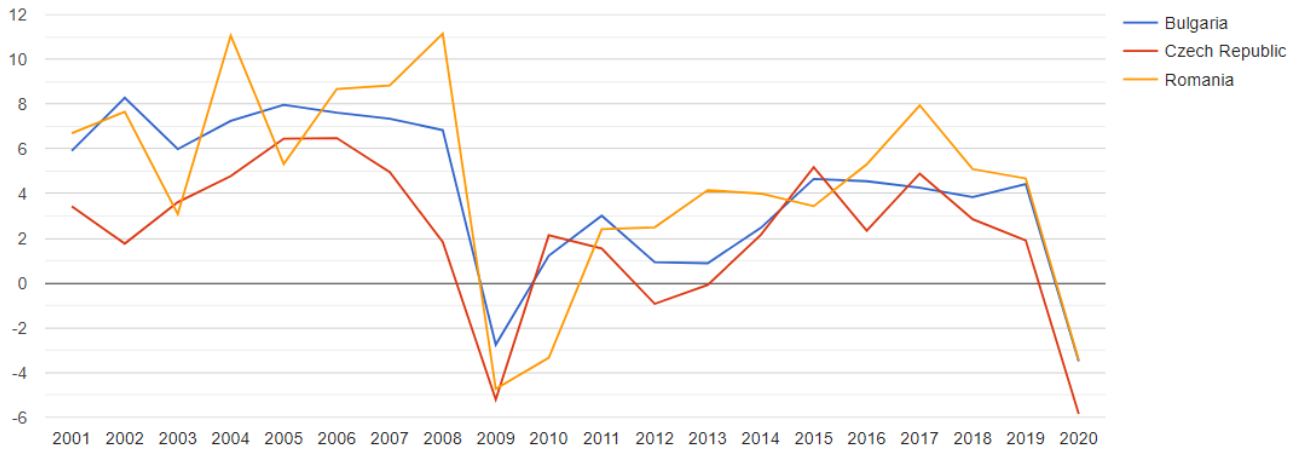
Fig. 1 shows that there are similarities in the evolution of GDP per capita growth (annual %) among the European countries. There is a significant decrease in the GDP growth rate in all countries after the world economic crisis in 2008. Similar trend is observed in 2020 since the outbreak of the global pandemic.

Fig. 1: Evolution of GDP per capita growth (annual %) among the European countries



The analyses of the three selected European countries in this research are following the same tendency in terms of annual growth (Fig. 2).

Fig. 2: Evolution of GDP per capita growth (annual %) per selected countries



Looking at the demographic indicators for 2019 before the Covid-19 crisis, we see there are slight differences between the eastern region and the other European countries. (Fig. 3)

The average life expectancy for the region belongs to the interval 74-83 years. For Bulgaria this indicator is equal to the minimum of 74 years, for Romania – 75, and Czech Republic – 79.

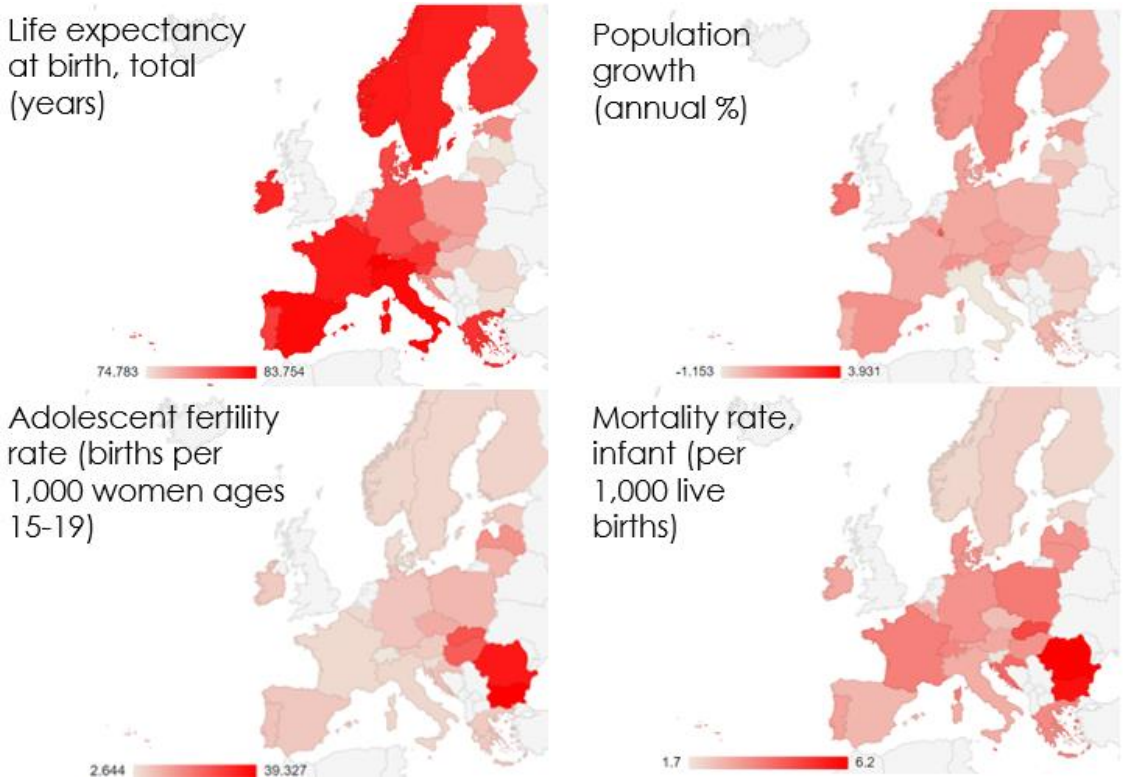
The adolescent fertility rate (births per 1,000 women ages 15-19) is between 9 and 39 for eastern region and significantly lower (2-10) for the other countries. For Bulgaria this indicator is equal to 38, for Romania - 34, and for Czech Republic 11.9.

The values of the indicator mortality rate, infant (per 1,000 live births) lies in the threshold 2.5-5.7 for eastern region, and quite lower for other countries. In Bulgaria and Romania, the observed values of this factor are the highest in Europe - 5.6 and 5.7 respectively, while in Czech Republic the value is at the minimum of 2.5.

The population growth (annual %) index for the eastern region is between -0.7 and 0.4, and higher for other countries. Bulgaria is again at the minimum point of -0.7 and for Romania this indicator is slightly higher (-0.5). On the other hand, in Czech Republic, we see the highest value for the eastern region (0.4).

Results show that there is similar situation in Bulgaria and Romania in terms of deteriorated demographic situation in comparison with Czech Republic, where relatively favorable demographic development is observed.

Fig. 3: Demographic indicators for the European countries at the most recent available observation date



The analyses of indicators related to education & health before the outbreak of global pandemic reveals that Bulgaria and Romania lag behind compared to Czech Republic (Fig. 4).

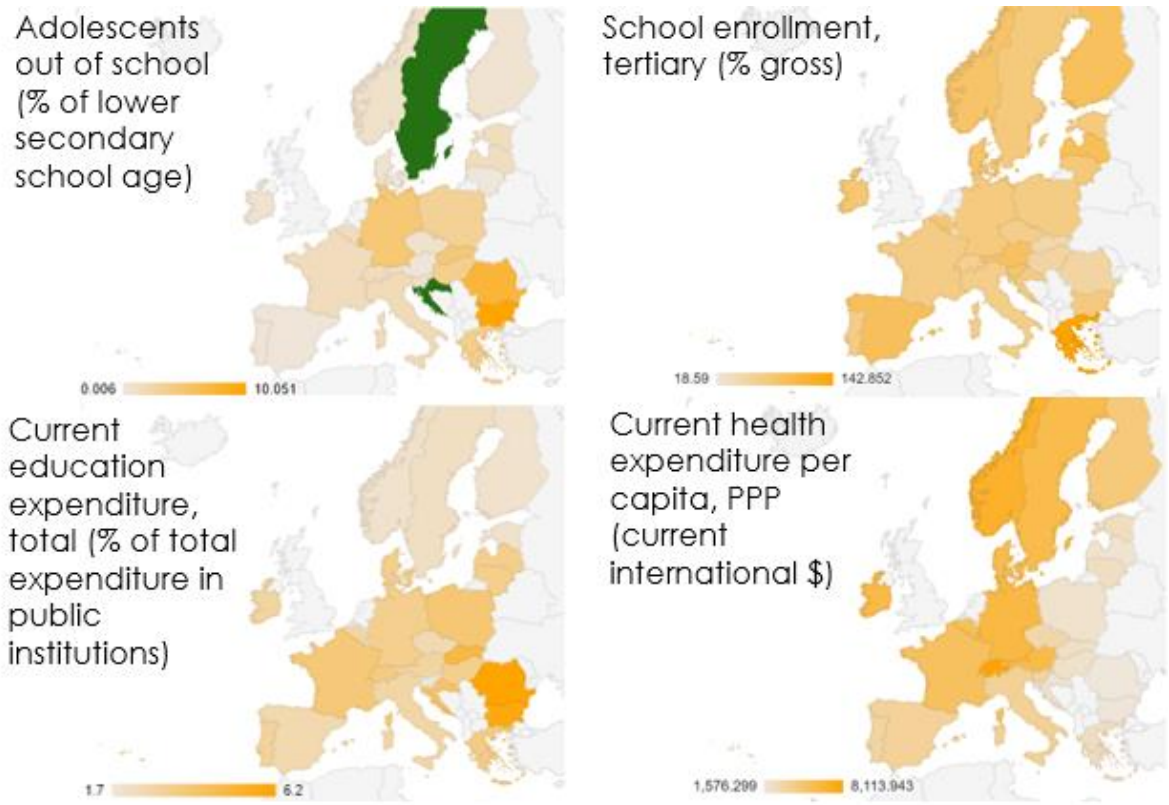
The values of the indicator adolescents out of school (% of lower secondary school age) are in the interval between 3-10% for eastern region and lower for the other countries. Again, in Bulgaria the maximum of 10% is presented, while in Romania the percentage is 25% better (7.4%). In comparison with the two countries, in Czech Republic this indicator is equal to 0.6% which is quite lower than the average minimum for the region.

In terms of school enrollment, tertiary (% gross), the percentage for the region is between 45-71% and a little higher for most of the other countries in Europe. For Bulgaria the value of this indicator is 71.5%, while in Romania and Czech Republic, it is slightly lower, 51% and 63.7% respectively.

The current education expenditure, total (% of total expenditure in public institutions) is in the range 2.5-6.2% for eastern region, and lower for the other countries. Looking at the selected countries we can see that the maximum value is observed in Romania 6.2%, followed by Bulgaria with 5.9%, while in Czech Republic we observe the minimum for the region (2.5%).

The current health expenditure per capita, PPP (current international $), is between 1.5-3 for eastern countries and higher for the other countries. The figures show that in Bulgaria and Romania the value of this indicator is closed to the minimum for the region (1.6), while in Czech Republic the maximum value of 3.0 is presented.

Fig. 4: Indicators related to education & health for the European countries at the most recent available observation date



Regarding the economic indicators, Czech Republic is again significantly ahead of the other two countries in its development (Fig. 5).

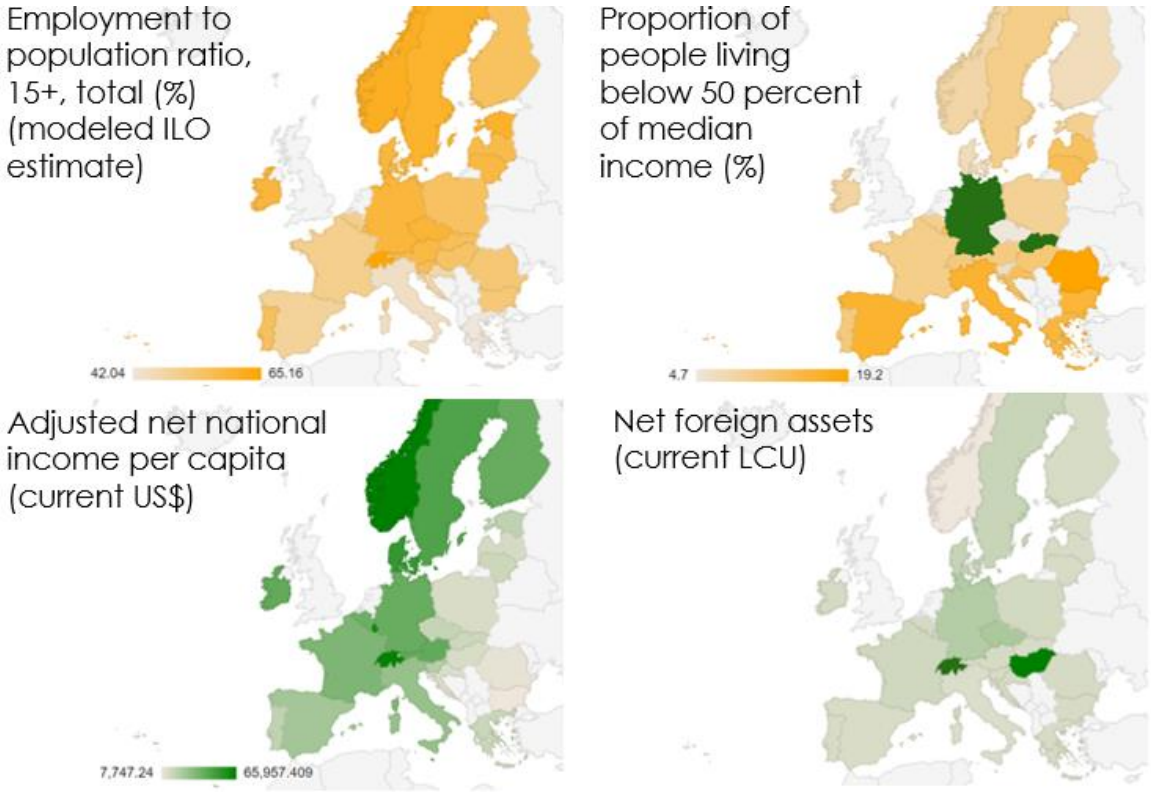
In 2020 the indicator “employment to population ratio, 15+, total (%) (modeled ILO estimate)" is in the range 51-58% for eastern region, which is around the average values for Europe. For Bulgaria the value of this indicator is close to the minimum (51.6%), and for Romania - slightly higher (52.4%). In comparison to them, in Czech Republic significantly higher percentage is observed (57.9)

Again in 2020 the net foreign assets (current LCU), are between 58-2250 mlrd for eastern region, where the minimum of 58 is presented in Bulgaria, a little higher amount is observed in Romania (171), while in Czech Republic the maximum value of 2250 is presented.

In 2019 the adjusted net national income per capita (current US$) is between $8-17 for eastern region and $18-65 for the other countries. Again, the minimum value is observed in Bulgaria $8.3, a little higher value could be seen for Romania ($10.9), while in Czech the maximum for the eastern region is presented ($17.3).

Before the outbreak of Covid-19, the proportion of people living below 50% of median income (%) is between 4.7-19% in Europe. Among the selected countries the highest percentage is presented in Romania (18.1%), followed by Bulgaria (14.1%) the lowest percentage, close to the observed minimum for Europe is observed in Czech Republic (4.9%).

Fig. 5: Economic indicators for the European countries at the most recent available observation date



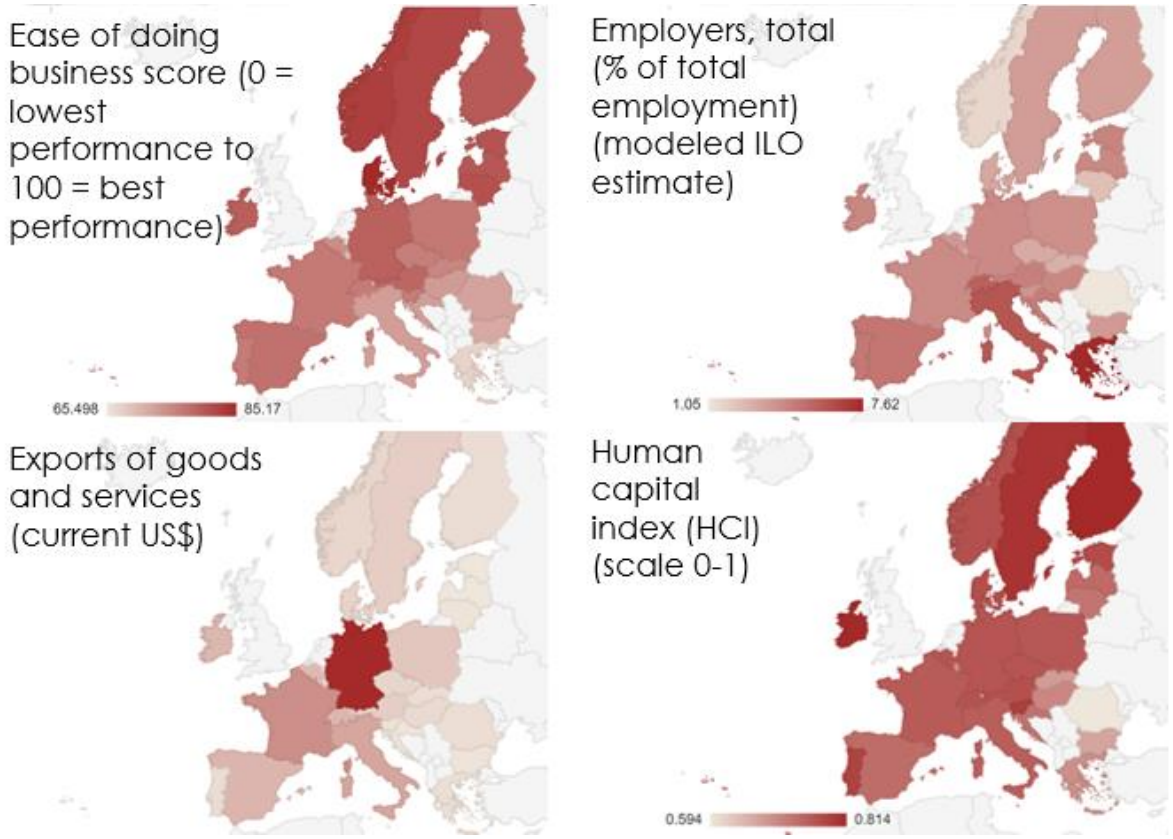
In 2019 the world economic indicator ease of doing business score (0 = lowest performance to 100 = best performance) is in the threshold 66-76 points for eastern countries and higher for the other part of Europe (Fig. 6). For the selected countries similar values are presented: 71 points for Bulgaria, 73 points for Romania, and slightly higher for Czech Republic (76).

In terms of the indicator “employers, total (% of total employment) (modeled ILO estimate)”, the values are between 1.14-4.5 for eastern region and higher for the other countries. The minimum value is presented in Romania (1.14%), while the values in Bulgaria and Czech Republic are almost three times higher (3.5% and 3.03% respectively).

Before the Covid crisis the exports of goods and services (current US$) is in the interval $38-331 mlrd. for eastern countries, where the minimum is presented in Bulgaria ($38 mlrd.). In comparison, in Romania this indicator takes the value of $92 mlrd., and undisputed leader again is Czech Republic with $174 mlrd.

In 2020 the human capital index (HCI) (scale 0-1), takes value between 0.58-0.75 for eastern region and higher for the other European countries. For Romania this index takes the minimum value of 0.58, in Bulgaria it is a little higher (0.61), while the maximum for the region is observed in Czech Republic (0.75).

Fig. 6: Economic indicators for the European countries at the most recent available observation date



The socio-economic indicators reveal significant differences among the selected countries (Fig. 7).

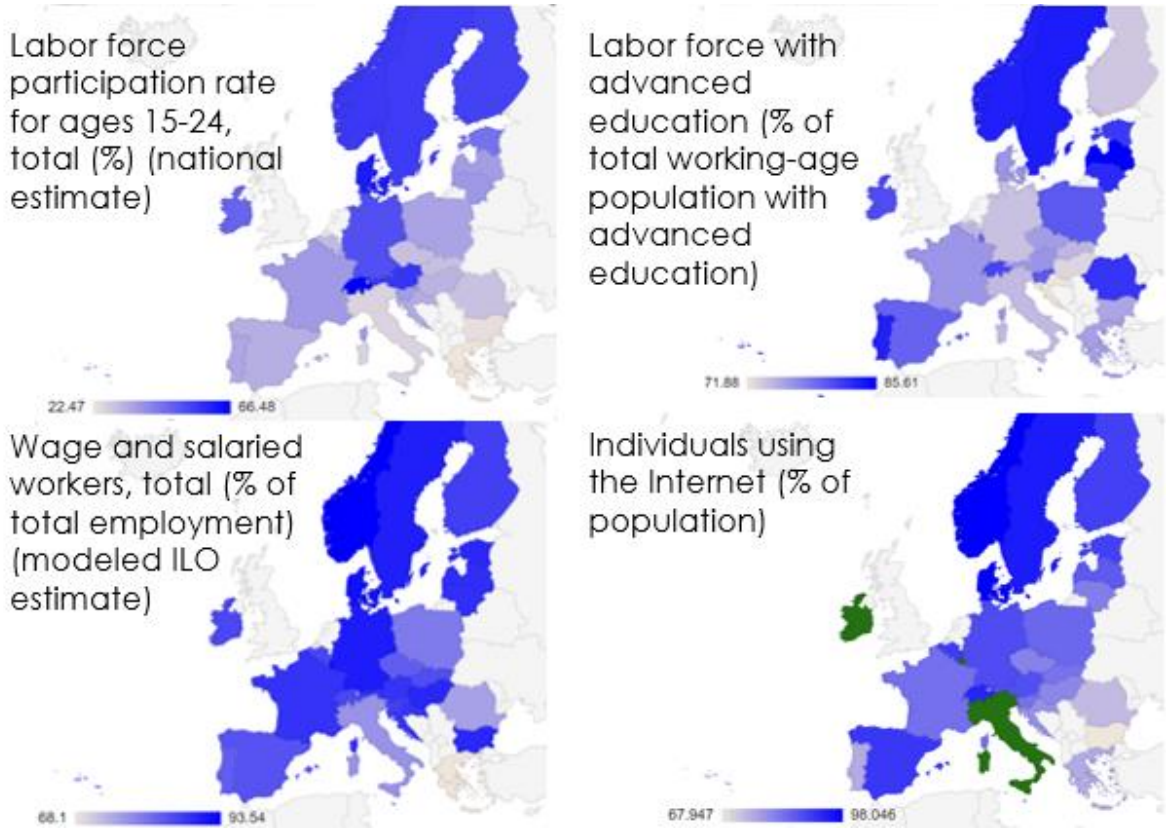
In 2020 the labor force participation rate for ages 15-24, total (%) (national estimate) is 21-31% for eastern region and higher for the other European countries. In Bulgaria almost the minimum of 21.9% is presented, while in Romania and Czech Republic significantly higher ratios are observed (29.7% and 27.3% respectively).

In 2019 the indicator labor force with advanced education (% of total working-age population with advanced education) takes values in the range 72-82% for eastern regions and almost the same for the others. Best values are presented in Romania 82%, while in Bulgaria and Czech Republic the percentage is lower (75% and 76% respectively).

In 2019 the values of the indicator wage and salaried workers, total (% of total employment) (modeled ILO estimate) is between 75-89% for eastern region and higher for most of the other countries. The leader for this factor is Bulgaria with 89%, followed by Czech Republic with 83%. The minimum is observed in Romania (75%).

In 2019 the percentage of individuals using the Internet (% of population) is in the range 68-87% for eastern region and higher for other European countries. The minimum value is presented in Bulgaria (68%), followed by Romania (73%). Highest value is observed in Czech Republic (80%).

Fig. 7: Socio-economic indicators for the European countries at the most recent available observation date

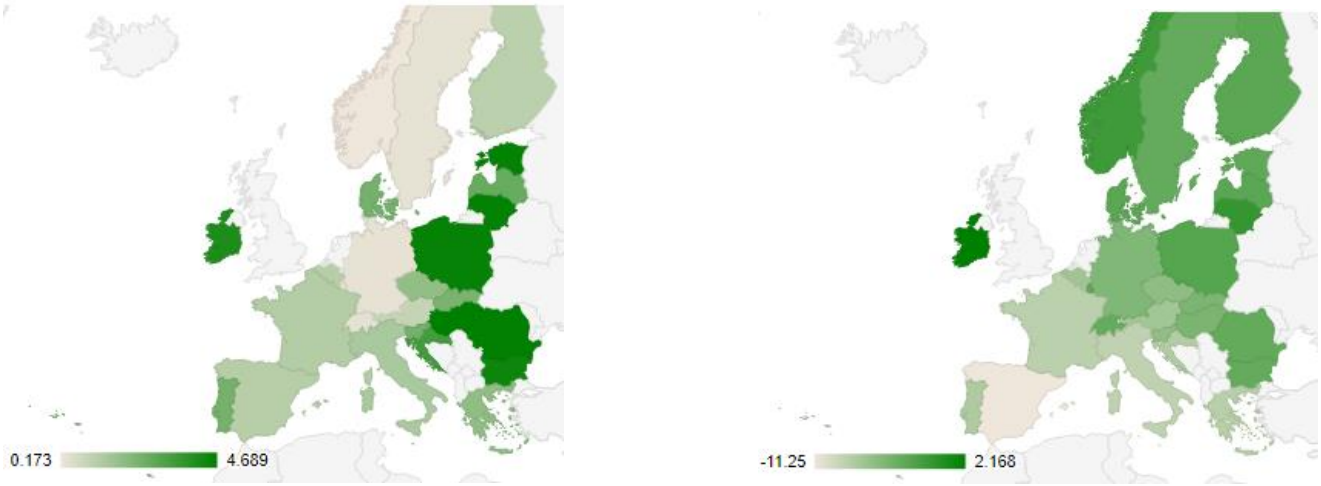


The analyses show that in 2019 (Fig. 8), before the outbreak of the global pandemic, the target variable “GDP per capita growth (annual percentage) takes only positive values in comparison to 2020 when for most of the countries the value or this indicator is negative. Moreover in 2019 this indicator shows significantly higher values for the eastern region in comparison to the other countries, while in 2020 (Fig. 9) the difference among the region and the other part of Europe is not so noticeable and the range of the values is much narrower.

For Bulgaria this indicator takes the value of 4.4% in 2019 and -3.5% in 2020. Similar situation is observed in Romania, where the value is 4.7% in 2019 and -3.7% in 2020. In Czech Republic the percentage is quite lower than the other two countries both in 2019 (1.9%) and in 2020 (-5.8%).

Fig. 8. GDP per capita growth annual % in 2019

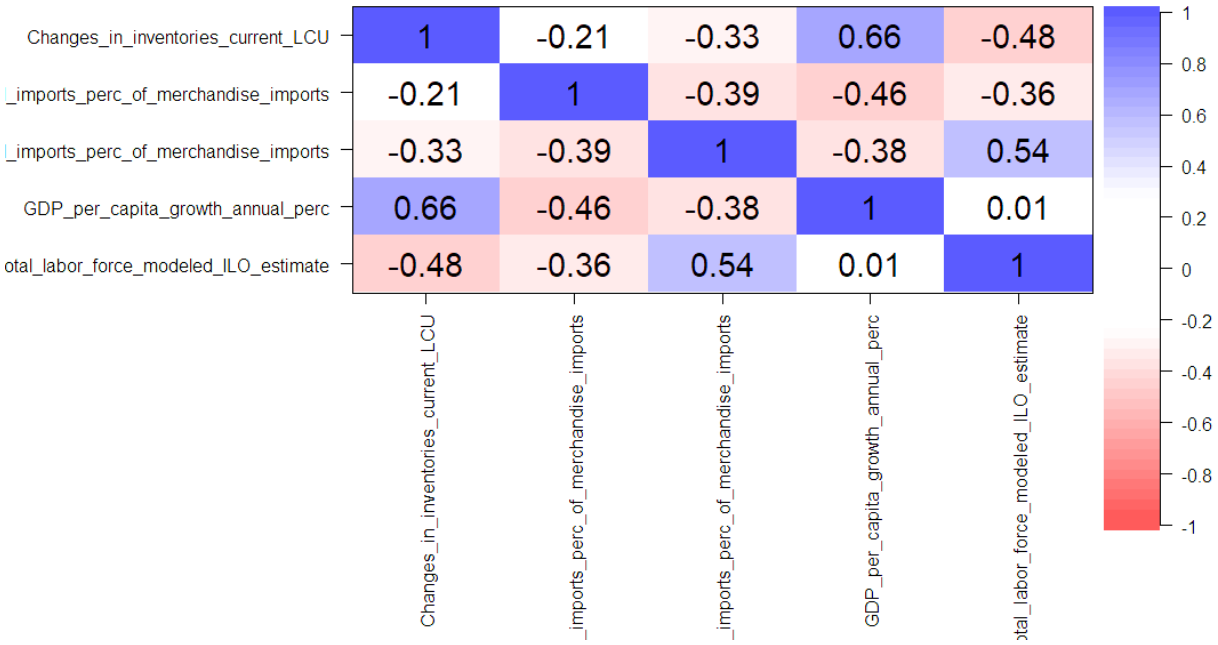
Fig. 9. GDP per capita growth annual % in 2020



2.2. Correlation matrix of the variables

The correlation matrices of the variables in the basic models for each of the country consists of different features and their respective correlation values. The matrices compute the Pearson's coefficients for each characteristic combination and present relationship between any two variables from the data frame. The correlation matrix for Czech Republic reveals the dependence within each combination among the selected variables. As it could be seen on the figure, there are no variables with high correlation and all characteristics can be used in the statistical modelling process (Fig. 10).

Fig. 10. Correlation Matrix for Czech Republic



The other two correlation matrices for Bulgaria (Fig. 11) and Romania (Fig. 12) are also cleaned from high correlations, which allows using all of the features for our further analysis.

Fig. 11. Correlation Matrix for Bulgaria

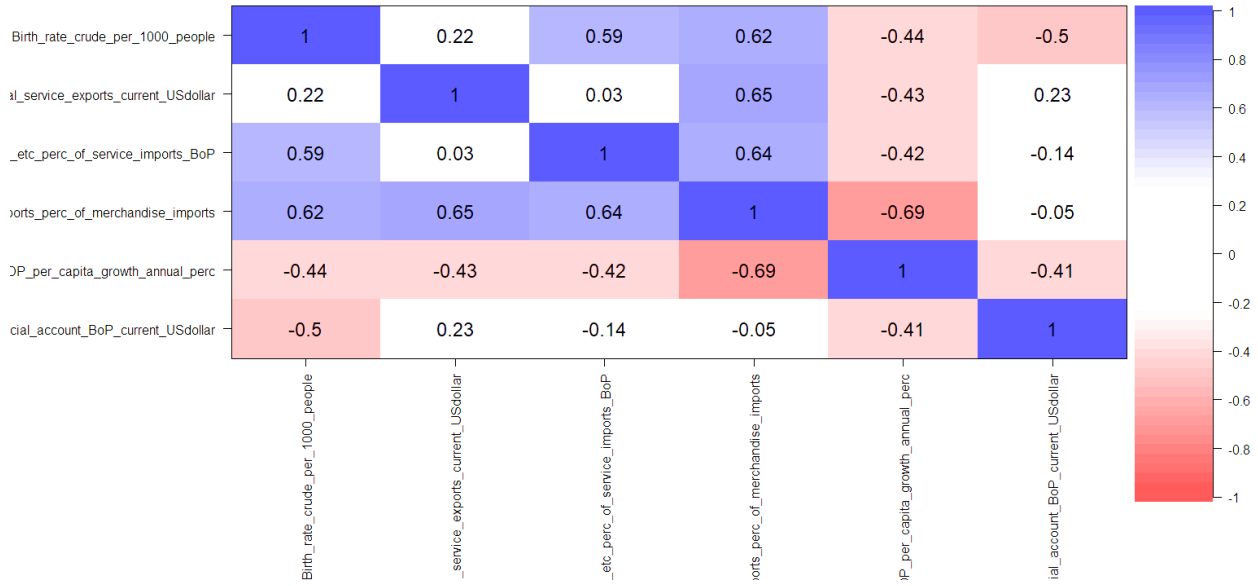
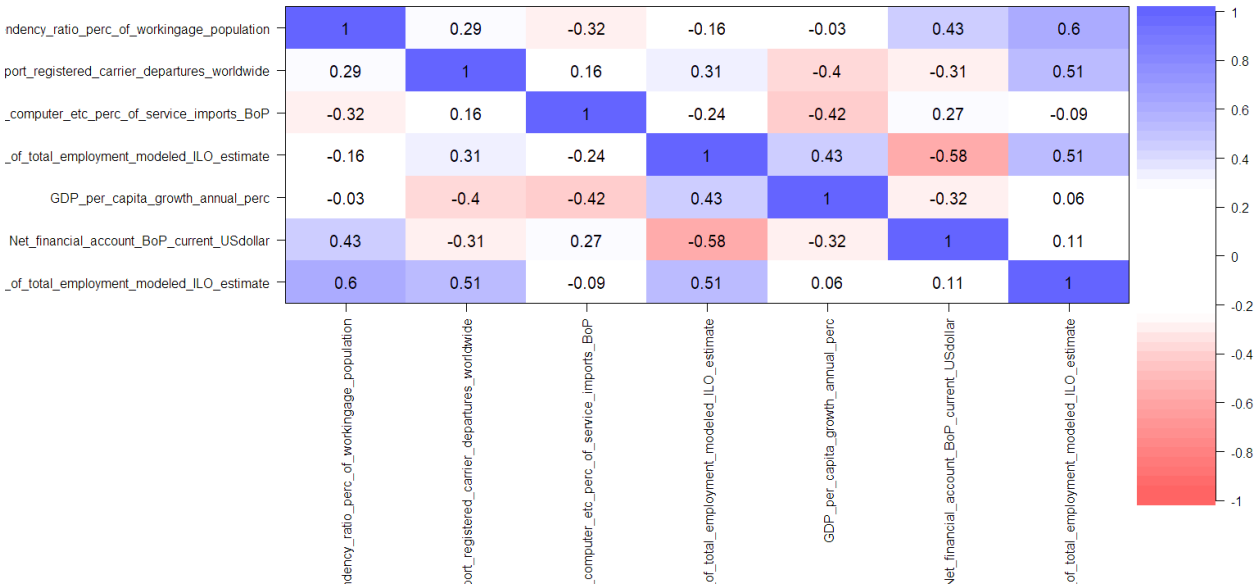


Fig. 12. Correlation Matrix for Romania



2.3. Determinants of economic growth - testing of hypotheses

H1: The economic growth depends on different socio-economic, demographic and ecological factors

In the original dataset for World Development Indicators (WDI) there are 641 explanatory features. As first step frequency distributions and demographic statistics are performed. Based

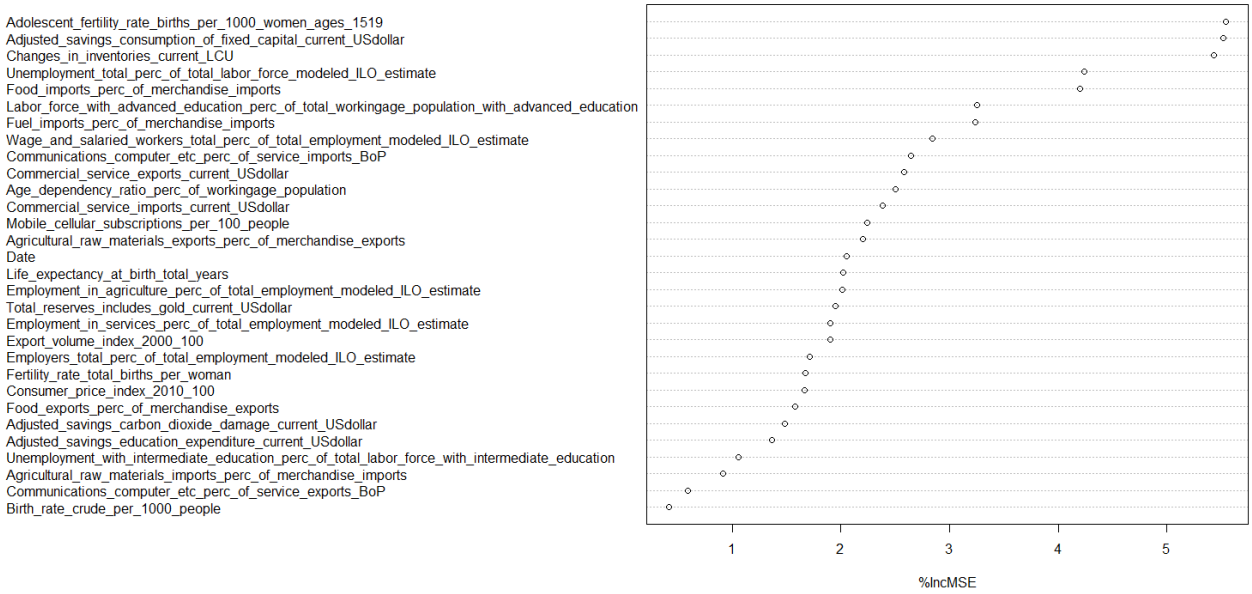
on the literature review, the more commonly used characteristics for describing the economic state are presented as graphical figures for the whole EU region. This provides a global view of the countries in Europe and opportunities for analysis in different economic segments. Even if for some features there is a correlation, and for other such relation is not observed, in economy the principle of interconnectedness is strongly set. Along with that the characteristics have different weight of the economic impact and time for manifestation. Some researchers (Gurgul and Lach (2011); Uzoma-Nwosu (2018); and Bandres and Cadea (2019)), highlight the effect of causality in the public sector over economic growth. According to the Elshani and Pula (2018), there is a unidirectional causality between government expenditure and economic growth, and on the same time bidirectional causality between total budget revenue and public expenditure.

In our study we use the methodology described by Biau and D'Ellia (2010) and Adriansson & Mattsson (2015), who found out that the random forest technique may best be used as a tool for selecting the most important predictor variables in terms of forecasting the GDP growth rate for the Euro area. The method fits multiple trees and selects randomly different features from the dataset. It maximizes the variance reduction and calculates out-of-the-sample error. The variables which have highest difference are considered as most important and used by the authors as input in an ad hoc linear model.

Applying the Random Forest algorithm to our dataset, we see on the variable importance plot for Czech Republic (Fig. 13) that the GDP growth rate depend on mixture of different socio-economic, demographic and ecological factors. There are differences and similarities between the models for the three selected countries.

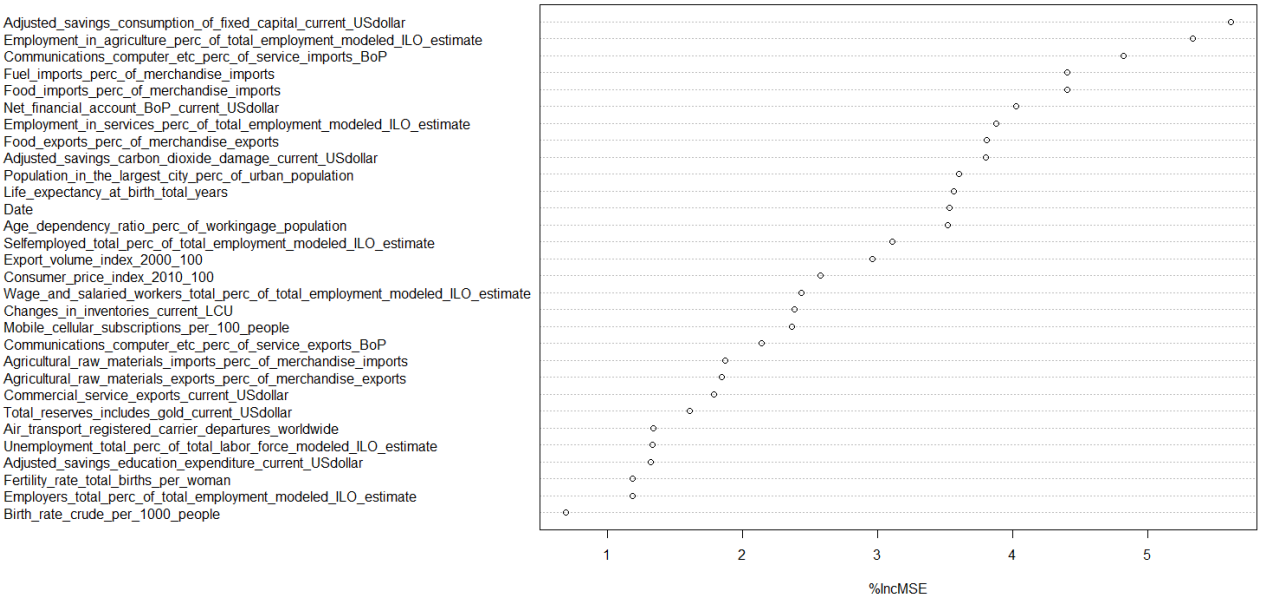
The results show that the most important predictors for the economic growth in Czech Republic are connected to adolescent fertility rate, adjusted savings consumption of fixed capital, changes in inventories, unemployment percentage, food imports percentage of merchandise imports, labor force with advanced education as percentage of total working population, fuel imports percentage of merchandise imports, percentage of wage and salary workers, communications – computer, etc. percentage of service imports, age dependency ratio of working population, commercial service imports, mobile cellular subscriptions per 100 people, agricultural exports, life expectancy, employment rates in different sectors, reserves, export volume, adjusted savings carbon dioxide damage, education expenditure.

Fig. 13. Random Forest Technique applied to the dataset for Czech Republic



The most important factors for the economic growth in Bulgaria according to Random Forest technique (Fig. 14) are linked to volume of transported goods, net financial account, adjusted savings carbon dioxide damage, employment rate in different sectors, food exports percentage of merchandise imports, school enrollment tertiary rate, population of the largest city percentage of urban population, age dependency ratio (% of working age population), birth rate crude per 1000 people, commercial service exports current US$, communications-computer, etc. (% of service exports BoP), fuel imports (% of merchandise imports).

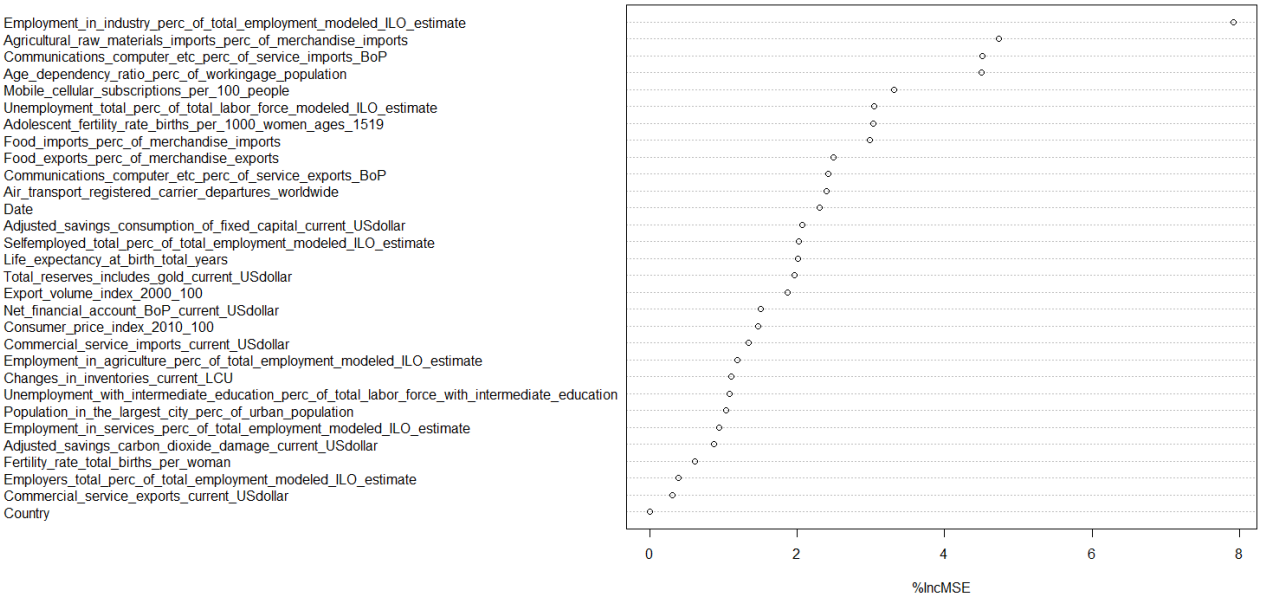
Fig. 14. Random Forest Technique applied to the dataset for Bulgaria



Applying the algorithm for the dataset for Romania (Fig. 15), we see the most relevant determinants of GDP growth rate are: employment rate in different sectors, ICT goods exports, mobile cellular subscriptions per 100 people, exports of goods services and primary income

US$, CO2 emissions (metric ton per capita), rural population (% of total population), adjusted savings consumption of fixed capital (current US$), agricultural raw materials imports as percentage of merchandise imports, changes in inventories, communications – computer, etc. (percentage of service exports), mobile cellular subscriptions per 100 people, wage and salaried workers total percentage of total employment.

Fig. 15. Random Forest Technique applied to the dataset for Romania



H2: The mixture of factors for economic growth is different in the three selected countries

We estimate a linear model containing selected variables on previous step and use it to make a prediction of GDP growth rate. Estimation of the model is done in two steps. Firstly, we estimate the model using all the variables pointed as the most important in explaining GDP by the Random Forest algorithm. On the second step, we leave in the model those variables that showed to be significant and estimate the final model. P-values <0.05 are considered statistically significant. The β-coefficients show the effect which each predictor has on the target variable.

We see in the results of the estimated linear regression model for Czech Republic that factors affecting the most the economic growth are food imports (percentage of merchandise imports), fuel imports percentage of merchandise imports, changes in the inventories - current local currency unit (LCU), and unemployment with basic education - percentage of total labor force with basic education (Tab. 1).

Most of these factors except for food imports (percentage of merchandise imports) and fuel imports (percentage of merchandise imports), have a right-proportional relationship with the target variable. Increase in the value of those variables will reflect in an increase of the GDP growth rate. On the other side, increasing the food imports (percentage of merchandise imports)

and fuel imports (percentage of merchandise imports) will lead to a decrease of the GDP growth rate.

Tab. 1: Determinants of GDP growth % for Czech Republic - linear regression output

Coefficients:	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	1.278e+01	5.171e+00	2.473	0.02587 *
Changes in inventories current LCU	5.105e-11	1.263e-11	4.041	0.00107 **
Food imports (% of merchandise imports)	-1.775e+00	6.770e-01	-2.622	0.01924 *
Fuel imports (% of merchandise imports)	-7.174e-01	1.793e-01	-4.000	0.00116 **
Unemployment with basic education (% of total labor force with basic education)	6.325e-01	2.148e-01	2.945	0.01004 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residuals:

Min	Q1	Median	Q3	Max
-2.7951	-0.9793	0.5778	0.7654	1.5008

Residual standard error: 1.351 on 15 degrees of freedom
Multiple R-squared: 0.8038, Adjusted R-squared: 0.7515
F-statistic: 15.36 on 4 and 15 DF, p-value: 3.482e-05

The results of the estimated linear regression model for Bulgaria reveals that the most important determinants of GDP growth percentage are birth rate crude per 1000 people, commercial service exports, communications - computer, etc. as a percentage of service exports, fuel imports percentage of merchandise imports, net financial account (Tab. 2). Some of the predictors have right proportional and others have an inversely proportional relationship with the target variable. For example, increase in commercial service exports and communications -computer, etc. as a percentage of service exports will lead to increase in GDP growth percentage. The effect of birth rate, fuel imports percentage of merchandise imports and net financial account will be the other way around, namely it will lead to decrease in the GDP growth percentage.

Tab. 2: Determinants of GDP growth % for Bulgaria - linear regression output

Coefficients:	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	3.004e+01	6.072e+00	4.948	0.000214 ***
Birth rate crude per 1000 people	-3.013e+00	7.229e-01	-4.168	0.000948 ***
Commercial service exports (current US$)	5.086e-10	1.802e-10	2.822	0.013568 *
Communications – computer etc. (% of service exports BoP	1.202e-01	4.886e-02	2.460	0.027523 *
Fuel imports (% of merchandise imports)	-3.394e-01	8.482e-02	-4.001	0.001314 **
Net financial account (BoP current US$)	-4.355e-10	6.511e-11	-6.688	1.03e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residuals:

Min	Q1	Median	Q3	Max
-1.86744	-0.60867	-0.03609	0.66113	2.05285

Residual standard error: 1.185 on 14 degrees of freedom
Multiple R-squared: 0.8753, Adjusted R-squared: 0.8308
F-statistic: 19.66 on 5 and 14 DF, p-value: 7.007e-06

The results of the estimated linear regression model for Romania show that the key factors for GDP growth rate are age dependency ratio (% of working-age population), air transport, registered carrier departures worldwide, communications - computer, etc. as a percentage of service exports, employment in industry as percentage of total employment, net financial account (Tab. 3). Three of the factors have right-proportional relationship with the target variable, while the other two features have negative coefficients. Increase in the value of those variables with inverse relationship will reflect in decrease of the GDP growth rate. On the other side, increasing the employment in industry, communications - computer, etc. as a percentage of service exports and age dependency ration will lead to an increase of the GDP growth rate.

Tab. 3: Determinants of GDP growth % for Romania - linear regression output

Coefficients:	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-1.172e+02	2.681e+01	-4.370	0.000641 ***
Age dependency ratio (% of workingage population	1.808e+00	4.633e-01	3.902	0.001597 **
Air transport registered carrier departures worldwide	-4.261e+00	7.478e-01	-5.698	5.5e-05 ***
Communications – computer, etc. (% of service exports BoP)	2.594e+00	1.180e+00	2.198	0.045231 *
Employment in industry (% of total employment modeled ILO estimate)	1.328e+00	3.961e-01	3.352	0.004744 **
Net financial account BoP (current US$)	-4.910e-10	1.290e-10	-3.805	0.001932 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residuals:

Min	Q1	Median	Q3	Max
-4.2295	-1.1559	0.1738	0.9486	4.0010

Residual standard error: 2.16 on 14 degrees of freedom
Multiple R-squared: 0.7903, Adjusted R-squared: 0.7154
F-statistic: 10.55 on 5 and 14 DF, p-value: 0.0002344

3. Discussion

Economic growth and key drivers are point of interest of each country. According to the literature review the predictors of economic development are quality of life, information and communication technologies, human capital, mortality rate, stock markets, foreign direct investments, productivity, carbon dioxide emissions, urbanization, energy consumption and export expansion.

The results from our study prove the importance of communication and computer service technology mentioned in the papers of Al-mutawkkil et al. (2009) and Lam et al. (2010). ICT as percentage of service import is found to be significant in the linear models for Bulgaria and Romania. In both counties right-proportional relationship with the GDP growth rate is observed according to their coefficients in the analysis. Comparing the three countries for the most recent available cohort, the highest values for this indicator are observed in Czech Republic, followed by Romania, and Bulgaria is noted with the lowest value of 6.60.

Our research proves also the role of stock market examined by the studies of Carp (2011) and Forti (2011). Food imports (% of merchandise imports) has significant predictive power for Czech Republic in our model. This indicator has right-proportional relationship with the GDP with a value around 5% of all stock import for the last 20 years. Moreover, Romania and Bulgaria have increased their food import for the last ten years to the values of 8.58% (19% increase for the period of 2000-2010) and 9.63% (35% increase for the period of 2000-2010) respectively.

Fuel imports (% of merchandise imports) is another factor found as important in the linear explanatory models for Czech Republic and Bulgaria. In both countries this feature has negative coefficient and reverse proportional relationship to the GDP. These findings are consistent with previous study on this topic (Arouri et al., 2012; Eggoh et al., 2011), that report energy consumption and carbon dioxide emissions are strongly related to the economic growth. For comparison, the values of this indicator for 2020 are observed to be highest in Bulgaria (13.83%), followed by Romania (7.65%) and Czech Republic (5.33%).

The export expansion and particularly its impact on the economic growth is examined by Kavaoussi (1984). The commercial service exports (current US$) are found to be a significant positively related determinant for GDP growth rate in our analysis for Bulgaria, where a value of $11,442,000,000 is observed for the last period (2020) of our timeframe. Higher results are observed for Romania and Czech Republic - $30,250,160,352 and $30,397,251,625 respectively.

Air transport, registered carrier departures worldwide is found to be significant factor for the GDP growth rate in Romania. It has negative coefficient in our linear model which means that increase of this indicator will lead to decrease in the economic growth. The value for the last year in our dataset (2020) for Romania has highest score (58509), compared to Bulgaria (10111) and Czech Republic (44051). According to the literature review, we have not found any evidence on the impact of transport industry to the GDP, except for the relationship between tourism development and economic growth examined by several studies (Oh, 2005; Nissan et al., 2011; Rasool et al., 2021; Selimi et al., 2017, Soukiazis and Proença, 2008). However, this is an interesting topic for research because it is highly connected also with the market of stock and services.

According to the socio-economic indicators, our research confirms the conclusions of Chakraborty (2004) that human capital drives economic growth. For example, age dependency

ratio (% of working-age population) is one of the features that is found to be significant for the determination of the economic growth for Romania. This is the ratio of dependents that represents people younger than 15 or older than 64 among to the working-age population (those aged 15-64). This factor has right-proportional relation to the GDP according to our model for Romania. In comparison to the other two countries, Romania has the lowest score for the last year (52.36%), while it is 55.10% for Czech Republic and 56.10% for Bulgaria.

Birth rate, crude (per 1,000 people), on the other hand, is one of the features which is found to be a significant determinant for the economic growth of Bulgaria. It has inversely proportional relationship with the GDP growth rate. In comparison with Romania where value is 9.6% (even it has slightly decreased for the last year 2020) and Czech Republic where it is a bit higher (10.5%), in Bulgaria the value of this indicator is 8.8% and has negative trend from past 5 years. One possible explanation for the observed negative relationship is that higher birth rate is related to more costs for education and healthcare. Moreover, the birth rates tell a lot about community health culture and high values could be due to the existence of minority groups of the population that overload the economic system of the nations.

In his paper, Kostov (2017) finds relationship between economic growth and unemployment. Such relations are also found in the output of our model for Czech Republic and Romania. For example, employment in industry (% of total employment) (modeled ILO estimate) is found to be positively related to the GDP growth rate in Romania. On the other hand, in Czech Republic unemployment with basic education (% of total labor force with basic education) is proved to be one of the most significant predictors for the economic growth.

According to our linear explanatory model, changes in inventories (current LCU) is positively related key predictor of GDP growth rate for Czech Republic. These findings are in line with the research of Senera & Sarıdoğan (2011) who concludes that countries which have science-technology-innovation oriented global strategies have sustainable competitiveness and long run growth.

Our research shows that decrease of GDP growth rate is observed in all countries in Europe for 2020, including Bulgaria, Czech Republic and Bulgaria. As we can see from the analyses the economic development is significantly influenced by the outbreak of global Covid-19 pandemic, which could be related to lockdowns and lack of activities which lead people to start saving more money. These results are also proved by the research of Angelova (2021), who examines the active life of elderly people in different European countries before and after the pandemic. The author observes a significant change in the behavior of people since the lockdowns with a tendency of being more inactive. This reflects to the whole society in a multi-socio-economic perspective for each country. The lockdowns in Europe have started with governments establishing restrictions on social events and public gatherings, closing stores, restaurants and pubs. In his study, Yordanov (2021) also observes negative relationship between governments' policy regarding social life and mental health of people. In his research

the author proposes that taking more relaxed measures during the pandemic might impact positively on the socio-economic life in general.

Each country has its strengths and weaknesses in terms of its economic development, natural resources and social benefits. In further studies it might be positive to observe the pos and cons between the countries from one region so they could collaborate between each other and support their mutual economic growth.

4. Limitations of the research

There are several limitations to this research. First of them is the missing or not enough data about some variables that literature review shows are determinants of economic growth like human development index, environmental quality, and personal security. The second one is the limited number of observations, that can be used for prediction. That's another reason the estimated models don't have very high explanatory power. As cross-sectional data, information is collected by different national institutes, that update the information at different times, which could also lead to data gaps. Another limitation is the causality in the data, specifically in the various ratios, which makes the data difficult for interpretation, because they are already synthetic characteristics, obtained by the synergy effect of several variables. Moreover, it is difficult to interpret some terms that don't have exact definition and that are dependable of various factors. Many of the factors in the data provide general information for a country without considering the influence of per capita.

Despite the above pointed limitations, this research complements the literature by examining the relevant determinants of economic growth in European countries.

5. Conclusion

The aim of this study was to provide explanatory analysis of the economic growth of three European countries from the same region. All of them are part of the European union and follow a common development policy. Our study proves that each of the factors has different weight in the impact of the economic growth in the countries, due to their local specifics.

The findings and results can be used for other studies of the economic growth. The obtained results could be applied in several aspects in the future politics. Coping strategies of the governments could be employment incentive programs, measures for prevention of early births, incentives for employers to hire more staff, measures for improvement of education and healthcare systems, introduction of new technologies in production and agriculture sector, promoting the use of energy from renewable sources and clean production in response to climate changes and lack of resources.

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