ECONOMIC RESEARCH INSTITUTE
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ИНСТИТУТ ЗА ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ НА БЪЛГАРСКАТА АКАДЕМИЯ НА НАУКИТЕ

ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
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EFFICIENCY OF HEALTHCARE SYSTEMS IN THE FIRST WAVE OF COVID-19 – A TECHNICAL EFFICIENCY ANALYSIS[4]

In this novel paper, we make use of a non-parametric method known as Data Envelopment Analysis (DEA) to analyse the 31 most infected countries during the first 100 days since the outbreak of the COVID-19 coronavirus for the efficiency in containing the spread of the virus – a question yet to be answered in the literature. Our model showed 12 of the 31 countries in our sample were efficient and 19 inefficient in the use of resources to manage the flattening of their COVID-19 contagion curves. Among the worst performers were some of the richest countries in the world, Germany, Canada, the USA and Austria, with efficiency between 50 and 60 per cent – more inefficient than Italy, France and Belgium, who were some of those hardest hit by the spread of the virus.
Keywords: Pandemic; COVID-19; Flattening the Curve; Data Envelopment Analysis; Non-Pharmaceutical Interventions; Healthcare; Technical Efficiency; Healthcare system efficiency barometer
JEL: C6; D2; I1

1. Introduction

The new coronavirus (COVID-19) has spread to nearly every country of the world since it first emerged in China in late December 2019 (Newey, Gulland, 2020). Within four months, it had spread to 185 countries and regions of the world and the Philadelphia Inquirer of 28 April (Lubrano, 2020) reported that more than 3 million people were known to be infected and more than 211,000 deaths had been recorded at this time. In a very timely study, Mbuvha and Marwala (2020) point out that the rapid spread necessitates rapid responses to mitigate the spread of COVID-19 under conditions of extreme uncertainty. Even in these early stages of the spread of the virus, many analysts and researchers have started to model the spread of the virus, often with very scant and unreliable data and often accompanied by probable outcomes. Mbuvha and Marwala (2020), for example, use the susceptible-infected-recovered

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(SIR) compartmental model with South African data, using the initial conditions inferred from China and Italy to study the spread of the virus during the first three months of the virus in South Africa. They acknowledge that it is too early to come to a definitive conclusion, but that in the case of South Africa, where it may seem as if the curve is flattening, that either the pandemic is at very early stages of progression or mitigating measures might have resulted in a slowdown in the spread and severity.

In the epidemiology literature, the main pandemic spread mitigating interventions are referred to as non-pharmaceutical interventions (NPIs). Typically, NPIs promote social distancing, case isolation and public hygiene (Correia et al., 2020) – similar to the global interventions with COVID-19. The difference with COVID-19 is the widespread, almost complete lockdown of economies around the world. Nevertheless, what was found when studying the 1918 Spanish Flu in the USA, also an influenza-type pandemic, in the regions that acted sooner rather than later with NPIs, there were significant reductions in peak mortality and moderate reductions in cumulative mortality (see, e.g. Bootsma, Ferguson, 2007; Markel et al., 2007; Hatchett et al., 2007). As a matter of fact, a recent study by Correia et al. (2020) of the 1918 Flu in the USA, has shown that there was substantial variation among cities in the speed and aggressiveness of the measures taken, and there was a direct link between the speed and aggressiveness of interventions and containment of the spread as well as mortality rates. Eichenbaum et al. (2020), taking a completely different approach, show the link between the spread of a pandemic and interactions with economic decisions. In short, they find that there is an inevitable short-run trade-off between the severity of a short-run recession caused by a pandemic (as people withdraw from demand and supply activity), and its health consequences. In other words, the more people withdraw from economic activity (refrain from social contact) the higher the speed at which the pandemic is ended.

Gourinchas (2020), confirms the consensus among many epidemiology studies that containment of the COVID-19 pandemic is of utmost importance. In short, he explains that the health system of any country puts an upper bound on the number of patients that can receive proper treatment (available number of hospital beds, nursing staff, number of equipped intensive care units, etc.). If the spread of the coronavirus cannot be slowed or contained quickly enough, the threat is almost beyond comprehension and according to Gourinchas, “with a 2 per cent case fatality rate baseline for overwhelmed health systems and 50 per cent of the world population infected, 76 million people or 1 per cent of the world population would die”.

Sufficient evidence exists that the speed and effectiveness with which governments act to contain the spread of COVID-19 (mainly through NPIs, e.g. lockdowns, social distancing measures, sanitary measures, etc.) will determine to a large extent what the final outcome will be on the world. The strength of health systems would mean very little if the spread is not contained quickly. This has already proven to be the case with the COVID-19 pandemic.

On a daily basis, new data is released and new analysis get published on the number of tests performed in each country, number of new cases, recoveries and deaths, etc. However, the data that is probably most covered in the media, are those related to the containment of the spread of COVID-19. This data is used to plot curves that all countries around the world watch with abated breath in the hope that these curves would “flatten” so that the

economically devastating lockdowns can come to an end. Invariably, the measures taken by each country and the outcomes achieved, are compared – either relative to a country perceived to have done well or to one perceived to have done worse. Whether the resources used in flattening the COVID-19 curve is used efficiently or not is a question yet to be answered in the literature. This paper fills this void in the literature on COVID-19, applying a benchmarking tool widely used to compare the efficiency of healthcare systems across the world – a healthcare system efficiency barometer. We do this by scientifically analysing data related to resources and outcomes achieved over the first 100 days[5] of COVID-19. In this novel paper, we make use of a non-parametric method known as Data Envelopment Analysis (DEA) to analyse the 31 most infected countries during the first 100 days since the outbreak, for the efficiency in their response to the outbreak and containing the spread of the virus – efficient use of available resources to flatten the curve (stabilise the rate of infection). At the time of writing this paper, 90 per cent of the more than 3 million infected people resided in these 31 countries (Worldometer, 2020).

We do acknowledge that national healthcare systems are different among countries because of differing cultural norms, market regulations, policies, etc. However, although there are differences in terms of infrastructure, patient numbers, funding, and governance between the healthcare systems, they face similar challenges and have common goals. Assessing and comparing the performance of several national healthcare systems, according to Nolte et al. (2006), provides an opportunity for policymakers to determine how well a particular national healthcare system is performing relative to its international peers, understand how it works in order to identify good and bad practices, and finally find more effective approaches to achieve sustainability and better quality. Our aim here is to see how the different national healthcare systems perform relative to their international peers (in our paper the peers are the sample of countries chosen with the highest infection rates), that is, how efficient resource utilisation was to reach the objective of flattening the curve.

We find that the average technical efficiency score is 83.3 per cent. This shows that not all the countries were efficient and on average were operating below the efficiency frontier. They would on average need to improve their efficiency by 16.7 per cent. Specifically, 12 of the sampled 31 countries implemented the COVID-19 lockdown measures very quickly and were efficient in the use of tests, doctors and health spending to manage the COVID-19 pandemic at prevailing output levels.

The rest of the paper is organised as follows: Section 2 deals with the literature, Section 3 with the model, Section 4 with the data, Section 5 with the results and Section 6 concludes.

2. Literature Review

DEA has been used extensively to analyse efficiency in the health sector globally. We could only find one paper that used DEA to analyse the efficiency of health systems in the midst of an epidemic or pandemic and using variables related to resources used in times of an

[5] Technically, it is 108 days from the first case reported outside of China in Thailand, on 13 January to the cut-off date of 30 April 2020.

epidemic or pandemic, as well as outputs achieved during an epidemic or pandemic. We discuss this paper below. However, DEA has been applied extensively to compare the efficiency of health care facilities within countries and between countries, and we briefly deal with some of that literature here.

Because our paper compares efficiency between countries, we do not deal with the literature on country studies. For literature on efficiency studies among different healthcare facilities within a country, see, for example, Ngobeni et al. (2020), who analysed the technical efficiency of provincial public healthcare in South Africa; Campanella et al. (2017), who assessed the technical efficiency of 50 Italian hospitals; Alhassan et al. (2015) used DEA to assess the technical efficiency of 64 health facilities in Ghana; DEA was also used by Jarjue et al. (2015) to determine the technical efficiency of 41 secondary healthcare centres in the Gambia. Also see Chowdhury et al. (2010); Gannon (2005); Marschall and Flessa (2009); Akazili et al. (2008); Masiye (2007); Zere et al. (2006); Kirigia et al. (2001); and Kirigia et al. (2000).

Literature on efficiency between health care facilities among countries

Available studies comparing healthcare efficiency among countries use either parametric or non-parametric analytical techniques such as the stochastic frontier analysis (SFA) model or the Data Envelopment Analysis (DEA), in which the healthcare systems are modelled as production units (see Giuffrida, Gravelle, 2001; Hollingsworth, 2003). As this study implements DEA as a method to compute efficiency across countries, the literature adopting DEA in this setting is discussed here. Bhat (2005) used DEA to assess the impact of financial and institutional arrangements on the national healthcare system efficiency in a sample of 24 OECD countries. He found countries having public-contract and public integrated-based healthcare systems are more efficient than public reimbursement-based systems. Lo Storto and Goncharuk (2017) employed DEA to measure the technical efficiency of 32 European (EU) countries. DEA was applied to compute two performance indices, measuring the efficiency and effectiveness of these healthcare systems. The results of the study emphasise that the national healthcare systems achieve different efficiency and effectiveness levels. Comparing the efficiency and effectiveness scores, the authors identified a group of countries with the lowest-performing healthcare systems that need to implement healthcare reforms aimed at reducing resource intensity and increasing the quality of medical services. Afonso and St Aubyn (2006) used a two-stage DEA to estimate a semi-parametric model of the healthcare systems in 30 OECD countries in the years 1995 and 2003. Conventional and bootstrapped efficiencies are estimated in the first stage and corrected in the second stage by considering non-discretionary variables such as GDP per capita, education level, and health behaviour using a Tobit regression. Results show that a large amount of inefficiency is related to variables that are beyond government control.

Varabyova and Schreyögg (2013) used unbalanced panel data from OECD countries between 2000 and 2009 to compare the relative efficiency of healthcare systems. They took a different approach by performing two-step DEA and one-stage SFA and evaluate the internal and external validity of their findings by means of the Spearman rank correlations. They found that countries with higher health care expenditure per capita have, on average, a more

efficient healthcare sector, and lower efficient healthcare is prevalent in countries with higher income inequality. Gonzalez et al. (2010), in a cross-sectional study using 2004 data, measured the technical and value efficiency of health systems in 165 countries. They used the amount of expenditure on health and education as inputs to the healthcare system and data on healthy life expectancy and disability-adjusted life years as health outcomes. Their study revealed that high-income OECD countries have the highest efficiency indexes. De Cos and Moral-Benito (2014) estimated alternative measurements of efficiency using DEA and SFA between 1997 and 2009 ascertain the most important determinants of healthcare efficiency across 29 OECD countries. They provide empirical evidence that there are significant variances with respect to the level of efficiency in healthcare services provision among countries. Hadad et al. (2013) compared the healthcare system efficiency of 31 OECD countries using conventional efficiency, super-efficiency and cross-efficiency and two model specifications, one including inputs under management control and the other inputs beyond management control. The results were ambiguous. Kim and Kang (2014), using a bootstrapped DEA, estimated the efficiency of healthcare systems in a sample of 170 countries. They divided the sample in four groups to obtain homogeneous sub-samples with respect to income. They found that a small number of the countries were able to manage their healthcare systems efficiently, that average efficiency in the high-income sub-sample was relatively high. Frogner et al. (2015), in a sample of 25 OECD countries, measured healthcare efficiencies between 1990 and 2010. They applied country fixed effects, country and time fixed-effect models, and SFA, including a combination of control variables reflecting healthcare resources, behaviours and economic and environmental factors. Rankings were found not to be robust due to different statistical approaches. Kim et al. (2016) estimated productivity changes in the healthcare systems of 30 national healthcare systems during 2002-2012. To analyse changes in productivity, efficiency and technology, they used the bootstrapped Malmquist index. They found for most countries in the sample, that recent policy reforms in the OECD countries stimulated productivity growth.

Literature on epidemics/pandemics and efficiency

Literature that deals specifically with the analysis of the outbreak of epidemics and pandemics, can be divided into the epidemiology literature and efficiency literature. In the epidemiology literature, the main focus is on the containment of the spread of an epidemic or pandemic; specifically, emphasis is placed on the effectiveness of the NPIs. Correia et al. (2020), revisited the 1918 Flu in the USA, also an influenza-type epidemic, and found that in the regions that acted sooner rather than later with NPIs, there were significant reductions in peak mortality and moderate reductions in cumulative mortality (see, e.g. Bootsma, Ferguson, 2007; Markel et al., 2007; Hatchett et al., 2007). Eichenbaum et al. (2020), taking a completely different approach, show the link between the spread of an epidemic and interactions with economic decisions. In short, they found that there is an inevitable short-run trade-off between the severity of a short-run recession caused by an epidemic (as people withdraw from demand and supply activity), and the health consequences of the epidemic. In other words, the more people withdraw from economic activity (refrain from social contact), the higher the speed at which the epidemic is ended. Mbuvha and Marwala (2020) found that in South Africa, the curve is flattening, that either the pandemic is at very early

stages of progression or the NPIs resulted in a slowdown in the spread and severity. Gourinchas (2020) confirms the consensus among many epidemiology studies that containment of the COVID-19 pandemic is of utmost importance. In short, he explains that the health system of any country puts an upper bound on the number of patients that can receive proper treatment (available number of hospital beds, nursing staff, number of equipped intensive care units, etc.). If the spread of the coronavirus cannot be slowed or contained quickly enough, the threat is almost beyond comprehension.

In regard to the efficiency literature on epidemics, Jouzdani (2020) does a brief evaluation of the global fight against COVID-19 using confidence interval and the temporal confirmed, death, and recovered cases data. He presented a statistical method to visualise and distinguish the countries with conditions that call for close monitoring and international attention. He found that Iran, the United States, Iraq, and San Marino are the regions requiring more attention, while Singapore, Malaysia, Vietnam, and Macau performed most effectively and efficiently in outbreak response management. Shirouyehzad et al. (2020) evaluate the efficiency of countries affected by COVID-19 considering their population density and health system infrastructure using Data Envelopment Analysis (DEA). The study is conducted in two steps. In the first step, considering their performance in contagion control of the disease, the efficiency values of the countries are estimated. In the second step, a comparison is made based on performance in medical treatment of the patients that could benefit from decreasing the number of death cases and increasing the number of recovered cases. The countries are classified into four classes based on their performance in contagion control and medical treatment and it was found that Singapore, Vietnam, and Belgium are the countries with the highest efficiency in both aspects. Singapore, with one of the highest population densities in Southeast Asia, has the highest efficiency among the countries. In Europe, Italy is the least and Belgium the most efficient. In the Middle East, Egypt has been the least efficient in contagion control but most efficient in medical treatment, while Iran has been the most efficient in contagion control.

This literature review shows that empirical work pivots mostly on healthcare system performance based on the efficiency calculated as a ratio of a measure of some quality of life variable as an output and the physical health resources or expenditure on health as inputs. As will gradually become evident, our paper is similar in regard to the modelling approach followed in the literature, but different in respect to our choice of input and output variables. Although Shirouyehzad et al. (2020) use DEA to analyse the efficiency of contagion of COVID19, they focus on the number of deaths and recoveries as outcomes, while the express aim of this paper is to focus on flattening the curve as the main outcome/output.

3. Modelling Approach

In this paper, we use the variable returns to scale (VRS) approach reported by Gavurova et al. (2017) and developed in 1984 by Banker, Charnes and Cooper to allow for consideration of scale efficiency analysis. This is called the Banker, Charnes and Cooper (BCC) model. The terminology “envelopment” in DEA refers to the ability of the efficiency production frontier to tightly enclose the production technology (input and output variables). Cooper et

al. (2007), and McWilliams et al. (2005), state that DEA was developed in a microeconomic setting and applied to firms to convert inputs into outputs. However, in efficiency determination, the term "firm" is often replaced by the more encompassing DMU. DEA is an appropriate method of computing the efficiency of institutions employing multivariate production technologies. Aristovnik (2012) and Martić et al. (2009) state that there are input-minimisation and output-maximisation DEA models. The former determines the quantity of inputs that could be curtailed without reducing the prevailing level of outputs and the latter expands outputs of DMUs to reach the production possibility frontier while holding inputs constant. However, the selection of each orientation is study-specific.

According to Taylor and Harris (2004), DEA is a comparative efficiency measurement tool that evaluates the efficiency of homogeneous DMUs operating in similar environmental conditions, for example, DMUs dealing with COVID-19 and where the relationship between inputs and outputs is unknown. Wang and Alvi (2011) report that DEA only uses the information used in a particular study to determine efficiency and does not consider exogenous factors. DEA measures the distance of production functions to determine the radial extent of DMUs to efficiency frontiers by categorising the DMUs into extremely efficient and inefficient performers. In terms of the DEA methodology, the current study uses the BCC model, with the ratio of DMUs being 6 times the combined number of inputs and outputs to ensure the stability of the efficiency results. However, before explaining the BCC model, it is prudent to describe first the constant returns to scale (CRS) model, developed by Farrell in 1957 and enhanced in 1978 by Charnes, Cooper and Rhodes (also called the CCR model) to convert the fractional linear efficiency estimates into linear mathematical efficiency programmes under the constant returns to scale (CRS). These models are described in the following paragraphs.

Under the CCR model, suppose there are C different number of inputs and D different number of outputs for N DMUs. These quantities are represented by column vectors xij (i = 1, 2, 3, …C, j = 1,2,3 …N) and qrj (r = 1, 2, 3, …D, j = 1,2,3 …N) The $C\ x\ N$ input matrix, X and $D\ x\ N$ output matrix, Q represents the production technology for all the N number of DMUs. For each DMU, the ratio of all the output variables over all the input variables is represented by u'qrj/v'xi. Where u $= D\ x\ 1$ vector output weights and v $= C\ x\ 1$ vector input weights. The optimal weights or the efficiency estimates are obtained by solving a mathematical problem. In the context of the CRS, an efficient DMU operates at a technically optimal production scale (TOPS). Hence, the optimal weights or efficiency estimates are obtained by solving a mathematical problem that is reflected in equation 1.

$$\begin{aligned} &\text{Tops} = \max_{u,v} (u'qrj/v'xij) \\ &St. \\ &u'qrj/v'xij \leq 1 \\ &u, v \geq 0 \end{aligned} \qquad (1)$$

Equation 1 shows the original linear programme, called the primal. It aims to maximise the efficiency score, which is represented by the ratio of all the weights of outputs to inputs, subject to the efficiency score not exceeding 1, with all inputs and outputs being positive. Equation 1, has an infinite number of solutions, if (u,v) is a solution, so is αv,αv. To avoid this, one can impose a constraint v'xij =1, which produces equation 2.

$$\begin{aligned} &\max u,v\ (u'qrj) \\ &St. \\ &v'xij = 1 \\ &u'qrj - v'xij \leq 0 \\ &u, v \geq 0 \end{aligned} \tag{2}$$

An equivalent envelopment problem can be developed for the problem in equation 2, using duality in linear programming. The dual for $\max_{u,v}(u'qrj)$ is $min\theta, \lambda\theta$. The value of θ is the efficiency score; it satisfies the condition $\theta \leq 1$; it is the scalar measure. Lauro et al. (2016) report that λ is an $NX1$ vector of all constants representing intensity variables indicating necessary combinations of efficient entities or reference units (peers) for every inefficient DMU, it limits the efficiency of each DMU to be greater than 1. This results in equation 3, which represents the CCR-CRS model with an input minimisation orientation.

$$\begin{aligned} &Min\theta, \lambda\theta \\ &\qquad St. \\ &-qrj + Q\lambda \geq 0 \\ &\theta xi - X\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \tag{3}$$

Avkiran (2001) states that the CRS postulates no significant relationship between DMU's operational size and their efficiency. That is, under the CRS assumption, the large DMUs are deemed to attain the same levels of efficiency as small DMUs in transforming inputs to outputs. Therefore, the CRS assumption implies that the size of a DMU is not relevant when assessing technical efficiency. However, in most cases, DMUs have varying sizes and this becomes a factor when determining their efficiency. As a result, Gavurova et al. (2017) mention that in 1984, the CCR formulation was generalised to allow for the VRS. Aristovnik (2012) adds that, if one cannot assume the existence of the CRS, then a VRS type of DEA is an appropriate choice for computing efficiency. Gannon (2005) advises that the VRS should be used if it is likely that the size of a DMU will have a bearing on efficiency. As such, Yawe (2014) cautions that the use of the CRS specification when the DMUs are not operating at optimal scale results in a measure of technical efficiency, which is confounded by scale effects. The solution is to use the VRS as it permits for the calculation of scale inefficiency. The CRS linear programming problem can be modified to account for the VRS by adding the convexity constraint: $N1'\lambda = 1$ to equation 3, where $N1$ is a $Nx1$ vector of ones to formulate equation 4. Equation 4 represents the BBC-VRS model with an input-minimisation orientation. Therefore, equations 1 to 3 represent the CRS models, while equations 4 to 5 represents the VRS models.

$$\begin{aligned} &Min\theta, \lambda\theta \\ &St. \\ &-qrj + Q\lambda \geq 0 \\ &\theta xij - X\lambda \geq 0 \\ &N1'\lambda = 1 \\ &\lambda \geq 0 \end{aligned} \tag{4}$$

Lauro et al. (2016) and Yuan and Shan (2016) report that the CCR and the BCC models only differ in the manner the latter includes convexity constraints. Since the current model

considers the VRS, the restriction $\sum_{i=1}^{n} \lambda n = 1$ is introduced. Ramírez Hassan (2008) cautions that, if this restriction is not there, it would imply the application of the CRS model. The same analogy applies to all the inefficient DMUs in the sample. That is, the slacks and the radial movements are calculated for all inefficient DMUs using equation 5. The BCC is adept to calculate pure technical efficiency and inefficiency and when applied with the CCR model, it also measures scale inefficiency. Where, $\sum_{i=1}^{I} \lambda I = 1$, a DMU is on a CRS frontier, if $\sum_{i=1}^{I} \lambda I < 1$, the DMU is located on the IRS frontier and if $\sum_{i=1}^{I} \lambda I > 1$, there is DRS. Given that this study has adopted both the CCR and the VRS with an input-minimisation orientation. The DEA models used in this study also consider the slack movements for the inefficient DMUs. As a result, the models account for the slacks in equation 5.

$$
\begin{aligned}
&\text{Min } \theta, \lambda j, Sr^{+}, Si^{-} \\
&\theta - \varepsilon \left[\sum_{i=1}^{C} Si^{-} + \sum_{r=1}^{D} Si^{+} \right] \\
&St. \\
&\theta \mathrm{x} i_0 - \textstyle\sum_{j=1}^{N} \mathrm{x} ij\, \lambda j - Si^{-} = 0, \\
&\theta \mathrm{qr}_0 = \textstyle\sum_{j=1}^{N} \mathrm{qr} j\, \lambda j - Sr^{+} = 0, \\
&\sum_{j=1}^{N} \lambda j = 1 \\
&\lambda j, Sr^{+}, Si^{-} > 0
\end{aligned}
\tag{5}
$$

Coelli et al. (2005) define slacks as input excesses and output shortfalls that are required over and above the initial radial movements to push DMUs to efficiency levels. Both the slack and radial movements are associated only with the inefficient DMUs. The radial movements are initial input contractions or output expansions that are required for a firm to become efficient. Si^{+} and Si^{-} in equation 5 are the output and input slacks, respectively to be calculated with θ, and λn. ε, is the non-Archimedean constant. Gavurova et al. (2017) hint that if the slack variables of a DMU are not equal to zero and the technical efficiency score is lower than one, it is necessary to perform a non-radial shift that is expressed by the slack variables to achieve technical efficiency. In equation 5, the slack variables determine the optimum level of inputs that DMUs would have to utilise and the outputs that they would have to produce to become efficient, provided that these DMUs are inefficient. Therefore, the slacks depict the under-produced outputs or overused inputs.

4. Data

We selected 31 countries (see Table 2) based on the fact that these countries collectively represented 90 per cent of COVID-19 cases reported at the time of this analysis, which was 100 days since the first case was reported outside of China. This study measures the efficiency of 31 countries in using the available resources to flatten the COVID-19 curve. Of the selected countries, excluding South Africa, 30 were selected as they were the top 30 countries with COVID-19 infections as at end 30 April 2020 (a cut-off period for the study which started on 31 December 2019, based on data from Worldometer (2020). South Africa

was included as a country with most infections in Africa to represent the continent, as the sample had no African country. DMUs with an efficiency score of 1, are technically efficient and serve as benchmarks for inefficient countries with scores of less than 1.

The study uses an input-minimisation variable returns to scale (VRS) data envelopment analysis (DEA) model[6]. The inputs and outputs for the model are shown in Table 1. The inputs are number of days to lockdown, in line with the work of Correia et al. (2020), Barro et al. (2020), Garrett (2008), Bootsma and Ferguson (2007) and Markel, et al. (2007), number of doctors per 1000 of the population, total tests per 1 million population and spending on health as a percentage of GDP. It is noted that with the exception of the number of days to lockdown, the other three inputs are not unique to COVID-19 though they are very standard input variables in the DEA health literature (see, e.g. Giuffrida and Gravelle, 2001; Hollingsworth, 2003; Bootsma and Ferguson, 2007, Campanella et al., 2017; Anton, 2013; Marschall and Flessa, 2009; Markel et al., 2007). For our main output variable, we were interested in data relating to the speed at which the curve was being flattened, i.e. how quickly countries are able to contain the rate at which the virus spreads. For this reason, our choice of output variable differs, for example, from Shirouyehzad et al. (2020), who chose as outputs and number of confirmed cases (stage 1) and in stage 2, two outputs, which are the number of the recovered cases and the number of death cases.

As the other input variables are standard, the analysis will focus mainly on a number of days to lock down. Figure 1 shows a quick scatter plot relating the number of days it took countries to introduce lockdown and the number of days to flatten the curve. A quick inspection of the plot shows that there is a positive correlation, in other words, quicker introduction of lockdowns are generally associated with shorter periods flattening the curve. It took the 31 countries an average of 21 days to institute lockdown, and an average of 51 days to flattening the curve.

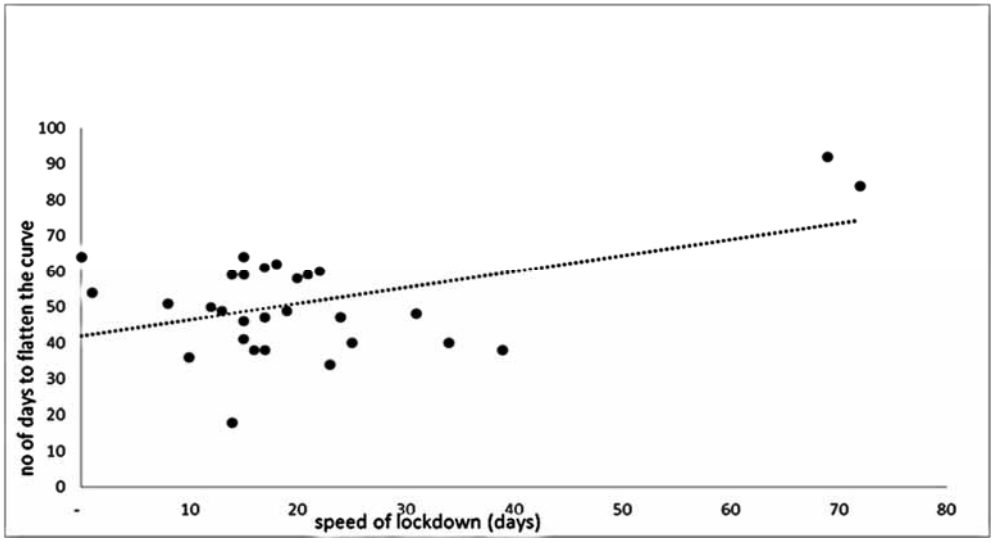
The original output variable for this study was the critical point to persistently reduced COVID-19 infections; which is the number of days from the start of each country's cycle up to a point where the COVID-19 infections start to fall consistently, showing that infections are substantially declining. For short, this is the inflexion point on the COVID-19 trajectory curve. This was derived by computing 14-day rolling averages across the study period for each country; with the corresponding dates yielding the number of days at the critical points (where the exponential trends of the epi-curves ended and deceleration started) (see Appendix 1). DEA benchmarks data samples in such a way that high values represent efficient units. Therefore, the critical point for persistent COVID-19 reduced infections (the actually selected output variable) presented a challenge where countries reaching the critical point earlier would be represented by low values. To prevent DEA model misspecification and skewing the efficiency results, this output was replaced with an inverted measure, the number of days left in a cycle after a country reaches the critical point of persistently reduced COVID-19 infections. However, in the interpretation of the results, either one of these variables or both can be used. This measure was calculated for each country by subtracting the days at the critical point of persistently reduced COVID-19 infections from the total days in a

[6] We also performed output maximization. The results were almost identical to the input minimization, which confirms the robustness of the results. The results are available on request from the authors.

country's cycle. This variable assigns higher output values to DMUs who swiftly reached the critical point and low values to those who delayed and zero to DMUs, still showing a consistent pattern of increasing COVID-19 infections by 30 April 2020. Data were obtained from the International Monetary Fund, Johns Hopkins University, The World Bank and Worldometer.

Figure 1

Correlation between number of days to introduce lockdown and number of days to flatten the curve



Source: Authors' graph based on data from Worldometer (2020).

Table 1

Analytical variables

Model	DEA Model	Number of variables	Variable description
COVID-19 Model	VRS	5	Output 1: Number of days left in a cycle after reaching persistent COVID-19 reduced infections (spared days) Input 1: Number of days to lockdown Input 2: Number of doctors per 1000 population Input 3: Total tests per 1 million population Input 4: Spending on health % of GDP

Source: Authors' table.

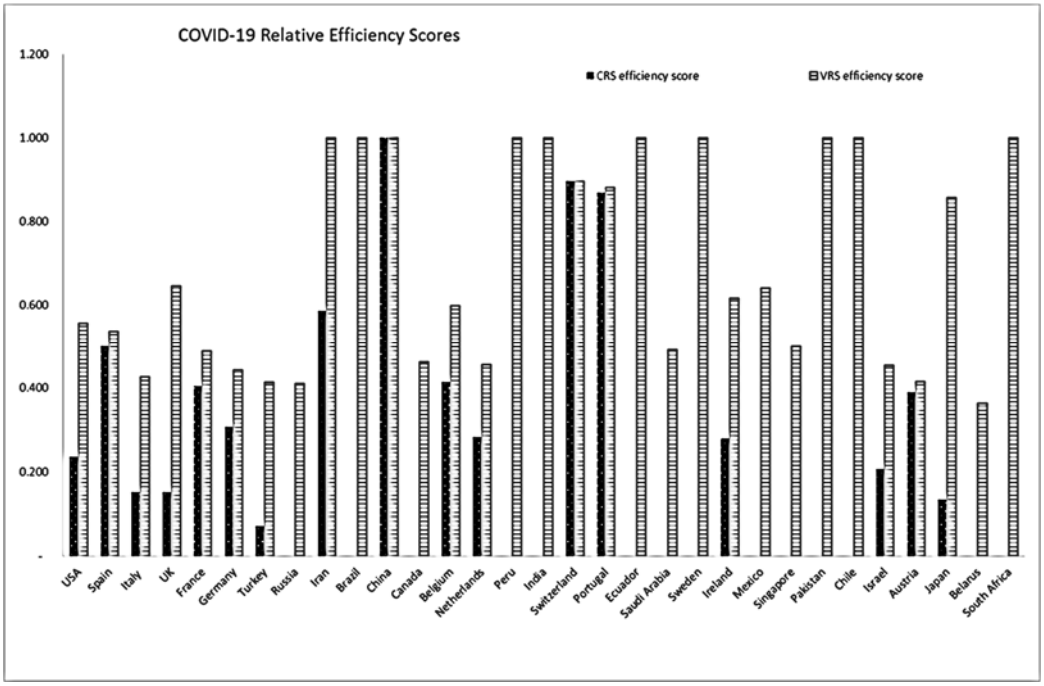
5. Results

The results of the efficiency analysis are reported in Table 2 and Figure 2. The mean technical efficiency score of the 31 DMUs was 83.3 per cent, as reflected in Table 2, showing that most of the sampled countries were operating close to the efficiency frontier. Of the 31 countries, 12 or 38.7 per cent were efficient in flattening the COVID-19 curve by instituting lockdown

measures, conducting tests, using the available doctors and prevailing levels of health spending to gross domestic product (GDP). Put differently, these 12 countries minimised (optimised) the use of all inputs in the model or used inputs efficiently in the quest to flatten the infection curve. These 12 DMUs serve as a benchmark and offer possible lessons in the optimal use of the production technology under consideration for the 19 or 61.3 per cent inefficient DMUs who should, on average, improve efficiency by 16.7 per cent.[7]

Figure 2

Technical efficiency scores



Sources: Authors' graph based on efficiency results.

[7] As mentioned by way of an earlier footnote, we also performed an output-maximisation DEA which confirms the efficiency scores obtained from the input-minimisation model. It confirms the robustness of our results and is available on request from the authors.

Table 2

Results of VRS input-minimisation

Country	VRS efficiency score	Efficient lockdown days*	Actual number of days to flatten the curve	Spared days in a full cycle after flattening the curve
Turkey	1,000	39	38	8
Iran	1,000	31	48	22
Brazil	1,000	12	50	0
China	1,000	24	47	75
Peru	1,000	13	49	0
India	1,000	14	58	0
Ecuador	1,000	1	54	0
Sweden	1,000	0	64	0
Singapore	1,000	69	92	0
Pakistan	1,000	15	64	0
Chile	1,000	14	59	0
South Africa	1,000	21	59	0
Russia	0,997	13	49	0
Saudi Arabia	0,960	20	59	0
Ireland	0,940	8	51	7
Switzerland	0,896	9	36	28
Portugal	0,881	12	18	38
Japan	0,857	23	84	10
Belarus	0,802	18	60	0
Mexico	0,757	11	59	0
Spain	0,703	11	38	25
Israel	0,670	23	40	22
Italy	0,646	11	61	9
UK	0,646	12	49	9
Belgium	0,634	11	38	22
Netherlands	0,634	10	47	15
France	0,606	9	41	19
Austria	0,588	14	34	28
USA	0,556	8	46	11
Canada	0,532	10	62	0
Germany	0,528	13	40	24
Mean	0,833			

Sources: International Monetary Fund (2020), Johns Hopkins University (2020), World Bank (2020a; 2020b), Worldometer (2020).Note: Zero spared days implies that the country has not yet flattened the COVID-19 curve and has been allocated the full duration from the first reported cases to the end April 2020. To prevent model misspecification, the number of spared days (total days less days when the curve was flattened) was used to ensure that underperforming countries are assigned a lower number.

*Note: * Purely for illustrative purposes; although countries that are below the efficiency frontier could reach that frontier by optimising the use of inputs in many different combinations of resource reductions, we use the number of days to lockdown to illustrate the relative improvements required by each country to become efficient.*

The 50 per cent cohort (4 or 13 per cent of DMUs)

Four countries, Germany, Canada, the United States of America and Austria had efficiency scores between 50 and 59 per cent, needing to improve the use of resources in the management of COVID-19 by 41 to 50 per cent. Germany had the lowest efficiency score of 52.8 per cent. In the 64 days period (27 February to 30 April 2020) pertaining to Germany's timeline, to be efficient in flattening the COVID-19 curve, the country needed to use fewer resources, for example imposing lockdown measures 13 days from the first reported case that is precisely on 10 March 2020[8]. In the 62 days related to analysing Canada, the country did not manage to reach the critical point (zero spared days). Canada recorded an efficiency score of 53.2 per cent. To improve this performance relative to efficient peers in the sample, the country needed to improve efficiency by 46. 8 per cent, e.g. by imposing lockdown measures within 10 days (saving 8 days) of reporting the first COVID-19 cases. The United States of America's inefficiency score was 44.4 per cent. Relative to efficient countries, this inefficiency rate could have been improved by using fewer resources, for example, by imposing lockdown measures within 8 days of reporting the first COVID-19 cases, instead of two weeks. Austria is the last and best-performing country in this cohort, realising a score of 58.8 per cent. Benchmarked against efficient peers, the country should improve efficiency in the use of resources by 41.2 per cent.

The 60 per cent cohort (6 or 19.4 per cent of DMUs)

France was the least efficient DMU in this category with a score of 60.6 per cent. To reach the optimal efficiency frontier relative to its efficient peers, France could improve the efficiency of resources by 39.4 per cent. Using lockdown days as an illustration, it should have acted with lockdown in 9 days (opposed to 15 days) after reporting the first COVID-19 case. The Netherlands and Belgium had efficiency scores of 63.4 per cent, needing to improve relative efficiency by 36.6 per cent. This implies that the resources used in flattening the COVID-19 curve should have been fewer. The United Kingdom and Italy recorded efficiency scores of 64.6 per cent. To become relatively efficient in the use of resources for flattening the COVID-19 curve, the United Kingdom and Italy could have used resources 35.4 per cent more efficiently. Israel was the best performer in this cohort, with a score of 67 per cent needing to improve efficiency by 13 per cent. To reach top efficiency, Israel would have, for example, had to institute lockdown in 23 days, instead of 34 days after recording the first COVID-19 case.

[8] Purely for illustrative purposes; although countries that are below the efficiency frontier could reach that frontier by optimising the use of inputs in many different combinations of resource reductions, we use the number of days to lockdown to illustrate the relative improvements required by each country to become efficient.

The 70 to 89 per cent cohort (6 or 19.4 per cent of DMUs)

Spain, Mexico, Belarus, Japan, Portugal and Switzerland fall in this category. Spain was one of nations mostly affected by the pandemic. Its efficiency score is 70.3 per cent. To improve its efficiency relative to peers, it was supposed to have used fewer resources in flattening the COVID-19 curve, such as implementing lockdown in 11 days (instead of 16 days) after reporting the first COVID-19. Mexico needed to target the same use of resources as Spain in respect of lockdown days. As it pertains to Belarus, it had a relative efficiency improvement target of 19.8 per cent. It could, for example, reach the frontier by reducing the number of days to lockdown from 22 to 18. Japan recorded an efficiency score of 85.7 per cent, while Portugal recorded an efficiency score of 88.1 per cent. They need to respectively improve the efficiency with which they use resources by 14.3 and 11.9 per cent. Switzerland recorded an efficiency score of 89.6 per cent; it maintained the critical point of persistently reducing the COVID-19 infections at 36 days, sparing 38 days. To be fully efficient, fewer resources could have been used. For instance, lockdown could have been introduced in 9 days (3 days earlier) after reporting the first COVID-19 case.

The 90 to 99 per cent cohort (3 or 1 per cent of DMUs)

Ireland, Saudi Arabia and Russia were very close to the optimal technical production scale. They had to respectively improve relative efficiency by 6, 4 and 0.3 per cent. Ireland had an output of 7 spared days after reaching the critical point to persistently reducing the COVID-19 infections. To reach the maximum efficiency level, it needed to use fewer resources, such as locking down 8 days after reporting the first COVID-19 case. Saudi Arabia and Russia had zero spared days as outputs. In their effort to reach efficiency, they had to lockdown within 20 (1 day less) and 13 days, respectively – again as an illustration of relative improvements in efficiency required to reach the frontier.

6. Conclusions

The study analysed the technical efficiency with which health systems in our sample of 31 countries were able to contain the spread of COVID-19 infections (flattening the curve) using the input-oriented DEA methodology. This means that those countries that were on the frontier with an efficiency score of one, managed to reach that frontier by optimising the combination of inputs available to them. In this study, those inputs were health expenditure, speed at which lockdowns were implemented, number of doctors/thousand and number of tests performed/million of the population. The average technical efficiency score is 83.3 per cent. This shows that not all the countries were efficient and on average, are operating below the frontier. They would on average need to improve relative efficiency by 16.7 per cent, in other words, on average, the countries operating below the frontier, could have reached the same outcomes in terms of flattening the curve by using fewer resources such as locking down the economy earlier than they did.

Specifically, 12 of the 31 countries in our sample implemented the COVID-19 lockdown measures very quickly and were efficient in the use of resources to manage the flattening of

their COVID-19 contagion curves. Given the objective to minimise the use of inputs in order to be efficient, the remaining 19 countries used their available resources inefficiently. Among the worst performers were some of the richest countries in the world, Germany, Canada, the USA and Austria, who obtained efficiency scores between 50 and 60 per cent. These countries were more inefficient in applying their available resources to flatten the curve than countries like Italy, France and Belgium, who were some of those hardest hit by the spread of the virus.

In some sense, these findings are in line with the recent study by Shirouyehzad et al. (2020), who found that some developing countries with a high population density and low International Health Regulations Core Capacity Scores (IHRCCS), were more efficient in contagion control of COVID-19, even though they may be worse in offering medical treatment. For example, Shirouyehzad et al. (2020) found that Singapore had the highest efficiency among the countries, even with one of the highest population densities in the Southeast Asia, and was far ahead of others. In the Middle East, Iran has been the most efficient contagion control, and although Egypt was worse, it was more efficient in medical treatment. This finding underscores the importance of using NPIs as efficiently as possible to stop the spread of an epidemic or pandemic (flattening the curve) in the shortest possible time, especially in countries with inferior health systems.

This study is limited in several ways. It should be noted that the results are obtained based on the data gathered during the (roughly) 100 days of what is perceived to be the first wave of the spread of COVID-19. Therefore, the results should not be generalised to other time periods and extrapolation should be done with caution. The selection of the indicators affects the outcomes of the model. Therefore, a different set of indicators may lead to a different collection of results and analyses.

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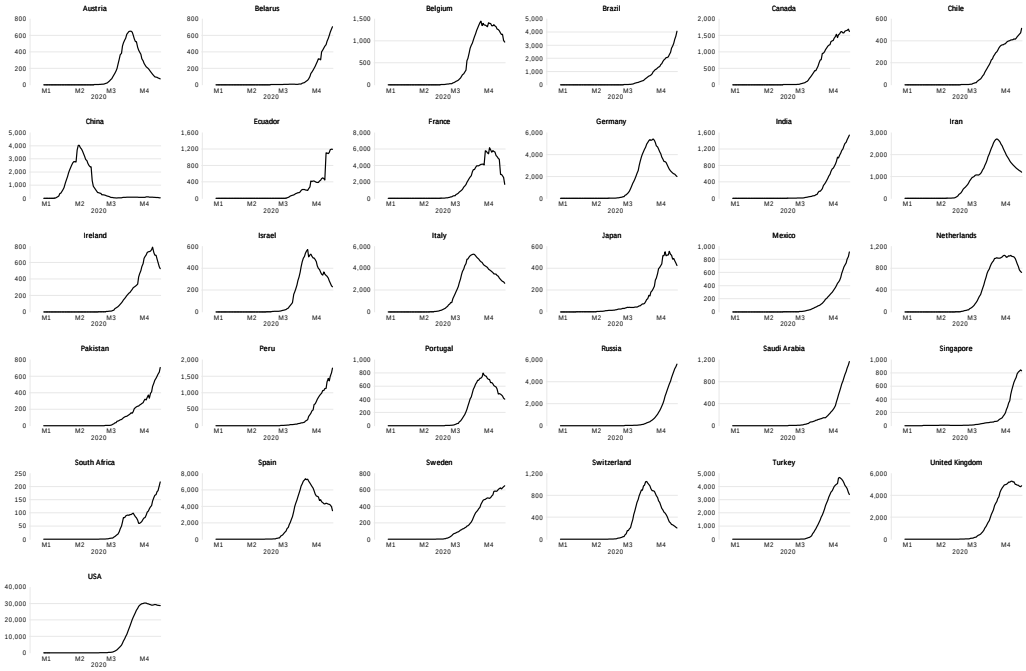
Appendix 1

Moving average of flattening COVID-19 case curve (infection trajectory curve)



Sources: Author's EViews extrapolations based on International Monetary Fund (2020), Johns Hopkins University (2020), World Bank (2020a; 2020b), Worldometer (2020) data.

ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
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THE RELATIONSHIP BETWEEN ENVIRONMENTAL QUALITY AND ECONOMIC GROWTH: AN EMPIRICAL INVESTIGATION APPLIED TO THE CASE OF ALGERIA (1970-2019)[3]

The aim of this paper is to study the existence of an environmental curve for the case of Algeria using the two-degree polynomial function presented in the linear and semi-log-linear and log-linear form in order to detect the effect of international trade and people on environmental quality. To reach our goal, we have structured our paper around two elements: Firstly, we will present a brief review of empirical and theoretical literature on the relationship between economic growth and the quality of the environment. Secondly, we will deal with the empirical study evaluating the impact of the issue of CO_2 on economic activity. We have found that the environmental Kuznets curve (EKC) exists in Algeria and the GDP per capita and the population have a positive impact on the emission of the CO_2. Furthermore, trade openness has a negative impact. In addition, there is a stable long-term relationship between emissions of CO_2 and the others various explanatory variables (GDP per capita, international trade and population).
Keywords: environmental quality; environmental Kuznets curve; economic growth; population; international trade; trade openness; environmental pollution; autoregressive distributed lag
JEL: C12; C22; Q56

Introduction

Different studies have shown that since 1970, carbon gas emissions in the world have multiplied, it is expected that this continuous effect of emissions will induce an increase in heat in the world of 0.7% in 2050 with all its consequences in the different areas (quality of life, government spending, natural disasters, etc.). At the same time, the continuity of the level of production in the various activities and at a sustained way, following trade liberalization, the increase in the level of trade, economic opening and all that accompanies such development of effects of secondary gases like carbon monoxide and other warming

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gases in the open air, and as a result of the increase in the degree of heat, the sea level; the whole of these induced effects will negatively influence agricultural production and cause a shortage in the supply of drinking water, an expansion of diseases and others negatives externalities. Faced with the pressure of social movements, international political decision-makers (ex Cop21) have been pushed to become aware of this state of disrepair, towards which we are moving to take measures to reduce these effects of pollution in the air and among them the most important carbon monoxide gas. To achieve the environmental objectives imposed on the Algerian economy, while pursuing its development policy which displays a change (a trade policy of free trade which has favoured a modification of the locations of industries) to adapt to the liberalization movements that the world economy have seen so as to bring about a strengthening of restrictive environmental legislation in order to avoid the examples linked to the sad natural disasters that have occurred to a set of countries in different areas.

The disasters of Seveso, Bhopal, the grounding of Erika and the Exxon Valdez, which caused a major oil spill and Chernobyl radiation, are all proven examples with releases into the environment that do not leave any ambiguity as to their source and potential danger. There is no country in the world, which is not safe from disasters, but it is usually the poorest countries that pay the highest price in human lives. The international dimension of disasters is their consequences, the damage they cause, but also sometimes their origins.

The relationship between economic growth and the quality of the environment takes an important place in the economic literature to become a great interest for economists and which has its origin in the hypothesis of the Environmental Kuznets curve (EKC). Several empirical works have attempted to make a link between environmental quality and economic growth. We can quote the works of Grossman and Kruger (1991, 1994), Shafik and Bandyopadhyay (1992), Cropper and Griffith (1994), Selden and Song (1994), Antle and Heidebrink (1995), Holtz-Eakin and Selden (1995), Majid Ezzati, Singer Burton H, et Daniel M Kammel (2001), David I. Stern (2004), Rob Hart (2020), Pincherra R and Zuniga F (2020).

Through this paper, we address the following issue: Is there a relationship between environmental quality and economic growth in Algeria? To analyze this problem, we set ourselves two objectives for this study:

1) Check if there is an EKC for the Algerian case using the two-degree polynomial function presented in linear, semi-log-linear and log-linear form.
2) Analyze the impact of international trade and the increase in the population in the level of CO_2 emissions.

This work derives its interest from the importance assumed by the dimension of environmental protection in such a way as not to jeopardize the lives of future generations within the framework of the application of the EKC. We realize that it exists an ever-increasing development in economic relations within the context of new global changes that involve different actors (governmental and non-governmental institutions) to be concerned with the existence of a healthy environment which can benefit all countries.

In order to achieve our objective, we have structured our work around fourth points: In the first point, we will present a brief review of the empirical and theoretical literature on the

relationship between economic growth and the quality of the environment. In the second point, we will use an empirical study to assess the impact of the emission of CO_2 on economic activity (Model specification of the EKC). In the third point, we present the extended polynomial model of the EKC. In the fourth point, we will present the interpretation of the results. A concluding remark is presented at the end of this work.

1. Review of Theoretical and Empirical Literature

1.1. Theoretical literature review

In economic theory, the relationship between economic growth and environmental quality is derived from the Environmental Kuznets Curve (EKC) hypothesis, which states that as a country develops, it is experiencing with a low growth, degradation and pollution increase. A greater environmental deterioration begins with low levels of income. But after reaching a high level of economic development, a better level of income, pollution will tend to decrease and cause an improvement in environmental quality. As the income increases, there is more requirement for investors to reduce environmental damage. A higher GDP makes it easier to have enough resources to finance environmental policies. So for the government, when the incomes are high, it is easier to reserve part of its consumption to protect the environment. The economic growth would be linked probably with environmental improvement. This shows that the influence and environmental impact is represented by an inverted U per capita income.

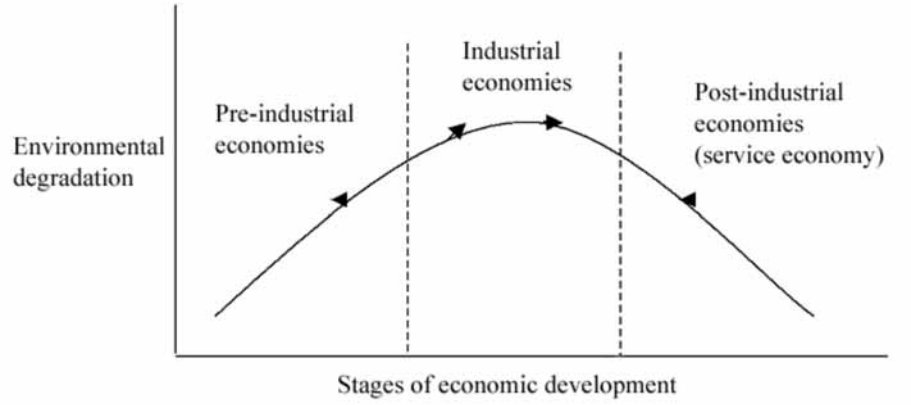
In fact, environmental degradation is inevitable at the start of a country's economic growth. In other words, the access to a sufficient level of economic development, the importance of problems related to sustainable development and the environment and efforts to prevent environmental degradation. The economic growth is achieved with less environmental damage.

The representation of the general shape of the Kuznets environmental curve is presented in Chart 1.

The developments on this subject tell us that the debate on the environment and economic growth has centred on these five main questions: The first one, the hypothetical inverted U-shaped relationship between income and environmental degradation, known as the *Environmental Kuznets Second'*. The second question explains the role played by others factors, such as population growth, income distribution, international trade, time and space as dependent variables. The third one showed how the economy of a country could be changed. The last one explained the implications of ecological thresholds and irreversible damage for the inverse relationship between environmental degradation and economic growth, namely, whether a static statistical interpretation can be interpreted in terms of carrying capacity, ecosystem resilience and sustainability. Finally, the role of environmental policy interferes in the treatment of the shape of the relationship linking income and environment to reduce the economic cost of economic growth and ensure more sustainable results.

Chart 1

The Kuznets Environmental Curve



Source: Theodore Panayotou, (2003)

1.2. The presentation of the empirical review on this relationship

The theoretical background can be divided into two categories: One using panel methods, the others with time series methods.

- **Studies carried out on panel data**

Shafik and Bandyopadhyay (1992), tried to validate the EKC on a sample of 149 countries during the period 1960-1990 by taking three environmental indicators: the emission of sulfur dioxide (SO_2,) deforestation and carbon emission. They found that the inverted U shape was only validated for SO_2. The turning point values alternate between 2000 and 4000 (US $ 1985). Grossman and Krueger (1991, 1995) studied the existence of EKC on a sample of developed and developing countries using a range of environmental indicators to integrate them into the random-effects model. They proved the inverted U shape for water pollution and SO_2, and the turning point varies between 4000 and 5000 (US $ 1985). Selden and Song (1994) took four pollutants (SO_2, SPM, NOx and CO_2). An inverted U curve was verified for the all four pollutants. The turning points exceed $ 8,000 1985 in the case of SO_2 and SPM. Cropper and Griffith (1994) considered a sample of 64 countries over the period 1961–1991 using deforestation as an environmental indicator. They found an inverted U-curve for Africa and Latin America, with the turning points alternating between 4760 and 5420 (in US $ 1985). Harbaug W, Levinson A and Wilson D [2000] used the air pollution data used by Grossman and Krueger (op cited), however they came to conflicting results displayed by Grossman and Krueger. They questioned the existence of an inverted U-shaped relationship between pollution and per capita income. The work presented by Meunié A and Pouyanne G (2007) aims to test the EKC "U" hypothesis for 37 cities around the world. they presented three results. They estimated the quadratic relations were giving many bell-shaped curves for the sample. Then, they showed that the curves are explained by two sets of factors: individual behaviours, and collective choices. Finally, they checked the validity of the hypothesis of the

CEK "U" by seeking to explain more generally the level of polluting emissions. Nkengfack H., Kaffo F. (2014), using an ARDL model, examined the effects of economic growth on carbon dioxide (CO_2) emissions in a few countries of the Congo Basin over the period 1978-2012. By this model, they showed that economic growth has a positive impact on CO_2 emissions in these countries. Then, they found that energy consumption, population density, industrial activities increase CO_2 emissions, although the impact of energy consumption and industrial activities are not significant in DRC. Trade openness has a negative and significant impact on CO_2 emissions in Cameroon, while its impact is insignificant in Congo, Gabon and DRC. This result contradicts the hypothesis of pollution "havens".

- **Studies carried out on time series**

Roca and Alcantara (2001) studied the validity of the EKC hypothesis for the case of Spain over the period 1972-1997; they demonstrated that the U-shaped curve between CO_2 emissions and GDP per capita is not verified. Soytas et al. (2007) studied the validity of the EKC hypothesis for the case of the United States over the period 1960-2004 and the existence of causality between income, energy consumption and CO_2 emissions. They proved the validity of the EKC hypothesis and established the existence of a unidirectional Granger causal relationship that goes in the direction of energy consumption towards CO_2 emissions. Pao and Tsai (2011) have tested the validity of KEC in Brazil by the ARDL approach using annual data of GDP and emissions of dioxide CO_2 . Their results show the existence of KEC in Brazil. Saboori and Sulaiman (2013) tried to validate the existence of EKC in the case of Malaysia by introducing energy consumption into their equations. They found that EKC does not exist and that there is a two-way causality between the emission of carbon dioxide CO_2 and GDP. Yavuz (2014) studied the validity of the EKC hypothesis for the case of Turkey during the period 1960-2007 using the ARDL model. He confirmed the hypothesis of EKC.

Moreover, Farhani et al. (2014) studied the dynamic relationship between carbon dioxide (CO_2) emissions, production (GDP), energy consumption and trade using the ARDL approach for the case of Tunisia during the period 1971-2008. The empirical results reveal the existence of two long-term causal relationships between the variables. In the short term, there are three unidirectional Granger causal relationships, which gone from GDP, from squared GDP and energy consumption to CO_2 emissions dioxide. Toumache (2009) examined the existing relationship between CO_2 and economic growth in Algeria over the period 1993 -2006, and he found contradictory results with the logic of Kuznets models. Noubissi E-D and Njangang H-N (2017) examined the effects of economic growth on carbon dioxide (CO_2) emissions and temperature trends in Cameroon over the period 1972–2010. Using the ARDL model, they found the existence of a long-term relationship in the form of "inverted N" between economic growth and indicators of environmental degradation (CO_2 emissions and temperature change). They found that in Cameroon, energy consumption and industrial activities increase CO_2 emissions but not temperature changes. On another side, trade opening leads to a drop in the level of CO_2 but not in temperature.

2. Model Specification of the EKC

In this point, we will check if there is EKC for the Algerian case by using the polynomial function of degree two presented in linear, semi-log-linear and log-linear form. Then we will expand this function by adding two explanatory variables other than the GDP per capita, namely international trade and the population, as control variables to detect their effect on environmental quality.

2.1. The specification polynomial model of the EKC

Referring to the studies presented by Toubache Rachid (2009) and Maamar Sabri (2009), we will examine the direct relationship between the evolution of the CO_2 per capita and GDP per capita by a polynomial function of degree two presented in linear, semi-log-linear and log-linear form. The three models are presented as follows:

$$CO_{2_t} = a_0 + a_1 GDP_t + a_2 GDP_t^2 + \varepsilon_t \quad (1)$$

$$CO_{2_t} = \alpha_0 + \alpha_1 \log GDP_t + \alpha_2 (\log GDP_t)^2 + v_t \quad (2)$$

$$\log CO_{2_t} = \beta_0 + \beta_1 \log GDP_t + \beta_2 (\log GDP_t)^2 + w_t \quad (3)$$

Where CO_2 is the per capita emissions of the CO_2 which is an indicator of pollution, GDP_t is the per capita income. a_i , α_i et β_i represent model parameters. ε_t , v_t and w_t represent the terms of the error. In order for the relationship between the CO_2 per capita emissions and per capita income to demonstrate the existence of a "bell" shape, it is necessary that:

$$a_1 > 0 \text{ and } a_2 < 0$$
$$\alpha_1 > 0 \text{ and } \alpha_2 < 0$$
$$\beta_1 > 0 \text{ and } \beta_2 < 0$$

2.2. The unit root test

Before estimating the parameters of the three equations (1, 2, 3), we will study the stationarity of these variables of equations 1, 2 and 3 by the ADF (Dukey Fuller Augmented) test. The application of the ADF test (Dickey and Fuller 1979; 1981) requires beforehand the choice of the number of delay "p" to introduce so as to whiten the residues. The delay “p” value is determined either using the partial autocorrelations function, or using the Box-Pierce statistic, or again using the Akaike criteria (AIC) or finally by Schwartz (SC).

In our study, we applied the ADF test and we determined the number of delays using the partial autocorrelations function to study the significance of the partial correlation coefficients. The application of this method, based on the "correlogram" study of the different variables of the equation (1), allowed us to obtain the delay "one" for all the variables.

Table 1

Augmented Dickey-Fuller test for the variables of the three equations

Variables of Equation 1			
In level			
Variables	(1)	(2)	(3)
CO_{2_t}	-2,19	-1,85	0,90
GDP_t	-1,47	-1,07	1,96
GDP_t^2	-1,16	-0,62	2,22
In difference			
ΔCO_{2_t}	-3,59*	-3,58*	-3,16*
ΔGDP_t	-3,22*	-3,30*	-3,29*
ΔGDP_t^2	-2,89*	-2,92*	-2,86*
Variables of equation 2			
In level			
CO_{2_t}	-2,19	-1,85	0,90
$\log GDP_t$	-1,87	-1, 50	1,73
$(\log GDP_t)^2$	-1,82	-1,45	1,75
In difference			
ΔCO_{2_t}	-3,59*	-3,58*	-3,16*
$\Delta \log GDP_t$	-3,77*	-3,97*	-4,01*
$\Delta(\log GDP_t)^2$	-3,69*	-3,87*	-3,90*
Variables of equation 3			
In level			
$\log CO_{2_t}$	-2,98	-3,18	-0,19
$\log GDP_t$	-1,87	-1, 50	1,73
$(\log GDP_t)^2$	-1,82	-1,45	1,75
In difference			
$\Delta \log CO_{2_t}$	-3,19**	-2,88*	-2,55*
$\Delta \log GDP_t$	-3,77*	-3,97*	-4,01*
$\Delta(\log GDP_t)^2$	-3,69*	-3,87*	-3,90*

(1), (2) and (3) indicate the models "with constant and trend", "with constant" and "without constant and without trend"

* indicates Significance levels at 5%

** indicates the Significance levels at 10%

After determining the delay for each variable, we adopted the sequential strategy of the ADF test to investigate the stationarity of the variables in our study.

The table below shows the results of the Dickey-Fuller Augmented Tests (ADF) for the variables of these three equations (1, 2, 3). We are testing:

The null hypothesis H0: Non-Stationarity;

Against The alternative; hypothesis H1: Stationarity.

The results of the unit root test presented in the table above, show that all the series of the three equations are non-stationary in level, but they are stationary in difference. They are therefore integrated of order 1.

2.3. The Johansen's cointegration test.

The Johansen Trace test allows us to detect the number of the co-integrating vectors. The hypotheses of this test are:

there are at most "r" cointegration vectors;

there are at least "r" cointegration vectors.

We accept when the Trace statistic is below critical values at a significance level of $\alpha\%$.

However, we reject otherwise. This test is applied sequentially from r = 0 to r = k-1.

Table 2

The Johansen cointegration test

The cointegration between the variables of the model 1			
Eigen value	Trace statistic	Critical value	Hypothesized on the number of Ces
0.811811	100.8360	29.79707	Any
0.338128	20.66123	15.49471	At least one
0.017602	0.852411	3.841466	At least two
The cointegration between the variables of model 2			
0.898036	130.9810	29.79707	Any
0.344627	21.39054	15.49471	At least one
0.022822	1.108128	3.841466	At least two
The cointegration between the variables of the model 3			
0.887678	125.0475	29.79707	Any
0.333479	20.10114	15.49471	At least one
0.013005	0.628340	3.841466	At least two

Table 2 shows the application of the Johansen Trace test between the variables to each model (linear, semi-log and logarithmic). This test allows us to conclude that there are two co-integrating relationships. Therefore, emissions of the CO_2 per capita and GDP per capita are co-integrated.

2.4. The estimation of the long-term equation

Having confirmed the presence of a co-integrating relationship between the variables, it is interesting to analyze the detailed results of the long-term relationship. We estimate the long-term relationship by the "OLS" method for the three models:

$$CO_{2_t} = -5,97 + 0,003GDP_t - 3,07\times10^{-7}GDP_t^2 + \varepsilon_t$$
$$(-2,99)\quad(-2,22)\quad(3,17) \qquad (4)$$
$$\bar{R}^2 = 0,70 \quad \text{F-Statistic} = 58,62 \quad \text{P(F-Statistic)} = 0,0000 \quad \text{DW=0,28}$$

$$CO_{2_t} = -148,03 + 16,4\log GDP_t - 0,44\ (\log GDP_t)^2 + v_t$$
$$(-1,35)\quad(1,22)\quad(-1,08) \qquad (5)$$
$$\bar{R}^2 = 0,70 \quad \text{F-Statistic} = 58,5 \quad \text{P(F-Statistic)} = 0,0000 \quad \text{DW=0,32}$$

$$\log CO_{2_t} = -247,9 + 29,18\log GDP_t - 0,85\ (\log GDP_t)^2 + w_t$$
$$(-3,71)\quad(3,58)\quad(-3,44) \qquad (6)$$
$$\bar{R}^2 = 0,71 \quad \text{F-Statistic} = 61,44 \quad \text{P(F-Statistic)} = 0,0000 \quad \text{DW=0,55}$$

We note through the results obtained from equations (4, 5 and 6) that all the coefficients of these equations are significant at the 5% level, except the coefficients of equation 5 (semi logarithmic), which are not significant, however, all have the right or correct sign. Thus, the coefficients a_2, α_2 et β_2 are negative, but on the other side the coefficients a_1, α_1 and β_1 are positive, which makes it possible to validate the existence of a EKC, including:

The diversion point $\frac{-a_1}{2a_2}$ would be at an annual income level of 4885.99 $ per capita for the linear model.

The diversion point exp $\frac{-\alpha_1}{2\alpha_2}$ would be at an annual income level of $ 124,070,888 per capita for the semi-linear model.

The diversion point exp $\frac{-\beta_1}{2\beta_2}$ would be at an annual income level of $ 28,479,807.4 per capita for the log-linear model.

The static relationship between the emissions of CO_2 per capita and income per capita is statistically acceptable, because P (F-Statistic) is less than 5%. The explanatory power is around 70% for the three models and the residuals are normally distributed.

2.5. The choice between the three specific economic models: linear, semi-linear and log-linear

We discard the semi-logarithmic model of our study, because its coefficients are not significant (they are not verified by the t-statistic), we have to make a choice between the linear model and the log-linear model by the use of three information criteria: Akaike info criterion (AIC), Schwarz criterion (SC) and the Hannan-Quinn criterion (HQ).

Table 3

The choice between the three specific models

Models	The choice criteria		
	AIC	SC	HQ
The linear model	1,11	1,22	1,15
the log-linear model	0,12	0,24	0,17

The three criteria show that the log-linear model is chosen, retained. For this purpose, we will extend

this model by adding two explanatory variables others than GDP per capita as control variables to study its impact on the level of the emissions of the CO_2.

3. The Extended Polynomial Model of the EKC

3.1 The specificity of the model and description of the variables

We will expand the polynomial model by adding two explanatory variables other than GDP per capita, namely international trade and population density in order to examine the effect of population density and international trade on the evolution of the emissions of the CO_2. The international trade is measured by the Trade Openness Index. This index is like the ratio of the sum of export (X) and import (M) to GDP [(X + M) / GDP].

Our model is inspired by that of Sebri Maamar (2009), which can be presented as follows:

$$\log CO_{2t} = \alpha_1 \log GDP_t + \alpha_2 \log GDP_t^2 + \alpha_3 \log dPOP_t + \alpha_4 \log OPEN_t + u_t \qquad (7)$$

Where CO_2 is the per capita carbon dioxide emissions. It is used as a proxy for air pollution and as an indicator of environmental quality. GDP is the Gross Domestic Product per capita, it is used as an indicator of economic growth, GDP_t^2 is the gross domestic product per capita squared, dPOP is the population density, $OPEN_t$ is the trade openness ratio used as a proxy for international trade, α_1, α_2, α_3 and α_4 represent the elasticities and u_t represent the error term.

Referring to the studies presented by Sebri Maamar (2009), Lamia Jamel, Samir Maktouf (2017) and Nkengfack H., Kaffo F. (2015), we justify the choice of these variables and the expected signs as follows:

- Real GDP per capita: Gale and Mendez (1998) demonstrated in their model that an increase in GDP per capita would be linked to a decrease in the level of pollutant, whatever the level of income of the country. This result allows us to deduct that the GDP per capita demonstrates the impact of the level of development on the environment. The expected sign of α_1 is positive.

- The population: Azomahou et al. (2006) have shown that an increase of the population provokes an increase in food requirements, which cause overexploitation and reduction of natural resources and the increase in polluting emissions. The expected sign of α_3 is positive.

- The degree of openness of the economy: In their respective work, Grossman and Krueger (1994) and Halicioglu (2009) found that the coefficient sign of the variable trade openness α_4 varies according to the level of development of the countries. In developed countries, trade openness reduces environmental degradation, while the opposite effect is seen in developing countries. The economic theory asserts the existence of three kinds of effects of external openness on environmental quality, which are the scale effect (it affects negatively the quality of the environment), the technical effect (it affects positively the quality of the environment) and the effect of composition (has an ambiguous sign with the quality of the environment).

We will evaluate the regression equation (7) for the Algerian economy. A sample of annual data is used spanning the period 1970 to 2019. The data are taken from the World Bank (GDP, population density and commercial opening) and the Carbon Dioxide Information Analysis Center (CO_2).

3.2. The causality test

At this level of analysis, we will see if the emission of CO_2 causes the growth or if the growth that causes the emissions of CO_2. We will further see if there is a feedback relationship between the two? To answer this question, we will apply the Granger causality test, whose principle is defined as follows;

We will say X causes Y if the forecast based on knowledge of the common past of X and Y is better than the forecast based on knowledge of Y alone. We apply the non-causality tests based on the maximum likelihood statistic:

$$\xi = TC_{X \to Y} \tag{8}$$

Where T and $C_{X \to Y}$ represents the number of observations and the causality measure respectively.

Under the null hypothesis of non-causality, the equation (8) follows a Chi-square law at $\tau(T-\tau)p$ degree of freedom where τ is the number of imposed constraints. The decision rule is as follows:

If $\xi < \chi^2_{(\tau(T-\tau)p)}$, we accept the null hypothesis of an absence of causality.

If $\xi > \chi^2_{(\tau(T-\tau)p)}$, we reject the null hypothesis of an absence of causality.

Table 4

The Granger causality test

the null hypothesis	F statistique	p-value
$\log GDP_t$ ne cause pas $\log CO_{2t}$	13.11	0.0007
$\log CO_{2t}$ ne cause pas $\log GDP_t$	0.63	0.43
$\log GDP_t^2$ ne cause pas $\log CO_{2t}$	12,37	0,0009
$\log CO_{2t}$ ne cause pas $\log GDP_t^2$	0,76	0,38

From Table 4, we deduct that there is a causal relationship between GDP per capita and the emission of CO_2. It is also unidirectional relation, that expresses an effect of per capita GDP on the emissions of CO_2. We also found the same result for $\log GDP_t^2$. These results allow us to consider that taking environmental protection measures into account cannot have adverse effects on economic growth. Decision-makers are aware that the preservation and improvement of the environment could benefit the general interest in such a way that the private interest (pollution reduction research, treatment of polluting water by economic agents, etc.) could coincide with the general interest in preserving government spending (health spending, waste treatment, wastewater treatment, etc.).

3.3. The stationarity test.

The ADF stationarity test is applied in our case; the null hypothesis of non-stationarity is accepted for the level variables (CO_2, GDP per capita, GDP per capita squared and trade openness). On the other way, we see that the null hypothesis is rejected for the same variables in the first differences. The variables (CO_2, GDP per capita, GDP per capita squared and trade openness) are then integrated in order 1. On the other hand, we reject the null hypothesis of non-stationarity for the variable density of the population in level. Indeed, the population density variable is integrated of order 0. The variables of our model are not integrated of the same order, so that their orders of integration are less than two. What drove us to opt for the empirical study of this model by the ARDL (Autoregressive distributed lag model) approach introduced and developed by par Pesaran, Shin and Smith (2001). The choice of this approach is justified by the fact that:

- The sample size is reduced.

- The variables are stationary in order of integration less than two, not taking into account the constraint of the same order of integration.
- The endogeneity is not a problem.

The ARDL representation of equation 7 looks like this:

$$\Delta \log CO_{2t} = \lambda_1 \log GDP_t + \lambda_2 \log GDP_t^2 + \lambda_3 \log dPOP_t + \lambda_4 \log OPEN_t + \sum_{i=1}^{n} \delta_{1i} \Delta \log \mathrm{CO}_{2t-i} + \sum_{i=1}^{n} \delta_{2i} \Delta \log GDP_{t-i} + \sum_{i=1}^{n} \delta_{3i} \Delta \log GDP_{t-i}^2 + \sum_{i=1}^{n} \delta_{4i} \Delta \log dPOP_{t-i} + \sum_{i=1}^{n} \delta_{5i} \Delta \log OPEN_{t-i} + \upsilon_t \quad (9)$$

Where Δ represents the first difference of the considered variables. It is derived from the following equation:

$$\log CO_{2t} = \sum_{i=1}^{n} \rho_{1i} \log CO_{2,t-i} + \sum_{i=1}^{n} \rho_{2i} \log GDP_{t-i} + \sum_{i=1}^{n} \rho_{3i} \log GDP_{i-i}^2 + \sum_{i=1}^{n} \rho_{4i} \log dPOP_{t-i} + \sum_{i=1}^{n} \rho_{5i} \log OPEN_{t-i} + \vartheta_t \quad (10)$$

3.4. The determination of delay number and the cointegration test

We used the criteria (Log L, LR, AIC, SC and HQ) to select the optimal number for the delays of VAR (P), with P varying from 0 to 4. The Schwarz criterion (SC) implies a delay of 2 (Table 5).

Table 5

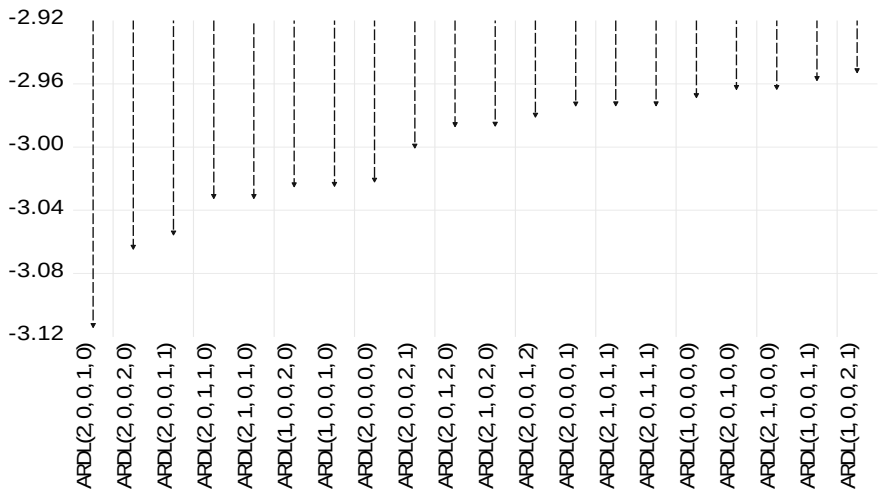
The choice of number of delay

Lag	LogL	LR	AIC	SC	HQ
0	112.4983	NA	-4.777703	-4.576963	-4.702869
1	588.0923	824.3629	-24.80410	-23.59966	-24.35510
2	703.4777	174.3601	-28.82123	-26.61309*	-27.99806
3	748.4787	58.00131	-29.71016	-26.49832	-28.51282
4	791.6284	46.02632*	-30.51682*	-26.30127	-28.94530*

We estimated twenty models (see Figure 2), based on the “Schwarz” criterion, our chosen optimal model is ARDL (2, 0, 0, 1, 0).

Chart 2

The twenty models estimated by ARDL



We used the "Bound test", which is based on the Fisher test, to assess the existence of a co-integrating relationship between the variables. From Table 6, the static F is 5.15, compared to critical values below and above the 5% significance level. The test statistic is greater than the upper limit (3.87). Therefore, we reject the null hypothesis of no cointegration and conclude that there is a long-term relationship between the model variables.

Table 6

The Bound's test

F-statistics	The Critical values		Meaning
	I_0	I_1	
5.15	2.372	3.32	10%
	2.823	3.872	5%
	3.845	5.15	1%

3.5. The estimation of the long-term and short-term equation

We have obtained an optimal ARDL model (2,0,0,1,0), so we can write it mathematically in the following form:

$$\log CO_{2t} = \rho_0 + \rho_1 \log CO_{2,t-1} + \rho_2 \log CO_{2,t-2} + \rho_3 \log GDP_t + \rho_4 \log GDP_t^2 + \rho_5 \log dPOP_t + \rho_6 \log dPOP_{t-1} + \rho_7 \log OPEN_t + \vartheta_t \quad (11)$$

The estimate of the coefficients of equation 11 is as follows:

$$\begin{array}{l} \log CO_{2t} = -148,13 + 1,07\ \log CO_{2,t-1} - 0,37\ \log CO_{2,t-2} + 17_1 79 \log PIB_t - 0,53 \log PIB_t^2 \\ \quad (-3.14)\ \ (7.05) \qquad (-2.70) \qquad (3,13) \qquad (-3,11) \qquad (12) \\ +12,8\ \log dPOP_t - 12,33\ \log dPOP_{t-1} - 0,015\ \log OUV_t \\ \quad (2,72) \qquad (-2,72) \qquad (-0,30) \end{array}$$

In the long term, we ask:

$$\log CO_{2t} = \log CO_{2t-1} = \log CO_{2t-2}$$

$$\log dPOP_t = \log dPOP_{t-1}$$

From equation 11, we deduct the long-term static equation:

$$\begin{array}{l} \log CO_{2t} = -448,09 + 58,64 \log GDP_t - 1,77 \log GDP_t^2 + 1,54\ \log dPOP_t - 0,05\ \log OPEN_t \\ \quad (-6.83)\ \ (6.75) \qquad (-6.69) \qquad (4,78) \qquad (-0,31) \qquad (13) \end{array}$$

$\bar{R}^2 = 0,99$ F-Statistic = 621,7 P(F-Statistic) = 0,01 DW=2,03

The examination of the above results, using the Student test, show that the variable GDP per capita $\log GDP_t$, GDP per capita squared $\log GDP_t^2$ and the population density $\log dPOP_t$ are significant. However, the variable trade openness $\log OPEN_t$ is not significant. Moreover, the adjusted R-squared found indicates that 99% of the dispersion is explained by the regression model. The value of adjusted R-squared confirms that the different explanatory variables $\log GDP_t$, $\log GDP_t^2$, $\log dPOP_t$ and $\log OPEN_t$ actually have an influence on environmental quality (explained variable). This allows us to say that we have a good linear fit and strong explanatory power.

.The long-term static relationship of environmental quality is statistically acceptable, since P (F-Statistic) is less than 5%. We also find that the value of the Durbin-Watson statistic (DW) is equal to 2, this shows that the residuals of the static relationship are not autocorrelated.

The estimate of the coefficients of the short-term equation is as follows:

$$\begin{array}{l} \Delta \log CO_{2t} = \ 0,37 \Delta \log CO_{2t-1} + 17,03\ \Delta \log GDP_t - 0,51 \Delta \log GDP_t^2 + \ 12,64\ \Delta \log dPOP_t \\ \qquad\qquad (3,63) \qquad\qquad (3,70) \qquad\qquad (-3,62) \qquad\qquad (5,51) \\ \quad -0,06\ \Delta \log OPEN_t\ -\ 0,30\ \text{Eq} \\ \quad (-1,12) \qquad\qquad (-5,36) \end{array}$$

3.6. The diagnostic test

We summarize the robustness tests in the following table: Estimation of the different tests.

Table 7

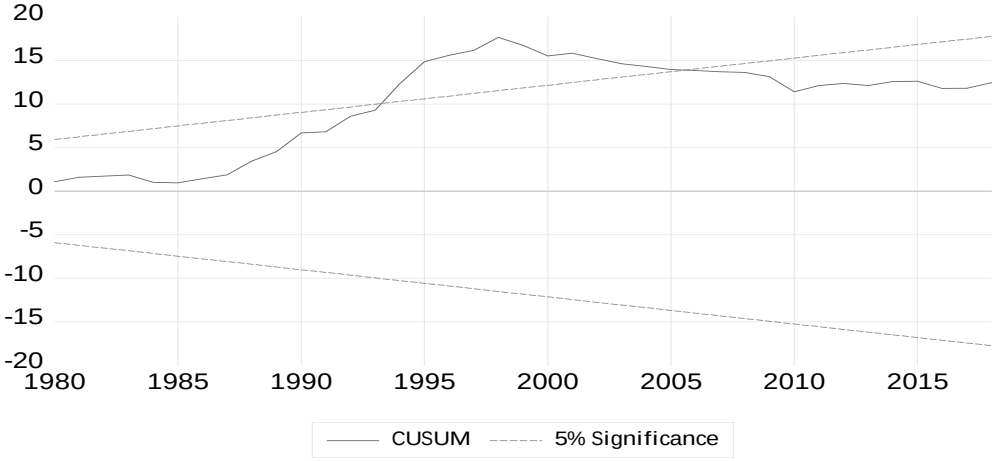
The robustness tests

Tests	F statistic calculated	P-value
Breusch-Godfrey Serial Correlation LM	2,07	0,13
Heteroskedasticity Test ARCH	0,97	0,32
Breusch-Pagan Godfrey	2,03	0,07
Ramsey Reset Test	3,52	0,06
Jarque-Bera	2,08	0,35

The residuals of our empirical model respect the four conditions: normality, stationarity, homoscedasticity and independence between the residuals (Table 7).

Chart 3

The CUSUM test applied to the model coefficients



These tests indicate that our model is statistically valid. To study the overall stability of our relationship, several tests can be used: the recursive residuals, CUSUM squares and CUSUM tests. In our case of treatment, we use this last test (CUSUM).

We observe in chart 3 that the CUSUM is outside the corridor. About this test, we confirm that the relationship is unstable. From the statistical study which we carried out, we can affirm that the model:

$\log CO_{2t} = -448,09 + 58,64 \log GDP_t - 1,77 \log GDP_t^2 + 1,54 \log dPOP_t - 0,05 \log OPEN_t$

is generally acceptable as long as the explanatory power of this model is very high (it is 99%), so that the conclusions drawn from this work are convincing.

4. The Interpretation of the Results

The GDP per capita variable $\log GDP_t$ exhibits a positive impact on environmental quality, an increase of 1% of GDP per capita leads to a 58.6% increase in environmental quality and a decrease in the level of air pollution. The long-term elasticity (58.6) is important. Findings show that the positive relationship which we have found between air pollution and economic growth. This link is compatible with the content of economic theory in this field. The positive effect between economic growth and emissions of the CO_2 indicates that the country would be in the ascending phase of the Environmental Kuznets Curve. Our result agrees with those found by Gale and Mendez (1998). We found a negative sign for the variable $\log GDP_t^2$, this shows an increase of 1% of GDP per capita squared $\log GDP_t^2$ will lead to a decrease in the emission of the CO2 in (1,77%). The signs of the coefficients associated with GDP per capita $\log GDP_t$ and GDP per capita squared $\log PIB_t^2$ are expected signs and consistent with economic theory and the existence of an EKC in the case of Algeria. The population has a positive and significant impact on the emissions of the CO_2, a 1% increase in the population allows a 1.54% increase in CO_2. This result, a positive relationship between population and the emissions of CO_2 reflets the basic economic theory which postulates that population reduction would be effective for environmental quality. Our result is consistent with that of Azomahou et al. (2006). Trade openness, $\log OPEN_t$ exhibits a negative and insignificant effect on emissions of the CO_2, an increase of one unit in the openness would result in an insignificant decrease in emissions of CO_2 in 0.05%. This negative relationship displayed between the two variables is consistent with the argument of economic theory. This means that the trade liberalization stimulates the migration of polluting companies from developed countries to invest in Algeria, even if it is more demanding and uncompromising in terms of environmental protection. Their location is also justified by other motivations, which we can explain by the rate of profit, a large internal market with strong potential of growth, etc. The negative sign of the coefficient of trade openness can be explained by the fact that free trade has accelerated economic activity by stimulating the volume of transactions, consumption and domestic production while creating more wealth, has been accommodated with the measures to preserve environmental quality. Our results are consistent with those of Gale and Mendez (1998). However, our results are contradictory to those of Grossman and Krueger (1994) and Halicioglu (2009), who found, trade openness increases environmental degradation in developing countries.

In the facts, faced with increasingly strict regulations, companies in industrialized countries are sometimes are interested to relocate their dangerous activities in the countries of the world where environmental protection and public health measures are less restrictive as well as occupational safety and environmental protection are not closely monitored by the government authorities. The examination of the short-term relationship lets us admit, that the coefficient associated with the restoring force, is negative (-0.30), but it is significantly

different from zero at the statistical threshold of 5%. Those results admit the existence of a long-term stable relationship between the emissions of CO_2 and the different explanatory variables. As this coefficient is less than unity, we can assert that the adjustment period indicates that the mismatches between the long term and the short term are absorbed in less than a year. From these results, we can assert that there is an error correction mechanism, which indicates the desire to seek a convergence of the trajectory for the series of CO_2 emissions. On another side, others variables show a negative impact on emissions of CO_2 as, the GDP per capita squared and the trade openness. We found that the EKC is also verified in the short term for the case of Algeria because the signs of the coefficients associated with $\Delta \log GDP_t$ and $\Delta \log GDP_t^2$ show positive and negative signs, respectively.

Concluding Remarks

The aim of our paper is to validate the existence of an environmental Kuznets curve (EKC) but also to study the influence of international trade and the population on emissions of CO_2 in Algeria during the period 1970 to 2019. To carry out this study, we used a polynomial model of degree two, the three economic specificities (linear, semi-linear and log-linear). We observed the stationarity, the cointegration between the variables and the estimation of the model by the Johansen approach. We found that the coefficients of the three models are significant except for the semi-linear model and the existence of the EKC for the three models. We have extended the log-linear model, which was retained by "Schwarz criterion" by adding two explanatory variables (international trade and population). We applied the ARDL approach for the boundary tests or the cointegration test of Pesaran et al. (2001) to this extended model.

With this model, we found that the EKC is verified in the long term and in the short term and that all the coefficients of the long-term and short-term variables are significant except for the coefficient of the trade openness variable, however all the signs of these coefficients are explained by the economic theory. The estimation of the coefficients of the static equation in the long and short term allows us to assert that the GDP per capita, the GDP per capita squared and the population have a positive impact on emissions of the CO_2 in Algeria, but conversely, trade openness has a negative effect on emissions of the CO_2. The moving towards further free trade to create more wealth must be accompanied with great severity in monitoring the quality of the environment by resorting a various forms of regulation (an environmental tax properly-implemented, change of model industrial by investing in renewable energies etc.) which could be imposed on investors, contradicts the hypothesis of the deterioration of the environmental climate of developing countries showing an evolution of the growth-pollution relationship. These explanations find their basis in economic theory and agree with the results of Gale and Mendez (1998). However, this result is contradictory to those of Grossman and Krueger (1994) and Halicioglu (2009). We found a long-term stable

relationship between the emissions of the CO_2. The various explanatory variables (the return force coefficient is negative and significant) as well as a unidirectional causal relationship that goes from GDP per capita to the emission of the CO_2. The quality of the estimate of our model is good, an interesting one with regard to the Fisher statistic, the coefficient of determination and the Jarque-Bera statistic.

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
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DEA EFFICIENCY APPROACH IN COMPARING MACROECONOMIC PERFORMANCE OF EU AND BALKAN COUNTRIES[3]

The past two decades have witnessed the emergence of various types of crises – financial, economic and even health crises affecting adversely the economic development of countries worldwide. This has highlighted the role of public revenue and public spending as drivers for both economic recovery and the achievement of economic policy goals such as price stability, high economic growth and low unemployment. Despite the potential of fiscal policy to influence economic development, more active use of public spending and hence its increase does not always result in increased well-being and better macroeconomic performance of countries. This study examines the macroeconomic performance of countries from the European Union (EU) and Balkan countries over the period from 2004 to 2019. For the purposes of assessing macroeconomic performance and public spending efficiency, it uses Data Envelopment Analysis (DEA), a non-parametric method for estimating technical efficiency through the use of a single input – public spending as a percentage of GDP, and several macroeconomic indicators as outputs. Our findings indicate a decrease in the efficiency of the countries under examination and larger differences in terms of macroeconomic performance during the crisis years 2009 and 2012. Moreover, countries with more significant public spending in GDP terms tend to be less efficient than others, that have lower public spending levels.
Keywords: efficiency; public sector expenditure; fiscal policy; DEA
JEL: E61; E62; E10

1. Introduction

The past two decades have witnessed the emergence of various types of crises – financial, economic and even health crises affecting adversely the economic development of countries worldwide. This brings the focus of attention on the role of the government and the

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application of measures that are most appropriate for effecting a faster recovery of the economies. To the extent that, in certain countries, the possibilities to implement a monetary policy are limited by the existence of special monetary regimes[4], fiscal policy emerges as a key, yet not as a substitute tool. According to some authors, the role of fiscal policy is determined primarily by the level of a country's economic development: while developed countries focus their efforts on maintaining full employment and stable economic growth, fiscal policies in developing countries set out, by applying an appropriate toolbox, to stimulate investment activity, accelerate growth and minimise the emerging social inequality (Popa, Codreanu, 2010). Despite the potential of fiscal policy to influence economic development, a more active use of public spending and hence its increase do not always result in an increased well-being and better macroeconomic performance of countries (Baciu, Botezat, 2014). For that reason, how efficiently public spending has been used is a very relevant question for researchers today. An analysis of the efficiency of public resources used in the course of the crisis-induced processes observed over the past decades is particularly relevant because a more substantial use of public spending generates substantial public budget deficits and rising government debt. Prior to the global financial crisis, public budget deficits in the EU countries amounted to just 0.9% of GDP and went up to 6.6% of GDP in 2009, dramatically exceeding the convergence threshold of 3% of GDP. Government debt in the EU countries was 58.1% of GDP in 2007, and 73.9% of GDP in 2009. It continued to go up in the years that followed, reaching 86.9% in 2014, on the back of the European debt crisis of 2012-2013.

For the purposes of estimating public spending efficiency, this study uses the non-parametric method of Data Envelopment Analysis (DEA). This method measures the technical efficiency of the countries included in the study, using the relevant inputs and outputs. The study covers all of the EU members states: Austria, Belgium, Bulgaria, Greece, Germany, Denmark, Estonia, Ireland, Spain, Italy, Cyprus, Latvia, Lithuania, Luxembourg, the Netherlands, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Hungary, Finland, France, Croatia, the Czech Republic, Sweden and the United Kingdom[5], and the Balkan countries which are located on the Balkan Peninsula: Bulgaria, Romania, Slovenia, Croatia, Greece, Albania, Serbia, Bosnia and Herzegovina, North Macedonia, Montenegro, Kosovo and Turkey[6]. The period under examination is 2004-2019, and the purpose of choosing a longer time period is to include several years prior to the global financial crisis.

The current research tests two hypotheses. The first hypothesis is that public spending efficiency decreases in the crisis years due to the more substantial use of public sector

[4] For example, under a currency board arrangement, national central banks cannot implement a monetary policy. Currency boards are in place in Bulgaria, Bosnia and Herzegovina, and used to exist in Estonia and Lithuania before the adoption of the euro as a national currency. Another example of an absence of a monetary policy can be seen in countries that have introduced unilaterally the euro, such as Montenegro.

[5] The United Kingdom is included in the study since it was a member of the EU during the analysed time period 2004-2019. As of 2021, the United Kingdom is no longer part of the EU.

[6] Bulgaria, Romania, Slovenia, Croatia and Greece are included in the EU as well as from the date when they joined the EU, i.e. Greece since 1981, Slovenia since 2004, Bulgaria and Romania since 2007, and Croatia since 2013, respectively.

financial resources in economic recovery. The second hypothesis is that countries that have a larger public sector as measured in terms of the share of a country's public spending in GDP, exhibit a lower efficiency compared to countries with a smaller share of public spending in GDP.

With this study, the authors attempt to contribute to economics literature by researching public spending efficiency and the delivery on ultimate economic policy goals by making a comparative analysis of countries in the EU and countries on the Balkan Peninsula. So far, comparative analyses of public spending efficiency have included but a few of the countries in the Balkan Region, mostly those that have become members of the EU. For instance, Bulgaria, Romania, Greece and Slovenia are presented in some of the research on public spending efficiency at the EU level (Baciu, Botezat, 2014; Halaskova et al., 2018). There are also analyses of public spending efficiency that deal only with countries in the Balkan Region for the period 2007-2019. (Nenkova, Mihaylova-Borisova, 2020). This study expands the scope of that analysis both in terms of the time period (as it covers the years from 2004 till 2019), and in terms of the range of countries.

The study is structured in five parts. The second part provides a detailed presentation of achievements in terms of the existing research on public spending efficiency and public sector efficiency. The next chapter presents the methodology used to calculate the technical efficiency of countries included in the study. The fourth part analyses the results, and the last part offers the main conclusions.

2. Literature Review

There is a range of studies on the purposes of the estimation of public spending efficiency and public sector performance and on the assessment of the efficiency of fiscal policy and the macroeconomic indicators achieved by the countries. Since the methods used to measure public spending efficiency differ, the studies can be divided into four groups:

- Using a composite indicator to measure efficiency (Afroso et al., 2003; Afroso et al., 2006; Afroso et al., 2007; Bazin, Botezat, 2014; Hauner, Kyobe, 2008; Todorova, 2004). Some of the research in that group employs a macro approach in calculating the efficiency of general government spending, while other studies use a micro approach, measuring the efficiency of a specific category of public spending (Afonso, 2006).
- Using the non-parametric method of Data Envelopment Analysis (DEA) to estimate public spending efficiency (Bazin, Botezat, 2014; Afonso et al., 2006; Afonso et al., 2019; Halaskova et al., 2018; Raber, 2017; Hauner, Kyobe, 2008; Wang, Alvi, 2011; Lovell et al., 1995; Mohamad, Said, 2011; Montes et al., 2019; Ouertani et al., 2018; Boueri et al., 2014; Herrera, Ouedraogo, 2018; Herrera, Pang, 2005; Mattina, Gunnarsson, 2007; Hu et al., 2020).
- Measuring public spending efficiency by applying the so-called parametric method of the Stochastic Frontier Approach (SFA) (Grigoli et al., 2013).

- Measuring public spending efficiency by applying the non-parametric method of Free Disposal Hull (FDH) analysis[7] (Herrera, Ouedraogo, 2018; Herrera, Pang, 2005; Afroso et al., 2003).

As noted above, the *first group* of studies focus on measuring the efficiency and the performance of public spending in the countries examined by using composite indicators. This method is widely used in the research conducted by Afroso et al. (2006), Afroso et al. (2007), Bazin and Botezat (2014), Hauner, Kyobe (2008), Todorova (2004).

Afonso et al. (2006) study the public sector efficiency of the new member states of the European Union and some of the emerging economies in Asia. To achieve its goal, the study covers the ten new member states of the European Union (EU) which joined in 2004, i.e. Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia; the two countries which joined in 2007, i.e. Bulgaria and Romania; three 'old member states of the EU, i.e. Greece, Ireland and Portugal; and nice countries which are considered emerging economies, i.e. Brazil, Chile, Korea, Mauritius, Mexico, Singapore, North Africa, Thailand and Turkey. Within the scope of the study, considerable differences are observed in respect of the public spending in GDP terms in those countries, with averages ranging from 18% to 50% of GDP in the period 1999-2003. The Baltic countries (Estonia, Lithuania and Latvia) have values for that indicator that is below 40% of GDP and are defined as countries with a small government. Nevertheless, the values of the indicator in those countries is notably higher than the average value for Asian emerging economies such as Thailand, Singapore and Korea. The analysis of the results, obtained by the authors, leads to the conclusion that the countries having a low level of public spending in GDP terms, i.e. countries with a 'small government', or those with public spending of up to 30% of GDP, are most efficient. Moreover, they are twice as efficient in terms of public spending as the worst-performing countries. By using the non-parametric method of Data Envelopment Analysis, Afonso et al. (2006) arrive at the conclusion that the countries do not use their resources efficiently, since they could obtain the same level of output by using only 45% of their inputs. The authors prove that the following factors: security of property rights, GDP per capita, competence of government officials and education level of the people, exhibit a strong correlation to the efficiency of government spending.

Afonso et al. (2007) calculate public sector performance and public sector efficiency for 23 industrial countries, and the scope of the study includes Canada as well. In 2000, Canada ranked 12th among the 23 industrial countries in terms of public sector performance, and the estimated indicator is exactly equal to that for the USA and just below the average for the 23 countries. Based on the calculated indicator for public sector efficiency, it was found that countries with a small government are significantly more efficient in achieving public sector performance levels compared to countries with mid-sized and big governments. A small government public sector is one that has public spending of below 40% in GDP terms, while a public sector having a mid-sized government has public spending equal to 40 to 50% in GDP terms, and a big government refers to public spending larger than 50% of GDP.

[7] The Data Envelopment Analysis (DEA) and the Free Disposal Hull (FDH) analysis belong to the group of non-parametric methods of measuring efficiency that are based on a production frontier (Mihaylova-Borisova, 2015).

Afonso, Schuknecht, Tanzi (2007) studies the extent to which countries use public spending efficiently to achieve the same level of public sector performance. Thus, for instance, they have calculated that Canada could achieve the same level of public sector performance using just 75% of the public spending it has actually used over the analysed period.

Baciu, Botezat (2014) analysed the public sector efficiency and public sector performance in EU countries, and in particular in the new EU member states that jointed in 2004: Cyprus, the Czech Republic, Hungary, Lithuania, Latvia, Malta, Poland, Slovakia and Slovenia, and those that became part of the EU in 2007: Bulgaria and Romania. The analysis of their public sector efficiency was made using two methods: 1) the composite indicator technique; and 2) the Data Envelopment Analysis (DEA). The period under examination is 2000-2009, and it has been defined more broadly in order to capture the periods before the accession and the period of integration, which affect the size and efficiency of the public sector.

The government efficiency in many developed and developing countries in the period from 1980 to 2006 has been studied by Hauner, Kyobe (2008). In calculating efficiency, they include a range of indicators in the area of education and healthcare. They estimate the efficiency of the government sector by calculating the indicators for public sector performance, public sector efficiency and technical efficiency by applying the Data Envelopment Analysis (DEA) approach. Then they regress the obtained technical efficiency coefficients by using a variety of economic, demographic, geographical and institutional indicators. Hauner, Kyobe (2008) also conclude that countries with high levels of public spending in GDP terms achieve lower public sector efficiency.

Todorova (2004) researched public sector performance by means of a composite indicator, using two types of indicators as opportunity indicators exploring the functioning of public administration, education and healthcare, and the traditional Musgravian indicators such as the Gini coefficient, economic efficiency indicator (average inflation rate over the past 10 years and real GDP growth through a coefficient of variation) and an allocation efficiency indicator (unemployment rate – average value for the past 10 years and GDP growth in real terms – average value for the past 10 years). The author takes into account also the public sector efficiency, where the public sector performance is considered as a ratio to public expenditure in GDP terms. The study covers the countries that acceded to the European Union in 2004, namely, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia, as well as Bulgaria and Romania, which acceded at the beginning of 2007. Based on the calculations, it concludes that the efficiency of public spending in each of these countries is generally low and differs quite a lot. The highest public sector efficiency is observed in countries where public spending in DGP terms amounts to around 35%. In the context of a crisis, it is concluded that most of the countries under examination should increase the efficiency of their public spending and reduce the share of public expenditure in GDP.

The review of the cited studies reveals that, notably, most of the researchers use both composite indicators and Data Envelopment Analysis (DEA). The following studies based on the DEA method can be instanced: Afonso et al. (2019), Halaskova et al. (2018), Raber (2017), Hauner, Kyobe (2008), Wang, Alvi (2011), Lovell et al. (1995), Mohamad, Said

(2011), Montes et al. (2019), Ouertani et al. (2018), Boueri et al. (2014), Herrera, Ouedraogo (2018), Herrera, Pang (2005), Mattina, Gunnarsson (2007), Hu et al. (2020).

Afonso et al. (2019) analysed the extent to which the tax system can affect the public spending efficiency. The study is based on data on the 36 advanced OECD countries and covers the 2003-2017 period and is divided into three sub-periods: 2003-2007, 2008-2012 and 2013-2017. The researchers' approach involves computing the efficiency coefficients of each of the countries included in the study using the Data Envelopment Analysis and then regressing the resulting efficiency coefficients with the data on the various types of taxes. The so-called Malmquist Index, on the basis of which the change in the total factor productivity, the change in efficiency and the change in technology are measured, is also calculated. Applying this methodology, the authors conclude that the countries could use less inputs (about 32 to 34%) to achieve the same target level of outputs. The ten-year period exhibited an improvement in efficiency but also a decline in the total factor productivity and in technologies. Regarding the influence of taxes on public spending efficiency, a negative impact of direct taxes and a strong negative impact of social security contributions and indirect taxes on government performance have been found.

Halaskova et al. (2008) estimated public spending efficiency in five areas of public service provision such as healthcare, education, social security, recovery, culture and religion, general public services. The study covers 27 member states of the European Union, excluding Malta, for which no data was available on all of the indicators included in the investigation. The countries included in its scope are Bulgaria, Belgium, the Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, the Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden and the United Kingdom. For the purposes of applying the DEA method, several inputs are defined as follows: expenditure in healthcare, expenditure in education, social security spending, expenditure for recovery, culture and religion and expenditure for general public services. GDP per capita and employment in services are the indicators used for outputs. The outcome of the estimated public spending efficiency in services shows that countries with a small or mid-sized public sector, i.e. those with public spending in the range of 40% of GDP or less, have a higher spending efficiency in services. Conversely, countries where that indicator exceeds 50% of GDP or those with a high standard of living achieve a lower public spending efficiency. The study also highlights the limitations relating to it – mostly limitations in terms of the data used, which are not always of sufficient quality.

Rabar (2017) presents the Data Envelopment Analysis (DEA) method as a key tool in computing and measuring the social and economic efficiency of OECD countries. The study distinguishes three groups of research that use DEA: 1) Research focusing on economic growth and employment; 2) Research using and combining economic indicators with environmental ones; 3) Research dealing with the supply and consumption of electric energy. Rabar (2017) notes that the Data Envelopment Analysis (DEA) method was first used in "researching macroeconomic performance by Fare, Grosskopf, Norris, Zhang (1944)".

Wang, Alvi (2011) measure public spending efficiency using the Data Envelopment Analysis approach. They cover 10 OECD countries (Australia, Canada, France, Germany, Italy, Japan, Korea, New Zealand, the United Kingdom and the USA) and 7 Asian countries (Hong Kong,

Japan, Korea, Malaysia, Singapore, Thailand and Taiwan). The period of investigation for the OECD countries is 1981-2008, while that for the Asian countries is 1986-2007. Wang, Alvi (2011) tested five hypotheses through which they attempted to explain the inefficiency of public spending. The first hypothesis refers to the extent to which private sector activity affects public sector performance. The next hypothesis has to do with corruption, while the third one deals with the link between the increase in money supply and public spending efficiency in stimulating income. The next hypothesis is related to the size of government, and the last one looks at government debt. The results of the study indicate that government sector inefficiency decreases with the increase in the activity of the private sector, which confirms the view of non-interference of the state in the economy, in line with the views upheld by monetarists.

Lovell et al. (1995) also employ the DEA approach for the purposes of policy performance with respect to four macroeconomic indicators such as real GDP per capita, inflation, employment and trade balance. The authors study 19 OECD countries, drawing a comparison between 14 European countries and 5 non-European countries over the period 1970-1990. The researchers arrive at the conclusion that DEA "[...] is fully suited for analysing the macroeconomic performance" of the countries (Lovell et al.,1995).

Mohamad, Said (2011) studied the way in which 54 countries that are members of the Organization of the Islamic Conference use their resources. The macroeconomic performance of the countries is examined using the DEA approach, defining inputs (government spending as a percentage of GDP[8]) and the following outputs: real economic growth, export-to-import ratio, inflation and employment rate.

Montes et al. (2019) explored whether countries are working towards improving their fiscal transparency and whether it affects public spending efficiency. To this end, they analysed 82 countries, of which 68 developing countries and 14 developed countries, over the period 2006-2014. The results prove that fiscal transparency helps reduce public debt and increases public spending efficiency. The method used to calculate public spending efficiency is, again, DEA. Ouertani et al. (2018) measured and analysed public spending efficiency by applying the DEA approach for Saudi Arabia over the period 1988-2013. Boueri et al. (2014) estimated the efficiency of the educational system in Brazil, applying the non-parametric method of DEA. The study proves the existence of a negative link between the cost of education per capita and the efficiency of the educational system in the country.

One of the studies that employ the Stochastic Frontier Approach (SFA) to measure public spending efficiency is that by Grigoli, Kapsoli (2013). The researchers apply the method for the purposes of measuring healthcare spending efficiency in emerging economies and developing economies. The results of the study show that African countries exhibit the lowest efficiency. There are also studies that apply the non-parametric method of Free Disposal Hull (FDH) for the purposes of computing public spending efficiency. Afonso et al. (2003) calculate a composite indicator for public sector performance and public sector efficiency for 23 industrial countries for the years 1990 and 2000. The study also examines the efficiency

[8] This refers to government consumption in the final use of GDP.

of inputs and outputs by applying the non-parametric method of Free Disposal Hull (FDH). It proves that the average public spending inefficiency is 20%.

In some of the research applying the Data Envelopment Analysis (DEA) method, the Free Disposal Hull (FDH) technique is also applied: Herrera, Ouedraogo (2018), Herrera, Pang (2005). The DEA and the FDH) also applied also by Herrera, Ouedraogo (2018) for the purposes of measuring public spending efficiency in the area of education, healthcare and infrastructure. Their study includes 175 countries over a ten-year period, from 2006 to 2016. Herrera, Pang (2005) apply the DEA and the FDH methods to measure public spending efficiency by including 140 countries over the period 1996-2002. The results of the study show that countries that have higher levels of public spending have a lower efficiency.

On the basis of the above review of the economics literature on the topic of the study, certain conclusions can be drawn that determine the next steps in our study as well:

- With regard to the methods applied to examine efficiency, the most widely used one is the Data Envelopment Analysis (DEA), or a combination of methods, where in addition to the specific non-parametric, a composite indicator is used (Afonso et al., 2006). The reason for using mainly the non-parametric DEA method in the economic literature is based on the advantages of this approach in particular its use in relatively small samples of production units. In addition, this method does not need to pre-define the type of production frontier, which eliminates the possibility of errors in this respect.
- Most of the studies also go on to measure the efficiency of specific public sector areas such as, *inter alia,* healthcare and education, which indicates that further research is needed to examine the effects of the applied fiscal policy on the countries' macroeconomic performance.
- The studies use a very limited time period, in the range of just a few years; in this study, we will focus on researching a longer time period that includes the accession of the new EU member states in 2004, and the observed crisis-related developments in the context of the global financial crisis and the European debt crisis.
- Lovell et al. (1995) и Mohamad et al. (2011) apply the Data Envelopment Analysis (DEA) method for the purposes of examining the macroeconomic performance of the countries, defining almost identical outputs and inputs. Considering the stated conclusion that this is a good approach to the measurement of the countries' macroeconomic performance, it will be the approach to be applied in this study as well.

3. Methodology and Data

For the purposes of measuring public spending efficiency and the countries' macroeconomic performance, this study will employ the Data Envelopment Analysis (DEA) technique. That is a non-parametric method of estimating the efficiency of Decision Making Units, based on production frontiers. The advantage of these methods based on production frontiers is that they enable the inclusion of a wide range of activities related to production units. In computing efficiency, all of those activities or outcomes can be translated into a single index

which is a measure of the efficiency of a particular unit in comparison to the rest of the units included in the scope of the study, i.e. what is measured is the so-called "comparative efficiency". To embrace the various activities, the so-called 'inputs' to be used to produce the desired level of outputs also need to be defined.

3.1. Data Envelopment Analysis (DEA)

The founder of the non-parametric method of Data Envelopment Analysis (DEA) is Farrell (1957), who built the model on the basis of defining one output and multiple inputs. The model was developed further by Charnes at al. (1978), to include not only multiple inputs but multiple outputs as well. Data Envelopment Analysis (DEA) is a non-parametric method of linear programming where the efficiency of each unit included in the research is estimated in respect of the most efficient units that make up the production frontier. Initially, it was applied to production units the purpose of which is not profit-making, such as universities, hospitals, etc., but later it was used with respect of units whose activity was aimed at generating a profit, such as banks and business enterprises. In this study, it will be applied with respect of the governments of the EU member states and the countries in the Balkan Region for the purposes of estimating public spending efficiency and the efficiency of fiscal policy as a whole.

The DEA method has a range of *advantages,* as listed below.

- It is not associated with any specific type of production function, unlike other methods require, e.g. the parametric Stochastic Frontier Approach. That reduces the probability of an error in attempting to determine the type of production frontier.
- The model allows for the inclusion of a variety of inputs and outputs without indicating which one is the most important for the production unit (Lin at al., 2009).
- It enables the computation of the overall technical efficiency, which can be disaggregated into pure technical efficiency and scope efficiency (Kumar, Gulati, 2008).
- It can be applied to small samples of production units as well.

One major *shortcoming* of the method that can be noted is that it depends to a large extent on extreme observations. For that reason, it is not possible to distinguish if the deviation from the production frontier is due to inefficiency or is the result of an random error.

The method has two forms: 1) the output-oriented DEA, where what is required is the minimum quantity of inputs that is necessary in order to produce a specific target level of outputs; and 2) the input-oriented DEA, where the aim is to find the maximum quantity of outputs that can be achieved with the inputs that are available to the production unit. The production units (DMUs – Decision Making Units) could operate under constant return to scale (CRS), as well as under variable return to scale (VRS).

The model at a constant return to scale (CRS) could be presented in the following way:

$$\begin{aligned} &\min_{\theta,\lambda} \theta \\ &-y_I + Q\lambda \geq 0 \\ &\theta x_I - X\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \tag{1}$$

The coefficient θ is the so-called efficiency coefficient of the respective production unit i. The respective production unit – i has inputs x_i and outputs y_i. All production units, included in the model, is represented by I. All inputs for production units are presented by inputs matrix X, while all outputs for the included production units are presented by outputs matrix Q. λ is the vector with weights Ix1.

The linear model is solved for each production unit. In such way, the efficiency coefficient is obtained. The coefficient takes values from 0 to 1. When the production unit receives a value of 1, then it lies at the production frontier. Other production units that receive a value below 1 are inefficient and may increase their efficiency.

The model (1) could be transformed and be presented for variable return to scale (VRS). It is necessary to include the restriction $I1'\lambda = 1$, where $Ix1$ is a single vector. The restriction means that the technical efficiency is greater than or equal to that obtained at a constant return on scale (CRS). Thus, the model is presented as follows:

$$\begin{aligned} &\min_{\theta,\lambda} \theta \\ &-y_I + Q\lambda \geq 0 \\ &\theta x_I - X\lambda \geq 0 \\ &I1'\lambda = 1 \\ &\lambda \geq 0 \end{aligned} \tag{2}$$

By solving the model, it is not possible to defined which production unit (Decision-making unit (DMU)) operates under constant return to scale and which operates under variable return to scale. To achieve this, it is necessary to change the restriction $I1'\lambda = 1$ in the following way: $I1'\lambda \leq 1.$

The following model is solved:

$$\begin{aligned} &\min_{\theta,\lambda} \theta \\ &-y_I + Q\lambda \geq 0 \\ &\theta x_I - X\lambda \geq 0 \\ &I1'\lambda \leq 1 \\ &\lambda \geq 0 \end{aligned} \tag{3}$$

In addition to the calculation of the technical efficiency of a production units, a change in the toral factor productivity could be investigated. For the purpose of calculation of the total factor productivity, a so-called Malmquist productivity index could be used. The Malmquist index is decomposed to the technology change and technical efficiency change.

3.2. Data used

For the purposes of calculating public spending efficiency of the EU countries and the countries from the Balkan Region, or the so-called macroeconomic performance, a number of macroeconomic indicators are used, and those are also main targets of the countries' fiscal and monetary policies. Since there are limitations in respect of the use of monetary policy data[9] about the selected set of countries, the focus is on studying public spending efficiency in GDP terms.

Official statistical data about the countries has been used, which is published by the statistical offices of the countries, Eurostat, the International Monetary Fund and the World Bank. The period under examination is 2004-2019, and the purpose is to capture also the period since the accession to the European Union of the new member states the Czech Republic, Hungary, Poland, Cyprus, Malta, Slovenia, Slovakia, Estonia, Lithuania and Latvia. This is important in view of the existing differences between these countries and the old EU member states.

The countries' macroeconomic performance is described by a number of indicators such as economic growth in real terms, inflation measured in terms of the harmonised index of consumer prices, employment and trade balance. These macroeconomic indicators will be used as outputs for the purposes of studying public spending efficiency and macroeconomic performance of the selected counties, similarly to the methodology applied by Mohamad, Said (2011). A similar approach has been used by Lovell et al. (1995). The indicator of government spending in GDP terms will be applied as an input. Chart 1 presents the inputs and outputs.

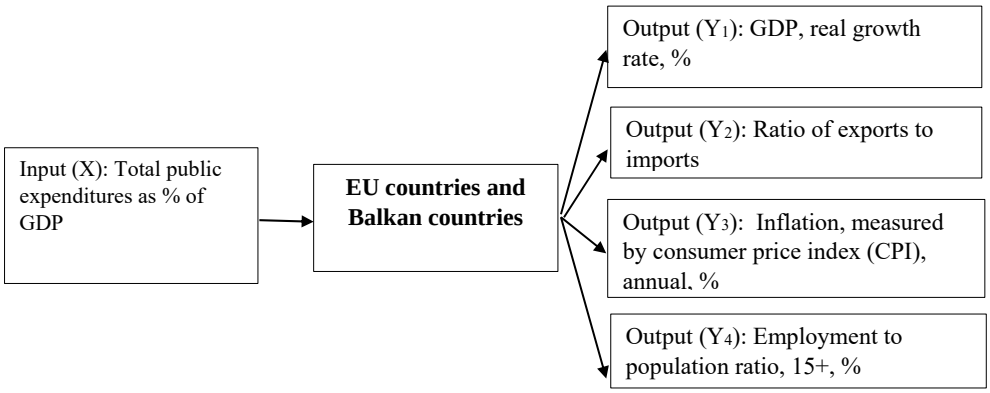
Table 1 shows descriptive statistics of inputs and outputs under the DEA method used.

Notably, there are significant deviations in the standard deviation of most of the indicators used in the model. This is explained by the significant differences among the countries in terms of their economic development and the inclusion of the ten new EU member states. The influence of the global financial crisis of 2008-2009 also leads to more substantial deviations and disparity in the countries' macroeconomic performance. The economic growth of the countries from the Balkan Region went down by 2.9% in real terms in 2009, while EU countries registered an economic downturn of 4.3% in 2009. The larger economic downturn of EU countries also accounts for the slower pace of their recovery from the global financial crisis.

[9] For example, some of the countries apply a specific currency board arrangement: Bulgaria, Bosnia and Herzegovina, Lithuania and Estonia prior to the adoption of the euro. Under a currency board arrangement, there is no monetary policy and hence the key interest rates are not the result of the defined monetary policy, unlike, for example, the interest rates set by the European Central Bank.

Chart 1

Inputs and Outputs of EU countries and Balkan countries



Sources: own presentation.

Table 1

Descriptive statistics of inputs and outputs

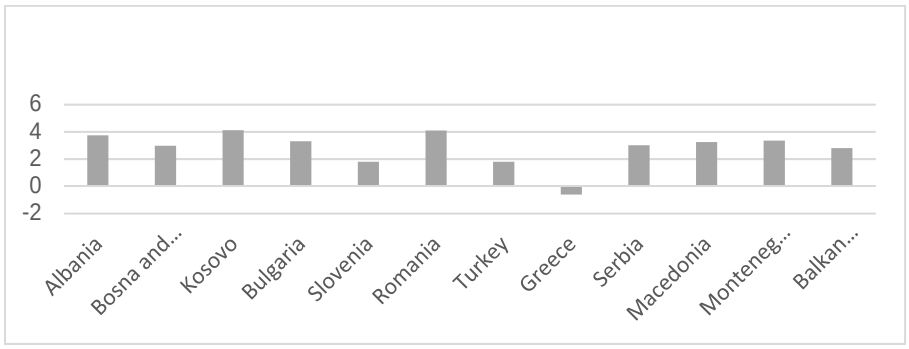
		2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
Inputs									
Public expenditures to GDP, %	Average	42.10	41.75	41.38	41.05	42.99	46.52	46.14	44.99
	Standard Deviation	7.02	7.31	7.10	6.96	6.29	6.65	7.65	7.30
Outputs									
GDP growth (annual %)	Average	4.60	4.30	5.21	5.20	2.00	-4.55	1.83	1.86
	Standard Deviation	2.36	2.63	2.24	2.56	3.30	4.00	2.98	3.65
Exports to Imports	Average	0.87	0.87	0.87	0.86	0.86	0.91	0.93	0.96
	Standard Deviation	0.25	0.24	0.23	0.24	0.23	0.22	0.19	0.17
Inflation, consumer prices (annual %)	Average	2.92	3.05	3.34	3.58	5.91	1.31	2.24	3.66
	Standard Deviation	2.49	2.75	2.31	2.26	3.26	2.27	1.79	1.70
Employment to population ratio, 15+, total (%)	Average	49.35	49.53	50.24	51.11	51.46	50.09	49.28	49.04
	Standard Deviation	8.26	8.28	8.34	8.52	8.33	7.62	7.66	7.74
		2012	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Inputs									
Public expenditures to GDP, %	Average	45.15	45.78	44.85	44.00	42.41	41.70	41.92	41.95
	Standard Deviation	7.68	9.06	7.55	7.73	7.39	7.19	6.95	6.84
Outputs									
GDP growth (annual %)	Average	-0.25	1.02	2.13	3.50	2.68	3.68	3.29	2.72
	Standard Deviation	2.79	2.61	2.10	4.12	1.28	1.93	1.55	1.41
Exports to Imports	Average	0.98	1.00	1.01	1.03	1.03	1.04	1.07	1.09
	Standard Deviation	0.17	0.17	0.18	0.19	0.19	0.21	0.35	0.47
Inflation, consumer prices (annual %)	Average	2.99	1.57	0.41	0.17	0.34	1.99	2.16	1.90
	Standard Deviation	1.51	1.73	1.65	1.53	1.47	1.73	2.49	2.41
Employment to population ratio, 15+, total (%)	Average	48.83	48.77	49.35	49.87	50.61	51.71	52.56	53.10
	Standard Deviation	7.90	7.64	7.58	7.69	7.39	7.20	7.33	7.25

Sources: Own calculations.

Figure 1 shows the economic growth of countries from the Balkan Region, with Albania, Kosovo and Romania as the best-performing countries in the period 2004-2019. The best performers among the EU countries in terms of the same indicator include Ireland, Romania, Malta and Poland (Figure 2). Other countries like Luxembourg, Sweden and the Netherlands, although exhibiting moderate levels of economic growth, in the range of 2-3% over the period as a whole, rank among the best performers in terms of the following indicators: export-to-import ratio (Luxembourg, with 1.28 on the average for the 2004-2019 period; Sweden, with 1.12; and the Netherlands, with 1.14, against an average of 0.96 for all the countries in the selection) and in terms of employment ((Luxembourg, with 54.9 on the average for the 2004-2019 period; Sweden, with 59.5; and the Netherlands, with 61.2, against an average of 50.3 for all the countries in the selection). These EU countries are responsible also for the achievement of moderate inflation rates, in line with the understanding of price stability.

Figure 1

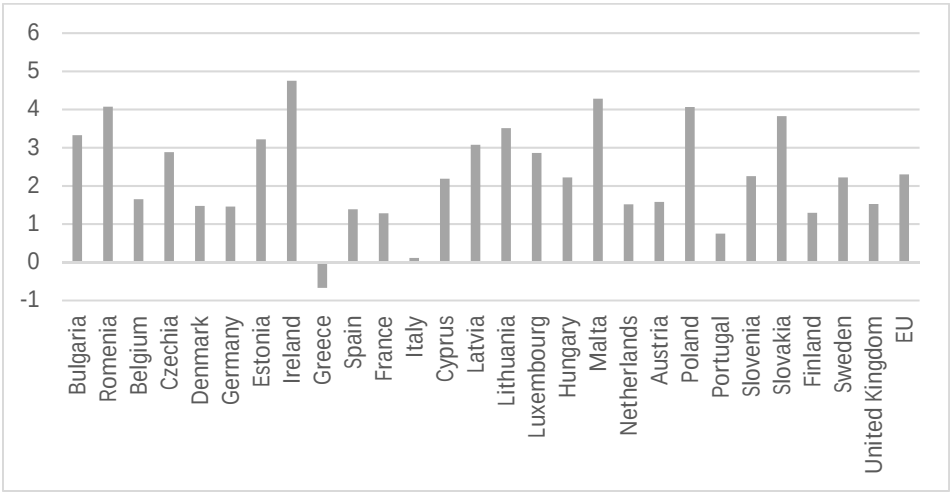
Economic growth of countries from the Balkan Region in the 2004-2019 period



Sources: World bank, authors' calculations

Figure 2

Economic growth of EU countries in the 2004-2019 period



Sources: Eurostat, authors' calculations.

Since the DEA method cannot be used on negative values, which are observed in economic growth and inflation rates for some of the countries, particularly during the global financial crisis in 2009, it is necessary to normalise the indicators. Normalisation on the scale from 1 to 10 is applied, using the approach of Mohamad, Said (2011).

The indicators – the real economic growth rate, the ratio of exports to imports and the employment to population ratio should be transformed. The formula is following:

$$Y_{nor} = \frac{9*(Y_{act}-Y_{min})}{Y_{max}-Y_{min}} + 1, \quad (4)$$

where:

Y_{nor} – is the value of normalised indicator Y;

Y_{act} – is the actual value of the indicator Y;

Y_{max} – is the maximum value of the indicator Y;

Y_{min} – is the minimum value of the indicator Y.

The inflation will be transformed by using the following formula:

$$Y_{nor} = \frac{9*(Y_{max}-Y_{act})}{Y_{max}-Y_{min}}+1, \quad (5)$$

where:

Y_{nor} is the value of normalised indicator Y;

Y_{act} – the actual value of the indicator Y;

Y_{max} – is the maximum value of the indicator Y;

Y_{min} – is the minimum value of the indicator Y.

As a result of transformation, the macroeconomic indicators Y will receive value between 1 and 10.

4. Analysis of the Results

To calculate the technical efficiency of government spending of EU countries and countries from the Balkan Region, the DEAP 2.1 (Coelli, 1996) software was used. The DEA approach was applied both with constant returns to scale (CRS) and with variable returns to scale (VRS). Due to market inefficiencies and market failures, it is not possible for countries to operate at constant returns to scale. That makes it necessary to analyse the results obtained for the countries with variable returns to scale.

Table 2 shows the results obtained for EU member states and for countries from the Balkan Region, where the technical efficiency is with variable returns to scale. In 2009, when the significant negative effects of the global financial crisis were observed in Europe, technical efficiency stands at a level that is the lowest during the whole period under examination. A drop in technical efficiency is observed in 2012 as well, when the European debt crisis

occurred. The data confirm the hypothesis that public spending efficiency decreases in the crisis years due to the more substantial investment of financial resources in economic recovery.

Table 2

Technical efficiency of EU member states and for countries from the Balkan Region

	2004	2005	2006	2007	2008	2009	2010	2011
Number of countries	37	37	37	37	37	37	37	37
Number of countries, being on the production frontier	13	10	13	14	11	8	14	15
Technical efficiency	0.951	0.952	0.961	0.960	0.954	0.919	0.949	0.962
Minimum	0.886	0.827	0.779	0.817	0.861	0.728	0.748	0.763
Maximum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Standard deviation	0.04	0.05	0.05	0.05	0.04	0.08	0.07	0.05
	2012	2013	2014	2015	2016	2017	2018	2019
Number of countries	37	37	37	37	37	37	37	37
Number of countries, being on the production frontier	14	17	14	9	13	5	3	11
Technical efficiency	0.957	0.970	0.976	0.954	0.974	0.951	0.950	0.976
Minimum	0.816	0.850	0.877	0.839	0.871	0.889	0.872	0.912
Maximum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Standard deviation	0.05	0.04	0.03	0.04	0.03	0.03	0.03	0.02

Sources: Eurostat, authors' calculations.

This hypothesis is also supported by the diminishing number of countries which, in crisis years, show a maximum technical efficiency and chart the production frontier. In 2009, only 8 countries were involved in the plotting of the production frontier, against 11 countries in the preceding year. This also reveals the more significant gaps among the countries in terms of public spending efficiency and macroeconomic performance, especially in the crises under examination.

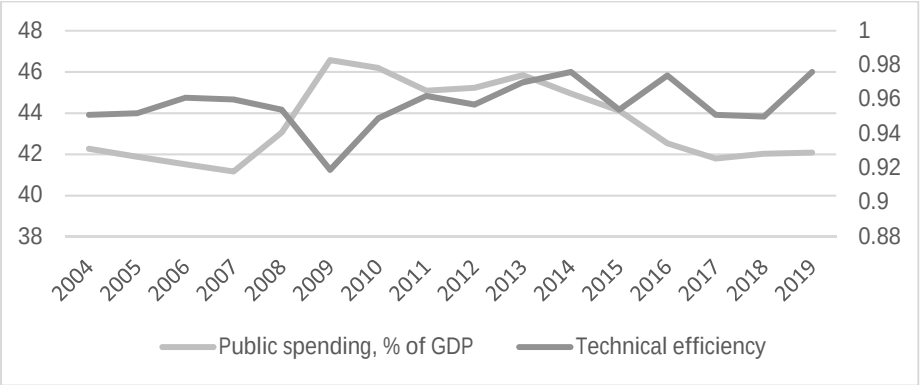
Tracing the dynamics of the countries' technical efficiency and public spending in GDP terms shows an inverse relationship between the variables (Figure 3). That negative correlation is quite pronounced, particularly in 2009, where the average public spending for all of the countries included in the study went up to 46.6% of GDP, against 43% of GDP in 2008. At the same time, there is a dramatic drop in technical efficiency by 3.7% in 2009 compared to the preceding year. The correlation between the change in public spending in GDP terms and the change in the efficiency of all the countries is negative in the period 2004-2019 (-0.48), which also supports the existence of an inverse relationship between public spending and its realised efficiency.

The total factor productivity increased in the analysed period 2004-2019 (Table 3). The productivity rose in the period by 0.6% on average per year due to improvement in technology change by 2.3% on average per year. The productivity had its lowest value of -9.6% and -5.4% in 2008 and 2009 respectively, when the negative effects of the global financial crisis on the economic development of the countries were seen. In 2009 the decline

in the productivity change was related to both factors: a drop in the technology change and decline in the technical efficiency.

Figure 3

Technical efficiency and public spending in GDP terms of EU countries and countries from the Balkan Region in 2004-2019



Sources: Eurostat, authors' calculations

Table 3

Technical efficiency, technology change, pure efficiency, scale efficiency and total factor productivity change index

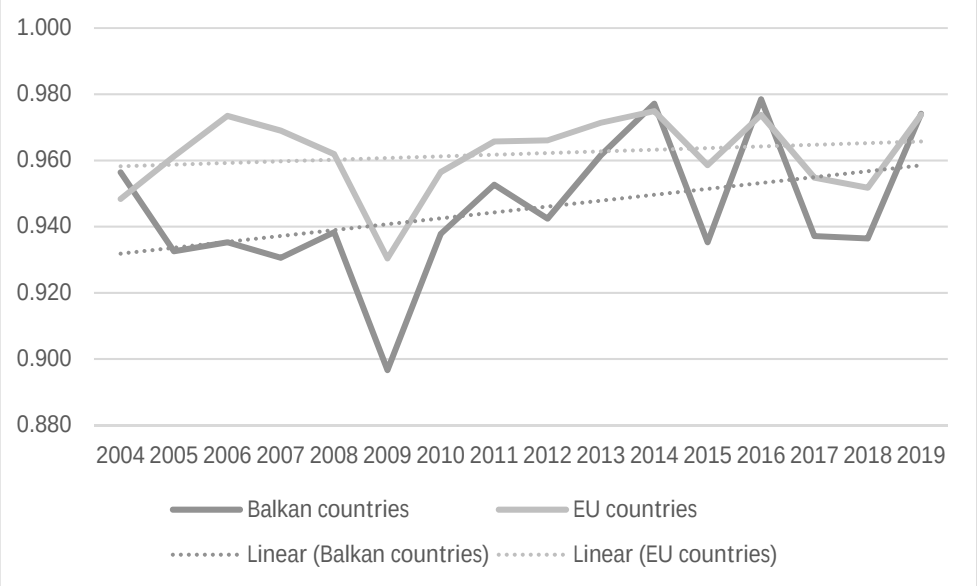
	Technical efficiency change index	Technology change index	Pure efficiency change	Scale efficiency change	Total factor productivity change (Malmquist productivity change index)
2005/2004	0.978	1.030	1.001	0.978	1.008
2006/2005	1.042	0.976	1.010	1.032	1.017
2007/2006	1.020	0.992	0.998	1.022	1.013
2008/2007	1.063	0.851	0.994	1.069	0.904
2009/2008	0.983	0.962	0.961	1.022	0.946
2010/2009	1.000	1.038	1.034	0.968	1.039
2011/2010	0.968	1.047	1.014	0.954	1.014
2012/2011	1.001	1.008	0.996	1.006	1.009
2013/2012	1.007	1.016	1.013	0.993	1.023
2014/2013	0.991	1.052	1.006	0.985	1.042
2015/2014	0.840	1.240	0.977	0.860	1.042
2016/2015	1.044	0.981	1.022	1.022	1.024
2017/2016	0.885	1.134	0.976	0.907	1.004
2018/2017	0.966	1.040	0.999	0.967	1.005
2019/2018	0.993	1.026	1.027	0.966	1.018
	0.984	1.023	1.002	0.982	1.006

Sources: Authors' calculations

When the countries that are included in the scope of the study are divided into EU countries and countries from the Balkan Region, the latter exhibit a lower average efficiency but also a faster increase in efficiency over the years (Figure 4). That trend can be explained by the process of convergence of the countries from the Balkan Region to the EU member states. In the two subgroups, the hypothesis of deterioration in efficiency, during the crisis years is upheld again, as it was for the whole set of the countries.

Figure 4

Technical efficiency of EU countries and countries from the Balkan Region in 2004-2019

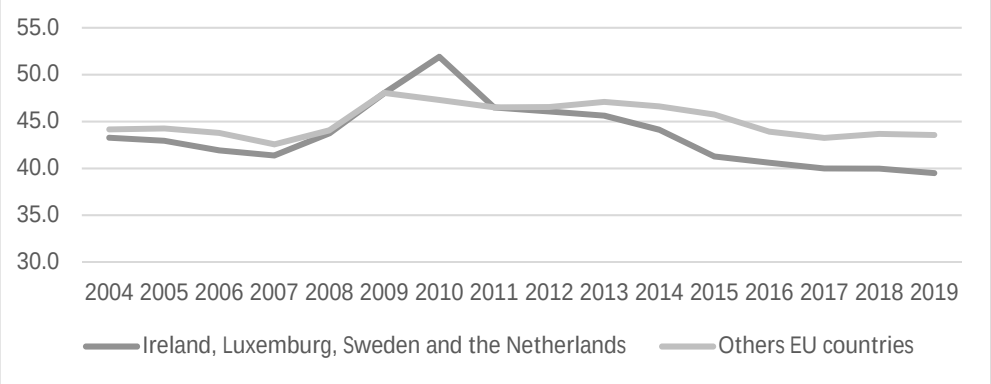


Sources: Authors' calculations

Among the EU member states, the highest average efficiency over the whole of the 2004-2019 period was reported by Ireland, Sweden, Luxembourg and the Netherlands, and it is equal to 1, i.e. the maximum efficiency possible over the entire period. They use their public spending efficiently to achieve their macroeconomic targets. These are also the countries with some of the highest rates of employment and the strongest export orientation, and also with moderate rates of economic growth and have achieved price stability. Their public spending on average in the period amounted to 43.6% (Figure 5). For the rest of the countries, average public spending was 45.1%. The data shows that the countries with the highest public spending efficiency for fiscal policy purposes also report lower public spending in GDP terms. That proves the second hypothesis that countries that have lower public spending are more efficient than EU countries that report high levels of public spending.

Figure 5

Public spending in GDP terms of EU countries in 2004-2019



Sources: Eurostat, authors' calculations

The EU member states reporting the lowest efficiency over the 2004-2019 period include Hungary, Belgium, Italy and Greece[10]. The average public spending efficiency in GDP terms for the analysed period is 0.93, and their public spending in GDP terms amount, on the average, to 50.4 % over the whole period, i.e. according to the existing research, they can be treated as countries with big governments ((Afonso et al. l., 2007; Halaskova et al. l., 2018).

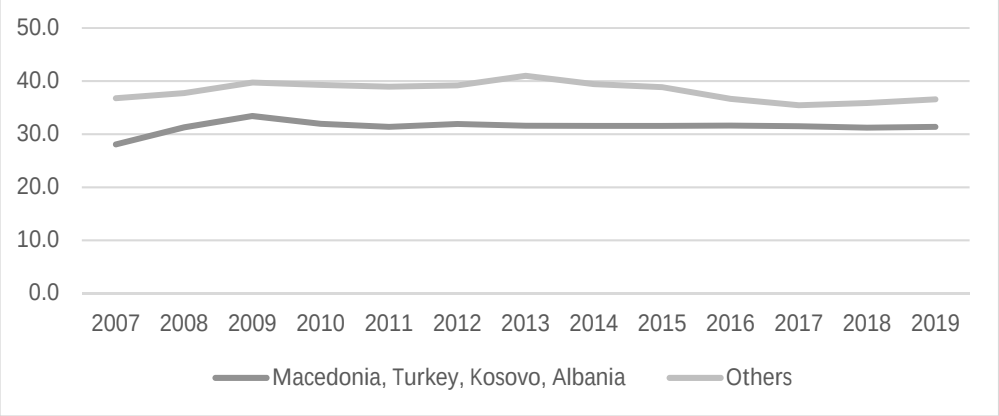
Among the countries from the Balkan Region, the best performers are North Macedonia, Turkey, Albania and Kosovo. Their average efficiency over the 2004-2019 period is 0.98, which means that they use only 2% of their public spending in GDP terms inefficiently. The rest of the Balkan countries have an average efficiency of 0.93. The average public spending efficiency in GDP terms of those countries over the same period is 31.1%, against 43.4% for the rest of the Balkan countries (Figure 6). In the case of the Balkan countries, the higher public spending efficiency and government sector performance of countries having lower public spending in GDP terms were also proven, i.e. they have small or mid-sized governments.

The countries with the lowest public spending efficiency in GDP terms from the Balkan Region are Serbia, Montenegro, Croatia and Greece. Their average efficiency over the whole period is 0.90, while their public spending in GDP terms amount to 46.6 %, which is 3.2 percentage points higher than the average for the Balkan Region. Again, this confirms the hypothesis that countries with big governments have lower efficiency compared to countries with a lower level of public spending in GDP terms.

[10] Greece is included both in the Balkan countries group and in the EU group since it belongs to both subgroups. The same approach has been applied with respect to Bulgaria and Romania, which are included in the EU group from 2007 to 2019.

Figure 6

Public spending in GDP terms of countries from the Balkan Region in 2004-2019



Sources: Eurostat, authors' calculations.

5. Conclusion

Over the past two decades of substantial changes in the economies and imbalances resulting from a series of crisis developments, the role of governments has shifted towards increased involvement in the economies. This involvement is driven by the need to support countries in their efforts to recover more quickly from the downturns they have experienced. This inevitably leads to increased public spending in GDP terms, but that cannot go on for a long time. In that context, the issue of more efficient use of public resources is becoming increasingly relevant. This study examining public spending efficiency and public sector performance in implementing its economic policy goals was also designed to address that topical issue.

The study used an approach based on linear mathematical programming that assesses the efficiency of each of the countries in comparison to the rest of the countries in the set. A comparative analysis of the public spending efficiency of EU member states and the countries in the Balkan Region was conducted.

The results from the computation prove the hypotheses formulated at the start of the research, namely, that in the conditions of the observed crises – the global financial crisis and the European debt crisis, the countries' public spending efficiency and macroeconomic performance deteriorates, due to the more substantial increase in the expenditure incurred by governments for the purposes of supporting the economies. Moreover, it has been proven that countries that have lower levels of public spending in GDP terms have higher efficiency compared to countries with higher levels of public spending, or those with the so-called "big government". These conclusions have been proven both for EU member states and for countries from the Balkan Region. In addition, the Balkan countries exhibit a higher increase

in the efficiency of government spending and of their government sector over the analysed period, which can be explained by their desire to achieve a faster convergence to the EU.

The factors behind the negative relationship between technical efficiency and public spending, especially during the crisis, is not subject to investigation in this study, but it would be a base for future research. The reason for the negative relationship between the efficiency and the level of the public spending could be fiscal multipliers, which takes different values. They can vary from negative to positive values (Yotzov, 2018, p. 1-2). The fiscal multipliers can take different values, depending on the specific characteristics of the economies: exchange rate regimes, level of government debt, phases of business cycles, openness of the economy, size of the government. The study covers a broad range of countries from more developed to less developed; from countries with common monetary policy to countries with strict monetary rules, based on the currency board arrangements; from countries with government debt over 100% of GDP to countries with government debt of about 20% of GDP. The fiscal multipliers for the EU countries and Balkan countries are different in value. Thus, the in-depth research in this respect can be a subject of a subsequent analysis.

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

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DYNAMICS OF ENERGY CONSUMPTION AND ECONOMIC GROWTH: A PANEL ESTIMATION OF NET OIL IMPORTING COUNTRIES[2]

This study revisits the relationship between energy consumption and economic growth in twelve net oil importing countries that are divided between two panels, namely, low net oil importing countries and high net oil importing countries for the data from 1971 to 2014. The study estimates a panel vector error correction model (VECM) and panel variance decomposition analysis and it is found that: Firstly, the carbon emission is an important factor in the interlinkage between the growth and energy. The economic growth evidently appears to drive energy consumption. Further, the carbon emission increases with an increase in economic growth and energy consumption and this inference could be drawn in the case of both groups of countries. But its magnitude is more pronounced in low oil importing countries. Secondly, a uni-directional causal relationship running from economic growth to energy consumption is detected and hence supports conservation hypothesis regardless of the level of oil import dependency of the countries. It implies that energy conservation policies do not negatively impact the economic growth of the oil importing economies. Therefore, countries, irrespective of the level of net oil import, are suggested to pursue a low carbon economy through sustainability practices, preferably in high carbon density sectors such as constructions and infrastructure, industries and power. This paper contributes to the literature by initiating the discussion on the energy-economy nexus in net oil importing economies by incorporating environmental factor.

Keywords: energy use; economic growth; carbon emission; net oil importing countries; GDP, CO2; Panel VECM
JEL: C23; E01; Q56

1. Introduction

Energy is regarded to be an integral part of the human ecosystem, as it is an important component among the drivers of the society and the economy. In view of this, energy consumption per capita is deemed as a major indicator of the economic development of a country (Esen, Bayrak, 2017). In the present world, when the countries are aiming at

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achieving welfare state, energy is not considered only as an economic resource, but also regarded as a key strategic commodity at the international level. The history reveals that the demand for energy increased in countries with industrialisation and infrastructure development. This could be evidenced from the industrialisation of the European economies in the past centuries and the eventual rise in the demand for energy. Similar scenario could be observed from the Asian economies in the past three decades or so. This leads to the postulation that economic growth accelerates the demand for energy. Energy consumption and economic growth, thus, appear to be interdependent and this linkage is an inevitable phenomenon (Neto, et al., 2014; Vandaele, Porter, 2015). With an increasing thrust on the rapid economic development, the energy scarce countries meet the domestic energy gap by importing. The oil importing economies, by virtue of increasing use of energy, generate more growth and a higher standard of living. Energy consumption and economic growth are deemed to have severe environmental implications. Though it is well known that energy consumption and economic development cause environmental degradation, which is popularly measured using the metrics carbon emissions per capita, empirical studies provide little information about whether the level of pollution changes depending on the import dependence. A substantially large part of the studies failed in considering the environmental factor while analysing the energy – economy relationship. The oil importing economies, by virtue of increasing use of energy, generate more growth and higher standard of living. Substantial number of studies failed in considering the environmental factor while analysing the energy – economy relationship. While attempting to address this gap, the present paper has an objective to revisit the energy consumption-economic growth dynamics by bringing environmental quality into the framework. This framework has been tested for 12 net oil importing countries. To understand whether the level of environmental pollution varies based on the net oil import dependence, these net crude oil importing countries are grouped into high net oil importing countries and low net oil importing countries. This classification is based on the net import dependence is more or less than 50 percent of the domestic consumption. The paper, by classifying the select countries into high net oil importing countries and low net oil importing countries focuses on exploring whether growth-energy-emission nexus differ significantly between the two groups. This paper contributes to the research literature as it begins the discussion on the energy-economy nexus with due consideration to the environment in net oil importing economies.

2. Study Area and the Scenario Analysis

This paper categorises countries with net oil import dependence of more than 50% as high net oil importing countries, while countries with oil import dependence of less than 50% as low net oil importing countries. This study covers Korea Republic, Japan, Italy, Spain, Hong Kong and Greece under the high net oil importing countries as their and the UK, India, Brazil, the USA, Argentina and China in the group of low net oil importing countries. The selection of the countries is guided by the availability of data from World Development Indicators (WDI) of the World Bank. Annexure-1 and Annexure-2 report the trends in the energy consumption per capita, GDP per capita and CO2 emissions per capita for both the groups of countries. The trends are mixed and not conclusive. In general, it appears that the decadal

growth rate of the energy consumption and CO2 emissions have declined in developed countries, probably after reaching the stage of high mass consumption as posited in Rostow's stages of development. These countries, in the recent decades are also found with a reduced growth rate of CO2 emissions. This could be owed to the technological advancement in all economic processes and rising awareness. Whereas, the emerging economies are found to be consuming a higher rate of energy, accelerating economic development at an increasing rate and simultaneously contaminating the environment. Table 1 gives us the summary of the changes in these factors during 1971-2014. In specific, it could be denoted from the Annexure 1 & 2 and Table 1 that in some of the low net oil importing countries (UK, USA), despite the growth rate of energy consumption has been negative, the economy grows at a higher rate and the growth is cleaner and greener. Whereas, in Korea and Hong Kong, amongst others in high net oil importing countries, during the same period, there are visible trends of the rapid growth of energy consumption, boom in economy as well as growing damages to the environment. The dynamics in these trends in high and low net oil importing countries need an investigation.

Table 1

Growth Rate of EC/c, GDP/c and CO2/c between 1971-2014 (%)

Country	EC/c	GDP/c	CO2/c
Low Net Oil importing Countries			
UK	-25.6192	126.2905	-45.0442
India	138.1058	316.7854	376.5597
Brazil	108.921	133.952	148.1753
Argentina	46.35294	41.13171	30.4228
USA	-8.94552	115.5234	-21.3409
China	381.0863	2456.97	623.817
High Net Oil importing Countries			
Korea Republic	924.8335	1137.439	549.0681
Japan	37.12532	140.5015	26.4148
Italy	23.87377	87.98872	16.31703
Spain	97.97854	109.4991	33.8801
Hong Kong	165.577	486.8599	182.3533
Greece	115.8341	56.92515	96.22635

Note: EC/c is energy consumption per capita, GDP/c is per capita Gross Domestic Product measured at 2010 constant prices in US dollars and CO2/c is the emission of carbon dioxide per capita.

Source: Author's estimation from WDI raw data.

3. Theoretical Postulations

The economic growth theories (Solow, 1969; Arrow, 1962) postulate that achieving sustainability in economic growth is an essential condition of the welfare state that, in turn, is determined by, amongst others, the availability and effective utilisation of factors of production. In past decades, energy has emerged as an important driver of growth and the national growth policies of energy scarce economies focused on strategic collaborations with oil economies to meet former's domestic energy requirements through larger imports (Stern, 2000; Pokrovski, 2003). The oil importing economies, by virtue of increasing use of energy,

generate more growth and higher standard of living. Further, theories also postulate that increasing economic activities and rising growth increase the energy consumption (Mahadevan, Asafu-Adjaye, 2007; Squally, 2007). This leads to the perception that energy and economy have interlinkage. Kraft & Kraft (1978) pioneered the investigation on the relation between energy and economy, and this was followed by an enormous number of studies.

The literature has debated the dynamics of the relation between energy and economic growth and resulted in the emergence of four different hypotheses viz. growth hypothesis, conservation hypothesis, feedback hypothesis and neutrality hypothesis. The growth hypothesis postulates that energy consumption leads to economic growth and hence indicates a uni-directional causality running from energy consumption to economic growth. It also demonstrates that energy conservation policies do not negatively affect the economic growth. In contrary, the conservation hypothesis theorises that energy conservation policies may not affect economic growth. Hence, the countries may implement sustainable development policies with less or no impact on the growth. It assumes a uni-directional causality running from economic growth to energy consumption. The feedback hypothesis predicts a bidirectional causality running between energy consumption and economic growth. It reflects the interdependence and complementarities among the variables. The neutrality hypothesis implies that neither the energy conservation policies affect economic growth nor economic growth affects energy consumption. It assumes the absence of a causal relationship between economic growth and energy consumption in any direction.

4. Analysis of Empirical Evidences

4.1. Bivariate models examining the nexus between energy consumption and economic growth

The first scientific study on the nexus between energy consumption and GNP was conducted by Kraft & Kraft (1978) for the US and obtained evidence to support the conservation hypothesis as a uni-directorial causality was found running from GNP to energy consumption. Energy conservation policies thus appeared to have no negative impact on the growth of the economy. Masih & Masih (1998) examined this issue in Thailand and Sri Lanka by applying econometric tools such as Johansen's multiple cointegration test, dynamic vector error-correction model (VECM), dynamic variance decomposition technique and impulse response function. The results confirm that shocks of energy consumption in both countries influence the economic growth and thereby supports the growth hypothesis.

Contrary to these, Oh & Lee (2004) had evidence to support the conservation hypothesis. They estimated VECM and found an absence of short-run causality between energy consumption and economic growth in Korea. While, in the long run, a uni-directional causality running from economic growth to energy use was detected. A similar result was observed by Chontanawat et al. (2008), who studied the relationship between energy consumption and economic growth in the context of over 100 OECD and non-OECD countries. Findings show that the causality running from energy use to economic growth is more pronounced in the developed OECD countries than the developing non-OECD

countries. This leads to the inference that policy measures to control energy use for reducing CO2 emissions do significantly impact the economic growth of the developed OECD countries than the developing non-OECD countries.

An investigation by Aslan & Kum (2010) applying FMOLS and DOLS approaches using data from 1971 to 2005 explored the existence of a stronger causal relation running from economic growth to energy consumption. Hence, the result supports the conservation hypothesis. A VECM estimation by Ozturk et al. (2013) also found support for the conservation hypothesis. They observed that energy consumption and GDP had no causal relationship in the short run. While in the long run, a uni-directional causality running from GDP to energy consumption was detected and thus supports the conservation hypothesis. In contrast, Jalil & Feridun (2014) concluded that energy consumption accelerates economic growth. Using ARDL bounds testing methodology, their study reveals that in China, every 1% increase of energy consumption causes 0.17% growth in GDP.

Dudzeviciute & Tamosiuniene (2014) studied the relationship between energy consumption and economic growth in Lithuania, Latvia and Estonia from 1995 to 2012. The results are not uniform. A uni-directional causality running from GDP to energy consumption is found in Estonia, giving support to the conservation hypothesis. While, in Lithuania and Latvia, no causality was detected in any direction between energy consumption and GDP, which in turn supports the neutrality hypothesis.

Kim & Heo (2012) examined the relation between economic growth and energy consumption for the US using decomposed time series of energy consumption. The result observed a bidirectional causal relationship between the variables, thereby supporting the feedback hypothesis. A study by Shakouri & Yazdi (2017) also validated the feedback hypothesis. By applying ARDL bound-testing approach to South Africa, they explored a bidirectional causality between economic growth and energy consumption.

Cho et al. (2015) analysed the nexus between renewable energy consumption and economic growth in OECD and non-OECD countries. The multivariate panel VECM for the annual data from 1990 to 2010 found the long-run causality running unidirectionally from economic growth to renewable energy consumption in 31 developed OECD countries. This supports the conservation hypothesis. While the 49 non-OECD less developed countries had a bidirectional long-run causality validating feedback hypothesis. Hence, the results vary between the developed and the developing countries. Whereas, a multivariate time-varying model estimated by Arora and Shi (2016) for quarterly data of the USA from 1973 to 2014 found that the causal relationship between energy consumption and real GDP was varying over the time. A bidirectional causality was detected between the two variables in the decade of 1990's, but during 2000's the causality was found running from real GDP to energy consumption.

Pastén et al. (2015) found evidence to support the growth hypothesis. This inference was made from a panel data study of 16 Latin American countries by applying a random coefficient method using annual data from 1971 to 2001. A uni-directional causality running from energy to economic growth was detected. A contrasting result was found by Çetintaş (2016). The study focused on the economic growth – energy consumption relationship of 17 transition economies and had evidence to accept the conservation hypothesis. It explored a

uni-directional causality running from economic growth to energy consumption in the long run, implying that in those transition economies, energy conservation policies do not impact economic growth negatively. In another bivariate study by Dlamini, et al. (2016) for South Africa using vector autoregression (VAR), however, found no strong evidence of causality in any direction between economic growth and energy consumption. In contrast, Rathnayaka et al. (2018) detected a bidirectional or feedback causality running between the said variables in China by estimating VECM.

Liu (2018) investigated the nexus between energy consumption and economic growth in China from 1982 to 2015 by estimating DOLS, FMOLS, ARDL and VECM models. The findings show that the economic growth of China is sensitive to energy consumption. Similar results are obtained by Azam (2019) in a panel of 10 developing Asian countries. It is found that energy has a significant impact on economic growth. The study used quarterly data from 1990 to 2014 and applied fully modified ordinary least squares and dynamic ordinary least squares methods and concludes that the Asian economies drive economic growth through sustained consumption of energy. A study on the Indian context by Habib (2019) also supported the conservation hypothesis. It observed that change in petroleum consumption has a significant impact on economic growth both in the short run and long run as a uni-directional causality was found running from petroleum consumption to economic growth.

4.2. Multivariate models examining the nexus between energy consumption and economic growth

Jafari, et al. (2015) estimated a multivariate model to examine the nexus between economic growth, energy consumption and emissions in Bahrain by employing Toda and Yamamoto's approach. The model was controlled for capital and urban population. The results indicate that Bahrain has a uni-directional causality running from economic growth to energy consumption, emissions and capital. Further, it is also found that carbon emission in Bahrain is Granger caused by urban population, economic growth, capital and energy consumption. In another study. Xiong, et al. (2015) estimated the relationship between energy consumption, economic growth, carbon emission and energy exports in Kazakhstan for the period ranging between 1993 and 2010. The study reveals that energy consumption was the major factor driving carbon emissions in Kazakhstan.

Mbarek, et al. (2016) investigated the causality relatios among energy consumption, greenhouse emissions and economic growth in Spain. It is observed from the study that: (1) energy consumption and greenhouse emissions have a feedback relationship; (2) energy consumption and economic growth have a significant and positive relationship; and (3) a uni-directional causality running from economic growth to greenhouse emissions.

In a multivariate causality analysis between economic growth and energy consumption in Turkey based on ARDL bounds testing approach, Pata & Terzi (2017) found a uni-directional causal relation flowing from energy consumption to economic growth and thereby supporting the validity of the growth hypothesis. In concurrence, Joo et al. (2015) also observed strong evidence to support the growth hypothesis. They investigated the relationship between economic growth, CO2 emissions and energy consumption for Chile and the causality was

found running from energy consumption to economic growth, from CO2 emissions to economic growth, and from energy consumption to CO2 emissions. There was no evidence for causality running from economic growth to energy consumption, from CO2 emissions to energy consumption, and from economic growth to CO2 emissions. In contrast, Kais & Mbarek (2017) found evidence in three African countries to support the conservation hypothesis. Their study on the linkage between energy consumption, carbon dioxide emissions and economic growth applied a panel VECM model and results explored a short-run relationship running from economic growth to energy consumption; from economic growth to CO2 emissions; and also from energy consumption to CO2 emissions. Further, it also detected a long run bidirectional causality between energy consumption and economic growth and a uni-directional causality running from energy consumption to CO2 emissions.

Destek & Okumus (2017) disaggregated the energy into oil, natural gas, and coal and examined the relation between consumption of each of these energy sources and economic growth in G-7 countries for the period from 1970 to 2013 using panel bootstrap causality approach. The results are mixed. In Germany, Italy, Japan, and the United States, oil consumption is found granger cause economic growth, in Germany and UK economic growth causes oil consumption, in Italy, Japan, USA and UK, consumption of natural gas causes economic growth, in Germany economic growth causes natural gas, in Canada consumption of coal causes economic growth, in USA economic growth causes consumption of coal. Tamba (2017) examined the short-run and long-run causal relationship among energy consumption, economic growth, and CO2 emissions in Cameroon by applying an error correction model using annual data from 1971 to 2013. The long-run equilibrium between these three variables and their capability to return to equilibrium has been confirmed. This apart, a bidirectional long-run causality between all variables, viz, between economic growth, energy consumption and CO2, was also detected. While in the short-run causality was detected only between CO2 emissions and energy consumption. In this case, CO2 emissions granger cause energy consumption.

The relation between energy consumption, CO2 emissions and economic growth is also examined by Saidi & Hammami (2016) by estimating dynamic simultaneous-equation panel data models for 58 countries divided into six regional panels. Results are not uniform across the regions. For four panels, the result shows a directional causality between economic growth and energy consumption and similarly between economic growth and energy consumption. While for Latin American and Caribbean countries, a uni-directional causality running from CO2 emissions to economic growth was detected. Sulaiman & Rahim (2017) examined the relation between CO2 emission, energy consumption and economic growth in Malaysia for the period between 1975 and 2015 using ARDL approach and DOLS method. The study also estimated the vector error correction model, variance decomposition and impulse response function. The results show that energy consumption and economic growth drive CO2 in Malaysia. There are no evidences of economic growth being influenced by either energy consumption or CO2.

Salahuddin & Gow (2019) studied the relation between economic growth, energy consumption, foreign direct investment, and financial development on environmental quality. The environmental quality was measured by three different indicators: per capita CO2 emissions, energy intensity and Adjusted National Savings. This study was undertaken for

the data of Qatar from 1980 to 2016 by applying ARDL model. It is observed from the results that energy consumption has an impact on all three indicators of environmental quality. FDI seems to have a negative long-run effect on environmental quality energy intensity. Results confirmed that all three variables (economic growth, energy consumption, and financial development) have a bidirectional causal relation with all three indicators of environmental quality (CO2 emissions, energy intensity and Adjusted National Savings).

Balcilar et al. (2019) examined the relation between CO2, energy consumption and economic growth in the G-7 countries using the historical decomposition method. Results found an interlink between the three variables such that fossil-based energy consumption causes substantial CO2 emissions, which in turn accelerates economic growth in Canada, Italy, Japan and to some extent the USA. It is also found that none of the countries has any evidence to support the EKC hypothesis.

A study by Bayar & Gavriletea (2109) focusing on emerging economies explores that in the long run, the energy efficiency positively influences the economic growth whereas, economic growth appears to have no significant impact from renewable energy. It also detected one-directional causality in the short run from both energy efficiency and renewable energy use to the economic growth. Li (2020) found an inter linkage between energy consumption, CO2 emissions and economic growth in China through a decoupling approach for the data from 1979 to 2018. The study reveals that though they are inter-linked, the speed of economic growth is higher than CO2 emissions and energy consumption.

4.3. Direction for this study

Though there is an abundance of literature on the relation between energy consumption and economic growth, the existing literature suffers from certain limitations. The findings from the literature on the relation between energy consumption and economic growth are not unanimous, rather conflicting as there is evidence to validate all four different but conflicting hypotheses. Some of the studies focussed on oil exporting countries, while some others focussed on a mixed group of oil exporting and importing countries. In cases of a mixed group, common policy suggestions are generalised across all countries based on the results, but practically such uniform policy suggestions are inappropriate as the inclination to and nature of energy consumption differs between oil exporting and oil importing countries. Further, it is also observed that hardly any study is available focussing on the oil importing countries. Again, the size of import of oil varies between the countries, and this will also impact the nature of relationship between energy consumption and economic growth. The present study takes these lapses and gaps in the available literature into account and contributes to the existing stock of literature.

5. Methodological Framework

5.1. Model Specification

Narayan & Smyth (2009) argued that most of the earlier studies on the energy-economic growth nexus employed a bivariate framework and such studies are subjected to the omitted variables bias and therefore, the findings and policy suggestions are potentially spurious. A study by Lutkepohl (1982) confirmed the notion that omitting relevant variable(s), in a bivariate model, may lead to a spurious finding of Granger causality. Subsequently, Triacca (1998) proved that omitted variables, in a bivariate framework, cause absence of causality between the variables. The inclusion of a third variable in the energy-growth analysis makes the model more robust as the sign and size of the coefficient reach closer to perfection and changes the direction of causality nearer to the reality (Odhiambo, 2009). In view of this, this study developed a tri-variate framework by including carbon emission to energy consumption and economic growth.

Some of the past studies, such as Jafari, et al. (2015), Xiong, et al (2015), Joo et al. (2015), Mbarek et al. (2016), Saidi & Hammami (2016), Sulaiman & Rahim (2017), Kais & Mbarek (2017), Salahuddin & Gow (2019), Balcilar et al. (2019) and Li (2020) among others studied the interlinkage between energy consumption, economic growth and carbon emission. It is revealed from their study that carbon emission is a significant having interlinkage with energy consumption and economic growth. The inclusion of carbon emission in the model, thus, will better explain the relation between energy and economy in the net oil importing economies. Thus, the proposed model of this study is broadly consistent with the literature, and is presented in equation (1):

$$GDP = f(EC, CO2) \tag{1}$$

The model states that economic growth (GDP) in net oil importing countries is the function of energy consumption (EC) and the level of carbon emissions (CO2). The economic growth is measured in terms GDP, the energy consumption is measured by energy use and carbon emission is measured in terms of CO2 emissions. The model has been presented in the form of a specific equation as given in equation (2).

$$GDP_{\mathrm{t}} = \beta_0 + \beta_1 EC_{\mathrm{t}} + \beta_2 CO2t + e_{\mathrm{t}} \tag{2}$$

Wherein, βo is the constant term, β_1 and β_2 are coefficient terms of EC and CO2, respectively, and e is the error term. The study uses annual data for all the model variables, and the time series is represented by t.

To smoothen the data and thereby obtain a more robust results from the model estimation the actual values of the data series are converted to the natural logarithm. After the logarithmic transformation of the data the equation (2) is re-written as in equation (3):

$$lnGDP_{\mathrm{t}} = \beta_0 + \beta_1 \, lnEC_{\mathrm{t}} + \beta_2 \, lnCO2_{\mathrm{t}} + e_{\mathrm{t}} \tag{3}$$

The study focuses on several oil importing countries and hence, the data is a panel in nature. By incorporating the cross-country factor, equation (3) is modified further into:

$$lnGDP_{\mathrm{i,t}} = \beta_0 + \beta_1 \, lnEC_{\mathrm{i,t}} + \beta_2 \, lnCO2_{\mathrm{i,t}} + e_{\mathrm{i,t}} \tag{4}$$

In equation (4) i indicates the respective countries in the panel.

5.2. Data Description

As there is a lack of studies on the relation between energy and economy in oil importing countries, this study is based on the data accessed from 12 oil importing countries. For the purpose of the study, the countries are classified into two groups such as high net oil importing countries and low net oil importing countries in terms of their net oil import dependence is greater or lesser than 50% according to the data sourced from WDI, 2020. Similar approach to the classification of the oil importing countries was followed in other studies (for instance, Esen, Bayrak, 2017). High net oil importing countries are those with energy import dependency is more than 50%, while countries with oil import dependency of less than 50 percent are group as low net oil importing countries. In this study Korea Republic, Japan, Italy, Spain, Hong Kong and Greece represent the high net oil importing countries and the UK, India, Brazil, the USA, Argentina and China form low oil importing group. The selection of the countries is guided by the availability of data apart from oil import dependency ratio. The study is based on the annual data collected for the sample variables for the period ranging between 1971 and 2014. The selection of sample periods is also guided by the availability of data.

Table 2 reports the study variables, their definitions and symbols used for the study. The data are extracted from the World Development Indicators (WDI) of the World Bank.

Table 2

Description to the study variables

Variable	Description	Symbol
Response Variable		
GDP per capita	measured in constant 2010 US$	GDP
Regressors		
Energy consumption per capita	measured in kilogram of oil equivalent per capita	EC
Emission of carbon dioxide per capita	measured in metric tons per capita	CO2

Annexure 3 presents the descriptive statistics of variables used in the study. It could be summarised that for each of the variables, the deviation of maximum and minimum from the mean is short. The standard deviation is very low and thereby, the aggregate behaviour of the data sets is almost close to their respective average behaviour.

The coefficients of Skewness and Kurtosis indicate that all the variables used in the study are characterised by non-normal distribution. The coefficient of most of the variables are negative and they indicate that such variables are skewed to the left. Only EC in high net oil importing countries is skewed to the right. Further, the coefficients of kurtosis show that the leptokurtic for all variables applied in this study in low net oil importing countries have the presence of a high peak or a fat-tailed in their volatilities. While, the data sets variables of high importing countries have a low peak.

In addition, the estimated coefficients of Jarque–Bera statistics are positive, thereby indicating the rejection of the null hypothesis of normal distribution of the variables used in the study. Further, the coefficient values of Jarque–Bera are high and they reflect that the data series are not normally distributed at 1 percent level of significance.

Thus, the results of skewness, kurtosis, and Jarque–Bera infer that all variables used in the study are not normally distributed.

5.3. Econometric approaches

Guttormse (2004) and Mehrara (2007) observed that the literature on the applied econometric methodology to the energy-growth nexus has evolved over four generations. The methodology of the fourth generation is primarily the estimation of panel cointegration and panel error correction models. Literature on the methodological issues highlights the advantages of panel estimation over other estimation methodologies of earlier generations. For instance, Osbat (2004, quoted from Hasanov, et al., 2017) brings forth four such advantages: (1) a better and clear information could be accessed from panel data when time series are combined with cross-sectional dimensions; (2) the results from panel estimation are more efficient as it has potential to mitigate collinearity among the explanatory variables and to increase degrees of freedom; (3) this estimation technique provides for controlling the individual heterogeneity; (4) the effects that are not identified in the time series or cross-section data, are detected by the panel estimation. Since the panel framework appears to be more efficient, the present study has employed the panel estimation techniques.

The econometric methodology to the panel estimation, in this study, begins with testing for time series properties of the variables through panel unit root test (PURT) followed by testing for order of integration. Further, using the cointegration approach, the paper estimates the impact of economic growth and energy consumption on carbon emission and detects whether there exists any long-run relationship among these variables. If the variables are found co-integrated in the long run, a panel vector error correction model (VECM) is estimated to examine the short-run dynamics of the relationship between the variables. In the event of absence of cointegration, a panel vector autoregressive model (VAR) will be estimated. Literature advocates that the variance decompositions are a better framework to summarise the dynamic relations between variables in a VAR. The selection of econometric methodology is guided by the literature of the past.

The objectives of this paper are to estimate how are the variables related in the long run and short run and examine the dynamic causality between carbon emission, energy consumption and economic growth in oil importing countries. To investigate on these, this paper follows four steps in the methodological approach.

1) The non-stationarity of the study variables, i.e. GDP, EC and CO2 are examined using first-generation panel unit root test (PURT) methodology. Three different methods of PURT, such as Levin, Lin & Chu test, (Augmented Dickey-Fuller) ADF – Fisher Chi-square test and (Phillips-Perron) PP – Fisher Chi-square test are estimated. Among the three methods Levin, Lin & Chu test assumes a common unit root process across cross-sections. While ADF – Fisher Chi-square and PP – Fisher Chi-square tests assume

individual unit root process. In all these three tests, null hypothesis is that the panel data have a unit root or non-stationarity. The general form of equation estimated for PURT is as given in equation (5):

$$\Delta y_{i,t} = \alpha y_{i,t-1} + \sum_{k=1}^{Pi} \mu_{ik} \Delta y_{i,t-k} + \beta_i X_{i,t} + e_{i,t} \quad (5)$$

Where y is the variable to be tested, X is the exogenous variable/s, i and t are cross-section (country) and time elements respectively, e stands for error term and Δ is the first difference operator. Here the null hypothesis of unit root is $H_0 : \alpha = 0$. The alternative hypothesis of no unit root is $H_1 : \alpha = 0$ for all i = 1,2,3…N_1 and $\alpha < 0$ for all i = N1+1, N1+2, N1+3……N.

2) If all the time series variables are found integrated at the same order, preferably I(1), a panel cointegration test (PCT) is applied. The presence of the cointegration among the model variables is tested through three different methods of PCT such as Pedroni Residual Cointegration Test, Kao Residual Cointegration Test and Johansen Fisher Panel Cointegration Test.

Pedroni method considers the heterogeneity at two different levels. In the first level, it considers the heterogeneity across sections (countries). It is estimated by Equation (6).

$$y_{i,t} = \alpha_i + \delta_{i,t} + \beta_{1t} X1_{i,t} + \beta_{2t} X2_{i,t} + \cdots + \beta z_t XZ_{i,t} + e_{i,t} \quad (6)$$

Variables y and X are assumed as I(1). $\alpha_i + \delta_i$ stand for individual and trend effects. The second level tests the stationarity of the estimated residual, i.e. $\hat{e}_{i,t}$ by Equation (7):

$$\hat{e}_{i,t} = Q_i \hat{e}_{i,t-1} + e_{i,t} \quad (7)$$

Unlike Pedroni, Kao considers homogeneity in cointegration with only intercept and no trend. The PCT under Kao methodology is tested by estimating equation (8):

$$y_{i,t} = \alpha_i + \beta_{1t} X1_{i,t} + \beta_{2t} X2_{i,t} + \cdots + \beta z_t XZ_{i,t} + e_{i,t} \quad (8)$$

If the variables are found co-integrated, a panel vector error correction model (VECM) is estimated to examine the short-run dynamics of the relationship between the variables. In the event of an absence of cointegration, a panel vector autoregressive model (VAR) will be estimated. If a cointegration relationship is detected, then Equation (4) for GDP is represented as in equation (9).

$$InGDP_{i,t} = \alpha_i + \delta_{i,t} + \beta 1\ InEC_{i,t} + \beta 2\ InCO2_{i,t} + e_{i,t} \quad (9)$$

Later, the study measures the error correction term or the long run residuals by estimating equation (10).

$$e_{i,t} = ECT_{i,t} = \ln GDP_{i,t} - (\alpha_i + \delta_{i,t} + \beta 1 InEC_{i,t} + \beta 2\ InCO2_{i,t}) \quad (10)$$

The study estimates the panel VECM by applying the set of vectors that are presented in equation (11).

$$\begin{pmatrix} \Delta InGDP_{i,t} \\ \Delta InEC_{i,t} \\ \Delta InCO2_{i,t} \end{pmatrix} = \begin{pmatrix} b^1 \\ b^2 \\ b^3 \end{pmatrix} + \sum_{k=1}^{n} \begin{pmatrix} B_{11,k} & B_{12,k} & B_{13,k} \\ B_{21,k} & B_{22,k} & B_{23,k} \\ B_{31,k} & B_{32,k} & B_{33,k} \end{pmatrix} \begin{pmatrix} \Delta InGDP_{i,t-k} \\ \Delta InEC_{i,t-k} \\ \Delta InCO2_{i,t-k} \end{pmatrix} + \begin{pmatrix} \tau_1 \\ \tau_2 \\ \tau_3 \end{pmatrix} ECT_{i,t-1} + \begin{pmatrix} e^1_{i,t} \\ e^2_{i,t} \\ e^3_{i,t} \end{pmatrix} \quad (11)$$

Where b is the vector of intercept, τ is the vector of speed of adjustment coefficients. This reflects the speed with which the deviations from the long-run equilibrium are corrected. B is the metrics of short-run coefficients, e is vector of serially independent residuals. Δ is the difference operator and $ECT_{i,t-1}$ is the lagged error term that is generated from long-run association. If the coefficient of the lagged ECT is negative and significant based on t-statistic, then it could be interpreted that there exists a long-run causality running from deterministic variables to the response variable. The presence of significant coefficients in the first difference/second difference indicates the existence of short-run causality.

After VECM estimation, the study uses a panel variance decomposition technique applying VAR system. Though the VECM model measures the short-run and long-run causality between the variables, it does not capture the relative strength of causal relation between the variables beyond the selected time period (Abosedra et al., 2015). In contrast, the variance decomposition method is capable of measuring the magnitude of the predicted error variance for a series accounted for by innovations from each of the independent variables over different time-horizons beyond the selected time period (Abosedra et al., 2015). Engle & Granger (1987) and Ibrahim (2005) also echoed the same. They believe that with VAR framework, the variance decomposition method delivers more reliable results than conventional approaches.

6. Results and Discussion

6.1. Panel Unit Root Tests (PURTs)

The PURTs based on Levin, Lin & Chu, ADF – Fisher Chi-square and PP – Fisher Chi-square methods are estimated on the natural logarithms of GDP, EC and CO2 at a level and first difference and the results are presented in Table 3. In both the groups of countries (high net oil importing countries and low net oil importing countries), all three tests provide consistent results. Data series of GDP, EC and CO2 are non-stationary and have unit root at level I(0) across both groups of countries. Non-stationarity of GDP data series indicates that the shocks to the economy by economic policies such as monetary policy or fiscal policy have permanent effect on the level of economic growth. EC being non-stationary, innovations in energy utilisation will have a permanent effect on the energy consumption. Further, any measures to control carbon emissions seem to have a longstanding effect on the level of CO2 emissions.

While after the first difference I(1), all data series, i.e., ΔGDP, ΔEC and ΔCO2 are found stationary. Hence, the null hypothesis that the data series have a unit root cannot be accepted. Thus the results reveal that GDP, EC and CO2 are integrated of order one I(1). The stationarity level of the data series implies that any innovations or policy reforms pertaining to the variable concerned have transitory effects and the series returns to its trend path (Abosedra et al., 2015). At first difference, economic policy reforms, innovations in energy use and policies and innovations to control carbon emissions leave an only temporary effect on GDP, EC and CO2 as the shocks are transitory in the time trend path.

After concluding that all data series are integrated of order one I(1) regardless of groups of countries, the study proceeds to test whether the model variables are co-integrated before estimating the regression model.

Table 3

Results of Panel Unit Root Tests

Variable	Method	Order	Low Net Oil importing Countries		High Net Oil importing Countries	
			Statistic	*Prob*	*Statistic*	*Prob*
ln $CO2_{it}$	Levin, Lin & Chu	Level	-0.10674	0.4575	0.81212	0.7916
		1st diff	-4.10566	0.0000*	-6.40674	0.0000*
	ADF - Fisher	Level	14.3120	0.2812	4.48174	0.9731
		1st diff	55.2581	0.0000*	65.2300	0.0000*
	PP - Fisher	Level	13.3746	0.3424	2.54958	0.9980
		1st diff	148.076	0.0000*	165.542	0.0000*
ln GDP_{it}	Levin, Lin & Chu	Level	5.37236	1.0000	3.64824	0.9999
		1st diff	0.38117	0.6485	-3.96973	0.0000*
	ADF - Fisher	Level	0.30001	1.0000	0.89363	1.0000
		1st diff	35.1245	0.0004*	28.9187	0.0041*
	PP - Fisher	Level	0.19311	1.0000	0.43662	1.0000
		1st diff	71.5252	0.0000*	75.4133	0.0000*
ln EC_{it}	Levin, Lin & Chu	Level	1.63884	0.9494	1.14438	0.8738
		1st diff	-3.58792	0.0002*	-5.30731	0.0000*
	ADF - Fisher	Level	6.93667	0.8618	2.78181	0.9969
		1st diff	48.5796	0.0000*	52.4683	0.0000*
	PP - Fisher	Level	5.11775	0.9539	1.36763	0.9999
		1st diff	138.603	0.0000*	167.061	0.0000*

***** $p < 0.01$

6.2. Panel Cointegration Tests (PCTs)

Pedroni residual cointegration test, Kao residual cointegration test and Johansen Fisher panel cointegration test are applied in this study to verify long-run relationship between economic growth, energy consumption and carbon emissions. Pedroni test assumes intercept and trend and presents two sets of cointegration, firstly, within the dimension and secondly, between dimensions. Kao test assumes individual intercept, no trend and the cointegration is based on the ADF t statistic. Johansen Fisher test assumes intercept, no trend in CE & VAR and the cointegration, in this case, is based on the two sets of tests, namely, trace test and max-eigen test. The results of PCTs are presented in Table 4.

Pedroni test denotes a weak cointegration relation between the variables regardless of groups of countries. For a stronger cointegration, statistic values of most of the tests should have been significant, but not the case here. Whereas, results of Kao test present that GDP, EC and CO2 have a strong long-run relationship among themselves in both the groups of countries as the ADF statistic is significant. Also, the findings of Johansen Fisher test corroborate the existence of long-run relationship between the variables. The Fisher statistic values extracted from both trace test and max-eigen test are statistically significant and this leads to the

rejection of the null hypothesis that there is 'none' number of co-integrating vectors between the three variables of the study. The Johansen Fisher test concludes that there exists at most one co-integrating equation between GDP, EC and CO2.

Table 4

Results of Panel Cointegration Test

Method	Test	Low Net Oil importing Countries		High Net Oil importing Countries	
		Statistic	*Prob*	*Statistic*	*Prob*
Pedroni	*Within-dimension*				
	Panel v-Statistic	2.482990	0.0065*	0.493719	0.3108
	Panel rho-Statistic	-1.710309	0.0436**	-0.440144	0.3299
	Panel PP-Statistic	-3.150557	0.0008*	-1.376593	0.0843***
	Panel ADF-Statistic	-1.312117	0.0947***	-0.991949	0.1606
	Between-dimension				
	Group rho-Statistic	-1.489683	0.0682***	0.159835	0.5635
	Group PP-Statistic	-3.119217	0.0009*	-1.517628	0.0646***
	Group ADF-Statistic	-0.374	0.3542	-1.251277	0.1054
Kao	ADF	-2.779904	0.0027*	-1.895081	0.0290**
Johansen Fisher	*Trace Test*				
	None	36.60	0.0003*	33.62	0.0008*
	At most 1	13.05	0.3654	14.78	0.2539
	At most 2	13.72	0.3187	16.80	0.1575
	Max-eigen test				
	None	36.79	0.0002*	28.46	0.0047*
	At most 1	11.95	0.4500	11.14	0.5169
	At most 2	13.72	0.3187	16.80	0.1575

* $p < 0.01$, ** $p < 0.05$ & *** $p < 0.10$

Based on the results of PCTs, the null hypothesis of no cointegration between the variables cannot be accepted and this provides stronger evidence for long run co-integrating association between GDP, EC and CO2.

The cointegration result is sensitive to the lag length used and hence it is critical to select an appropriate and reliable lag length. In this paper, the selection of lag length is guided by VAR Lag Order Selection Criteria and the result is presented in Annexure-4. Since the literature considers Schwarz information criterion (SC) as one of the highly accepted, the optimal lag length in this study is selected based on SC. Based on this criterion, lag 2 is found to be the optimal lag for both the groups of countries.

As all the variables are integrated of order one I(1) and the long run co-integrating relationship between them is established in both the groups of countries, the study proceeds to examine the causal relationship among the series by estimating an error correction model. The clear understanding of the direction of flow of the causal relationship would guide in framing appropriate policies for sustainable development.

6.3. Panel VECM

The VECM estimates long run and short-run causality between the GDP, EC and CO2. Table 5 presents the results of long-run causality. The error correction term (ECT) measures the speed of adjustment of the dependant variable towards long-run equilibrium for the shocks of determinants. The results are uniform across all three groups. The energy consumption and carbon emissions do not have a significant impact on the economic growth. While GDP and EC are found to be significant factors in determining the changes in CO2 irrespective of the size of oil imported by the countries. Similarly, EC is determined by GDP and CO2. Again, regardless of the group of countries, the speed of adjustment in CO2 towards its long-run equilibrium is faster than EC, as this is evident from the size of the ECT. The imbalances caused to CO2 by the fluctuations in EC and GDP, will return to their earlier state by 52%, and 11% during a year in high oil importing countries and low oil importing countries, respectively.

Irrespective of the size of oil imports, in both groups of countries, a bidirectional long-run causality is evident between EC and CO2. A uni-directional long-run causality running from GDP to EC and also from GDP to CO2 is detected. While no causality is found running from EC to GDP and also from CO2 to GDP.

Table 5

Panel Vector Error Correction Model

	Low Net Oil importing Countries			High Net Oil importing Countries		
	$\Delta lnGDP_{it}$	$\Delta lnEC_{it}$	$\Delta lnCO2_{it}$	$\Delta lnGDP_{it}$	$\Delta lnEC_{it}$	$\Delta lnCO2_{it}$
ECT(-1)	0.006664	-0.001501	-5.28E-06	-0.007416	-0.005311	-1.18E-05
Std. Error	0.00214	0.00047	1.40E-06	0.005853	0.000988	2.97E-06
t-Statistic	3.11733	-3.18552	-3.68159	-1.267123	-5.373097	-3.989363
Prob.	0.0019*	0.0015*	0.0002*	0.2055	0.0000*	0.0001*
R-squared	0.293614	0.112895	0.140031	0.183170	0.149624	0.103703
Adj.R-squared	0.272838	0.086804	0.114737	0.159146	0.124613	0.077341
S.E. of regression	424.9227	93.68118	0.285248	647.0502	109.2716	0.327998
F-statistic	14.13230	4.326920	5.536290	7.624333	5.982314	3.933845
Log likelihood	-1833.762	-1461.807	-36.41085	-1937.209	-1499.676	-70.76416
D-W stat	1.926086	1.91863	1.858199	1.943806	1.997797	1.986894

* $p < 0.01$

Diagnostic tests are performed to check the reliability of the results. The D-W statistic, as per the statistical norm, should be around 2 and in our case, for all models across groups of countries, it is almost 2. This implies that the result is not inflated by the autocorrelation in the residuals. Furthermore, high F-statistic also shows that variables as a group are jointly significant in all the models.

The short-run causality between the variables is also estimated and the results are presented in Table 6 and Table 7. The joint impact of the lagged terms of the deterministic factors on the dependent variable is measured through the Wald test. Table 6 and Table 7 also cover the results of Wald test.

Table 6

Short Run Causality and Joint Wald Test of Lagged Terms – Low Net Oil importing Countries

Regressor & Lagged Terms	Coefficient	t-statistic	Chi-square	df	Prob	Decision
Dependent Variable: $\Delta lnGDP_{it}$						
ΔlnEC-1	0.306379	0.37729	2.449575	2	0.2938	Accept Ho
ΔlnEC-2	1.184941	1.46637				
Δ*lnCO2-1*	-113.0239	-0.42915	3.658276	2	0.1606	Accept Ho
Δ*lnCO2-2*	-476.567	-1.81643				
Dependent Variable: $\Delta lnEC_{it}$						
ΔlnGDP-1	0.015221	0.80676	0.652774	2	0.7215	Accept Ho
ΔlnGDP-2	-0.005017	-0.27068				
ΔlnCO2-1	-113.9427	-1.96238	5.355688	2	0.0687	Reject Ho
ΔlnCO2-2	-60.19532	-1.04068				
Dependent Variable: $\Delta lnCO2_{it}$						
ΔlnGDP-1	3.67E-05	0.63873	0.443408	2	0.8012	Accept Ho
ΔlnGDP-2	-3.59E-08	-0.00064				
ΔlnEC-1	0.001212	2.22335	5.177912	2	0.0751	Reject Ho
ΔlnEC-2	0.000124	0.22908				

Table 7

Short Run Causality and Joint Wald Test of Lagged Terms – High Net Oil importing Countries

Regressor & Lagged Terms	Coefficient	t-statistic	Chi-square	df	Prob	Decision
Dependent Variable: $\Delta lnGDP_{it}$						
ΔlnEC-1	0.534875	0.82441	2.864065	2	0.2388	Accept Ho
ΔlnEC-2	-0.851234	-1.30231				
Δ*lnCO2-1*	-238.847	-1.0821	4.634272	2	0.0986	Reject Ho
Δ*lnCO2-2*	396.7019	1.77405				
Dependent Variable: $\Delta lnEC_{it}$						
ΔlnGDP-1	0.018295	1.5127	8.348459	2	0.0154	Reject Ho
ΔlnGDP-2	0.022002	1.82418				
ΔlnCO2-1	54.02000	1.44922	3.281622	2	0.1938	Accept Ho
ΔlnCO2-2	36.7989	-0.97446				
Dependent Variable: $\Delta lnCO2_{it}$						
ΔlnGDP-1	9.46E-05	2.6052	7.280340	2	0.0262	Reject Ho
ΔlnGDP-2	-7.14E-06	-0.19728				
ΔlnEC-1	-0.000113	-0.34338	1.591418	2	0.4513	Accept Ho
ΔlnEC-2	-0.000416	-1.2562				

A feedback causal relationship between CO2 and EC in the short run is found in low net oil importing countries. This implies that carbon emission is caused by energy use in low oil importing countries, and in turn, energy use is also caused by carbon emission. No short-run causality is found running between EC & GDP and GDP & CO2 in any direction. This has policy implications that if any sustainable development policy measures are implemented to

reduce energy use and cut carbon emissions to protect the environment will not affect the national economic growth and the average income of the individuals.

In the case of high oil importing countries, changes in the economic growth appear to cause energy use in the short run, but not vice-versa. Further, a bidirectional short-run causality is detected between GDP and CO2. This implies that: firstly, more economic activities will cause more emissions; secondly, implementation of policy measures that are aimed at reducing emissions and improving the quality of the environment will affect the growth of the economy negatively.

Since the results of the study are based on the time series, it is important to test whether the results are affected by serial correlation in the data sets. To investigate whether error terms of the past in each variable data set transfer to future period, two accepted tests of serial correlation such as Portmanteau serial correlation tests and LM serial correlation tests are applied and results are reported in Table 8. Since the current study selected 2 optimal lag order, the focus is to check for any possible serial correlation beyond lag 2. The Q statistic of the Portmanteau test and LM statistic of LM test are not statistically significant in both low oil importing countries and high oil importing countries beyond lag 2. This leads to the rejection of the null hypothesis that there is serial correction at higher lag order than the optimal lag order of the study. Hence the model is not affected by serial correlation and the VECM results are reliable.

Table 8

VEC Residual Serial Correlation Tests

Test	Lags	Low Net Oil importing Countries		High Net Oil importing Countries	
		Q-Stat/LM Stat	Prob.	Q-Stat/LM Stat	Prob.
Portmanteau Tests	1	0.660899	NA*	0.357720	NA*
	2	3.426295	NA*	0.987591	NA*
	3	15.92378	0.3871	12.31249	0.6552
	4	32.70383	0.1105	25.14332	0.3980
LM Tests	1	19.82069	0.0191	9.029181	0.4346
	2	23.50618	0.0052	5.645103	0.7748
	3	13.77608	0.1305	13.27698	0.1505
	4	18.40263	0.0308	14.74965	0.0980

*The test is valid only for lags larger than the VAR lag order.

6.4. Variance Decomposition

Subsequent to analysing the short run and long-run dynamics, the paper proceeded to apply the variance decomposition technique to the VAR system to measure the predicted changes in the given variable for the innovations or shocks in each of the regressors over a time path beyond the selected time period. The results of the variance decomposition are presented in Table 9 and Table 10 for low oil importing countries and high oil importing countries, respectively. The results appear to be uniform across both the groups of countries. The innovative shocks of energy consumption and carbon emissions do not appear to contribute to economic well-being. The changes in economic growth are defined by its own shocks in the given time path that are linked to various exogenous factors. The theoretical argument of

increasing energy consumption due to industrialisation, mechanisation, improved transportation and increased economic activities shall contribute to economic growth has not found supporting evidences. Innovative shocks of GDP explain 36% and 21% changes in the energy consumption of low net oil importing countries and high net oil importing countries, respectively. The explanatory power of GDP on EC remains stronger throughout from the time path of period 1 to period 10. The increased income of the people seems to induce more usage of automobiles, electric and electronic equipment at the household level and increased economic activities at the macro level, causing more consumption of energy. Interestingly, changes in energy consumption do not appear to be influenced by the shocks of carbon emissions. This contradicts with the outcome of some of the past studies, which argue that there is a significant flow of relationship from carbon emissions to energy consumption. The argument that increasing environmental pollution forces countries to reduce energy consumption is not validated in the case of either high net oil importing countries or low net oil importing countries.

Regardless of the level of net oil imports, innovative shocks of GDP and EC contribute to carbon emissions. The contribution of GDP to CO2 seems to be increasing as we move on in the time path from period 1 (short term) to period 10 (long term). In the long run, a shock in GDP is predicted to define 24% and 37% of changes in carbon emissions in low net oil importing countries and high net oil importing countries, respectively. Further, CO2 also depends heavily on the shocks of energy consumption. Innovative shocks stemming in energy consumption is predicted to contribute to carbon emissions by 53% and 44% in low net oil importing countries and high oil importing countries, respectively.

Table 9

Results of Variance Decompositions: Low Oil importing Countries

Period	SE.	$lnGDP_{it}$	$lnEC_{it}$	$lnCO2_{it}$
Variance Decomposition of $lnGDP_{it}$:				
1	424.9227	100.0000	0.000000	0.000000
4	1110.278	99.14993	0.019637	0.830437
7	1521.347	98.69163	0.038938	1.269429
10	1867.055	98.65588	0.031536	1.312586
Variance Decomposition of $lnEC_{it}$:				
1	93.68118	39.42447	60.57553	0.000000
4	199.8169	39.69283	57.56847	2.738698
7	257.5964	37.92656	58.15114	3.922305
10	302.7693	36.62524	58.85609	4.518667
Variance Decomposition of $lnCO2_{it}$:				
1	0.285248	38.59929	48.30788	13.09284
4	0.605804	43.02212	51.11776	5.860118
7	0.779357	42.68004	52.67464	4.645323
10	0.912115	41.86120	53.98635	4.152445

Table 10

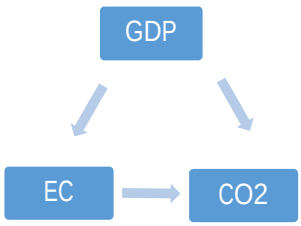
Results of Variance Decompositions: High Oil importing Countries

Period	SE.	$lnGDP_{it}$	$lnEC_{it}$	$lnCO2_{it}$
Variance Decomposition of $lnGDP_{it}$:				
1	647.0502	100.0000	0.000000	0.000000
4	1823.814	99.89028	0.022443	0.087280
7	2575.563	99.82472	0.062708	0.112572
10	3124.695	99.75724	0.124813	0.117943
Variance Decomposition of $lnEC_{it}$:				
1	109.2716	14.31004	85.68996	0.000000
4	220.7022	24.08636	75.73566	0.177978
7	296.7818	24.08560	75.81189	0.102508
10	358.4794	21.19152	78.73327	0.075206
Variance Decomposition of $lnCO2_{it}$:				
1	0.327998	18.45833	49.76449	31.77718
4	0.688084	28.26668	41.51276	30.22056
7	0.909971	26.95764	42.36541	30.67694
10	1.082698	24.41986	44.99684	30.58330

From the analysis of variance decompositions, it is found that there is no feedback effect between EC and GDP. However, GDP, EC and CO2 are found strongly interlinked. The flow of relationship between the variables as found from variance decompositions in both the groups of countries could be presented as in Figure 1. This indicates that the relationship flows from GDP to energy consumption and GDP and EC to CO2. The results of variance decompositions are consistent with findings of VECM with minor discrepancies.

Figure 1

Flow of relationship between GDP, EC and CO2



Though the direction of flow of relationship between GDP, EC and CO2 is the same in low net oil importing countries and high net oil importing countries, the magnitude of the relationship differs between the two groups of countries. In low net oil importing countries, shocks of energy consumption contribute 53 percent to the carbon emissions, whereas it is 44 percent in high net oil importing countries. The countries having a high dependency on the net imported oil are spending Forex heavily on import payments and hence are likely to be more responsible and judicious in using the energy. This might cause lower emissions

unlike the countries having a lower dependency on imported oil. Abundant availability of energy domestically at highly affordable price might cause irrational and substantial usage of the energy leading to high carbon emissions. Shocks in GDP though impact EC in both the groups of countries, it is more pronounced in low oil importing countries. In low net oil importing countries, 36 percent of changes in EC is due to the shocks of GDP, while it is only 21 percent in high net oil importing countries. Hence energy consumption in low net oil importing countries is more vulnerable to shocks of GDP. This is because many of these countries such as China, India, Brazil and Argentina are emerging economies, and increased GDP is seen deployed for further economic projects that in turn push demand for more energy. On the other hand, since the economies are not highly developed, the capabilities of the people and industry to absorb recession and slowdown is week, energy consumption gets affected. Whereas, high net oil importing countries such as Korea Republic, Japan, Italy, Spain are basically developed economies that have reached optimal growth and any rise in GDP does not incentivise them to venture with new economic engagements and hence energy consumption remains stagnant despite economic growth.

7. Conclusion and Policy Implications

Unlike many of the past studies, carbon emission has been included to the model that examines the dynamics of the relationship between economic growth and energy consumption. The results reveal that carbon emission is an important factor in the interlinkage between economic growth and energy consumption. The economic well-being of the net oil importing countries is found inducing their energy consumption. Further, it is also noticed from the results that higher economic well-being and increased energy consumption cause damages to the environment. This implies that carbon emission increases with an increase in economic growth and energy consumption. Further, though this trend is visible in both the groups of countries, the magnitude of linkage between economic growth, energy consumption and carbon emissions is more pronounced in the panel of low oil importing countries such as UK, India, Brazil, the USA, Argentina and China. In other words, in these countries the sensitivity of: i) energy consumption to the fluctuations in GDP and ii) carbon emissions to changes in energy consumption and economic growth – is higher than high oil importing countries of Korea Republic, Japan, Italy, Spain, Hong Kong and Greece.

The study explores a uni-directional causal relationship running from economic growth to energy consumption. As no causality is found running from energy consumption to economic growth in oil importing countries, the highly debated feedback hypothesis cannot be accepted in this case. Rather, the results of the study support the case of the conservation hypothesis regardless of the level of oil import dependency of the countries.

In summary, energy consumption and economic growth are detected to be the main drivers of carbon emissions in net oil importing countries in general, and high oil importing countries in particular. Further, it is also evident that the economic growth of the net oil importing countries neither depends on energy consumption nor on carbon emissions. Hence, energy conservation policies, measures of environmental protection and regulations on emissions do not negatively impact the growth of the oil importing economies. High net oil importing

countries amongst all net oil importing countries, are suggested to pursue a low carbon economy through adopting sustainable development strategies, with no compromise on the economic well-being. Thus, the study proposes to improve and rationalise energy consumption structure, develop renewable energy, design and use energy-efficient technologies and machines, improve industrial efficiency and increase forest cover up to 33 percent of the total geographical area of the nation. Appropriate policies governing these areas will not only improve energy efficiency and energy saving but also curb carbon emission. Overall, it is suggested that all growth related polices in the sectors of construction and infrastructure, industries and energy need to target at emission reduction.

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ANNEXURES

Annexure 1

Trends in EC, GDP and CO2 in Low Net Oil importing Countries

Country	Year	EC	Decadal Growth (%)	GDP	Decadal Growth (%)	CO2	Decadal Growth (%)
UK	1971	3733.28		18281.72		11.82	
	1981	3415.38	-8.52	21453.85	17.35	9.96	-15.80
	1991	3707.95	8.57	27992.39	30.48	9.87	-0.85
	2001	3784.93	2.08	36592.81	30.72	9.23	-6.46
	2011	2972.15	-21.47	39731.42	8.58	7.08	-23.33
	2014	2776.84	-6.57	41369.80	4.12	6.50	-8.22
India	1971	267.35	-90.37	393.53	-99.05	0.36	-94.42
	1981	293.74	9.87	438.01	11.30	0.47	30.65
	1991	357.37	21.66	575.50	31.39	0.74	55.91
	2001	416.01	16.41	851.62	47.98	0.97	31.15
	2011	577.99	38.94	1410.43	65.62	1.47	52.10
	2014	636.57	10.13	1640.18	16.29	1.73	17.28
Brazil	1971	715.84	12.45	5108.40	211.45	1.05	-39.06
	1981	883.88	23.47	7796.85	52.63	1.39	32.06
	1991	942.04	6.58	7963.11	2.13	1.45	4.02
	2001	1076.28	14.25	8804.33	10.56	1.90	31.67
	2011	1367.19	27.03	11627.81	32.07	2.22	16.83
	2014	1495.54	9.39	11951.21	2.78	2.61	17.45
Argentina	1971	1387.01	-7.26	7368.08	-38.35	3.67	40.31
	1981	1440.78	3.88	7380.67	0.17	3.60	-1.78
	1991	1435.48	-0.37	6721.28	-8.93	3.54	-1.69
	2001	1570.90	9.43	7776.14	15.69	3.59	1.34
	2011	1952.05	24.26	10883.32	39.96	4.64	29.47
	2014	2029.92	3.99	10398.69	-4.45	4.78	2.95
USA	1971	7644.52	276.59	23670.35	127.63	20.98	338.78
	1981	7647.54	0.04	29028.90	22.64	19.77	-5.78
	1991	7631.47	-0.21	35542.14	22.44	19.06	-3.59
	2001	7827.89	2.57	44728.60	25.85	19.64	3.05
	2011	7030.03	-10.19	48862.42	9.24	16.98	-13.54
	2014	6960.68	-0.99	51015.14	4.41	16.50	-2.79
China	1971	464.93	-93.32	238.43	-99.53	1.04	-93.68
	1981	597.15	28.44	360.43	51.17	1.46	40.12
	1991	736.85	23.40	786.13	118.11	2.23	52.66
	2001	928.81	26.05	1901.41	141.87	2.74	23.00
	2011	2086.49	124.64	4961.23	160.92	7.24	164.08
	2014	2236.73	7.20	6096.49	22.88	7.54	4.18

Annexure 2

Trends in EC, GDP and CO2 in High Net Oil importing Countries

Country	Year	EC	Decadal Growth (%)	GDP	Decadal Growth (%)	CO2	Decadal Growth (%)
Korea Republic	1971	516.11		1965.64		1.78	
	1981	1046.41	102.75	3904.13	98.62	3.61	102.44
	1991	2306.64	120.43	9249.39	136.91	6.04	67.36
	2001	4033.32	74.86	15667.38	69.39	9.50	57.36
	2011	5216.59	29.34	22724.71	45.04	11.80	24.19
	2014	5289.28	1.39	24323.57	7.04	11.57	-1.97
Japan	1971	2531.09	-52.15	19328.01	-20.54	7.55	-34.79
	1981	2864.37	13.17	26744.56	38.37	7.90	4.72
	1991	3575.25	24.82	39253.64	46.77	8.87	12.28
	2001	4008.27	12.11	42239.18	7.61	9.46	6.68
	2011	3610.81	-9.92	44538.73	5.44	9.32	-1.55
	2014	3470.76	-3.88	46484.16	4.37	9.54	2.37
Italy	1971	1949.15	-43.84	17908.89	-61.47	5.76	-39.59
	1981	2265.93	16.25	24652.54	37.66	6.69	16.11
	1991	2645.67	16.76	31324.53	27.06	7.47	11.63
	2001	3020.62	14.17	37017.37	18.17	7.90	5.84
	2011	2828.40	-6.36	36192.87	-2.23	6.70	-15.21
	2014	2414.48	-14.63	33666.69	-6.98	5.27	-21.36
Spain	1971	1244.90	-48.44	14032.81	-58.32	3.76	-28.67
	1981	1820.10	46.20	17331.07	23.50	5.49	46.01
	1991	2397.71	31.74	23027.25	32.87	5.79	5.48
	2001	3060.88	27.66	29321.89	27.34	7.29	25.91
	2011	2689.68	-12.13	30147.00	2.81	5.79	-20.61
	2014	2464.64	-8.37	29398.61	-2.48	5.03	-13.03
Hong Kong	1971	741.96	-69.90	6086.24	-79.30	2.26	-55.02
	1981	995.04	34.11	11448.78	88.11	3.61	59.24
	1991	1554.12	56.19	19132.40	67.11	4.98	38.08
	2001	2109.68	35.75	22975.10	20.08	5.65	13.54
	2011	2087.21	-1.07	33888.50	47.50	6.19	9.55
	2014	1970.48	-5.59	35717.69	5.40	6.39	3.24
Greece	1971	984.04	-50.06	14379.90	-59.74	3.15	-50.74
	1981	1505.28	52.97	18677.48	29.89	5.21	65.52
	1991	2094.62	39.15	19746.38	5.72	7.18	37.66
	2001	2578.11	23.08	24111.42	22.11	8.64	20.34
	2011	2407.76	-6.61	24495.71	1.59	7.19	-16.75
	2014	2123.90	-11.79	22565.68	-7.88	6.18	-14.04

Annexure 3

Descriptive Statistics

Particulars	Low Net Oil importing Countries			High Net Oil importing Countries		
	In $CO2_{it}$	*In* EC_{it}	*In* GDP_{it}	*In* $CO2_{it}$	*In* EC_{it}	*In* GDP_{it}
Mean	1.279602	7.352188	8.706647	1.839872	7.709000	9.921251
Median	1.279177	7.265925	8.983869	1.880500	7.780677	10.02302
Maximum	3.113986	9.040548	10.83988	2.468351	8.573437	10.74687
Minimum	-1.014649	5.588404	5.474060	0.578078	6.246321	7.583573
Std. Dev.	1.131120	1.010450	1.601965	0.364241	0.456876	0.619564
Skewness	-0.008484	0.135269	-0.512246	-1.087464	-0.71235	-1.565471
Kurtosis	2.003800	2.005371	1.999889	4.262991	3.371814	5.702785
Jarque-Bera	10.91973	11.68725	22.54787	69.58003	23.84835	188.1862
Probability	0.004254*	0.002898*	0.000013*	0.000000*	0.000007*	0.000000*
Sum	337.8148	1940.978	2298.555	485.7263	2035.176	2619.210
Sum Sq. Dev.	336.4909	268.5252	674.9345	34.89263	54.89755	100.9552
Observations	264	264	264	264	264	264

*p < 0.01

Annexure 4

VAR Lag Order Selection Criteria

Group	Lag	LogL	*Criteria*				
			LR	FPE	AIC	SC	HQ
Low Net Oil importing Countries	0	-4920.72	NA	1.32e+14	41.03098	41.07449	41.04851
	1	-2968.09	3840.164	12243143	24.83410	25.00813	24.90422
	2	-2941.27	52.08802*	10553449*	24.68554*	24.99010*	24.80826*
	3	-2934.11	13.70752	10718272	24.70095	25.13603	24.87625
	4	-2929.6	8.539178	11128463	24.73833	25.30393	24.96623
High Net Oil importing Countries	0	-4727.72	NA	2.65e+13	39.42267	39.46618	39.44020
	1	-3299.81	2808.227	1.94e+08	27.59841	27.77244	27.66853
	2	-3271	55.93088	1.65e+08	27.43336	27.73791*	27.55607*
	3	-3260.41	20.30672*	1.63e+08*	27.42007*	27.85515	27.59537
	4	-3253.02	13.98568	1.65e+08	27.43346	27.99906	27.66135

* indicates lag order selected by the criterion

ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

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Teodora Peneva[1]

GREEN DEAL'S IMPACT ON ENERGY POVERTY IN BULGARIA[2]

With no definition of energy poverty in Bulgaria and with obligations for decentralisation and decarbonisation of the energy sector, our country is entering a period of new commitments related to the Green Deal. What measures will the government take for these purposes in the households' sector, and how will this affect energy poverty levels? Will the measures have a significant effect on reducing energy poverty levels and take us out of the top position for this indicator in the EU? The article attempts to answer these questions by assessing the impact of a set of policies to reduce energy poverty among households, using anonymous data on energy income and expenditure from the 2017 Survey of Household Budget Surveys with a sample of 2950 households.
Keywords: green deal; policies; energy poverty
JEL: I32; I38; P36; P46; P48

Introduction

The Green Deal set new targets for the governments of the EU member states at the end of 2019, and required specific action plans with investments in Renewable Energy Sources (RES). By signing the agreement, the member states commit to develop and adopt a number of long-term strategic documents to ensure the achievement of the goals of the Green Deal for decarbonisation, decentralisation, democratisation, justice, etc. Among the most important documents concerning energy poverty is the "*Long-term national strategy for supporting the renovation of the national building stock of residential and non-residential buildings until 2050*", published for public discussion in July 2020.[3] The strategy plans an investment of nearly BGN 23 billion for the renovation of 46% of the living area of inhabited residential buildings in Bulgaria by 2050, which is part of a total investments of BGN 27 billion for all buildings in the country, including municipal and business. The strategy identifies 10 types of package measures varying according to the energy class of multi-family buildings and 11

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[2] This paper should be cited as: *Peneva, T. (2021). Green Deal's Impact on Energy Poverty in Bulgaria. – Economic Studies (Ikonomicheski Izsledvania), 30 (6), p. 90-105.*
[3] Long-term national strategy to support the renovation of the national building stock of residential and non-residential buildings until 2050, http://www.strategy.bg/PublicConsultations/View.aspx?lang=bg-BG&Id=5315.

packages for single-family houses, and estimates the cost per square meter for each of the packages. The strategy also shows the results of previous government programs to renovate the country's housing stock.

On this basis, the author uses anomised data on household income and energy expenditure for 2017 to estimate the effect on energy poverty of individual groups of households living in single-family houses and multi-family buildings, considering only a reduction in energy consumption. Possible factors with a strong impact on energy poverty, such as income, household structure, etc., are not considered.

The aim of the study is to evaluate the effect of a set of policies from the green deal on energy poverty in single-family and multi-family houses and apartments in multi-family buildings.

Subject: Energy poverty in the country before and after the measures.

Object: 2950 households from the survey "Monitoring of household budgets" conducted by the NSI in 2017 divided into three groups – living in single-family, multi-family houses and apartments in multi-family buildings.

Tasks:

- To review energy poverty policies and new strategic guidelines.
- to analyse the specifics of households by types of buildings, in order to better assess the impact of policies.
- to calculate the effect of policies on energy poverty among the target groups.

Methods:

- Statistical analysis of anomized data on income and energy expenditure of 2960 households participating in the NSI survey.
- 4 types of definitions of energy poverty are applied: 1) **10% rule**: a household is energy poor if its energy expenditure exceeds 10% of net total income; 2) **Poverty after energy expenditure** measures households with net total income after expenditure for energy below the official poverty line; 3) **Low income** – **high cost-share** (LI-HCS) – households with net total income after energy expenditure below the poverty line and share of energy expenditure above 10%; 4) **Low income** – **high cost** (LI-HC) – households with net total income below the poverty line and energy expenditure above the median for the country. The poverty line for the three definitions is BGN 5,222 for 2017.
- The effect of an average statistical package of measures defined in the long-term national strategy for renovation of the building stock of Bulgaria for single-family and multi-family houses is calculated on the basis of expenditure per unit area and a number of households out of energy poverty. Three variants of measures are considered – for multi-family buildings, for single-family houses, and for households with disposable income below the official poverty line.

1. Changes in Energy Poverty Policies in Bulgaria

1.1. Energy poverty policies before the Green Deal

One of the biggest problems in the understanding of society and government officials is the intertwining of the term "vulnerable consumers"[4], which is officially defined in the Energy Act §1, item 66 (Ministry of Energy, 2016), with the terms "energy poor" and "socially weak". Each of these concepts is different, and by the end of 2020 **there is no official definition of energy-poor households in Bulgaria**. Energy poverty policies have changed little in the years before the Green Deal, with the following being in place:

- **Ordinance № 5** providing heating allowance in operation since 1995, the only instrument for social protection linked to inflation, reflecting the increase in energy prices annually, covering 252,615 persons and families in the 2019/2020 season (about 3% of the population). Until 2007, the aid was determined on the basis of 450 kWh for heating per room, which is reduced to 385 kWh in 2008 and increased to 500 kWh per month in 2019. For the 2019/2020 season, this amount is equal to BGN 93.18 per month, or BGN 465.90 per season, or BGN 495.8 for the current 2020/2021 season.
- **Program "Support for energy efficiency in multi-family residential buildings"**[5] of the Operational Program "Regional Development" (2007-2013) with a total budget of BGN 500 million, with renovated 155 buildings with 2,184 homes for the period 2007-2013.
- **National Program for Energy Efficiency of Multi-family Residential Buildings (2015-2020)**[6] with a total budget of BGN 1 billion with renovated 2,022 buildings and 147,761 dwellings with a total area of 11,525,389 m^2 and expected savings of 975,226 MWh /year of energy and 319 $ktCO^2$ /year of greenhouse gases.
- "Improving Ambient Air Quality"[7] Program of the Operational Program "Environment 2014-2020", including replacement of old solid fuel stoves (15,000 in Sofia for BGN 44.5 million[8]), Life+ program for stoves replacement in Sofia), Vidin (1600 families of BGN 3,000[9] each), and 26 other identified municipalities with a requirement to replace solid fuel stoves by 2021 in order to reduce pollution with fine dust particles and fulfil the World Bank requirements (Nikolov, 2018).
- Other programs and projects for reducing energy poverty, with local scope: **REACH, POVERTY, REPLACE, IDEA, etc.**

These policies are characterised by their partial effect on energy poverty. Ordinance №5 of 1995, for example, serves the lowest-income 7% of the population (just over 500,000 people), and has a much smaller coverage than the population living below the poverty line (fluctuating by 2 percentage points around an average level of 22% for the period 2007-

[4] Households in the market placed at a disadvantage in terms of product purchase. This is an artificial category designed to set out a group of consumers, representing an explicit 'minority' of society, to be granted a minimum free access to energy resources for a limited period of time in order to reduce the number of energy supply disruptions.

[5] Report of the program "Support for energy efficiency in multifamily residential buildings", http://www.bgregio.eu/op-regionalno-razvitie/izpalnenie-na-oprr-2007-2013.aspx.

[6] National program for energy efficiency of multifamily residential buildings, https://www.mrrb.bg/bg/energijna-efektivnost/nacionalna-programa-za-ee-na-mnogofamilni-jilistni-sgradi/.

[7] National Program for Improving Atmospheric Air Quality (2018-2024), http://www.strategy.bg/StrategicDocuments/View.aspx?lang=bg-BG&Id=1288.

[8] https://www.segabg.com/node/147530.

[9] All solid fuel stoves replaced by 2021, 24chasa.bg https://www.24chasa.bg/novini/article/7075387.

2019). The effectiveness of this type of aid is weak, it meets short-term needs, and it does not have the capacity to reduce energy poverty in the long run, which is not the goal of the program. Energy efficiency programs are long-term, but target the entire population, and do not have an income criterion, as buildings are usually inhabited by families with different types of income. The last largest program renovated only 3% of the multi-family homes in the country (2,022 buildings out of 66,865 inhabited buildings). The „Improving the Ambient Air Quality" Program aims to reduce fine dust particles, and although it is aimed at poor households, its aim is to improve air quality, with a lack of ex-post follow-up control over the use of replaced stoves.

The effect of the above policies is weak, the scope is small, and the real energy poverty, measured by officially recognised methodologies in the world, increased in the period 2014-2017, despite the subjective measures of Eurostat (Peneva, 2019, p. 174-182) described in the long-term strategy. According to these measures, energy poverty in Bulgaria fell sharply from 67% in 2010 to 46% in 2011 and a gradual decline in the remaining few years to 30.1% in 2019, without significant changes in research methodology (Peneva, 2020, p. 43).

1.2. Energy poverty policies set out in the Green Deal

The European Commission envisages that 458 million euros of the European budget will be set aside for Bulgaria between 2021-2027 to help it make the transition to a cleaner economy (Dimitrova, 2020).

With the adoption of the Green Deal, EU Member States are committed to developing long-term strategies and drawing up roadmaps for housing renovation and energy savings in every sector, including buildings. One of the leading programs of the Green Deal is "Buildings renovation", with the aim of doubling or tripling the level of renovation of the buildings, which at the time of adoption of the document is about 1% (for all buildings).[10]

To develop the strategy, there is a specific document – Commission Recommendation (EU) on the renovation of buildings.[11] In the section "Review of policies to increase the efficiency of the building stock", monitoring is required in several aspects, as the following indicators of energy poverty are: 1) percentage of people affected by energy poverty; 2) share of household disposable income spent for energy; 3) arrears on utility bills; 4) population living in inadequate housing conditions (leaking roof, for example) or insufficient heating and cooling.[12] However, the Bulgarian government chooses subjective Eurostat criteria that are inadequate for the situation in the country (Peneva, 2020, p. 43). The share of disposable

[10] The European Green Pact. Communication from the Commission. COM (2019) 640. Brussels. 12/11/2019, https://eur-lex.europa.eu/legal-content/BG/TXT/HTML/?uri=CELEX:52019DC0640&from=EN.

[11] Commission Recommendation (EU) 2019/786 – of 8 May 2019 – on the refurbishment of buildings – (notified under document number C (2019) 3352) (europa.eu) https://eur-lex.europa.eu/legal- content / BG / TXT / PDF /? uri = CELEX: 32019H0786 & from = DE.

[12] Commission Recommendation (EU) 2019/786 on the renovation of buildings, https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:32019H0786&from=DE.

income is not considered on its own, and the percentage of people affected by energy poverty is much higher than Eurostat's subjective measurement.

On July 10, 2020, Bulgaria published a draft "Long-term national strategy to support the renovation of the national building stock of residential and non-residential buildings until 2050"[13] (hereinafter "the Strategy"), which outlines the main steps, types of measures by type of building and energy class, financial instruments and scope of individual programs for the renovation of the building stock. The set goals for achievement are shown on Table 1.

Table 1

Indicators for milestones for the renovation of residential buildings

		2021-2030	2031-2040	2041-2050
Saved energy	GWh	2477	5694	6294
Renovated area	**m^2**	**19 026 656**	**43 735 175**	**48 343 297**
Emissions savings CO^2	tonne	1065184	2448461	2706441
Share of total area (%)		**7.9**	**18.2**	**20.1**

Source: The Strategy.

More than 95% of the total number of year-round inhabited buildings in Bulgaria are single-family houses, with a usable area of less than 49% of the total. The share is calculated on the basis of data in the strategy for year-round residential buildings, 2011 (Table 2).

Table 2

Year-round occupied residential buildings, 2011

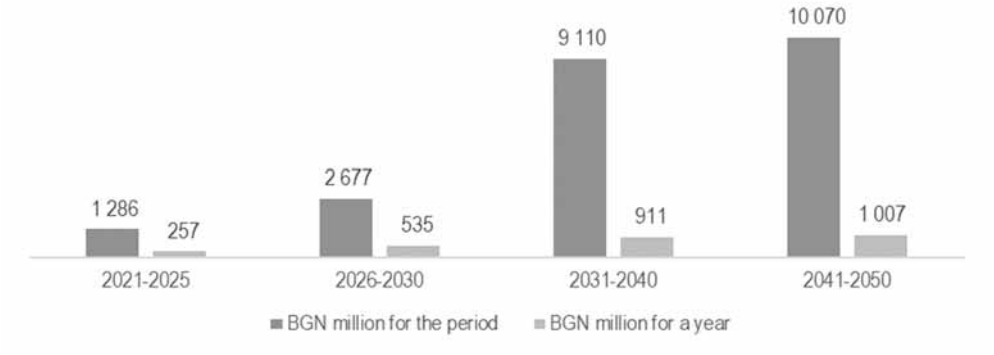
	Buildings Number	Area, sq.m м2	Number of dwellings
Single-family houses	1 291 549	118 300 032	1 490 460
Multifamily buildings	66 865	117 158 877	1 640 120
Mixed type buildings	6 465	4 052 585	53 838
Dormitories	1 019	1 103 153	20 157
Total	**1 365 898**	**240 614 647**	**3 204 575**

Source: The Strategy.

According to the national strategy for the renovation of the building stock in Bulgaria by 2050, the state will invest BGN 27 billion for the renovation of 60% of private homes and 17% of public buildings such as hospitals, kindergartens and ministries. In the first five years of the period, namely in 2021-2025, the state will invest BGN 1.5 billion, and in the next 5 years – BGN 3 billion. In the decade after 2030, investments will increase to 10.5 billion, and in the next – up to BGN 11.7 billion.

[13] Long-term national strategy to support the renovation of the national building stock of residential and non-residential buildings until 2050, http://www.strategy.bg/PublicConsultations/View.aspx?lang=bg-BG&Id=5315.

Figure 1
Necessary investments for the renovation of residential buildings 2021-2050



Source: The Strategy.

At the end of October, the government published a National Plan for Reconstruction and Sustainability, in which BGN 1.6 billion are planned for renovation of buildings in the period 2021-2023, as over BGN 1.5 billion are provided for residential buildings, of which over 90% for multi-family. A total of BGN 103 million of this money will be for the renovation of single-family houses (Tsvetkov, 2020). As it is difficult to predict in what percentage the single-family and multi-family buildings will be financed, in the present study, the effect is calculated alone for each group separately, with the most desired 100% scope of measures for all households in the country.

2. Empirical Analysis

2.1. Methodology

The analysis of household income and expenditure data in a sample of 2950 households is made using only the following indicators:

- Net total income (only this type of income is commented everywhere in the analysis)
- Energy consumption
- Number of household members
- Age of members
- Type of building

Four types of energy poverty indicators are applied: 1) 10% rule: a household is energy poor if its energy expenditure exceeds 10% of net total income; 2) Poverty after energy expenditure measures households with net total income after energy expenditure below the official poverty line; 3) Low income – high cost share (LI-HCS) – households with net total

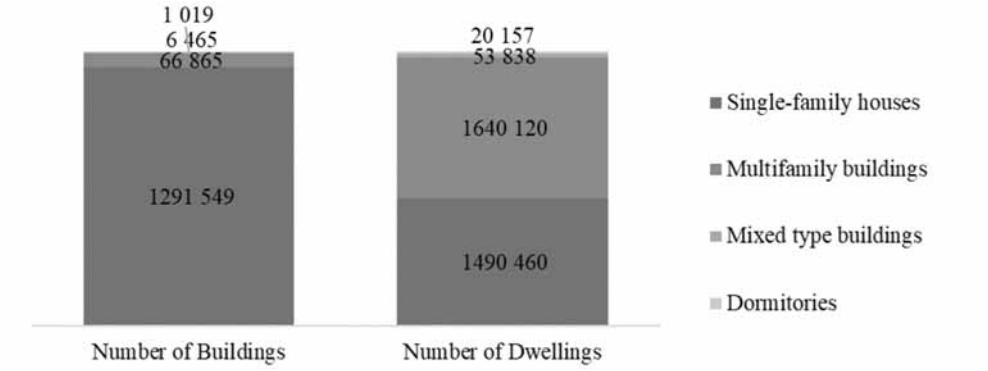
income after energy expenditure below the poverty line and share of energy expenditure above 10%; 4) Low income – high cost (LI-HC) – households with net total income below the poverty line and energy expenditure above the median for the country. The poverty line for the three definitions is BGN 5.222 for 2017. The medians of each measure are recalculated, and are applied to each indicator with expenditure thresholds.

2.2. Specifics of energy poverty by type of buildings

According to data from the long-term strategy, 1.29 million single-family homes have 1.49 million dwellings (47% of the total), and 66,865 multi-family houses have 1.64 million dwellings (51% of the total number) and about 2% of the dwellings are in mixed type buildings.

Figure 2

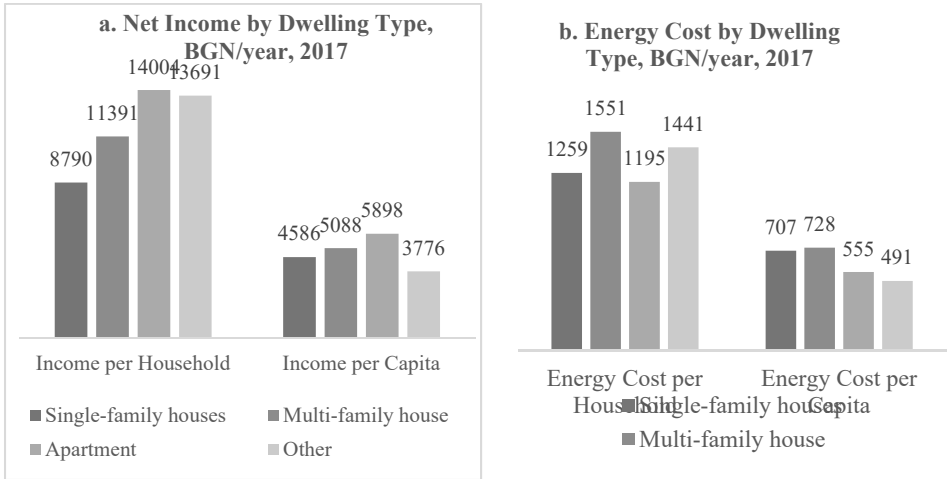
Distribution of buildings, dwellings, population by type of buildings, 2011

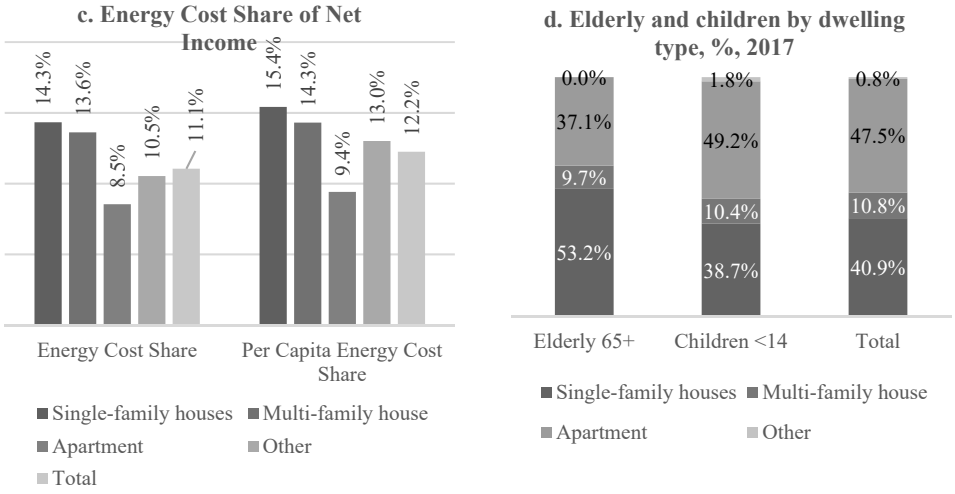


Source: The Strategy.

Figure 3

Income, expenditure and structure of households by type of building



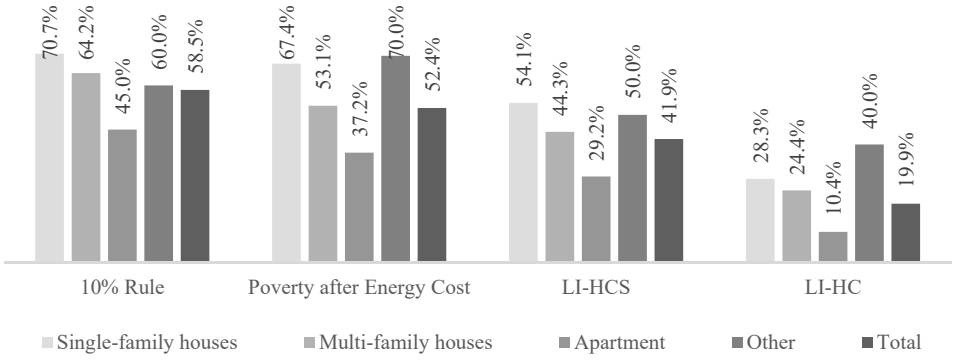


Source: Calculations with anomized data from the NSI.

The data show that people living in detached houses are mostly energy-poor, have lower incomes, afford lower energy costs, and at the same time, the share of total income expenditures is much higher than the average for all households in the sample of 11.1%, and over 53% of those living there are over 65 years of age.

Figure 4

Energy-poor households by dwelling type, 2017



Source: Calculations with anomised data from the NSI

The data clearly show the difference in energy poverty by type of building, with **energy poverty predominating in detached houses**, reaching the highest levels by all definitions, covering as much as 25% more households than in apartments according to the 10% Rule and the Low Income – High-Cost Share Definition, and over 30% according to the definition of poverty after energy consumption. According to the definition of Low Income – High

Cost, there are 2.8 times more energy-poor households in houses than in apartments, but this indicator is unsuitable for application in Bulgarian conditions, as the only thing that shows is that there are households with income below the poverty line, which have an energy consumption above the median for the country. This type of consumption is not typical for Bulgarians, and therefore the range of energy-poor in this indicator is very limited in our country.

It should be noted that in the NSI sample, there are about 10% living in "other" type of buildings, which are characterised by a much higher number of household members, with more children and almost no adults. Given that the sample is nationally representative and updated annually, they should be leading.

2.3. Effect of programs by type of buildings

Multi-family buildings

According to data from the Strategy, multi-family homes in our country, inhabited year-round, account for 1.64 million dwellings, in 66,865 buildings. In this type of buildings, according to anomised data from the NSI from 2017, live 47% of the population and nearly 50% of children under 14. They are characterised by slightly higher incomes, as they are located mainly in large cities with better-developed economy, and a lower share of energy expenditure in net total income, relatively lower levels of energy poverty. About 37.2% of households fall below the poverty line of BGN 5.222 per year, after energy consumption, against the background of 52.4% for the whole population and 67.4% in single-family homes.

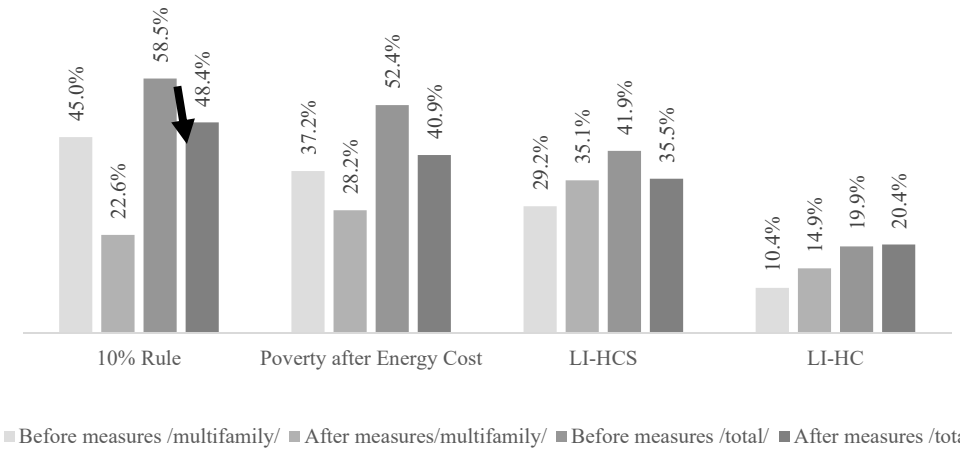
Data of the Sustainable Energy Development Agency on the effect of the renovation of residential buildings from the largest national program conducted from 2015 to 2020 show that for buildings up to classes B the average monthly cost of housing with an average heating area of 65 m^2 falls from 156 BGN to BGN 107. This is according to calculations from the surveys of buildings, which also show that the largest share are class E buildings (40.5%), followed by class F (35.3%) and class G (16.1%).

A survey of the Ministry of Regional Development among households in renovated buildings from 2017 shows that nearly 60% of the respondents believe that the bills have decreased significantly, 26.6% not significantly, and the rest that there is no change in the bills. The report expects that the renovation of a building can result in a reduction in the average monthly cost of BGN 48.74. for 5.5 winter months during the year, or for BGN 268.07 per year.

Features in some parameters of the model:

The median energy expenditure changes in the formulas for energy poverty, falling from BGN 990 in 2017 to BGN 915 after deducting BGN 268.07 from the annual energy expenditure of households living in multi-family buildings. About 14 households remain with an expenditure of BGN 0, these are households that had an expenditure below this amount.

Figure 5
Energy-poor households before and after lowering energy consumption in multi-family buildings, 2017



Source: Calculations with anomised data from the NSI.

Specifications of the model are that the cost of all residents in multi-family buildings has been reduced by BGN 268, which is 17% of the total cost for the segment, but for some low-income households, it is much higher percentage. This is considered to be the more adequate way to reduce expenditure with the BGN equivalent rather than in percentage terms, as it is possible to make inaccuracies in high-cost households.

The results show that a reduction of BGN 268 of the annual expenditure of all multi-family buildings in Bulgaria would reduce energy poverty by 10% under the 10% rule and by 9% in poverty line calculations after energy expenditure, as the percentage of energy-poor households in multi-family buildings, it will fall by 23% from 45% to 22.6%, where the expenditure will exceed 10% of the net total household income.

The result after decreasing energy cost in the last two definitions, which measure only the population below the official poverty line, is interesting. In the first case, with a share of expenditures above 10%, and in the other with expenditures above the median. According to these definitions, after the decrease in energy cost, poverty increases! This is a paradoxical result, which shows clearly **how inadequate these definitions are for Bulgaria**.[14] This is because after deducting BGN 268 from the expenses of all multi-family houses, the median expenditure falls, which automatically brings households with higher energy cost above the

[14] All definitions for energy poverty in the UK and Western Europe do not use the actual energy consumption, but a modelled cost – the necessary cost for the given housing characteristics and features of the household, which is made on the basis of an annual survey. In Bulgaria this cost is not developed. The author believes that the current cost in Bulgaria is much lower than the required to maintain comfort of 21^0C in winter (according to WHO requirements).

threshold and turns them into energy poor, without actually changing the situation in any way.

The fact that the strategy envisages renovation of no more than 46% of the buildings by 2050 is not considered here either. All these calculations are based on a total renovation of 100% of the multi-family buildings. This means that only half of these results are achievable with measures for half of the multi-family buildings within the intended investment of BGN 23 billion.

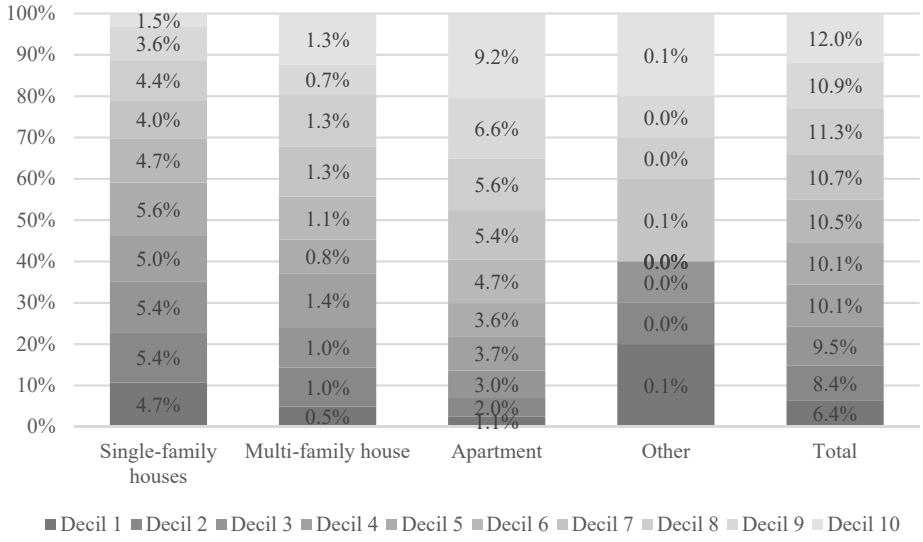
Single-family houses

Single-family homes are inhabited by about 40.9% of the population, over 53% of the elderly over 65, and in most cases, low-income families. Energy poverty in this segment is extremely high, over 70% of households spend more than 10% of their income on energy, and the average share of their expenditure on energy alone exceeds 14.3% of the net income in 2017. These are nearly 1.49 million buildings.

The following graph shows the distribution of decile groups in different buildings, to understand more clearly the income difference of each segment.

Figure 6

Percentage of households by decile group and type of building, 2017



Source: Calculations with anomised data from the NSI.

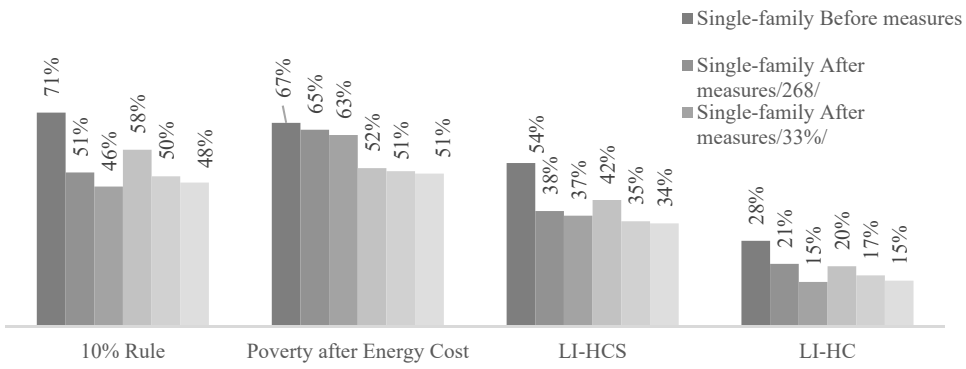
In the case of single-family houses, the question is with what percentage or amount of the cost to be deducted, as there has been no national program so far or a reputable institution to release official data on the effect on heating bills after renovation. A decrease in the energy bill by BGN 268 per year for single-family buildings is no longer 17% of the net total income,

but 21.2%, due to the lower total expenditure and lower incomes of households in this segment. Accordingly, the measures needed to renovate single-family houses are calculated for an air-conditioned volume of 195m^2, according to strategy data[15], while the 8-storey panel building is for a volume of 3800 m^2 with an average of 24.5 apartments or a volume of 155 m^2 per dwelling.

Due to data limitations and limited possibility of applying different types of measures, the same amount is applied in this segment – BGN 268.07, to compare the effect, in the next step, a calculation of the effect of reducing the financial cost by 33% is used, taken from a report on good practices of the Replace project (Peneva, Nikolaev, 2020), using an example of a replaced solid fuel pellet stove and installed solar collectors.

Figure 7

Energy-poor households before and after lowering energy consumption in single-family homes, 2017



Source: Calculations with anomised data from the NSI.

The results of the calculations show similar results of multi-family buildings, a decrease of 25% in the share of energy-poor households after a decrease of 33% in the costs of single-family buildings, and a decrease of 20% in the share of energy-poor households after a decrease of BGN 268.

The low decline in the definition of "poverty after energy consumption", which is close to the official poverty line, shows how little energy expenditure has an impact on overall poverty, and how a reduction of BGN 268 is much more effective than a reduction of BGN 33% of cost, which is already very low. Suppressed consumption is clearly visible in low-income groups. The paradoxical trends for the last two definitions – LI-HC and LI-HSE – are present again, when consumption is reduced by an absolute amount equal for all households, energy poverty increases. With a percentage decrease, there is a decrease in energy poverty.

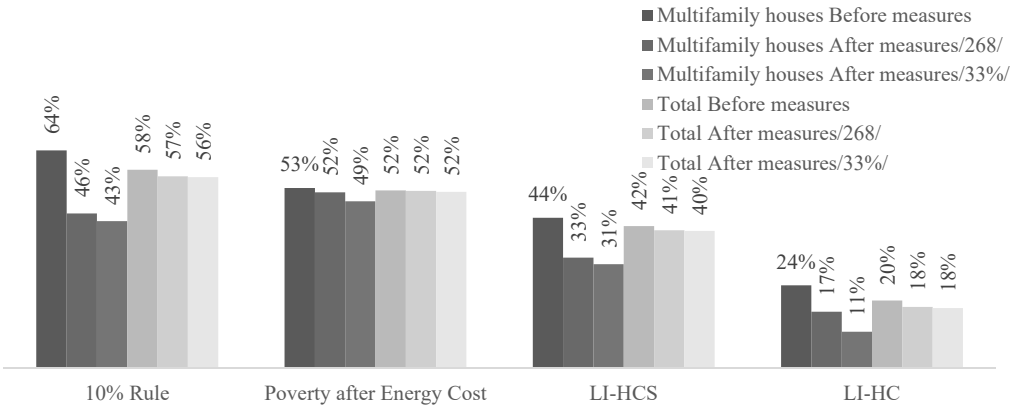
[15] Annex 3 of the Long-Term National Strategy to support the renovation of the national building stock from residential and non-residential buildings until 2050.

Multi-family houses

About 10.8% of the households in the sample (nationally representative) of this study live in multi-family houses (see Figure 3d). Half of the occupants of this type of buildings are very poor, more often large families, while the other half are very rich. Therefore, this segment should be regarded carefully when setting policies. Regardless of the definition, measures in this segment have a minimal effect on the overall energy poverty due to their low share in the total. The decrease in the share of costs in the segment is smaller than in the application of the same measures in the other segments.

Figure 8

Energy-poor households before and after lowering energy consumption in multi-family houses, 2017



Source: Calculations with anomized data from the NSI.

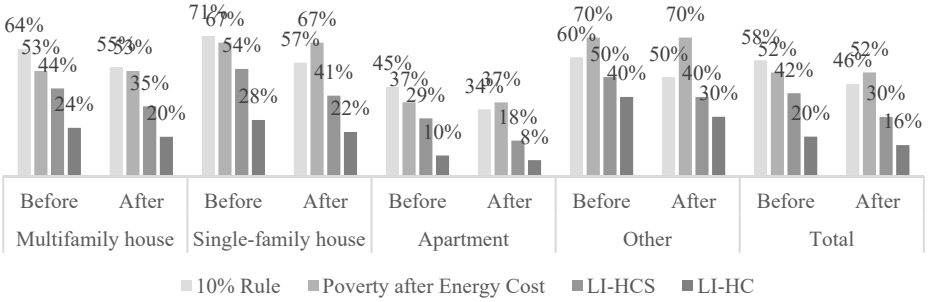
2.4. Targeted measures to households below the official poverty line

This section examines the effect of the measures if a formal definition of the energy-poor is applied. The financing of buildings is set specifically for these households and not for all. Energy expenditure is reduced by BGN 268 per year for all households with incomes below the poverty line, in the sample, these are 40% of all households in the country (net total income).

Targeted measures undoubtedly have a better effect. To summarise the measures by buildings, let's see the effect after the different types of soft, by each of the definitions. It is important to clarify again that the median cost as a threshold for some of the definitions is different in the application of each measure and reflects the median result after the measure.

Figure 9

Energy poverty after measures for low-income households only



Source: Calculations with anomised data from the NSI.

Table 3

Decrease in the percentage of energy-poor households after energy efficiency measures[16]

	Ten percent rule	Poverty after energy cost	Low Income High Share of Energy	Low Income-High Cost
Measure 1:	**All dwellings (cost reduction of BGN 268/year)**			
Single house	0.0	0.0	0.0	-3.1
Multifamily house	0.0	0.0	0.0	-3.3
Apartments	22.4	2.1	14.3	2.9
Total	**10.1**	**0.9**	**6.4**	**-0.4**
Measure 2:	**All single houses (cost reduction of BGN 268/year)**			
Single house	19.8	2.3	15.9	7.6
Multifamily house	0.0	0.0	0.0	-0.7
Apartments	0.0	0.0	0.0	-0.6
Total	**8.8**	**1.0**	**7.1**	**3.1**
Measure 3:	**All single houses (cost reduction by 33%)**			
Single house	24.4	4.0	17.4	13.6
Multifamily house	0.0	0.0	0.0	-3.3
Apartments	0.0	0.0	0.0	-2.0
Total	**10.8**	**1.8**	**7.7**	**4.8**
Measure 4:	**Low-income households (cost reduction of BGN 268/year)**			
Single house	13.4	0.0	13.4	5.4
Multifamily house	9.1	0.0	9.1	3.6
Apartments	11.3	0.0	11.3	1.9
Total	**12.0**	**0.0**	**12.0**	**3.7**

[16] The presence of negative results in the last definition again shows the inapplicability of this definition in Bulgaria. Low income-high cost is a very popular definition in Western Europe, and is the official one for England in the UK. However it uses not the actual, but the modelled individual cost for a home. We do not have such a regulatory cost and such a database.

Targeting measures specifically on households below the poverty line would involve more single-family homes.

3. Conclusion

The effect of the Green Deal on the well-being of the population will be small, as the level of energy poverty in Bulgaria is high. In Bulgaria, people already consume the minimum amount of energy needed to survive the winter, and any upgrade of the building envelope would increase their comfort, but would fairly reduce their cost. This is also a good effect, but the expectations for energy savings can only remain on paper.

In order to reduce poverty, it is necessary to develop small investment tools for more households and to apply a differentiated income criterion.

The analysis of the NSI data shows **the impossibility of a complete or tangible reduction of energy poverty by reducing energy cost**, as household income is a stronger determinant. In order to make better use of the budget provided for the Green Deal, it is important to expand the possibilities for creating more prosumers[17], so that the measures have a double effect – to reduce costs and generate income. Only in this way, over time, can these measures partially replace social benefits for low-income families, as they now fail to have a long-term effect. Targeting a resource (program) to low-income families in single-family homes would be the fastest and most appropriate measure for the strongest possible effect, and could, with much less investment, lead to a significant difference in the well-being of the population.

The introduction of an official definition close to the current official poverty line with deduction of energy costs, as well as the development of special measures linked to the definition, will significantly support the work in implementing the measures to achieve the objectives of the Green Deal. Such a definition can use the indicator for poverty after energy. A stronger effect is a great incentive for any government to develop and implement specific tools specifically for energy-poor households with differentiated income criteria.

It is important that the government's approach is comprehensive and combines both approaches – energy cost reduction and income increase (Peneva, 2017). Otherwise, it may have little effect on energy poverty in general. Reducing energy poverty must go hand in hand with measures to reduce poverty and inequality, otherwise, it will not be effective.

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
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DETERMINANTS AND MODELS OF COMPETITIVE PERFORMANCE OF SMES IN AN INTERNATIONAL BUSINESS ENVIRONMENT: COMBINING MACRO-LEVEL AND FIRM-LEVEL ANALYSES[6]

The article is targeted at exploring determinants associated with the internationalization process and related performance of Bulgarian enterprises. Examined are data on a macro-level such as national and European statistical data and export data for comparative purposes, as well as firm-level determinants and measures. Thus, the study conducted as part of a research project integrates and builds on previous research of the authors, with an addition of a macro perspective. By providing a macro viewpoint and longitudinal perspective on internationalization modes, it attempts to enrich the understanding of the internationalization of SMEs mostly explained by individual and organizational determinants. The empirical sample includes 500 Bulgarian enterprises, both family and non-family, with diverse internationalization patterns and performance. Findings show that export is characterized by a relatively stable contribution for economic growth, balanced geographic scope, but an unfavourable structure where this contribution is mostly made by low value-added goods, low share of high technology export, and low share of firms' export sales. The typical international involvement of Bulgarian SMEs is by less

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complex and resource-intensive modes following both reactive and proactive motives. Their international performance is characterized by a low degree and scope of internationalization and preference of geographically and culturally proximate target markets.
Keywords: internationalization; competitive performance; determinants; models; macro-level; firm-level; individual-level; SMEs
JEL: D22; M16; L25; L26

Introduction

In today's economy, the traditional internationalization of business known from the past is transforming and reshaping into a process of globalization, provoked by the accelerated relations between a growing number of international players, including both large and small firms from different countries and regions around the world. Global orientation improves firm performance and achieving a global reach has a significant positive effect on profitability (Cerrato, Piva, 2015). The globalization of industries since the last decades of the past century has forced companies to increase the pace by which they commit resources to foreign markets (Petersen, Pedersen, 1999). Early internationalizers achieve higher rates of firm growth from internationalization activities than late internationalizers (Lu, Beamish, 2002). In contrast to the traditionally internationalizing firms described by the Uppsala model, selling to foreign customers does not require additional time or effort for the so-called international new ventures and born globals (Hennart, 2014). This transformation exerts an inevitable impact on the motivations, drivers, and patterns of competitive performance for firms that are internationally active. As far as the motives are concerned, they remain relevant when analyzing various aspects of the firm's internationalization and are also useful elements for theory building in international business regarding a firm's international behaviour (Benito, 2015). About export performance, the model studies as determinants the firm's commitment to developing an international marketing strategy, the organizational structure for exports, international modes other than exporting (foreign direct investment, international alliances, global sourcing), and some firm's characteristics (size, age, international experience) (Grandinetti, Mason, 2012).

In addition to economic globalization favoured by the reduction or removal of several restrictions imposed on trade, one should consider regionalization trends – cooperation and increased trade in different regions of the world. Various internationalization theories and models try to explain this phenomenon. Still, the complexity, specifics, and diverse manifestations dependent on the historical, geographical, and economic context make it difficult to find a generally accepted comprehensive definition of the concept of business internationalization. For example, a systematic review of the literature on the internationalization of family SMEs shows that the impact of family ownership and management on internationalization may change in different contexts (culture, traditions, and economic development); samples (firm's size and age; sector; independent; incorporated enterprises); firm-level characteristics (generation: management; innovation and technology; networking); and entrepreneurs' characteristics (education, risk-taking propensity, experience) (Ivanova, Dentchev, Todorov, 2015). The relevance of the theories also depends on the industrial context to which it is applied, on the firms' degree of internationalization,

and whether the industry is mature or growing (Andersson, 2004). In the general case, the term internationalization refers to the different types of exchange relations between countries and regions and the economic entities in them, including the exchange of goods. It denotes the growing involvement of enterprises in international markets, while for some SMEs a faster expansion is possible. Past research proposed an integrative conceptual model of international entrepreneurship based on four internationalization properties (mode, market, product, and time), internationalization performance, and key antecedents and consequences of the internationalization process (Ruzzier, Hisrich, Antoncic, 2006).

This study was conducted as part of a research project targeted, among others, at the accumulation of novel knowledge about the determinants of competitive performance of enterprises in an international environment, contributing for testing of existing theories, models, and development of new research hypotheses about the sources and drivers of competitive advantage and performance in an international business environment. To contribute to that, here, the objective is to explore both macro-level and company-level determinants that are associated with the process of internationalization and related performance of Bulgarian enterprises. It simultaneously attempts to pay attention to alternative theoretical views, models, and concepts explaining internationalization. The research question addressed is what determinants and measures shape the competitive performance of SMEs operating internationally in terms of drivers, modes, and internationalization patterns. This piece of work adds to extant research on the internationalization of Bulgarian SMEs by combining macro-level and firm-level data. By doing so, the study attempts to enrich the understanding of SMEs' internationalization typically explained with individual and organizational determinants and measures by providing a macro viewpoint and longitudinal perspective on SMEs' internationalization modes. This is in line with the call for literature contributions for the adoption of a longitudinal approach with larger samples to capture the dynamics of internationalization (Kuivalainen et al., 2012).

The remainder of the article is organized as follows. First, it presents a theoretical overview of the literature and other relevant sources of information and developed hypothesis. Next comes the method section that clarifies the procedure, data collection, and sample. And finally, presented are the results from the statistical processing of macro-level longitudinal and company empirical data, followed by discussion and conclusions.

Literature Review and Research Hypotheses

The traditional view of internationalization represented by so-called stage theories and models attempts to explain the choice of foreign markets and the modes of entry to these markets. Internationalization occurs gradually, in a series of stages: from non-permanent exports to exports through a trade intermediary, opening a sales subsidiary, and production abroad. The original Uppsala model is based on four basic concepts: *(foreign) market knowledge* leading to increase in the *market commitment,* provoking further *commitment to internationalization decisions* with an impact on *current activities* that, at a later stage, ultimately lead to better knowledge and understanding of the foreign market (Johanson,

Vahlne, 1977). Similarly, Cavusgil's stage theory conceptualizes the internationalization process using five stages (domestic marketing, pre-export, experimental involvement, active involvement, and committed involvement) and it is empirically proven that within certain limits, it holds for European manufacturing SMEs (Gankema, Snuif, Zwart, 2000).

Besides the Uppsala model, other theories and constructs that are most used in the entry mode studies include but are not limited to the transactions cost theory (Anderson, Gatignon, 1999; Brouthers, Nakos, 2004); cultural distance; control; eclectic paradigm; risk; resource-based view; foreign direct investment; organizational capabilities; knowledge-based view, and uncertainty (Andersen, 1993; Anderson, Gatignon, 1999; Canabal, White, 2008).

A specific view is provided by the international entrepreneurship perspective. It is already known for more than a decade that SMEs' internationalization modes are not path-dependent and not incremental, and stage models cannot cover the phenomena such as 'born globals', 'instant internationals' (traditional SMEs entering the international market), 'backsourcers' (re-focusing international activities back to the home country), and 'born regionals' (regional players with mostly export activities) (Schulz, Borghoff, Kraus, 2009). International new ventures (INVs) and born globals (BGs) are accidental internationalists with foreign sales from the outset, or very quickly afterwards due to their business model targeting spatially dispersed customers and offering distinctive niche products that incur low communication, transportation, and adaptation costs (Hennart, 2014). Previous research proposed an integrative conceptual model of international entrepreneurship based on four internationalization properties (mode, market, product, and time), internationalization performance, and key antecedents and consequences of the internationalization process (Ruzzier, Hisrich, Antoncic, 2006). In the case of born globals, international entrepreneurial orientation, focus on product/service quality, and competitor orientation are critical drivers of international performance (Gerschewski, Rose, Lindsay, 2015).

Competitive Performance and Modes of Internationalization

An enterprise is considered internationalized when it develops its business outside the territory of the country in which it was established, and it is very likely to have a combination of operations on the local and international market. The internationalization process is implemented in two alternative ways: outward-inward or inward-outward. It is often realized in more complex forms, including a combination of those types. Examples of activities where 'inward' and 'outward' activities are 'linked', are some cooperative agreements, as happens with strategic alliances and cooperative manufacture (Fletcher, 2001). Therefore, examining both types of modes corresponds to the theoretical presentation and practical understanding of internationalization as a holistic phenomenon (Luostarinen, 1994; Fletcher, 2001; Ivanova, 2016).

International market entry modes can be differentiated according to the specific activities implemented on international markets, each of which is characterized by a certain degree of commitment and risk – indirect exports, direct exports, international licensing and franchising, outsourcing, business networks, strategic partnerships such as joint ventures or direct establishment of own sales subsidiary or export production. This may include the so-

called passive form of internationalization – imports. Modes frequently applied by SMEs are exports, subcontracting and entrepreneurial networks. An argument to focus on export is that this mode is often the first step in the internationalization process of SMEs (first international activity) (Karami, 2007). This is confirmed by a previous study in the Bulgarian context, concluding that the most common internationalization modes used as a first and last step in the process are import and export. Import is a starting point to further development of internationalization, and export is the most common last step (Ivanova, 2016, 2017).

Hypothesis 1. *At a macro level, the export is characterized by a relatively stable contribution for economic growth, balanced geographic scope, improved performance, but an unfavourable structure where this contribution is expected to be mostly made by low value-added goods, limited high technology export, low share of firms' export sales and typical involvement of SMEs in less complex and resource-intensive forms.*

The motives for internationalization are diverse and specific for each company. By adopting a too simplified view of firm-level performance and neglecting internationalization motives, the effects on performance may remain ill-understood (Verbeke, Brugman, 2009). Hence, in addition to other determinants motivations to expand international activities are also studied. Examples of such motivations include securing sales through greater proximity to the market, access to other (international) markets in case of a limited internal market and insolvent demand, access to resources or infrastructure that are not available on the local market, placement of the surplus in case of overproduction, cost reductions, taking advantage of opportunities provided by ICT, etc. Findings from a survey of Finnish SMEs suggest that management interest, limited domestic market, and inquiries from buyers are rated as the most significant incentives to start exporting (Holmlund, Kock, Vanyushyn, 2007). Classification of motives, for example, on market-seeking, efficiency-seeking, resource-seeking, and strategic asset-seeking motives, is a useful tool for companies to analyze their strategic alternatives and actions, especially regarding performance measurement (Benito, 2015).

Here we use the proactive-reactive type of classification of motives. Following either proactive or reactive motives distinguishes firms that have an inferior performance from those that perform better. Reactive internationalization occurs when a firm receives unsolicited foreign orders, follows a customer overseas, or distributes worldwide through a customer's established network, while proactive internationalization is when the firm leverages established networks to enter new markets supported by the management team's global mindset and international experience (Stangl, 2012). Following the reactive approach is typical for smaller family firms. Rather than being proactive, family SMEs respond reactively to opportunities that emerge coincidentally (Kontinen, Ojala, 2011).

Having in mind the structure of SMEs, the competitive profile of the Bulgarian economy in terms of exports and contribution to economic growth, and the share of family firms in it, one should expect small and medium firms to follow mostly reactive motives. By exclusion of micro-enterprises, a change may occur leading to a mix of motives. Still, we expect that the reactive motives will be predominant, leading to the hypothesis:

***Hypothesis 2**. The motivations for the internationalization of Bulgarian SMEs are a combination of proactive and reactive internationalization, with a predominance of the latter.*

The network perspective acknowledges that the internationalization of firms occurs in a network with business partners from other countries. The underlining reason is that today's business environment is viewed as a web of relationships, a network, rather than as a neoclassical market with many independent suppliers and customers – a perspective incorporated in the revised Uppsala model (Johanson, Vahlne, 2009). Networking is essential for the success of internationalization, as it facilitates privileged access to information and the use of opportunities available only to internal players. Inter-firm collaborations with business partners help SMEs to handle the lack of tangible and intangible internal resources and to enhance their international performance (Ghauri, Elg, 2018).

Network relationships are indispensable for SMEs' international growth (Coviello, Munro, 1997). A multi-level analysis shows that for innovative entrepreneurial firms, there is a complex, interconnected, and multi-level relationship between networks and internationalization in a way that networks contribute to the creation of awareness, pathways, and competencies for internationalization (Stangl, 2012). This relation between networks and internationalization is also valid for other types of firms as well. Establishing alliances with partners that have local knowledge can be an effective strategy to overcome the deficiencies in SMEs' resources and capabilities when they expand into international markets (Lu, Beamish, 2001).

Network relationships are most likely to provide linkages with and facilitate entry into psychically and geographically close markets (Ojala, 2009). By strategic networking, SMEs could gain access to valuable resources – information, know-how, technologies, finance, etc., needed to build and maintain a competitive advantage. The network involvement of Bulgarian firms operating in a limited domestic market can be a tool for gaining access to external markets (Vasilska, Kereziev, Ivanova, 2014). In addition to business networks, the role of external support can also be interpreted as an important determinant of the internationalization of SMEs to proximate EU markets.

In the network economy, the dynamics of the global business environment create both opportunities for small and medium-sized enterprises (SMEs) related to partnerships with other companies and usage of external support, but also poses requirements to their international competitive performance, in terms of extent and scope.

***Hypothesis 3**. The international performance of Bulgarian SMEs is associated with involvement in networks and is characterized by a low degree and scope of internationalization and preference of geographically and culturally proximate target markets (either from the EU or such with a lower physical and psychic distance).*

Some authors associate the decision to internationalize the activity of a small or medium-sized enterprise, as well as the successful implementation of this decision with the personal characteristics of the entrepreneurs managing the enterprise (Glas, Hisrich, Vahčič, Antončič, 1999; Manolova, Brush, Edelman, Greene, 2002; Zucchella, Palamara, Denicolai, 2007;

Villar, Linares-Navarro, Toral, 2010; Love Roper, Zhou, 2016). The main characteristics that are most often studied are:

- degree and type of education;
- duration and type of professional experience;
- type of experience of the entrepreneur in an international environment.

Of course, the cited studies cover other characteristics such as the age and gender of entrepreneurs, but since no significant effects of these characteristics on the success of internationalization are revealed (Achtenhagen, 2011), the present study will focus mainly on the educational and professional experience of Bulgarian entrepreneurs as one of the determinants of internationalization. In general, higher education in areas, related to knowledge of foreign markets, long-term experience related to key entrepreneurial skills, as well as long-term experience in an international environment are associated with an earlier decision to internationalize a business and a higher degree of success in implementing this decision.

The research focused on the influence of personal characteristics on the internationalization of Bulgarian SMEs is relatively rare but can also serve as a starting point for formulating a research hypothesis. Another study concludes that entrepreneurs with no previous experience or those occupied as employees before to their own business are rather oriented towards a smaller number of countries that are geographically and culturally proximate, while experienced entrepreneurs are targeted at traditional trade partners of Bulgaria, regardless of geographic and cultural distances and managerial experience (Kolarov, Ivanova, Todorov, 2018). This study also found that another personal characteristic – training acts as a prerequisite in choosing active and direct internationalization approaches, that can be riskier but more effective (Ibid.).

Hypothesis 4. *Personal characteristics of the entrepreneur, such as education, professional experience, and international experience, contribute to a higher degree of internationalization and competitive performance in an international environment.*

Method

The applied methodology includes analyses of secondary data, collection of primary data by sampling and interviewing, and subsequent analyses of the empirical datasets.

Studied variables

By making a conceptual distinction between international and general performance, a previous study proposes a basic dynamic model of determinants and measures of SMEs' performance, acknowledging that the link between international and general performance is

characterized by complexity and duality (Ivanova, Todorov, 2019). Similarly, following the proposed basic dynamic model, here we include both measures of international performance, such as internationalization degree and scope, and measures of general performance – entry mode choice and involvement in networks. By considering the conditional division between hard and soft determinants and measures (Ivanova, Todorov, 2019), in this article, we examine both types of variables, such as motivations for international business activities and achieved outcomes.

Procedure and data collection

The research procedure was based on the mixed use of primary and secondary data. Primary data were gathered by an empirical study conducted by an experienced agency for social and marketing research. The target population from which the sample was selected includes Bulgarian companies that have international activities. Respondents are companies' owners and managers that are most involved in international activities. One respondent is responsible for each company. The collection of primary data was done through a structured interview. The sample is formed by reliable information from the Commercial Register for extracting a list of companies with contact data and the National Statistical Institute for the distribution of enterprises by ownership – family or non-family, size – small, medium, or large, sector, and planning region. The identification of internationalized companies is based on a recruiting question regarding their foreign trade activity.

In the process of data collection for the statistical data section and related research hypothesis, was applied a longitudinal approach encompassing ten years. This is related to an accumulation of secondary macro-level national and European data about the export statistics. This longitudinal approach aims to reveal the role of companies of different sizes in the realization of Bulgarian exports and to make comparisons with average EU, where applicable. Public data on the Bulgarian foreign trade activity was sourced from the National Statistical Institute (NSI), Bulgarian National Bank (BNB), and Eurostat. The analysis covers the period 2009-2019.[7]

Sample

To conduct the empirical study, a sample of 500 companies was prepared, representative by the following characteristics: company's ownership (family, non-family), company's size (small, medium, or large), sector, planning region (Severozapaden, Severen tsentralen, Severoiztochen, Yugoiztochen, Yugozapaden, and Yuzhen tsentralen), and internationalization degree. A percentage distribution between groups of enterprises based on the number of employees is illustrated in the table. Micro-firms were excluded due to their overall lower propensity for internationalization and resource limitations.

[7] For some of the indicators where data for 2019 were not yet available, values for the previous year were used.

Table 1

Distribution of enterprises by size in terms of employed (%)

Statistical regions	Groups of enterprises by number of employed				
	Total	Up to 9	10-49	50-249	250+
Total	100	92.6	6.1	1.1	0.2
Total *without micro-enterprises*	100	-	82.2	15.4	2.4

Note: to form the sample and determine the percentage distribution by size of the company (and planning area) are used data from the NSI as of 11.2017; data as of 11.2020 in terms of proportion between groups of enterprises are approximately the same.
Source: National Statistical Institute. Number of Non-Financial Enterprises by Size in Terms of Employed and Statistical Region.

First, an initial sample was made of companies throughout the country. To structure the sample, an initial list of all companies registered in the Commercial Register was prepared from which companies were selected by size, sector (according to NCEA-2008), six planning regions, type of company (family, non-family), and internationalization according to the accepted definitions. As a next step, companies were selected based on their type – family/ non-family and internationalization through recruiting questions about the company's type and activity.

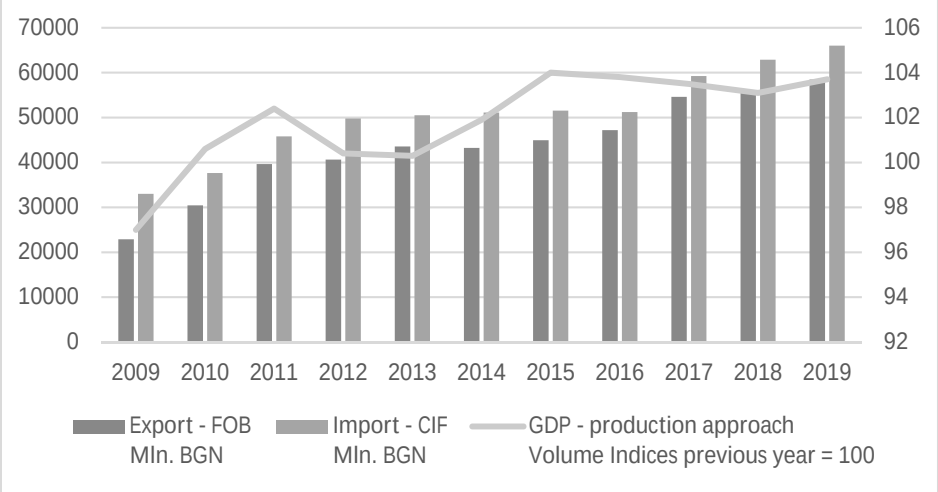
Validation of Research Hypotheses and Main Findings

The internationalization of SMEs in Bulgaria: statistical evidence

To test the first hypothesis were used longitudinal micro-level data for the period 2009-2019 for the structure of Bulgarian exports, their contribution to the economy, export performance exhibited by the so-called indicator 'terms of trade', the geographical scope of export exhibited by the coefficient for geographical diversification of exports and share of high-technology export.

Contribution for economic growth. After the global economic crisis of 2008-2009, exports formed the main source of growth of the Bulgarian economy. This is the reason why here we concentrate primarily on this internationalization mode in the longitudinal data collection and research. Overall, Figure 1 shows the impact of exports on GDP growth. Data were also gathered for import as a passive form. During this period, Bulgarian companies made exports that exceeded the levels before the global economic crisis. But the structure of exports continues to be dominated by raw materials. According to data for 2019, exports formed by high value-added goods are estimated at 24% (excluding exports of special products), while exports of raw materials, energy and materials with a low degree of processing have a share of about 32% (Iliev, 2020).

Figure 1
Index of the physical volume of GDP (%), exports, and imports of Bulgaria (in Mln. BGN)



Source: National Statistical Institute.

The export structure by way of use shows that Bulgaria remains an exporter mainly of low value-added goods. After 2013, there is a slight improvement in the structure. This is expressed by a slight decrease in the share of raw materials and materials and an increase in the share of investment goods by 1-2%. This seems like a favourable trend toward a slight increase in exports of higher value-added goods.

Export performance. The indicator 'Terms of trade' based on data from Eurostat compares the prices of exported goods with those of imported ones. It is a measure of trade competitiveness, as it represents how many imports can be obtained per unit of exported goods and services. The indicator refers to the percentage change for 5 years. Until 2015 there was a tendency to a decrease in the indicator's values, while after 2015 there was a steady growth, which outlines an increase in the commercial competitiveness of Bulgarian exports. This trend is positive, but more serious problems remain with the structure of exports, which remains unfavorable.

Export sales. Bulgarian small enterprises are in the last place in the EU with 539 thousand euros of export sales with EU average values over 1300 thousand euros. The companies from the Netherlands have the highest average values (3900 thousand euros). Bulgarian medium companies have the lowest performance – 2800 thousand euros per year. EU average value is 8400 thousand euros of company's exports of goods per year. Again, with the highest values are in the Netherlands and Belgium (respectively over 26800 thousand euros and over 24000 thousand euros). The discrepancies between Bulgaria and other countries can be explained by the different levels of productivity of enterprises.

Geographic scope. To study the relation of Bulgarian exporting firms with the economic situation in other countries – the share of the major trading partners is used as an indicator.

The country – trade partner with the largest share in Bulgarian exports, is Germany with 16%. In total, the first three countries – Germany, Romania, Italy form 32%. And with the addition of Greece and Turkey, 45% of Bulgarian exports are formed. Only EU27 countries – 65%. The Bulgaria's neighbouring countries – Turkey, Serbia and Macedonia and the EU27 countries together form the share of 75% of the export.

The data show that the Bulgarian contribution is formed mainly by transactions with neighbouring countries and other EU27 countries. This can be explained on the one hand by geographical proximity. On the other hand, trade in the EU is much easier than trade with third countries.

This higher concentration is unfavourable due to greater dependence and commitment to fewer foreign trade partners and their terms of trade.

Share of high-technology exports. Data from Eurostat and the National Statistical Institute for the EU-28 and Bulgaria reveal that high-tech goods account for about 4 percent of Bulgaria's exports of goods at the beginning of the period 2009-2018. During the period under review, this share increased to nearly 6% in 2018. It is noteworthy that the average European share (calculated for the 28 EU countries) is far higher than the Bulgarian one. It ranges from 15 to 18 percent. But unlike other countries, the main share of exports is formed by intermediate rather than end products. This is leading to a stronger dependence of production and exports on the economic situation in the main trading partners, where the producers of the end product are based. This fact implies that Bulgarian firms contributing to these statistics are likely to operate as subcontractors manufacturing product components for their international contractors.

To test the first hypothesis, we also used data from the empirical study of sampled firms. Given the inherent characteristics of Bulgarian SMEs, it is logical to prefer less complex modes of internationalization, such as imports and exports, rather than modes involving greater resources and risk, such as foreign direct investment. The data analysis confirms it. The most frequently mentioned modes are imports (55%), regular exports (39%) and occasional, non-permanent exports (13%). Surprisingly, participation in joint ventures – another joint activity is in fourth place (also with about 13% of responses). A possible explanation is that firms that have contract relations with foreign firms often operating as their subcontractors, for example, have indicated this option instead of contract manufacturing. This can be due to a misunderstanding of the meaning and features of specific economic terms, such as joint venture and subcontracting relations, from a theoretical viewpoint. Next are sales representatives, participation in consortia and contract manufacturing. These data confirm the typical involvement of Bulgarian SMEs in less complex and resource-intensive forms such as import and export.

The second hypothesis was tested based on the information about motivations for international activities. The most significant reasons for the surveyed companies for internationalization of their activity include both proactive and reactive types: Goals related to profit and growth; High-tech or unique product; Information about foreign markets and opportunities; Small (limited) domestic market (Bulgaria); Necessity to be closer to consumers, Inquiries from foreign consumers and Increase in sales of seasonal products. Still,

on average, respondents rated higher mostly reactive motives: economies of scale, overcapacity, and increased sales of seasonal products, which provides some support for the second hypothesis. Meanwhile, previous research of authors in the framework of the same project has found that regarding the main opportunities for international business development in the next 2-3 years, the most opportunities are proactive and are related to both measures of international and general performance, such as growth by an increase in sales, profits, export, market share. Still, there is a reactive opportunity of looking for cheap contract manufacturing (Ivanova and Kolarov, 2020). Based on this data, there is no evident prevalence of reactive motives, meaning that data are not sufficient to support the developed hypothesis.

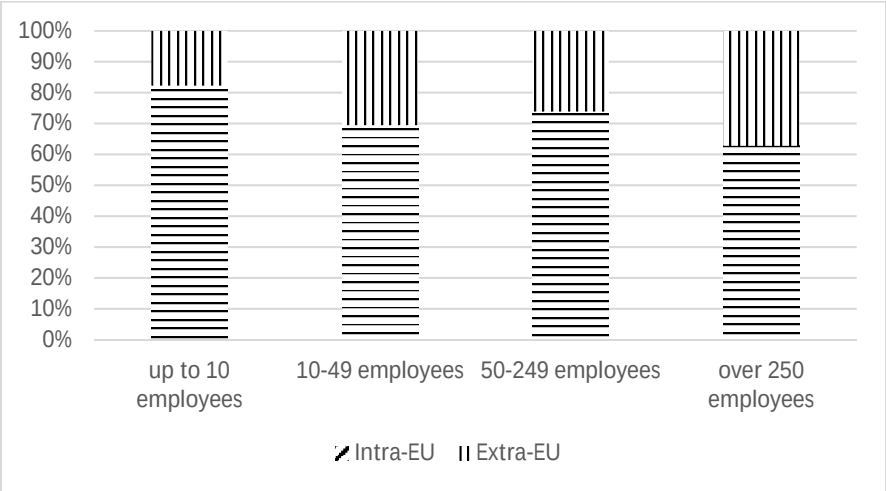
To test the third hypothesis, we used both macro-level and company-level data. Internationalization degree can be interpreted in terms of export share in company turnover and through the overall volume of sales from the international market (all international activities).

Geographic scope. As far as the geographic scope is concerned, it is noteworthy that Bulgarian small and medium-sized enterprises prefer to carry out export transactions mainly within the EU. This indicates their preference for proximate markets.

Based on these data, we can conclude that the facilitation and help provided by Bulgaria's membership in the EU can be interpreted as important determinants of the internationalization of SMEs to proximate EU markets.

Figure 2

Distribution of export transactions according to the target market and the number of employees in exporting enterprises in 2018



Source: based on available Eurostat data.

Out of 500 sampled enterprises, 312 answered that they operate in other countries: a majority of 135 companies have internationalized in two countries, and another 70 have entered only

one international market; 36 of the respondents operate in three foreign markets, and 13 and 15 companies are operating in four and five markets, respectively. Only six of the companies have international operations in 10 different countries. The countries where surveyed firms started their international activity, are mostly from Europe – Greece, Italy, Germany, England, Serbia, Romania, and Russia. Three of the countries are territorial neighbours of Bulgaria, which explains why they are among the most popular destinations among respondents.

These results are expected, given that Greece and Italy, along with Germany, are among the traditional foreign trade partner countries of Bulgaria when it comes to the export of goods (National Statistical Institute, 2019). Examined empirical data confirm the hypothesized lower scope of internationalization of Bulgarian SMEs that tend to internationalize to physically and culturally proximate countries first, which is in line with the Uppsala model and its concepts of physical and psychic distance. The choice of a first foreign country is determined by the existence of previous management experience – those who do not have such experience are more oriented towards geographically and culturally proximate countries (Kolarov, Ivanova and Todorov, 2018). Hence, choosing mostly geographically and culturally proximate countries can likely but not necessarily be viewed as an indication of a more limited management experience, but this premise needs to be further tested empirically. At the same time, in the answers to the question about the primary reasons for choosing a country to do business with, the empirical study showed that cultural proximity is an extremely rare reason – only in 0.64% of cases. It turns out that there are two primary reasons for choosing a country – good logistics and the business climate created by the government of the country. These results do not contradict the Uppsala model, but raise questions that need further clarification: whether the idea of cultural proximity is enough known among entrepreneurs, or just the geographic scope of the internationalization of Bulgarian business does not imply significant cultural differences?

Internationalization degree and export sales. For small and medium-sized enterprises, the manufacturing industry stands out with over 40% and 32% of foreign transactions, respectively. As expected, the data for large companies also show the dominant role of the manufacturing industry, with over 65% of sales abroad.

Table 2

Share of exports in the companies' turnover, according to the number of employees, destination, and leading economic sectors in 2018

Economic sectors / Number of employees	Below 10		10 – 49		50 – 249		Over 250	
Export direction – in the EU or outside the EU	EU	External	EU	External	EU	External	EU	External
Total for all activities	9.8	2.1	4.9	2.2	12.8	4.5	20.6	12.2
Manufacturing industry	16.2	4.5	16.6	4.1	32.7	9.4	40.6	24.5
Trade; repair of motor vehicles and motorcycles	14.2	3.1	4.0	2.4	8.1	4.1	4.2	0.7

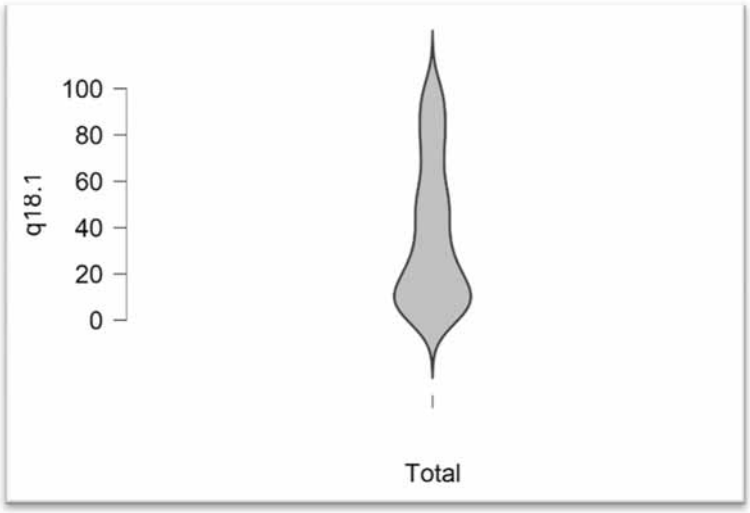
Source: Dimitrov, Tassev, Nestorov, 2021.

For all the groups of micro-, small-, medium-sized, and large firms, the volume of export sales in the EU (total for all activities) is greater than foreign sales realized in external markets of third countries. Still, larger firms have a greater share of sales in both EU internal and external markets compared to other groups of enterprises. These data mean that *small and medium-sized firms have lower internationalization degrees in terms of export sales.*

Results of the conducted empirical study demonstrate that the revenues generated on the foreign market amount to 36%. The largest number of surveyed companies have revenue from the international market in the range of 1 to 20% or 187 out of a total of 406 companies:

Figure 3

Revenue from the International Market of sampled firms in percentages



Source: own empirical study of 500 Bulgarian enterprises.

The distribution of foreign revenues mostly at the bottom of the 0 to 100% scale confirms the hypothesized low internationalization degree of Bulgarian SMEs.

Involvement in international networks. We examined whether the company's participation in business networks (sustainable partnerships) has a direct impact on the company's performance over the past three years compared to major competitors in terms of market efficiency. The results from Pearson correlation analysis makes it clear that for each criterion: increasing market share in international markets, growth in sales revenues from international markets, increasing sales of existing customers in the international market, and attracting new customers through innovation, the correlation coefficient is below 0.05, i.e., participation in business networks has no significant influence on these criteria. On the other hand, the influence of participation in business networks on receiving support from national and European funds is significant. According to the data obtained and their analysis, it cannot be proved that participation in networks contributes to a higher degree of internationalization and competitive performance in an international business environment measured by the

criteria set. On the other hand, the analysis, based on the subjective assessments of the surveyed entrepreneurs and managers, shows that networking is perceived as having a positive impact on the competitive performance of SMEs, as networks facilitate increased speed of services and better quality and design of products, which the enterprises offer, strengthening the company's reputation in the domestic and foreign markets, cutting the costs, etc. (Georgieva, Vasilska, 2019).

On the other hand, the authors' research – part of the same project reveals, based on cluster analysis, that enterprises involved in international networks have slightly better measures of international and general performance. They have a greater volume of revenue from international sales, a bigger number of countries for international activities, and a bigger number of employees. Their support needs also differ according to their internationalization degree. Firms with the lowest revenue from international sales mostly need information about foreign markets, while those with the highest revenue need support for finding foreign market partners (Ivanova, Kolarov, 2020). Accumulated contradictory empirical evidence provides only partial support of the third hypothesis. Additional research is needed to study the relationships between external financial, managerial, and financial support and the higher degree of internationalization.

Entrepreneurs' personal characteristics and internationalization. The results of the analysis of the influence of the personal characteristics of the entrepreneur on the internationalization were published in several articles, developed by individual members of the team formed for conducting the present research. In one of them (Vasilska, 2020), the author comes to the conclusion that enterprises run by entrepreneurs, who have a specialised university education with included management or business subjects or have attended management courses, report better competitive performance. The importance of the high educational level of entrepreneurs for the internationalization of the surveyed SMEs is discussed in a report by S. Georgieva (2020), which emphasizes the fact that all surveyed entrepreneurs have a master's degree or equivalent. A thorough analysis of the impact of personal characteristics of entrepreneurs on internationalization was made with the participation of part of the research team, the results of which were the subject of a separate publication (Ivanova, Georgieva, Kolarov, Shindarova, 2020) and based on which the following conclusions were drawn:

- In the analysis of the impact of the type of education (economic, technical, legal or other) on the studied measures of success, it was found only one relationship – in terms of the number of countries in which activities are carried out, but its statistical significance is questionable (Sig. 0.190). It turns out that entrepreneurs with technical education (38.1% of all those who provided this information) work in an average of twice as many countries. However, with the more significant variables for success – the size of the enterprise and revenues from sales abroad, the type of education does not affect;
- The variance analysis of the impact of the length of professional experience showed that this factor has the most significant impact on the success of internationalization, measured as a share of sales revenue abroad (Sig. 0.003). That is, entrepreneurs with longer professional experience are able to realize a larger share of sales in foreign countries, or achieve a higher degree of internationalization. With low reliability (Sig. 0.064) it is

found that longer experience is associated with a larger number of countries in which the company operates;

- No influence was found on the type of professional experience (both as a type of job and as a position before starting one's own business) and the success of internationalization. Probably, the professional experience contains other, more significant elements, which the present research has not been able to cover. The study also asked questions about the availability of specific experience in an international country, but the analysis of variance also did not find significant links between the relevant types of experience in an international environment and the success of internationalization.

In summary, it can be said that the data from the empirical study support, but do not conclusively prove the fourth hypothesis. Proving it will undoubtedly require the study of a more comprehensive sample in terms of education, as well as the requirement of more detailed information concerning the studied characteristics of entrepreneurs.

Discussion and Conclusions

The current study integrates and builds on previous research of the authors, with an addition of a macro perspective based on longitudinal export data. Thus, it attempts to enrich the current understanding of SMEs' internationalization, typically explained by individual and organizational determinants and measures. There are four major research contexts on internationalization, namely the level of aggregation, internationalization modes, activities configuration, and other specific elements at the firm level (Letto-Gillies, 2009). Here we tried to examine determinants on a macro level, different internationalization modes, and other determinants and measures on the company level. The internationalization process of smaller firms is different from that of large international firms, such as multinational enterprises, and therefore, smaller firms' internationalization may not follow extant theories of MNEs and related theoretical constructs, e.g., international business focus on the firm and entrepreneurship focusing on the entrepreneur (Etemad, 2004). Such a statement suggests that individual determinants need to be incorporated in a study of SMEs' internationalization which can be considered as a major limitation of this study due to its focus on macro and firm-level data.

The longitudinal analysis of macro-level data shows that the foreign trade activity of Bulgarian companies is key to achieving economic growth. The Bulgarian economy maintains the unfavourable structure of predominant exports of raw materials and export mainly of low value-added goods. Still, there is a tendency in recent years to increase the share of exports of goods with higher added value. The study of Bulgarian exports in the period 2009-2019, shows that it is balanced in terms of its geographical structure. In the separate years, the leading five main partner countries form between 43 and 56% of the total exports of goods of Bulgaria. For the small and medium-sized companies, the average annual sales abroad are the lowest in the EU. There is a clear tendency of most Bulgarian foreign trade companies to carry out transactions mainly in other EU countries than in third countries. It is also noteworthy that in the general case, the share of exports in the turnover of enterprises increases with an increase in the number of employees. Based on this, we can make the

following conclusion: the larger the enterprise, the greater the share of export in the total turnover. Findings from previous research indicate that internationalization degree and scope are positively related to firm performance (Schwens *et al.*, 2018). Following this logic, the lower degree and limited scope of internationalization of sampled firms can be associated with overall lower performance.

By this study, we also suggest that while the internationalization of companies is a complex phenomenon, SMEs' international involvement often starts with simple modes and passive forms, such as import, therefore this mode should be considered. Another argument for that is that importing per se can have a moderate, but statistically significant influence on exporting (Holmlund, Kock and Vanyushyn, 2007). This means that one might expect for some firms that are already experienced in internationalization, be it in a passive way, to consider resource commitments and subsequently switch to an active mode or combine both types. Bulgarian enterprises are mostly active in modes with lower resource commitment and risk, such as import and export. Meanwhile, it is empirically proven that foreign direct investment activities are a more effective growth strategy for SMEs than exporting (Lu and Beamish, 2002). In this context, the characteristics of the entrepreneur related to his/her educational background and previous professional experience, including his experience in an international environment, should be taken into account, as the results of the empirical study indicate a link between these characteristics and the degree of internationalization, including the internationalization's mode. The policy implication is that support for Bulgarian SMEs should be targeted at facilitating inclusion in more complex modes of internationalization.

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
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LIFE CYCLE: FORMATION, STRUCTURE, MANAGEMENT[5]

The article aims to define the management mechanism of complex, open dynamic systems with human participation. The following parts of the system life-cycle were identified and unified in the theoretical scope: general and specific compositional elements of repeating changes, marginal index boundaries, the dynamics of the compositional elements of the life-cycle, the key points of the change in the character of the index dynamics. In the practical scope, two common trends of socio-economical system life-cycle management are considered. The first trend is the regulation of the comprising element ratio, which provides the increase in the duration of the maximally effective performance of a functioning system. The second trend is the regulation of the reproduction time of a new system. The systems life cycle aspects are investigated in almost all sciences and studied within many disciplines in the field of higher education. Therefore, deepening the mastery of scientific and methodological foundations of the life cycle of a complex open dynamic system is useful for any subject in everyday and practical activities. A human being – in the formation of own human capital. Families – when it is formed, the birth of children, the distribution of income and expenses. Companies – for efficient business activities. As well as local communities, local self-government bodies, public authorities and global entities within their profile activities. The results of the research provide the possibility of the development of applicable mechanisms for effectiveness and stability enhancement of managerial and entrepreneurial operation in business projects.
Keywords: life cycle; cyclicality; system; structure; management; human being
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1. Introduction

The "life cycle" term has become widespread in scientific and popular sources. For instance, as of 31.08.2019 the Google Chrome provided 1090000000 for the English term "Life-cycle", 120000000 for "Life-cycle", and 126000000 for "Life-cycle". At the same time, Google Academy for the term "Life-cycle" – 4670000, for "Life-cycle" 3810000, for "Life-cycle" – 660 000 references.

This category is used in almost all sciences in the 21st century and applies to a wide field of research. In higher education, the life cycle aspects (directly or indirectly as a factor of time) are also studied across many disciplines and are familiar to qualified university graduates who apply them into further professional activities, subjects, objects, and more. Therefore, the life cycle formation, its structure identification and the development of management measures, are very important issues that are of scientific interest in the past and are relevant now in the theory and practice of social development.

Understanding the scientific and methodological foundations of the life cycle is useful for any entity in own household and practical activities. A human being – In the formation of own human capital (health support, training and advanced training, organization of social and work careers, doing business). Families – when it is formed, the birth of children, the distribution of income and expenses. Companies – for efficient business activities (designing new and developing existing businesses, types of activities, goods). As well as local communities, local self-government bodies, public authorities and global entities within their profile activities.

2. Analysis of Recent Publications Studies

The idea of the recurrence and reversibility of society has set its origins in ancient Chinese and ancient philosophy. The thesis of programmed cyclicality is confirmed by the Christian religion, which states that the world and mankind are created, will develop for some time and cease to exist. These issues gradually began to be addressed by scholars in: theories of the cycle in the history of Vico (cited in Helfat, Peteraf, 2003); theories of life cycles of cultural organisms by Spengler (1923) (cited in Spengler, 2017); concepts of the cycle of local civilizations (which came to light in 1947 and reprinted in 1987) Toynbee (1987); the theory of "challenges" and "answers", social and cultural cycles of the main types change of cultures in P. Sorokin's dynamic model; the cyclical concept of "ethnogenesis" by Gumilev (1993); cycles of American history Schlesinger (1986), etc.

Thus, from the beginning of the 19th century (from the first economic crisis of 1825), the theories of economic cycles appear in scientific thought – the concepts of different directions, currents and schools of political economy regarding the cyclicality of production and the mechanism of cyclical instability, which determined the causes of cyclical patterns: V.-C. Jevons (accounting for solar activity cycles that cause fluctuations in agricultural productivity and cyclicality of industrial production); G. Moore (determined the rhythm influence of the Venus movement); J.-B. Say (argued that the supply generates its own demand and that crises in the whole economy are impossible; as they can only occur in certain regions or in

individual markets of goods); T. Malthus (noted that the demand tends to keep up with supply); D. Ricardo (explained the crises being of injustice in the distribution of wealth); S. Sismondi (noted the mismatch between production and consumption); K. Marx (noted the reasons for the average 7-11 years of economic cycles in the contradiction between social nature of capitalist production and private-capitalist appropriation of its results, and the material basis of cyclicality – the massive renewal of fixed capital); E. Tugan-Baranovsky (saw the causes of crises in the disparities between movement of savings and investment in industries producing means of production and in particular the accumulation of fixed capital); G. Kassel (noted the contextual nature of the material culture progress); A. Aftalion (explained the duration cyclical nature of the construction and commissioning period of fixed assets, specifics of interaction between accumulation of fixed capital and production of consumer goods); J. Schumpeter (linked the cycle of capitalist production with the uneven nature of scientific and technological progress (STP) and peculiarities of development of fixed capital); I. Fisher (saw the cause of cycles and crises in disrupting the relationship between demand for money and its supply); M. Kondratiev (noted the qualitative changes of basic generations of engineering and technology, vehicles, large structures, etc.); J. Keynes (noted the psychology role of consumption and income); R. Harrod, P. Samuelson and E. Hansen (explained economic cycles by process of interaction between national income movement, consumption and accumulation of capital, in particular, the effects of changes in effective demand, which depends primarily on dynamics of consumption and investment); Friedman (1977) – saw the main reason for the production cyclicality in instability of the money supply caused by state intervention in the economy.

Among the scientists who have most thoroughly investigated aspects of the systems' life cycle, it is necessary to note the following authors.

At the beginning of the 19th century, William Herschel suggested that there is a relationship between sunspot cycles and weather, which affects the price of the crop and, ultimately, the economy as a whole (cited in Schwager, 1995). Since that time, many scientists have dealt with cyclical issues in the economy, and a large number of scientific papers have been devoted to this problem. For instance, in the twenties of the 20th century, Kondratyev determined that in the long-term dynamics of some economic indicators, there is a certain cyclical nature, when the growth phases of corresponding indicators are replaced by phases of their relative decline with a characteristic period of fluctuations of about 50 years.

Greyner (2002) in the seventieth of the 20th century, was one of the first founders of the life cycle model and development of the organization. It notes that the organization in its development goes through five evolutionary stages, which succeed each other as a result of specific crises (crisis of leadership, crisis of autonomy, crisis of control, crisis of prohibitions, new crisis), leading to revolutionary transformations.

Developing the ideas of Greyner (2002), Adizes (2003) presented the cyclical development of the organization in ten successive stages: nursing, infancy, 'come on', youth, prosperity, stability, aristocracy, early bureaucratization, bureaucratization and death.

Daft, Murphy and Willmott (2010) identify four enlarged stages of enterprise development (entrepreneurship, teamwork, formalization, development of group work).

Miller and Friesen (1984) proposed a model, where five stages of organization of development are distinguished: birth, development, maturity, flowering, decline.

Shnejder, Kacman and Topchishvili (2002) drew up the "Methodology for Feasibility Studios", as well as the "Quantum-Economic Analysis", which is mainly based on the use of the relationship between the life cycle of the product, enterprise and market.

Thorough collective publications are published on this issue. For example, in 2018, Springer published a collective monograph (Hauschild, Rosenbaum, Olsen, 2018), which highlights the historical, theoretical and applied aspects of the LCA methodology and its wide range of applications. Also, the Springer Berlin Heidelberg publishing house since 1996 publishes the scientific journal The International Journal of Life Cycle Assessment (online) (n.d.), which by target publication publishes the results of modern studies of sustainable cyclic laws in environmental, economic, environmental engineering, biotechnology, environmental chemistry. Targeted publications of scientists reveal the aspects of modelling and metrics in life cycle sustainability assessment (Wood, Hertwich, 2012).

Life-cycle aspects and leading international organizations are also being studied. For instance, in 2005, UNEP published Life Cycle Approaches (2005), which looked at theoretical and practical solutions to global development issues and individual challenges, considering cyclical patterns of social development at this stage of human technological development.

3. Unresolved Issues That Are Part of the Overall Problem

The complexity of this area of fundamental and applied research lies in the magnitude and multidimensionality of the problem and it can be argued that the science is developed, gradually harmonized and introduced into the scientific circulation and educational process only by a few aspects of life. The vast majority of research is concerned with describing only specific entities, first of all, product, company, market, where the formalized clear components of change and their correlation are distinguished (Shnejder, Kacman, Topchishvili, 2002). However, there is no unified classification of cyclic laws of multi-level systems, the number of constituent elements and their names in the sources differ and are given according to the context by managerial levels and situational characteristics (Afonin, Bandurka, Martynov, 2008; Farr, 2011; Sokolov, Devezas, Rumyantseva, 2017). This fact necessitates the continuation of scientific research in the conceptualization of methodological aspects of the life cycle of complex open dynamic systems.

The paper purpose is to identify and unification the system components of the life cycle for the sake of rational formation, structuring and management.

4. Methodology and Methods

The research uses the author's methodology, which:

- examines the multi-level cyclical patterns, identifies problematic and discussion issues and identifies systemic features of cyclicality;
- investigates peculiarities of complex open dynamic multi-level systems, an element of which a human being appears;
- applies systematic approach, methods of analysis, synthesis, analogies, observation, comparison, abstraction, grouping, generalization, modelling;
- uses principles of scientificity, objectivity, rationality, economy, balance, sustainability, purposefulness, complexity, planarity, information security, creativity, priority, multivariate, efficiency, structured, harmonized, manageable, secure, dynamic, collectivity;
- system life cycle structure is conceptualized and visualized;
- the directions of system life cycle management are considered by regulating the ratio of system components and the creation time of the new system.

5. Analysis and Results

In the scientific literature, the study of scientific and methodological aspects of "Life cycle" occurs mainly within the framework of a systematic approach, when based on the existing cyclical regularities, the temporal aspects of system development are considered.

The origins of understanding cyclic regularities have developed in ancient times and become an archetype constructed as a result of observing the properties of the material world. For instance, in the natural dimension, it is the change of season: winter, spring, summer, autumn, etc., caused by the rotation of the Earth around the Sun; these are daily changes: night, morning, day, evening, etc., caused by the rotation of the Earth around its axis; is the transition of substances from one state to another: liquid, solid, vapour, plasma, etc. under the influence of changes in temperature. In the biological dimension for animals and plants, it is the set of development phases of a living organism, which gives birth to a new generation while passing them. In living beings, the life cycle is regarded as ontogeny – a set of successive changes from the organism's moment of birth to the end of life. For humans, ontogeny involves the phases of: fertilization, embryonic, post-embryonic, and adult organisms. The ontogeny of plants distinguishes growth, development and ageing. The stages of the social cycle are revolution, involution, co-evolution and evolution. The economy considers economic cycles as the movement of production from one crisis to the next according to the phase of the economic cycle, the main of which are: crisis, depression, recovery, exaltation; or, according to other approaches, determine peak, bottom, bust or recession.

The systems' formation idea dates back to antiquity, in the mid-1920s, the term "system" became one of the key philosophical and methodological and scientific concepts, and in the late 1960s – early 1970s, began to use the term "systematic approach" in the philosophical

and systems literature, which concluded the object research expediency as systems (Blauberg, Judin, Sadovskij, 2001).

In a general sense, a system is a collection of individual elements that are in a relationship and bond with each other, forming a new integrity and quality. According to the basic principles of system theory, any object, phenomenon, or process can be considered as a system if: there are two or more system elements; each element has inherent qualities only; there are links between the elements by which they interact; the elements are organized according to a certain structure; functioning in time and space; there is a possibility of dimension; there are boundaries and the environment, etc. (Thomson, 1998).

Systems are formed artificially by embedded retention constants (e.g., gravity, motion, charges, masses, orbits, temperatures of the matter transition, structures of substances, fixed relations, etc.) and memory. The system's main characteristics define: endurance, stability, soundness, tolerance, resistance, elasticity. For its operation, the system performs a set of interrelated functions, the main ones are: collection, storage and reproduction of information; maintaining the structure of the system components; maintaining the order of processes and resources in time and carrying out their transformation; removal of substances, energy and information from the environment; system activity waste removal into the external environment; system protection; adjusting the performance of individual sub-systems; adjusting for deviation of flow parameters from optimal values (Mel'nyk et al., 2005).

The life-cycle of systems is methodologically explained by axiomatics, regularities and laws. Axiomatics: covers all spheres of human life from the standpoint of consciousness, understanding, outlook, feelings, activity; defines categories, events, phenomena; is a statement. Patterns are stable, common and repetitive relationships between phenomena, processes, categories, objects, entities, functions, methods, principles, decisions, status, etc. Patterns are observed, identified, considered and used to rationalize human life. Laws are objectively existing, constant, proven, logical and necessary interrelations among objects, phenomena or processes, arising from their internal nature, essence, reflect cause and effect relationships and characterize the course of events.

Exploring the life cycle allows distinguishing natural, biological, technical, economic, social and management systems in overall. The most sophisticated systems are the human element that forms combined system connections. Consider such complex open dynamic combined systems in more detail.

The "human being" system. A human being has a unidirectional biological life cycle: birth (the period from conception to birth – seven to nine months); childhood (the period from the moment of birth to the beginning of the process of conscious social communication and education – up to 5-7 years); youth or adolescence (the period of accumulation and development of the body's vital forces until puberty, acquisition of civil rights, the possibility of self-sufficiency in society – from 5-7 to 14-21 years); maturity (the period of becoming a human being who has already reached the full physiological formation and capacity in society and is involved in active labour and social process, creates own family, gives birth and raises children – from 14-21 to 50-70 years); ageing or old age (period of exclusion from active labour and social process and loss of health, working efficiency and capacity, which ends with a death of a human being – 50-70 years and more); death (social and biological) (Afonin,

Bandurka, Martynov, 2008). Accordingly, human resources have life-cycle stages: birth, formation, development, and exhaustion (Kuznecova, Nosyreva, 2009). Modigliani and Brumberg (1954) developed a life-cycle hypothesis as a model explaining the planning of consumption and conservation of a population over the life cycle to maintain a sustainable standard of living.

Stages of the employee's work career, as a rule, are associated with the working life of a human being, and in the scientific literature, those are traditionally classified as: preparatory (a period associated with the process of becoming a human being, training, adaptation, self-affirmation – up to 25 years); adaptation (the period of becoming an employee, when the development of the profession, skills are formed and fixed – 25-30 years); promotion (career growth and significant employee achievement – 30-45 years); preservation (the period of fixing achievements of an employee and the highest skill results – 45-60 years); final (period of curtailment of labour activity, decrease in efficiency and productivity, preparation for the end of career, completion of professional affairs, transfer of knowledge – 60-65 years); pension (period of non-professional activity of a human being, which may be accompanied by active social activity – 65 years and more). Those stages can also be classified according to other approaches, depending on attitude to work, behavioural characteristics, perception, etc. For instance, such steps could be orientation, anchoring, demonstration of opportunities, monotony, exit, etc. (Zakharova, 2018).

Family system. There are different approaches to looking at the family life cycle. For example, Neubert identifies 5 stages of family-related birth and cohabitation, Satir classifies 10 stages of crisis-related family, Vasilyeva highlights 5 stages related to communication and birth of offspring, Hill notes the presence of 7 stages associated with birth, upbringing and death, Erikson proposes 6 stages of family, formed by relationships and age of marriage (given in Karabanova, Konopleva, Garanina, 2007).

The commodity system. When considering the life cycle of a product, the following stages are usually determined: product introduction, sales growth, maturity stage, market saturation, commodity decline; growth, maturity, decline (Shnejder, Kacman, Topchishvili, 2002). In international trade, the life cycle of a product is viewed in close relation to innovation, markets, national economies, and international competition (Audretsch, Sanders, Zhang, 2017). In the area of commodity policy, Life Cycle Sustainability Assessment (LCSA) is a popular trend, as an interdisciplinary basis for integrating development models, as well as for tracking the environmental impact of production, use and disposal of products (Onat et al., 2017; Rajagopal, Vanderghem, MacLean, 2017).

The enterprise system. Usually, there are distinguished such life cycle stages of an enterprise as birth, childhood, adolescence, early maturity, final maturity, ageing and rebirth; or birth, growth, peak activity, and decline; or the emergence, rise, high point, recession, crisis process; or creation, formation, stabilization, consolidation, problematic, brink of bankruptcy, bankruptcy (Shnejder, Kacman, Topchishvili, 2002; Adizes, 2003), modern studies note that life cycle phases significantly influence the management of an organization (Gurianova, Gurianov, Mechtcheriakova, 2014). Currently, new developments are constantly emerging in the optimization of production and organizational activity of an enterprise due to cyclic regularities (Mikulášková et al., 2020).

The business system. Alexandrov (2018) examines aspects of business-cycle – that is, business, economic, and enterprising cycle that manifests itself at the micro, meso- and macro levels. An important feature of business cycles is that they emerge naturally from the logic of economic development and operate synchronously across industries. Accordingly, the assessment of business cycles phases contributes to a successful forecast of the economic environment and entities (Guvenen, 2016).

The business model system Jabło´nski and Jabło´nski (2016) highlights differences in business models in the context of company life cycles and sustainability criteria. It is noted that the company development can be viewed in terms of a business model that should consider stages of Initiation, Growth, Maturity and Decline.

The city system. Turgel' (2008), exploring theoretical approaches to analysis of urban cyclicality, notes that the life cycle of a city is a sequence of phases' changes of emergence, growth, maturity and decline, which driving force is the development cyclicality of functional specialization, ensuring the interaction of external elements of environment economy.

The region system. Butorina, Pazdnikova, Karpovich (2018) identified cyclical processes in innovation, investment, technological, technical, industrial, social and structural components of regional development of the country's region.

The branch system. According to the ADL/LC model developed by Arthur D. Little (2016) consulting company, the life cycle of an industry includes four stages: birth, growth (or development), maturity, ageing (or decline). Developments by Hauschild, zu Knyphausen-Aufseß and Rahmel (2011), who have found a relationship between cyclical changes in industry indicators and "Customer preferences", "Competitive situation", "Technology" (are thorough in this area of research). Vasylieva and Velychko (2017) consider the questions of the cyclic patterns and the interconnections of industrial cluster development in their research. The results acquired are used in the regional management optimization process on the whole and in controlling function optimization in particular.

The market system. The market, as a set of economic relations between buyer and seller, also has cyclical patterns that significantly affect the frequency of goods sale, profitability and the entities market policy (Coibion, Gorodnichenko, Hong, 2012).

The elite system. It is necessary to note the cyclical dynamics of continuity and of changes in the control sub-systems of the macroeconomic level, observed in the 14^{th}-15^{th} centuries. Arab scholar Ibn Khaldun identified the patterns of change in the ruling dynasties (elites) over four generations within the 80-100-year political and demographic cycle as a result of a decline in their collective solidarity (cited in Korotaev, 2006).

The state system. Cyclical phenomena in countries can be identified by macro indicators. In the twenties of the XXth century, Kondratyev determined that in the long-term dynamics of some economic indicators, there is a certain cyclicality when the phases of growth of the respective indicators come with phases of their relative decline with a characteristic period of fluctuations of about 50 years. Detailing the structure of Kondratyev cycles has led to the advent of a four-phase model, when within one Kondratyev cycle (long wave), there are not two, but four phases – prosperity, recession, depression and recovery (Poletaev and Savel'eva, 1993), and provides an opportunity to exercise long-term forecasting with 40-year

oscillation time periods (Tănăsescu, Bucur, Oprean-Stan, 2016; Wilenius, Kurki, 2017). Moreover, Pavlov et al. (2019) spot the connections between the cyclic patterns in different countries.

The global process system. In global development processes (challenge, problem, trend, threat, risk), cyclicality is also manifested (Sardak et al., 2017). For instance, globalization is the first phase of the formation of a unified system of the world economy, the second phase is defined as the struggle of national capitals, the third is identified by the Cold War, the fourth is the general expansion of the market economy system. Terrorism, also viewed in terms of a systems approach, has cyclical features and components of maturation, propagation, peak, extinction, and cessation (Schoenenberger, Schenker-Wicki, Beck, 2012).

The humanity system. The world population also has signs of cyclical development. This applies to both historical aspects of rising social and economic development and current demographic trends of humanity as a whole and of individual civilizations (Barraquand et al., 2017; Guo, 2017), and from 2030 will go to the beginning of the stabilization phase.

The world system. Different development cycles of the Universe, humanity, civilizations (religious, ancient Indian cycles, Mesoamerican cycles, zodiacal epochs, Pushkin's cycles, Sorokin's social and cultural cycles (Sorokin, 1996), Chmikhov's cosmogeosocial cycles, language cycles etc.) (Grinin, Korotayev, Tausch, 2016).

It should be noted that at the grassroots management levels of the global environment of human life system, the thesis about cyclical development and life cycle stages is considered by a wide range of scientists and is beyond any doubt. At hierarchically higher managerial levels of the global environment of the human life system, the scientists notice only similar patterns of cyclical nature. But despite the great research material, the important question raised by Popper on scientific objectivity of explaining cyclical development of social and economic systems remains unresolved (Popper, 1983).

For example, based on analysis of the papers of the above scientists, we can note the following problematic and discussion issues regarding cyclical development of systems with human participation:

- uncertainty of the driving forces' source of repeated changes;
- fuzzy delineation of systemic (internal) and extra-systemic (external) influence on development;
- lack of a unified description of the nature of development at different managerial levels;
- the use of different descriptive terms for the same constituent elements of repeated changes (period, step, stage, phase, wave, cycle);
- uncertainty in the number of constituent elements of repeated changes;
- lack of a mechanism for identifying the exact time of change of constituent elements of repeated changes;
- a superficial description of the off-system life of subjects (pre-system creation period and post-system elimination period);
- paying more attention to initial and less attention to final components of repetitive change;

- lack of a reliable mechanism for forecasting and predicting dynamics of constituent elements of repeated changes (Sardak, Dzhyndzhoian, Samoilenko, 2016).

At the same time, it can be stated that all social and economic systems develop within repeated changes and are characterized by the same signs of cyclicality:

- indicators' variations characterizing the state of subjects are noted;
- systemic (from the moment of creation to liquidation) and extra-systemic (pre-systemic creation – "design" and post-system liquidation – "utilization") periods are ascertained;
- subjects are created by actions of other entities (that is, the entities do not arise "unknown from where" but are the result of the actions of other entities – "constructors");
- after the entity's termination, their resources are used by other entities (i.e., the entities do not disappear "unknown", but they get transformed into resources of other entities – "utilizers");
- entities have a unidirectional life cycle from "birth" to "death";
- entities do not necessarily go through the entire life cycle (each point in time may be the last);
- entities' activity sometimes shows similar changes in indicators;
- entities experience upward, peak, and downward fluctuations in indicators;
- slight fluctuations occur in constituent elements;
- nature of fluctuations in the indicators and length of life of the entities are individual.

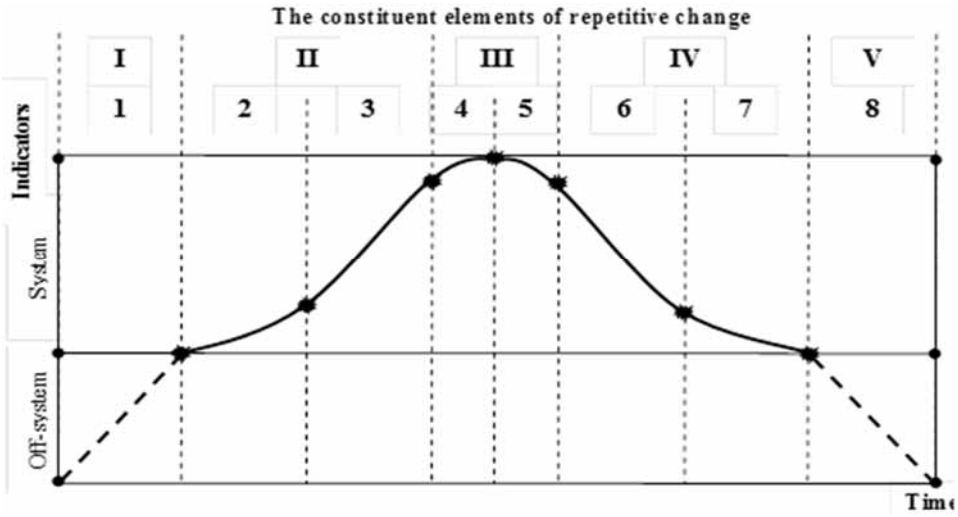
These definite signs allow to point to a simplified structure of the life cycle of a system Figure 1 (where a human being becomes an integral element and forms a combined system connection), by constituent elements of repeated changes (general and specific), which are determined by indicators (natural or relative) and time (hours, days, months, years).

Presented in Figure 1 graph is given as a proportionally balanced curve that describes the off-system (highlighted two common components) and systemic (highlighted three common components) state of a system. Determining the two off-system and three system-wide components of recurring change allows to diagnose, predict and regulate the dynamics of systems development indicators.

In this context, it is necessary to note the important role of finding the key points of change in the nature of the indicators' dynamics. Key points of change in the nature of the indicators' dynamics determine specific components (periods, steps, stages, phases, waves, etc.). For instance, there identified 8 specific constituent elements. However, the number of key points of change in nature of indicators' dynamics and, accordingly, the number of specific life cycle components (as well as their duration and fluctuation limits) may differ from entities and be larger, because in practice, the trend curve is not "smooth", it is subject to constant imbalances ("jerks" and "delays").

Figure 1

Simplified system life cycle structure



– dynamics of system indicators;
– dynamics of out-of-system indicators;
– limit values of indicators;
– components dynamics of the life cycle;
– key points of change in the indicators' dynamics;
I – the first common component – the "pre-system state" (creation of system sub-system forces);
II – the second common component, the "growth" (increase indicators);
III – the third common component, the "stabilization" (alignment of indicators);
IV – the fourth common element, the "reduction" (reduction indicators);
V – the fifth common component element is the "post-system state" (elimination of the consequences of system activity by extra-system forces);
1 – the first concrete component is "creation";
2 – the second specific component is "slow growth";
3 – the third concrete component is "rapid growth";
4 – the fourth specific element is "increasing stabilization";
5 – the fifth concrete component is "shortened stabilization";
6 – the sixth concrete component is "rapid reduction";
7 – the seventh concrete component is "slow reduction";
8 – the eighth concrete component is "liquidation".
Source: compiled by the authors.

The ratio correctness of repetitive changes components in systemic state of the life cycle of entities of human life in graphical form is indirectly confirmed by the development of Weibull (1961), Gauss (cited in Fisher, 1958; Pogorelov, 1974; Kolmogorov, 1987; Petrov, 2008) in "normal distribution" in technical, natural and biological systems.

This trend is abstracted in comparison with dynamics of biological activity of flora and fauna according to the annual calendar, which is most clearly observed in the middle latitudes of the Earth for seasons:

I – the first constituent element is winter (January, February) time of "sleep" or "rest";

II – the second component is spring (March, April, May) is a time of "growth";

III – the third component is summer (June, July, August) is the time of "highest growth" or "development";

IV – the fourth component is autumn (September, October, November) is the time of "slowing down";

V – the fifth component is winter (December) is the time of "sleep" or "rest".

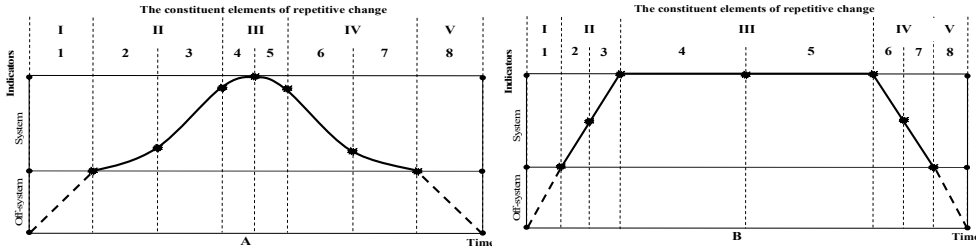
The history of mankind testifies to the continuous effort of humans to consciously manage the life cycle of systems. However, it should be noted that in naturally created systems, the ratio of constituent elements is not subject to significant changes. In artificial systems, there is a wide possibility of management actions. For instance, consider two common areas of system life cycle management.

The first direction is the ratio regulation of the constituent elements of a system. For example, in business activities, entrepreneurs focus their efforts, on the one hand, on minimizing the time of "pre-system state", "growth", "contraction" and "post-system state", and on the other, on maximizing the time of "stabilization". The schematic ratio control of the system components is shown in Figure 2.

Figure 2

Adjusting the ratio of system components

A – conditionally organic ratio *B – adjustable ratio*



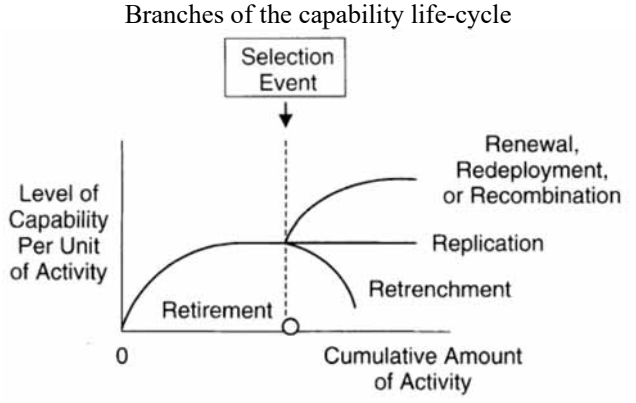
Source: compiled by the authors.

Accordingly, in Figure 2A there is a relatively organic ratio of the system constituent elements for nominal distribution visualization, and Figure 2B depicts an adjustable ratio of system components, which is carried out artificially due to managerial influence. In an economic system, this approach ensures that the duration of the most effective business activity is increased.

The Helfat and Peteraf (2003) research notes, that as a result of "Selection Event" at a certain time, there is a change in system dynamics and there is a realization of three scenarios: growth – "Renewal, Redeployment, or Recombination", stabilization – "Replication" or reduction "retrenchment" (Figure 3).

Figure 3

Branches of the capability life-cycle

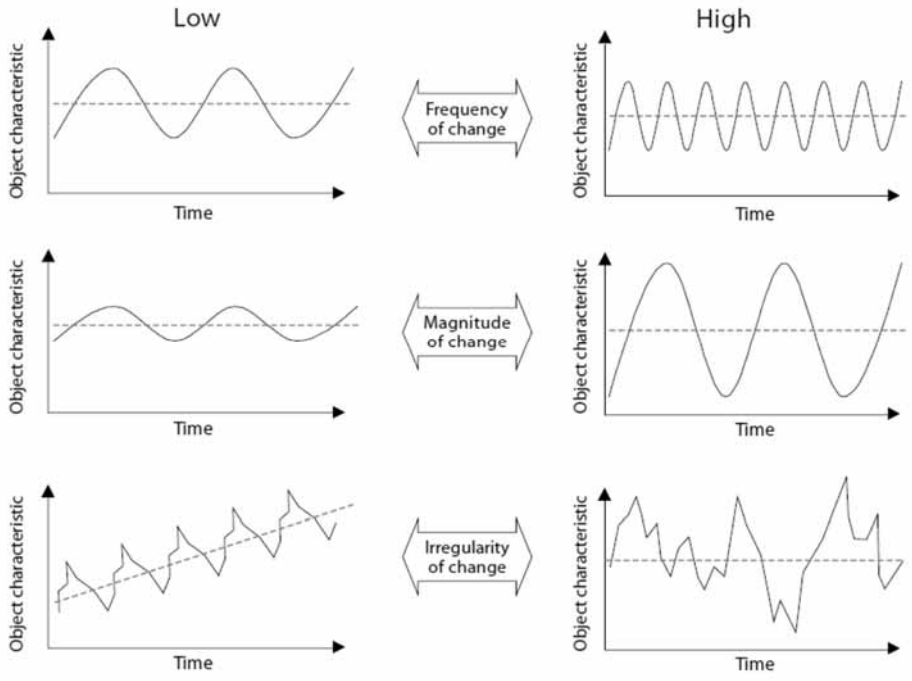


Source: Helfat and Peteraf, 2003.

As a regulation variant of the constituent elements ratio of a system, the visualization given in the research by Hauschild, zu Knyphausen-Aufseß and Rahmel (2011) can be cited. This research notes that changes in system indicators can occur in three directions – "Frequency", "Magnitude", "Irregularity" (Figure 4).

Figure 4

Attributes of industry dynamics



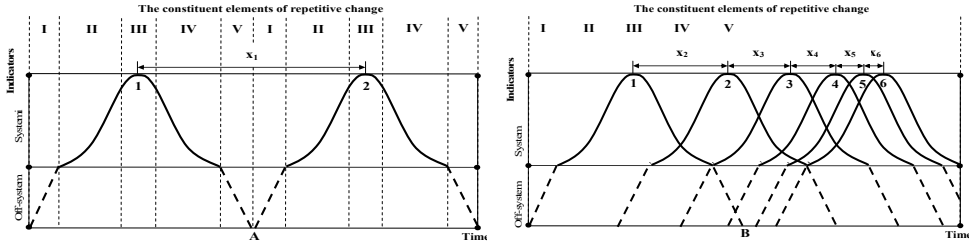
Source: Hauschild, zu Knyphausen-Aufseß and Rahmel, 2011.

The second direction is to regulate the time of the creation of the new system. For instance, in business activities, entrepreneurs focus their efforts on accelerating the releasing new products, new activities, new businesses and more.

Figure 5

Adjusting the time to create a new system

A – conditionally organic ratio *B – adjustable ratio*



Source: compiled by the authors.

Figure 5A shows the time ratio of creation of a new system №.2, after complete passage of all constituent elements of system № 1, when the time between the averaged centres of the "stabilization" element is equal to the value of x_1.

Figure 5B shows adjustable ratio time to create a new system №.2, at the beginning of its "before system state" in the "stabilization" period of system №.1 (respectively, time x_2 is reduced compared to x_1). When designing system №.3 in the period of "growth of system" №.2, time x_3 is reduced compared to time x_2. And so on ($x_1>x_2>x_3>x_4>x_5>x_6$), while accelerating the time of the creation of new systems, it is desirable for entrepreneurs to prolong the time of entrepreneurial activity with its maximum efficiency.

6. Conclusions

The research identified the life cycle components of the system: general ("pre-systemic", "growth", "stabilization", "contraction", "post-systemic") and specific ("creation", "slow growth", "rapid" growth", "increasing stabilization", "reduced stabilization", "rapid contraction", "slow contraction", "elimination") are constituent elements of repetitive change; limit values of indicators; the components' dynamics of the life cycle; key points of change in the nature of performance. This forms a scientific and methodological basis for effective design, creation, management and development of multi-level systems with human participation.

7. Practical Importance

The paper explores and generalizes the approaches of scientists to defining concept of the life cycle of a certain system.

The research suggests that throughout the life cycle of a system at different stages, there are so-called key points that can dramatically affect the life/growth of a system. All this allows to form a scientific and methodological basis for effective design, creation, management and development of multi-level systems with human participation.

The prospect of further research is the development of an applied mechanism for determining parameters of system life cycle components and system life cycle relationships.

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
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DEMOGRAPHIC DEVELOPMENT AND LABOUR FORCE: DEPENDENCIES AND KEY CHANGES[2]

This study systematises the fundamental dependencies between demographic development and labour force and identifies key changes in the labour force in the country over the last two decades. A theoretical model was presented featuring the formation of the labour force focusing upon demographic factors. The place of reproduction of labour force among the systems of public activities and the classification of factors impacting it were defined by applying a system approach. Some leading tendencies in the evolution of the labour force in the country during the period 2001-2019 were featured. To achieve a fuller and more objective evaluation, an international comparison was made, including four European countries: Greece, Hungary, Czechia and Sweden. The analysis includes some indicators of general and age-specific levels of economic activity, working-age population replacement rates and the age and educational structures of the labour force and inactive persons.

The received results testify that the tendencies, observed in Bulgaria, are close to those, registered in the selected European countries over the reference period. There is, however, a number of particularities and specificities of their manifestation in the country and these are key or the reproduction of the labour force in Bulgaria.

Keywords: labour force reproduction; generational model; economic activity levels; labour force ageing; economically inactive population's structures

JEL: J11; J21; J18

The last few decades were a period of significant changes in the reproduction of the labour force in post-modern societies entailing long-term implications (Trubek, Mosher, 2001, p. 1-9; European Commission, 2011). Our nation is no different. We would even claim that, given the fact Bulgaria is a small country with relatively limited resources, the socio-economic consequences ensuing from the changes in the labour force have always been of key importance (regardless of whether these have been prioritised by governments' policies or not). The adopted National Development Programme: Bulgaria 2020 testifies that some aspects of the country's labour force development are already being included in the political vision on Bulgaria's development. These, however, should be written into the core of the national long-term economic development concept and bound to the other aspects of both

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economic and demographic strategies. This necessity is growing into an increasingly compelling imperative for this country. Given the long-term reduction of the nation's population, it should be emphasised that Bulgaria's socio-economic development will be closely dependent on the way and degree of solving the problems relative to the development and efficient use of the labour force (Naidenova, 2013, p. 16).

Over the last several decades, a number of mutually related issues have been accumulating in the domain of Bulgaria's labour force reproduction. Undoubtedly, these extend their influence upon the demographic development of this population group. However, they also have certain impacts on the overall development of the country and society, which may become significantly more complicated in the future (Borissova-Marinova et al., 2018; Beleva, 2017; Atanassova, 2013). The changes in some basic demographic parameters of the labour force largely ensue[3] from long-term trends in the main demographic processes:

- High general and premature mortality in a European context (European Commission, 2011a);
- Fertility below the level of replacement of generations from the mid-1980s to the present (Moraliyska-Nikolova, 2020; Coleman, 2009);
- Relatively high for the scale of the country and a relentless negative migration balance (Kalchev, 2019).

From a demographic point of view, there are two main consequences stemming from the combination of negative natural change and negative migration balance maintained for several decades (Borissova-Marinova, 2013). In one respect, as a result of such population development over the last 15 years, Bulgaria has been invariably in the group of European countries with ongoing depopulation. (Dumont, 2019). Another aspect thereof is that there has been a significant acceleration in population ageing. This process implies its demographic effects upon the labour force and population in working age, which population is a natural resource for its replenishment. The most significant among them are the reduction of the size of the labour force and the working-age population in the country and the rapid deterioration of their structures on a number of demographic, social and economic grounds (Borissova-Marinova et al., 2018; European Commission, 2018).

According to the developed demographic forecasts and projections by the UN Department of Population, Eurostat, and the NSI, no changes in the reproduction regime of the country's population are envisaged (Borisova-Marinova and Moraliyska-Nikolova, 2019). The results of the forecasts on Bulgaria's labour force published over the last decade show that, other things being equal, the trends of labour force reproduction will also continue for at least the next 20 years (Borisova-Marinova, 2019). Due to the above considerations and given a strong competition today between developed countries for attracting labour force, the importance of more efficient labour force management is growing. The state policy based on scientific data and aimed at well-being and balance in society is a leading tool for adapting to the current parameters of demographic reproduction in Bulgaria. In the present-day context,

[3] However, they are also dependent on many other factors, including economic and social factors, as set out below in the exposition.

counteraction to the reduction and rapid ageing of the labour force should be sought in measures to improve the reproduction of the labour force, such as increasing economic activity and the parameters of human capital.

This study's objective is to systematise the fundamental dependencies between demographic development and labour force and to identify key changes in the labour force in the country over the last two decades. A generation model was presented featuring the factors for the formation of the labour force focusing upon demographic factors. The place of reproduction of the labour force and the classification of factors impacting it were defined by applying a system approach. Based on it, some leading changes in the evolution of the labour force in the country during the period 2001–2019 were featured. To achieve a more complete and objective assessment of the changes produced in the characteristics of Bulgaria's labour force, an international comparison was made, including four more European countries (Greece, Hungary, Czechia and Sweden).

Modelling Demographic Development/Labour Force Dependencies

Labour force reproduction is a theoretical concept to look into the generation renewal process and the labour force structure changes. Modelling was introduced to the demographic theory after the blueprint of the "reproduction of population" concept as a process going on within one of the most important subgroups of the overall population of a nation. This term would designate "the result of all changes to the units of the dynamic aggregate and their reflections upon the number and composition of population" (or of a subgroup thereof) over a given period (Sugarev, 1975, p. 295). This theoretical concept would help researchers study some key aspects of the process of change and replacement of generations in the population (Pressat, 2006, p. 38).

Reproduction of labour force is a complex process with a number of dimensions generating a number of hardships in modelling thereof. Among these, the complex nature of the labour force stands out in particular, which is why a dualist approach has been applied in both science and academic practice. Today it is considered generally accepted that the demand for labour is mainly an economic category and the result of the development of economic processes, with the supply of labour being an external value for the economy. In other words, labour offer is only viewed as a demographic category characterising the availability of people willing to join the labour market. From a demographic perspective, however, what is an external factor for the population is the labour demand. This factor has a decisive impact upon the very formation of the labour force – both on the number of its demographic and socio-economic structures and on the process of reproduction thereof taken in its dynamics. Therefore, the main, and still unresolved problem while modelling labour force reproduction stems out from its dualist nature and the dualist approach to it in the labour market models. Regardless of the rapid development of the so-called demo-economic models[4] starting from the 1960s onward through to this day, the attempts to shape a unified labour market model

[4] Where various demographic and other processes are included as endogenous variables.

have so far failed to yield a satisfactory result from the perspective of theory, methodology of modelling or practice (e.g. forecasting).

What should be done prior to categorising the factors and clarifying the nature of relations between demographic development and labour force reproduction is to model its location among the elements of society. To this end, the systemic approach was applied to this problem requiring the main activities in a society to be grouped based on the specific internal element-to-element relations. Sources reveal various viewpoints on how society's elements should be classified into subsystems. The model applied here to society as a system was authored by the member of the Bulgarian Academy of Sciences E. Mateev, a model which, in our view, allows to derive precisely and adequately the place where the labour force reproduction belongs. This model groups the fundamental activities in a society into four subsystems based on some specific internal relations between their elements (Figure 1). It reserves an explicit location for the population as a subsystem through which the demographic development is expressed[5]. The dualist nature of the labour force is defined quite precisely: labour, which from the viewpoints of the other systems is an input, is an output from the viewpoint of a demographic system. Therefore, persons who perform it belong to two systems at a time. For example, persons employed in economy "given their origin, make part of the demographic system as inside this system and as a result of its intrinsically specific bonds, they are reproduced. However, if viewed their functioning, they become part of the economic system as, by default, a production process includes man" (Mateev, 1987, pp. 64-65). The same duality is observed at the other entrance-exit: "Demographic system-Noosphere". The elements of the system thus defined, the connections between them and the connections with the other systems of society are in full agreement with the theoretical definitions of demographic reproduction of both the whole population and the labour force as cited above.

Among other things, the theoretical model shows explicitly the place of the processes running on the labour market, or if defined from a demographic viewpoint, the reproduction of the labour force. On Figure 1, it is shown as a dotted rectangle covering parts of three of society's systems. It includes a large part of the demographic system (these are the economically active persons in and outside working age), parts of the economic system and the noosphere (expressing the processes of job searching) and the two exits from the demographic system to them (representing, in fact, the labour offer processes).

A further hurdle in modelling the reproduction of the labour force ensues from the multitude of heterogeneous factors[6] impacting this process. Two are the factors most commonly mentioned in the sources: the number of the working-age population and the social division of labour, which determines the existing structure of social production (Haines, 1979; Sauvy, 1963; Stefanov et al., 1974). The cited authors take the view that the social division of labour is both exogenous and structure defining factor as far as they esteem economic activity as

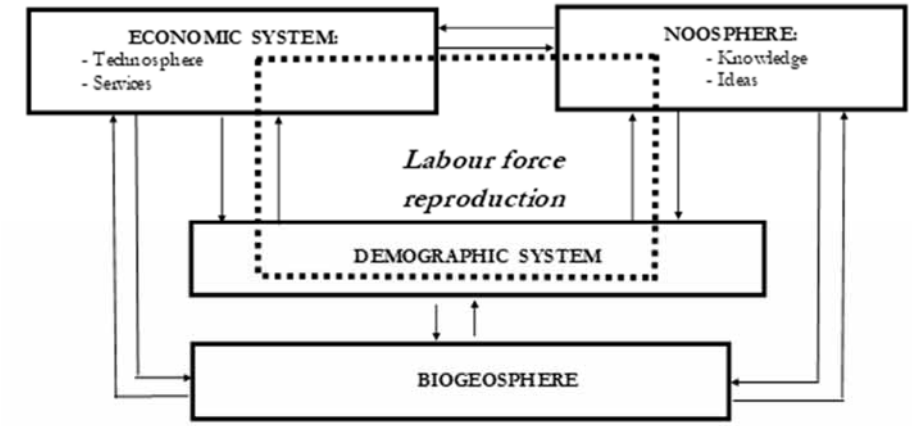
[5] The specific internal bond between the elements of the demographic subsystem is the reproduction of humans.

[6] The term *factor* is employed not in its specifically statistical meaning, but in a broader sense. It designates the reasons, which generate the change and are part of it, and the external conditions that cause those changes.

belonging only to society's economic system. Moreover, sources may also offer some more detailed groupings of factors, with none of them purporting to be exhaustive. According to Sauvy, economic activity depends on a number of factors, among which those demographics are last but not least so long as each age and sex group has its own intrinsic activity rates and there are certain regular patterns in their transformations while making transitions between such groups (Sauvy, 1963).

Figure 1

Place of reproduction of labour force among the systems of activities in a society



Source: After Mateev, 1987, pp. 15-69.

The most general classification of factors would include two groups: demographic and non-demographic factors (Stefanov et al., 1974, p. 397). If the first group of factors is concerned, the picture has almost entirely been clarified from a macroeconomic perspective while considering the momentary condition of the labour force. Their influence is considered to be greatly defining the overall number of the labour force. This group would usually include: number of the working-age population; number of disabled persons due to disability and early retirement for age for certain categories of occupations; number of active disabled and working-age pensioners; and number of active persons in non-working age. As long as a large portion of the above listed demographic factors is dependent in turn on the size and the age and sex structure of the entire population, it is quite obvious that "the available labour force comes as a result of population's reproduction and is largely dependent upon the demographic development in previous periods" (Stefanov et al., 1974, p. 397). Going further deeper into this formulation shows that this classification is incomplete because, to say the least, it lacks factors such as mortality and external migrations.

The other group includes factors of different nature: economic, social, cultural, psychological, historical, etc. The most quoted in the sources are: division of labour; change

of the branch and territorial structure of the economy; level of labour costs; development of the educational system of the country; the age specified by law for starting and ending economic activity; the level of completed education; the age of completion of the respective educational degree and entry into activity; organisation of production and management; the degree of urbanisation; labour force mobility (territorial, professional, sectoral); the intensity of migrations; the level of income in households; the state policies regarding economic activity; and a number of others.

Even such a brief listing of the main factors influencing the formation of the labour force shows that there are many of them. Moreover, they form a heterogeneous aggregate owed to the differences in their nature, origin and opportunities to quantify them. Furthermore, it should be outlined that the division thereof into two groups, demographic and non-demographic, is not sufficiently grounded or precise, particularly for the purposes of labour force reproduction modelling.

The third specific particularity while modelling the labour force reproduction ensues from the fact that there are different types of dependencies existing between the factors and the event/result. Even the most superficial look would show that, e.g., the dependencies between the labour force and the number of disabled in active age or the branch structure of the economy belong to different types. The results of the analysis thereof show that there are two types of causal relationships existing between the labour force and factors (Borissova-Marinova, 2007, p. 98-101). The first type covers structural dependencies of a portion and whole that come very clearly to the fore when the labour force is treated as part of the population[7]. The second type of bonds is a correlation, i.e., the same changes in the value of factors do not always correspond to the same changes in the event/result. This is the nature of bonds existing between non-structural demographic and other factors and the labour force. This type of dependencies stands out when the dependencies of the labour force with the other society's systems are scrutinised.

Taking into account the considerations presented so far, the process of formation and reproduction of the labour force can be represented by the following theoretical model (Figure 2). This model divides the factors into separate groups depending upon their nature. Given the purposes of this study, the scheme separates five main groups: direct demographic factors, indirect demographic factors, economic, social and other factors.[8] As demographic factors are considered to have the strongest and longest-lasting impact on the number and distribution by sex and age of the workforce, they are presented in more detail. This is why the proposed model divides the demographic factors into two separate groups (direct and indirect), according to the period over which their impacts upon the overall population and working-age population takes place. In the model studied, non-demographic factors are distributed into three separate groups. Economic and social factors have a much stronger

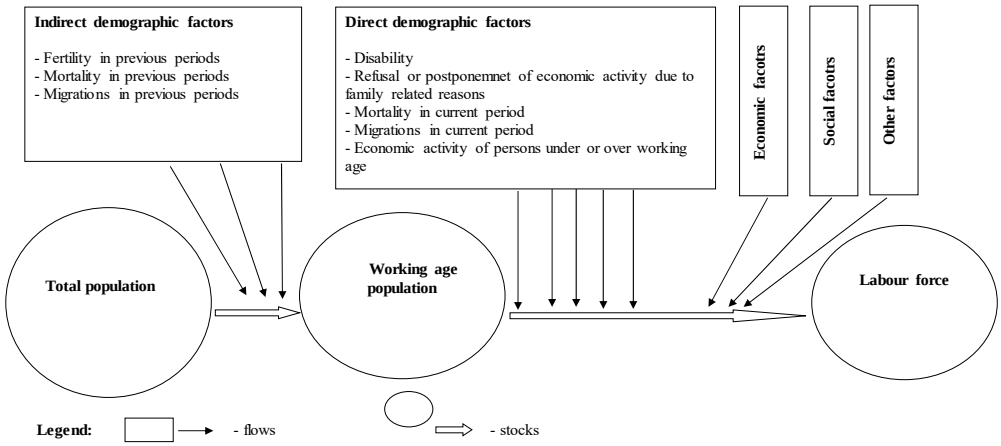
[7] This type of dependencies is used to calculate the size of labour force in a given moment: persons who are not economically active due to health or other reasons (disability, raising children, continuing education, etc.) are excluded from the working age population. To the number obtained is added the number of economically active persons outside working age.

[8] This group includes some cultural, historical, psychological and other factors, which are relatively detached and may be structured into a system, whose effects however are difficult to quantify.

influence upon the qualitative characteristics of the labour force, however, their impact over the quantitative parameters of the labour force should not be overlooked in the modern period of development.

Figure 2

Generation model of labour force reproduction



Source: Borissova-Marinova, 2007, p. 96.

Indirect demographic factors form the first group. The distribution of the working-age population by sex and age in a certain moment of time is conditional on the levels of fertility, mortality and migrations over the precedent periods. In other words, the number of people in the 20–24 age group in 2020, for example, depends at the same time on how many children were born in the period 1996-2000, how many of them lived to 2020 and how many of them did not emigrate (immigrated, respectively) in the period 1996-2020. The number of children born in the period 1996-2000, in turn, depends on the size and age distribution of the groups of women in fertile age, which are determined by the level of these three processes during the period starting from the birth of the maternal generations and ending in 1996. The group of indirect demographic factors expresses this chain dependence back in time on the levels of births, deaths and external migrations. It illustrates the demographic impacts on the age-specific distribution of the working-age population having taken place in the preceding periods.

The second group encompasses the direct demographic factors. These are the fundamental demographic factors largely influencing both the size and the age-specific distribution of the labour force in the present-day period. It includes the refusal of economic activity due to family-related reasons mostly associated with confinements and raising children, the level of economic activity among the persons in working age, as well as the levels of disability, mortality, emigration and immigration among the individuals in working age. Four of the indicated six factors exert their influence toward a reduction in the number of labour force vs. the number of working-age population. These are: refusal of economic activity, disability, mortality and emigration. The remaining two factors exert their influence toward an increase

in the number of labour force vs. the number of working-age population. The specific combination of matching the factors of this group in the individual periods largely determines how close are the working-age population distributions and the labour force distributions by sex, age and a number of socio-economic attributes.

Insofar as the impacts of the other three groups of factors lie beyond the objective of this study, these were mostly just flagged in the model. For example, the group of economic factors includes factors such as: structure of the economic complex; price of labour; phase of the economic cycle; degree of organisation of production and management; degree of urbanisation, etc. Social factors encompass the level of education; the ages of completion of the respective degree and of entry into activity; the age stipulated by law for starting and ending economic activity; degree of labour force mobility (territorial, professional, sectoral), etc. Factors of cultural, psychological, historical and other nature, such as the permanent establishment of the pursuit of social and financial autonomy of individuals in developed countries; perception of professional activity as the main means of personal expression of the individual in them, etc. form the fifth group.

The suggested generation model perhaps reflects more adequately and in more details the labour force formation process in the changing context of today's society. Moreover, it provides a general theoretical framework to study the dependencies between demographic development and the changes in labour force. It systematises the influences of multiple factors, either discovered by theory or proved empirically.

The significant changes in the nature of demographic reproduction and in the levels of economic activity in most of the European nations over the last few decades call for applying an interdisciplinary approach while analysing the development of the labour force. Studying the impacts of factors over the development of the labour force would allow both to study the reflection of the regime of population reproduction over the labour force and to outline a more realistic range of possible variants of its future evolution. A further clarification and improvement of the theoretical formulations in this field will allow for the development of the specific tools for studying the influence of individual factors.

Leading Tendencies in the Parameters of Labour Force in Bulgaria During the Period 2001-2019

The results of the analysis of the development of labour force in the country during the period 2006–2016 revealed several tendencies, three of which are indicated as key for its reproduction as part of the EU (Borissova-Marinova et al., 2018, p. 20-69 and 168-178).

- Relatively low employment and economic activity levels in a European context of all age groups;
- High share of the economically inactive population;
- Increasing territorial differentiation between the provinces by number and basic parameters of the labour force and working-age population.

The first two tendencies are the subject of our further analysis.[9] To assess their validity during the period 2001-2019, the results from the international comparison of the EU Member States were also presented. The analysis was conducted under five indicators: total and age-specific economic activity rates by sex, replacement rate of the working-age population, age and education structures of the economically inactive population in working age. The changes produced in the selected indicators come as a result of the impact of a number of factors, however, what is decisive are both the significance of the development of the economic system and the particularities of the demographic evolution in each of the countries.

Level of economic activity

To highlight the general trends in the development of the workforce and participation in the labour market over the reference period, two indicators were used: total economic activity rates by sex and age-specific activity rates by 5-year age groups.

In 2001, **economic activity rates[10]** of males in 15 EU Member States (Figure 3[11]) were above the average indicator for EU-28, which was 76,8% as was the value of this indicator for Greece (76.9%). Another 9 countries (from Luxembourg to Slovenia inclusive in the figure) make up a second group where the indicators are below the EU average, but the difference with it is within the interval 1-5 pp. Six of them were also in the same group by the end of the period (Lithuania, Slovenia, Romania, Luxembourg, France and Italy). The third group includes four countries where this difference is the largest, i.e. between 5 and 10 pp: Hungary (9.6), Bulgaria (8.9), Croatia (7.3) and Poland (5.2).

Until 2019, the economic activity rates of males have been rising in almost all MS in the context of comparatively low increase for the EU-28 (2.6 pp). An exception of this finding were Denmark and Portugal, where a very low decrease was noticed, 1 pp in 2019 in comparison with 2001. In one-third of the countries (Belgium, Ireland, Greece, Spain, France, Cyprus, Luxembourg, Netherlands, Finland and UK), the dynamics of this index for the entire reference period is insignificant (under 1 pp). In another 8 countries (Germany, Sweden, Romania, Malta, Austria, Croatia, Slovakia and Italy), the growth in this index is between 1 and 5 pp. The highest growth of the rates among men (above 5 pp.) is accounted for 8 countries: Estonia (8.7), Latvia (7.2), Poland (6.1), Slovenia (5.5) and Czechia and Lithuania (5); where in the countries with the lowest levels of this index in the beginning of the reference period, the increase is the highest – Hungary (12.8 pp), Bulgaria (9.7).

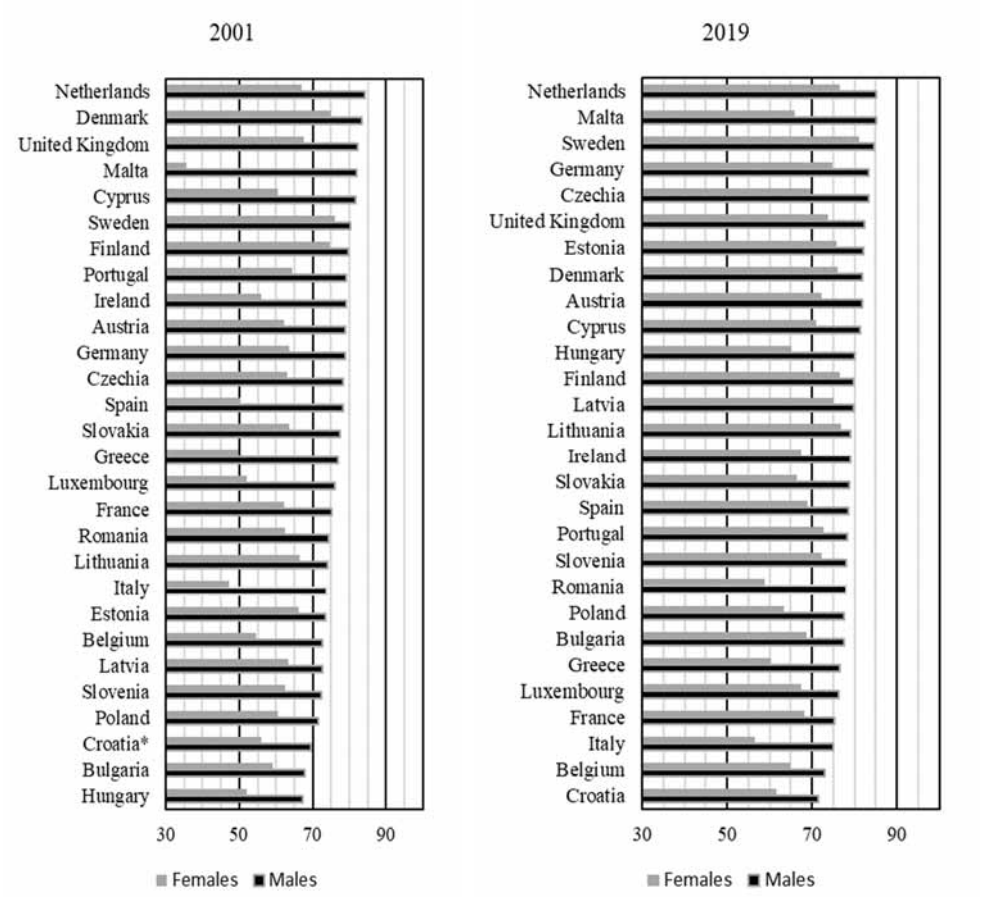
As a result of the described dynamics, in 2019 the indicator for men was above the EU-28 average of 79.4% in a whole of 13 countries (Latvia: 79.9%). While Ireland (-0.2 pp), Spain (-0.9), Portugal (-1.1) have left the group, Estonia (2.7 pp) has entered. The number of the MS in the second group increased by 13 with Ireland, Slovakia, Spain, Portugal и Greece having entered there, with all those having dropped out from the first group, as well as Poland

[9] The study of the degree of the territorial differentiation should be a subject of a separate research.
[10] To more clearly delineate the existing differences, the countries are grouped according to the size of the difference between the indicator and the EU-28 average.
[11] The countries are arranged in a descending order according to the value of the economic activity rates of men.

and Bulgaria, having dropped out of the third group. The group of countries where the activity rate remained by 5 pp below the EU-28 average, included two more countries in 2019: Belgium (6.3) and Croatia (7.9).

Figure 3

Economic activity rates by sex in EU-28 in 2001 and 2019, %



* Data for Croatia are for 2002.
Source: Eurostat, Activity rates by sex, age and citizenship (%) [lfsa_argan]. Accessed: 21.04.2020.

At the beginning of the reference period, the nations assembled four groups according to the size of the difference between economic activity rates of females and the respective average EU indicator. In 2001, the first group, having indicators above the EU-28 average of 60.5%, was the most numerous and included 18 MS with the difference being the most significant in Sweden (15.5 pp), Denmark (14.5) and Finland (14.2). The second group covered three countries where the rates of women were a little under the EU average. Bulgaria (-1.4 pp), Croatia и Ireland (4.5 pp each). The third group would cover Belgium (-6), Luxembourg and

Hungary – 8.5 pp each, respectively, and the lowest were the economic activity rates of females in four of the countries in South Europe: Spain (-10.1 pp), Greece (-10.7), Italy (-13.4) and Malta (-24.9).

The rates for women were also increasing over the reference period where the EU average increase was over threefold if compared to what was observed among men (8.1 pp). It was only Romania that registered a decrease of 3.5 pp. Four were the countries (Denmark, Poland, Slovakia and Finland) where the dynamics for the whole period was relatively low, namely below 2.8 pp. Over one-third of the countries (Bulgaria, Czechia, Estonia, France, Croatia, Italy, Netherlands, Portugal, Slovenia, Sweden and UK) showed an increase of this indicator of 5-10 pp. 9 MS (Belgium, Germany, Ireland, Greece, Cyprus, Latvia, Lithuania, Hungary and Austria) featured a growth in this indicator of 10-15 pp within this period. Over 15 pp was the increase among women in Luxembourg (15.4), Spain (18.6) and Malta (30.4 pp).

In 2019, the distribution of the groups of countries according to the difference of this indicator to the EU average was much more different as the period showed a significant growth of the economic activity among women in a number of countries. By the end of the period, the indicator remained above the average for EU-28 in 16 countries (while France, Poland, Romania and Slovakia were out of the group, Bulgaria and Spain entered). The number of countries in the second group, i.e. those having indices (difference up to 5 pp) lower than the EU average, already includes seven countries: Belgium (-3.7), Hungary (-3.3), Malta (-2.6), Slovakia (-2.2), Ireland and Luxembourg (-1.2 pp each) and France (-0.4). The third group of countries where the activity rate among women stands between 5 and 10 pp below the EU-28 average, included four countries in 2019: Romania (-9.7), Greece (-8.2), Croatia (-7) and Poland (-5.2). The fourth group, featuring a difference of over 10 pp away from the EU average indicator, includes only Italy (-12.1 pp).

It should be noted that despite the trend of increasing activity rates, the scope of the indicator remained almost unchanged during the period for women (14.8 in 2001 and 15.1 in 2019), with a slight decrease among men (from 17.0 pp to 13.6, respectively).

While there has also been a significant reduction in the value of the differences by sex in the activity rates[12], the EU average indicator plunged by over one third in 2019 if compared with 2001 (Table 1). The number of countries where the differences by sex were not above 10 pp grew more than twice over the period and in 2019 already comprised 18 EU Member States. At the same time was registered a twofold reduction in the number of countries featuring high levels of this indicator (over 10 pp). These were predominating in the distribution in 2001, i.e., their number was 21, while their number in 2019 was already 10. A significant achievement in this area is that in 2019 no European nation showed differences by sex above 20 pp. It is noticeable that Bulgaria's indicator remained unaltered (8.8 in 2001 and 8.9 in 2019), but this may not be assessed as a positive tendency. While in 2001 this value was twice as low as the EU average, in 2019 the respective indicator was already nearing the EU average.

[12] This indicator was calculated as a difference between the relevant activity rates among men and women for a given nation.

Table 1

Distribution of EU-28 countries according to the difference by sex in economic activity rates* in 2001 and 2019, in percentage points

Difference by sex	Countries	
	2001	2019
Up to 5 pp	Sweden (4,2), Finland (4,9)	Lithuania (2,3), Finland (3,3), Sweden (3,4), Latvia (4,8)
5-10 pp	Estonia (7,1), Lithuania (7,8), Denmark (8,3), Bulgaria (8,8), Latvia (9,4)	Portugal (5,4), Slovenia 5,8), Denmark (5,9), Estonia (6,3), France (7,1), Belgium (8,2), Netherlands (8,4), Germany (8,6), UK (8,7), Bulgaria (8,9), Luxembourg (9,0), Spain and Austria (9,5 each), Croatia (9,9)
10-15 pp	Slovenia (10,0), Poland (11,0), Romania (11,9), France (12,8), Croatia** (13,5), Slovakia (13,8), UK (14,5), Portugal (14,7)	Cyprus (10,5), Ireland (11,8), Slovakia (12,4), Czechia (13,6), Poland (14,3), Hungary (14,7)
15-20 pp	Germany and Hungary (15,1 each), Czechia (15,4), Austria (16,7), Netherland (17,3), Belgium (18,2)	Greece (16,3), Italy (18,5), Malta and Romania (19,1 each)
Over 20 pp	Cyprus (21,0), Ireland (23,2), Luxemburg (24,1), Italy (26,6), Greece (27,1), Spain (27,9), Malta (46,5)	-
EU average	16,3	10,8

* The countries are arranged in a ascending order according to the value of the difference by sex in economic activity rates.

** Data for Croatia are for 2002.

Source: Eurostat, Activity rates by sex, age and citizenship (%) [lfsa_argan]. Accessed on 21.04.2020.

The results from the analysis show that the economic activity rates were growing during the period in almost all EU countries. The growth among men as a whole was lower in comparison with the growth in the indicator among women, however, it should be taken into consideration that the latter were significantly lower in a number of countries in the beginning of the period. Furthermore, both sexes kept the trend where more than the half of the EU Member States featured indices above the EU average. The number of nations where the economic activity rates were significantly under the EU average indicator (the groups where the difference to the EU average indicator exceeded -5 pp) dropped down to 2 among men and to 5 among women in 2019. The period showed a significant reduction in the differences by sex in the economic activity rates in the European countries, which came as a result of the gradual convergence of indicators for women to those for men in most of the countries considered.

As for the place of Bulgaria against the background of the described dynamics, the obtained results show that despite the observed increase over this period, the levels of economic activity in the country permanently remain insufficiently high in the European context. From the penultimate place in the EU in 2001 for men, the country climbed a little, but in 2019 it was in the last quarter of the ranking of countries (22nd place). The indicators for women hovered around the EU average (in 2001 respectively 59.1% and 60.5%, and in 2019 – 68.7% and 68.6%) and the country's rank rose from 19th position in 2001 to 16th position in 2019.

By comparison, in 2019 the overall activity rate for men in the country was 7.5 points lower than in the Netherlands (85.1%), with that for women being 12.5 points below the figure of Sweden (81.2%), i.e. the countries with the highest levels of economic activity for the respective sex in the EU. The values of the total activity rates show that a large part of the working-age population in Bulgaria remains outside the labour market (about 1⁄4 for men and almost 1/3 for women) at the end of the period under review.

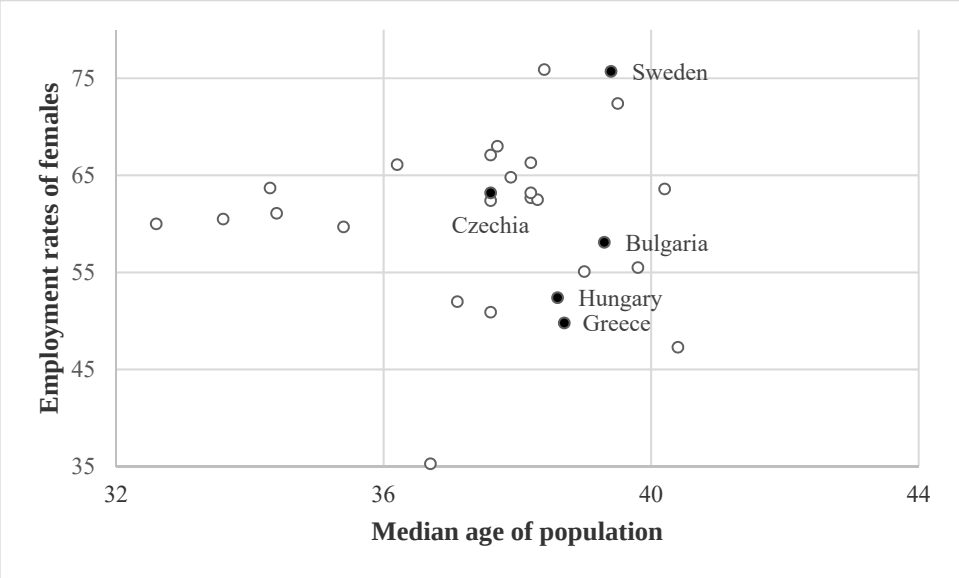
Due to the limited size of this exposition, five European nations were selected for the further comparative analysis: Bulgaria, Greece, Hungary, Czechia and Sweden. The main reasons for such a selection include three aspects. The basic attribute while selecting the countries was the proximity in the numbers of the overall population to Bulgaria's. Bearing in mind that the main target of this study is to go into the dependences between demographic development and reproduction of the labour force, the absolute number of the overall population and of the labour force has a particular importance. A second reason associated with the choice of the nations was the similarity of all those nations' demographic and/or socio-economic development. This was the basis to select Greece as a Balkan country Bulgaria has some similarities in its development from a historical perspective with, and the two East-European countries we share some characteristics and trends of development of our socio-economic systems in the past and which, like to Bulgaria, passed through a period of transition from centralised planning economy to market economy (Czechia and Hungary). Sweden was purposefully added to this group as it has maintained for decades some of the highest levels of activity and employment in the EU. Moreover, its demographic development trends in a certain period of time in the past were similar, and therefore the kinds of problems the state management faced, irrespectively from the degree of social and economic development of the respective country, were also the same or similar. However Sweden, unlike Bulgaria, is a nation of constant immigration, not very high though.

As a result of the selection made, a group of five European countries was formed with two old EU Member States and three new members having accessed the EU in the first decade of 21st century. Figure 4 displays the position occupied by EU countries in 2001, combining two indicators expressing the reproduction patterns of the overall population and of the labour force: median age of population and employment level among women (calculated for the population aged 15+). The countries chosen for the international comparison are marked with a different sign on the figure (black circle) to be easily distinguishable against other European countries.

Obviously, the countries selected for comparison are located in the middle of the figure. This shows that the comparison group includes nations with an aged population, but in different combinations with the values of the female employment rate. In 2001, Germany and Italy's populations had a higher median age than Bulgaria, along with Sweden, which is included in the group. Excluded from the comparison is the lowest middle rectangle, where Malta, the country with the lowest female employment rate in 2001, is located.

Figure 4

Position of EU countries according to the median age of the population and total employment rates of females in 2001



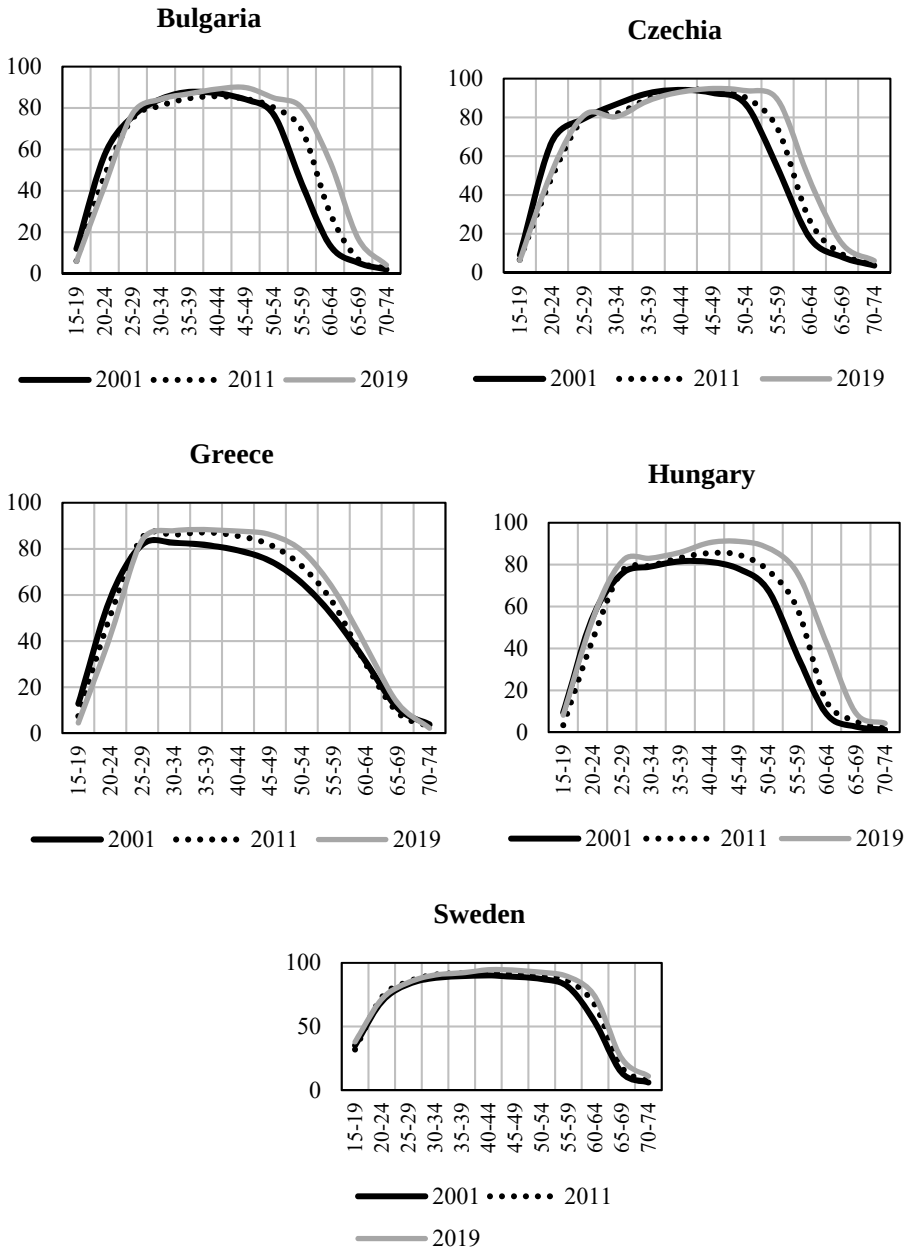
Source: Eurostat, Employment and activity by sex and age – annual data [lfsi_emp_a] and Population structure indicators [demo_pjanind]. Accessed on 24.04.2020.

Age-specific activity rates were used to characterise changes in age activity levels. The main trends during the period under review, which are observed in all five compared countries, are three. The first is the increase in activity levels in almost all age groups in all analysed countries. Depending on the direction of change of the rates and their size, the selected countries can be divided into three groups (Figure 5). The first group includes Bulgaria and Czechia, in which during the period under review there was a decrease in activity rates of all ages under 40 (which reaches 15 pp for the group 20-24), a slight increase in the activity levels in the age range 40-54 and a significant increase in the indicator for the ages 55-65 (35 pp for the group 55-59 in both countries, and for the group 60–64, 40.4 pp in Bulgaria and 29.8 pp in Czechia, respectively).

The second group of countries contains two: Greece and Hungary. Over the reference period, they also saw a reduction in activity levels, however, it only affected the two youngest age groups: those under 25. All other age-specific rates of activity there showed a steady increase until the end of the reference period. It should be noted that the registered increase in activity in the age range 55-64 until 2019 in Hungary had values close to those indicated for the first group of countries (39.3 and 33.9 years, respectively).

Sweden was separated into a stand-alone group, as the period 2001-2019 saw a growth in all age-specific rates of activity there. The largest in terms of value was the increase of the indicators for the age groups 60-64 (20.2 pp) and 65-69 (11.1 pp).

Figure 5
Age-specific activity rates in Bulgaria, Greece, Czechia, Hungary and Sweden in 2001, 2011 and 2019, in %



Source: Eurostat, Activity rates by sex, age and citizenship (%) [lfsa_argan]. Accessed on 21.04.2020.

The second common trend is relative to the much more significant growth registered in the age groups 55+ over the reference period vs. the changes in this indicator in the remaining age groups. This is associated with the extension of working life and the legislative changes undertaken in all European countries to gradually increase the retirement age. The results from the analysis of age-specific activity by sex show that most of this increase was owed to the significant increase of the activity among women belonging to those age groups. It should be noted here that despite the large and rapid increase in activity rates for pre-retirement age groups in 2019, they remained much lower in four of the countries compared with the levels reached in Sweden: 89.0% for the group 55-59 years and 73.5% for the age group 60-64, respectively.

The third trend affects the height and the width of the so-called plateau curve. In three of the countries, Bulgaria, Greece and Hungary, in 2019, the values of the rates from the plateau were below 90%, except for the age groups 40-49 in Hungary (90.5 and 91.1%, respectively). In Sweden, all the rates from the plateau exceed 90%, and in Czechia – only part of them, in the age groups 40-54.

With regard to the width of the plateau, it should be noted that it covers the age groups 30-59 in Bulgaria and Hungary, 25-59 in Czechia and up to 54 in Greece and is the widest and most evenly distributed in Sweden, 25-64.

The results from the comparative analysis show unfavourable trends in Bulgaria, despite the large increase in activity among people of pre-retirement age. The decrease in the activity among the youngest persons, which is also observed in some of the other compared countries, can be explained to some extent by the extension of the training period of young people, which makes it difficult for them to enter the labour market (ILO, 2010). However, the stagnation of activity rates over the reference period in the average age groups, i.e. 25–40, is mostly related to the development and structure of the economy, economic growth and the state policy regarding the economic activity. Among the main reasons for such stagnation can be pointed out the deteriorating situation on the labour market owed to the global financial and economic crisis of 2008, the shut-downs and bankruptcy of a number of small and medium enterprises (Beleva, 2014), maintaining a high share of long-term unemployed, a strong increase in the number of those discouraged to find a job, older generations' insufficient skills and qualifications (Atanassova, 2016), substandard conditions for combining birth and upbringing of children with the professional development of parents (Vladimirova, 2020, pp. 83-225), etc. Despite the large increase in the rates among people aged over 55, at the end of the period, they remain significantly lower than in Sweden, for example (54.0 vs. 73.5% for the 60-64 age group).

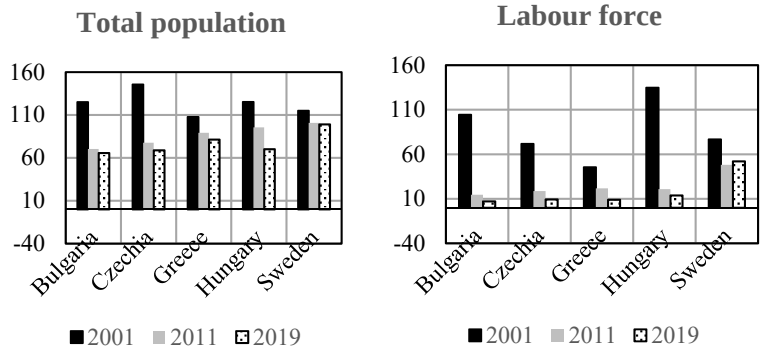
Demographic ageing

Ageing of labour force is directly related to ageing of the total population along the lines of the above-mentioned direct and indirect demographic factors. Moreover, this is very heavily influenced by the changes in the age activity arising mainly from the economic factors, but also under the influence of the other factors indicated in the model (Borissova-Marinova, 2007, p. 87-116). The replacement rate of the age group 60-64 by the age group 15-19 was

used to measure the degree of ageing among the working-age population over the reference period. The indicator is calculated as a ratio between the number of persons aged 60-64, the pre-retirement age group where the levels of economic activity tend to diminish from the peak values, and the number of persons aged 15-20, the youngest age group entering in economic activity. The indices were calculated per 100 people from the relevant age group of the total population and the labour force (Figure 6) and they are one of the synthetic characteristics of working-age population and labour force's reproduction.

Figure 6

Replacement ratios in the selected countries in 2001, 2011 and 2019



Source: Calculations on Eurostat, Population on 1 January by age group and sex [demo_pjangroup] and Active population by sex, age and citizenship (1000) [lfsa_agan]. Accessed on 14.07.2020.

In 2001, the values of the total population indicator exceeded 100 in all compared countries. In 2001, the levels of incoming flows exceeded the levels of outgoing flows: per each 100 leaving working age, there were 125 enterings in Bulgaria and Czechia and 146 in Hungary, respectively. The high rate of population ageing has led to a very rapid decrease in the demographic replacement rate over the reference period in four of the selected countries (excluding Sweden). By the end of the period, Bulgaria, Hungary and Czechia showed around a twofold reduction in this indicator, if compared to 2001. Today in these countries, each two people aged 60-64 leaving working age are only replaced by 1 person aged 15-19 entering there. In is noteworthy that, according to the data available, in Bulgaria[13] and Czechia, the bulk of the reduction in these rates happened until 2011 and thereafter, the process slowed down significantly. In Hungary, the reduction in the index ran evenly within the reference period. In 2001, the lowest was the value of this index in Greece, with 108 people entering working age per each 100 leaving it. At the end of the period, the lowest value of this index was in Bulgaria (66 enterings per every 100 leavers).

[13] A reason for doubt about the speed of the process in Bulgaria during the second decade of the reference period gives us the inaccurate and incomplete current registration of emigrants during the period, which affects the sizes of both age groups included in the rate. A similar situation was also observed during the period 2001–2010, the data on which was subsequently corrected based on the information retrieved from the 2011 population census.

Sweden also demonstrates a decrease of this index, however showing two key differences when compared to the countries analysed above. First, the index drop was much milder: from 115 enterings working age in 2001 down to 99 in 2019. And second, over the period 2011-2019, the value of this index was around 100. This shows a simple replacement of the two flows or, in fact, the halt to the process of population's ageing.

In one respect, the reduction in the index is conditional upon the growth in the absolute number of people aged 60–64 over the period in all five nations. The increase in this age group over the reference period was in the interval from 44% in Czechia to 5% in Greece (8% in Bulgaria). On the other hand, four out of the five compared nations report a reduction in the absolute number of the youngest age group in 2019 vs. 2001. The level of such reduction varies between 43% in the case of Bulgaria to 21% in the case of Greece. In the fifth nation, Sweden, the number of people aged 15-19 grew by10% throughout the period.

Behind the indicated relative numbers stand specific changes in both the direct and indirect demographic factors. A good example of the influence exerted by an indirect factor may be fertility in past periods. In 2001, those aged 15-19 were the individuals born during the period 1982–1986. Back then, the total fertility rate (TFR) was 1.9-2.0 births per woman in fertile age in Bulgaria, Czechia and Greece, around 1.8 in Hungary and 1.6 in Sweden. In 2019, the same age group was populated by those born during the period 2000-2004, when TFR was 1.2-1.3 in Bulgaria, Czechia, Hungary and Greece, while in Sweden, it was 1.7.[14] In 2019, the age group 60-64 comprised the generations born during the period 1954-1959, while in 2001 – those born during the period 1937-1941, respectively. According to UN data (UNPD DESA, 2015)[15], during the period 1955-1959, TFR was much higher in all compared nations and exceeded the simple population reproduction limit: 2.3 in Bulgaria, Hungary, Greece and Sweden, with 2.4 in Czechia. Therefore, merely taking the context of the indirect effect of fertility, it becomes obvious that the generations born increasingly back in time were more and more numerous. This should be supplemented by the mortality-related effect, which was decreasing in the European nations throughout this period. As a result of this, living to the age of 64 is going up. The effects of external migrations over the distribution of population are dependent upon the value of the migration balance in the respective country. According to data from a research, in the period 1965-2005 it was stable and positive in Sweden and Czechia throughout the entire period, in Greece and Hungary it was negative until the early 1980s, after which they gradually became nations of immigration and since mid-1990s the index settled at relatively stable positive values, while it was negative in Bulgaria throughout the entire period (Borissova-Marinova and Moraliyska-Nikolova, 2011, pp. 59-65).

The dynamics of the similar labour force index is much more impressive (Figure 6): its value also decreased in all compared countries during the period. It also features two groups of countries, which differ sharply depending upon the strength and speed of decline in the index. Bulgaria, Czechia, Greece and Hungary all fall into one group where the reduction of the

[14] After data of Eurostat. Available at: https://appsso.eurostat.ec.europa.eu/nui/show.do. Accessed on 17.07.2020.

[15] The UN basis of demographic information on individual countries around the world covers data having been collected since 1950 and until today, and therefore no information could be provided on the TFR values for the period 1937-1941.

indicator is huge: 5 times in Greece, 7.8 times in the Czech Republic, 10 times in Hungary and 14.5 times in Bulgaria. This means that in these countries in 2019 there were be less than 10 people aged 15-19 per 100 people aged 60-64 (13 people in Hungary). Sweden falls into another group where the decline in this index is much weaker (by 1/3), with 100 economically active persons aged 60-64 corresponding to 52 active individuals belonging to the youngest age group.

To what has been said so far, it should be added that at the beginning of the period Hungary (134 people) and Bulgaria (104 people) were the only nations showing a complete replacement of the outflow of the labour force by the inflow. The remaining three nations showed values of this index much lower than this level as early as in 2001: 77 people in Sweden, 72 in Czechia and 45 in Greece, respectively, with a significant drop by the end of the period.

The absolute size of labour force age groups that are correlatable in the index analysed is shaped under the impact of the entire aggregate of drivers represented above rather than just by the demographic ones. The result of their influence is a huge increase in the number of active people aged 60-64 in 2019 vs. 2001 in most of the selected countries: 6 times in Hungary, 4 times in Bulgaria and Czechia and 1.7 times in the case of Sweden (with Greece showing +30%). Undoubtedly, a large part of this increase is related to the increase of the retirement age. At the same time, there was also a considerable fall in the number of active persons aged 15-19. Apart from the demographic drivers, this trend has a bearing to the ever-increasing period of education of young people before they can enter the labour market (ILO, 2010), with the variety of traditions and opportunities offered to reconcile training with economic activity (McDonald and Kippen, 2000, p. 4-5), etc. The biggest is the shrinking of this age group in Bulgaria and Greece, by 3.5 times, followed by Czechia (twofold) and Hungary (by 50%). The tendency toward change in this index, among others, is radically different in Sweden: in 2019, it accounts for a 20% increase in the number of active people belonging to the youngest age group vs. 2001.

The results obtained from the analysis give grounds to conclude that the dynamics of both indicators in Bulgaria over the reference period was extremely unfavourable. The size of the reduction of replacement rates and the speed of the process of ageing are the highest among the selected countries both in terms of the population in working age and in terms of the labour force. In both cases, the values of the indices reached in Bulgaria in 2019 were the lowest among the countries selected for such comparison.

Structure of economically inactive population

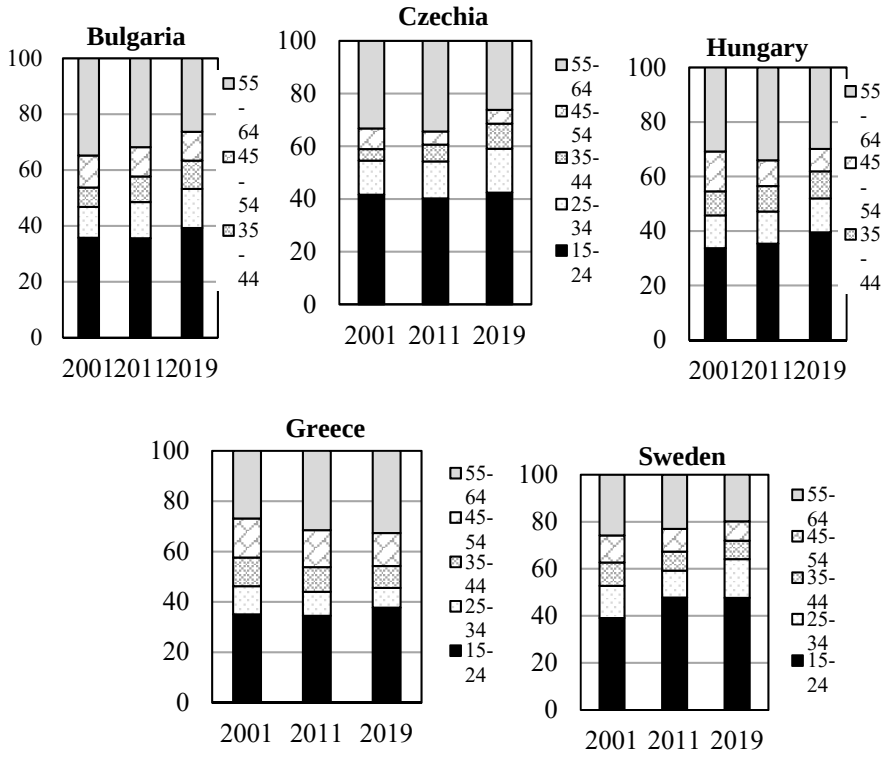
Two distributions of the inactive population aged 15-64 are used to characterise the changes among the inactive individuals: age structure and educational structure.

Basically, the age structure of the economically inactive people in working age has its distinctive specifics relative to the specific conditions and parameters in terms of entering or leaving the labour market. It is expressed as large shares of people from the young and pre-retirement age groups within the total number of individuals outside the labour market. The remaining age groups feature much lower and relatively more evenly distributed shares.

The above particularities in the distributions are, first of all, relative to the lengthier period of education owed to the growing requirements of the labour market to the labour force's education and qualifications. Alongside with this, they make young people's participation in the labour market more difficult during their training periods. This is why the share of inactive people from the age groups under 25 is high (Figure 7) and as it might be expected, it increased over the reference period. As a result of this trend, in 2019 their percentage approached 40% in Hungary, Bulgaria and Greece, while in Czechia and Sweden, it exceeded this value (42% and 48%, respectively). Some other reasons for the high levels of inactivity in the young ages are the high unemployment, the high share of long-term unemployed (Beleva et al., 2014); the incongruence between the education received and the levels of qualifications, and the requirements of the labour market (Atanassova, 2014); etc.

Figure 7

Distributions of the economically inactive population aged 15-64 by age groups in the selected countries in 2001, 2011 and 2019



Source: Calculations on Eurostat, Inactive population by sex, age and citizenship (1000) [lfsa_igan]. Accessed on: 14.06.2020.

There is a slight increase (around 3 pp) over the same period in the share of the age group 25-34 in Czechia, Bulgaria and Sweden. While in Hungary, the index remained almost

unaltered (12.4%), a reduction was recorded in Greece at the end of the period (again around 3 pp). Under the impact of such trends, in 2019, the share of individuals aged under 35 outside the labour market already exceeded 50% of the overall number of inactive persons in all compared countries except Greece (45.6%). In Sweden, the value of this indicator reached 64.1%, which means that two out of each three inactive persons in working age were under 35.

The second key tendency over the period is the reduction of the share of people aged 55+ in the total number of inactive population in three of the countries. As a result of this, in 2019, the share of this group plunged from 33% to 26% in Bulgaria and Czechia and below 20% in Sweden (vs. 25.8% in 2001). Hungary experienced a slighter reduction, with the index remaining around 30% in 2019. Greece saw an increase of the index by over 5 pp until the end of the period. The absolute quantity of this age group declined over the period in all countries, with the decline ranging from 3 pp in the case of Greece, through 33 pp in Sweden and 40 pp (Czechia and Hungary) to 54 pp recorded in Bulgaria.

Therefore, there was a reduction in the absolute number of inactive young persons (bar Sweden) and in the pre-retirement age groups in all countries considered. In relative terms, the trends are opposite – the share of young people was increasing, while the share of people aged 55–64 was declining by the end of the period. As a result of these trends, two out of four inactive people of working age were under 35 and one was over 55 in 2019.

The results of the analysis show that the age structure of the inactive population in Bulgaria in relative terms does not differ significantly from those in the selected countries. This finding is valid both for the direction and for the pace of change in the age distribution within the reference period. As for the size of the absolute decrease, Bulgaria ranks second as to the size of the reduction of inactive persons of working age (by almost 1/3) after Hungary and leads in the group of compared countries in the decline in the number of youngest inactive persons aged 15–19 (by 33 pp) and persons in pre-retirement groups (over 2 times)

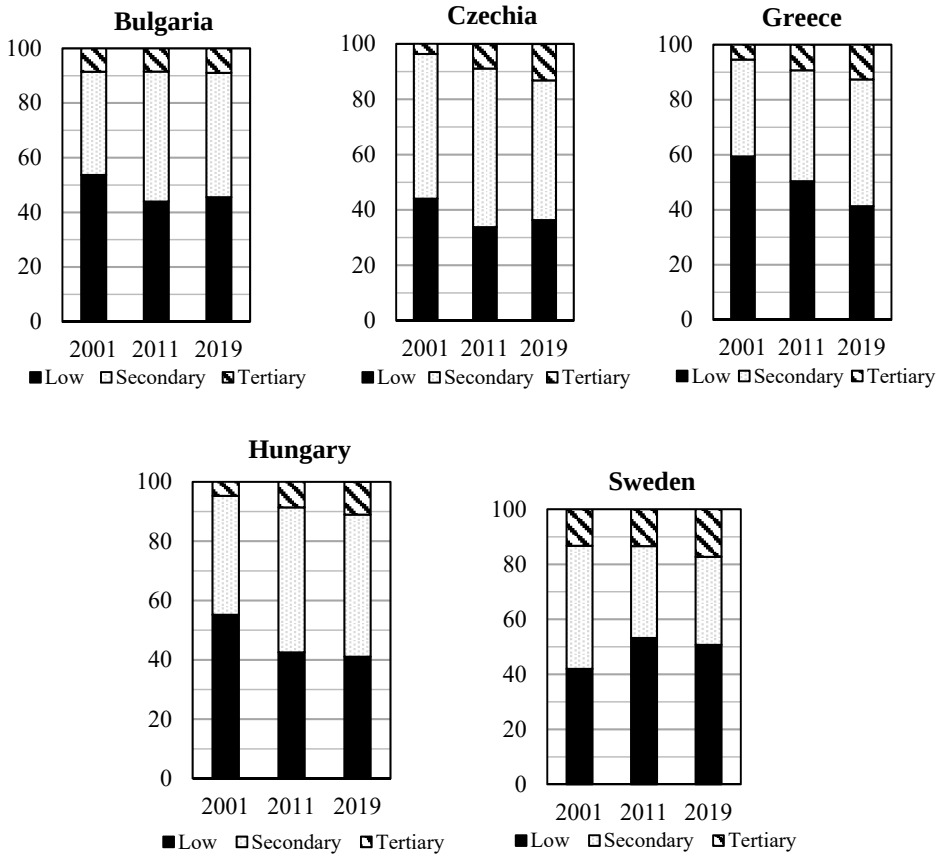
The **level of education** was selected as a major social characteristic of the economically inactive population in working age. Three categories were formed according to the educational degrees: low (less than primary, primary and lower secondary education or levels 0-2 of ISCED, 2011), secondary (levels 3 and 4) and a higher level of education (levels 5-8).

The educational structure of the inactive population shows high shares of people of lower educational levels and a small share of those with higher education or higher (Figure 8). In 2001, more than half of the inactive population was persons with low education in three of the compared countries: Greece (59.4%), Hungary (55.2%) and Bulgaria (53.5%). Czechia and Sweden show a predominant share of people with secondary education (52.3 and 44.8, respectively). The share of highly educated inactive people was below 10% in the countries compared, with the exception of Sweden (13.2). By the end of the period under review, the share of those low-educated decreased in all countries except Sweden, where there was an increase of more than 8 pp. The decline was strong in Greece (18 pp) and Hungary (14 pp) and moderate in Bulgaria and the Czech Republic (8 pp). The share of inactive people with secondary education was increasing, and therefore at the end of the period, it exceeded the share of the low-educated in Czechia, Greece and Hungary. In Bulgaria, the shares of the inactive with lower and secondary education equalised (45.5%) in 2019. In Sweden, a

significant decrease of 13 pp in the share of the inactive with secondary education is reported. Furthermore, noteworthy is the rise of the share of inactive people with high education levels over the period, however slight it may be. As a result of this tendency, in 2019 the index exceeded 11% in four of the countries considered, and only Bulgaria, where its rise was minimal (under 0.5 pp) showed a value 9.0%.

Figure 8

Distributions of the economically inactive population aged 15-64 by educational level in the selected countries in 2001, 2011 and 2019



Source: Calculations on Eurostat, Inactive population by sex, age and educational attainment level (1 000) [lfsa_igaed]. Accessed on: 14.06.2020.

The changes in the absolute size of the analysed aggregates are significant over the reference period. The dynamics in the absolute number of inactive persons with low education levels is similar to the described relative index, however, its decline is much bigger. In 2019, it was down by two times in Bulgaria, Greece and Hungary, by over 1/3 in Czechia, while in Sweden it rose by 19 pp (i.e. by over 85 thousand people) vs. its level registered in 2001. A

decline, slighter though, was registered in the quantity of inactive persons with secondary education levels. This group was down by 1/4 in 2019 in the reference countries bar Greece, where there was a slight rise by 4 pp (40 thousand people). Furthermore, there was a substantial increase in the number of inactive persons with high education levels: almost threefold in Czechia, around twofold in Greece and around 1.4 times in Hungary. In Bulgaria, their number shrank by 40 pp in 2019 vs 2001 (60 thousand people).

The results from the analysis show a number of similarities between the educational structure of Bulgaria's inactive population and in the rest of the countries compared. This finding refers to both the proximity between the momentary distributions and to the trends observed over the reference period. The high and similar shares of people with low and secondary education are typical not only for Bulgaria at the end of the period, but also for Hungary and Greece. The share of people with high education levels is low in the structure studied here in all countries over the analysed period. During the period, similar trends were observed in the absolute size of the aggregates: a larger decrease in the number of inactive persons with low education and a smaller decrease among the persons with secondary education. A particular feature of the development of the educational structure in Bulgaria during the period is the large absolute decrease in the aggregates if compared to the selected countries. It stands among the highest for people with low (after Hungary) and secondary education levels (after Sweden) and is the highest among the people with university degrees.

Conclusion

The results from the performed comparative analysis of the key characteristics of the labour force results in the selected countries over the last two decades suggest several conclusions:

First, the results obtained show that the total levels of economic activity were rising over the period in the EU Member States. The increase among women was much higher vs. what was registered among men, and therefore the gaps by sex in the indices shrank significantly. There is some convergence between total activity levels, judging by the declining number of countries whose rates are well below the EU average.

Despite the observed increase over the period, the levels of economic activity in Bulgaria remained relatively low in the European context (from 27th position in 2001, the country rose up to 22nd in 2019). This means a big portion of inactive persons in working age remaining outside the labour market. From a perspective of the model adopted of labour force formation, a number of reasons may be indicated for such evolution, but two of them are key to its development. Given the shrinking quantity of working-age population over the entire period, it is obvious that economic and social drivers play an important part. Another possible reason may be that part of the inactive persons would be out of registration as active people for being employed in Bulgaria's grey economy or being temporary or part-time (unregistered) employees in the other EU Member States.

Secondly, there has been a growth in the levels of activity over the analysed period in most age groups in the studied countries. The most prominent, however, is the increase in the 55+ age groups. During the period, in part of the compared countries, there has been a decline in

the economic activity among the youngest people aged under 25. As an exception of this finding stands out Sweden where both rates have grown (slightly though) and the rate of the 20–24 age group has stood firmly at the level of 70% over the period. It is also indicative that the width of the "plateau" of the economic activity curves is the biggest in Sweden (25-to-64 age groups by the end of the period) and that the maximum values of age-specific rates over that same period are the highest (over 90%).

The specificity in the development of the age-specific activity in Bulgaria over the reference period includes the very high growth in the rates for the 55–69 ages, whose rates at the end of the period were already higher than the EU average. Such positive trends inherent in most European countries, however, are combined in Bulgaria with a stagnation in the activity rates in all ages in the 25–40 range and a significant decline of activity among people aged under 25. Some possible reasons for such negative trends may be sought in the economy's insufficiently developed and low-productivity sector structure, in the slow and low economic growth, the insufficiently focused and adequate policies implemented by the State in terms of economic activity and lifelong learning, etc.

Thirdly, the comparative analysis showed that over the period 2001–2019, all selected countries experienced the processes of demographic ageing of both the working-age population and the labour force. The results obtained testify that ageing had been developing much more intensively among the labour force than among the working-age population. This tendency is primarily relative to the significant rise in the retirement age and of employers' requirements to both qualifications and education levels of employed people over the period. This trend, however, is undoubtedly influenced by some drivers such as the economic development strategy and the economic and social policies implemented in each of the compared States, the degree of accessibility and adequacy of the suggested trainings for further training and retraining of people of different ages and with different educational degrees, the structure of the policies applied to the labour market, the adequate focus and effectiveness of the conducted anti-crisis policy, etc.

The results, obtained for Bulgaria, prove beyond doubt, that both the size of the decrease in the generation replacement rates and the pace of their decline are among the highest in the group of selected compared countries.

Fourthly, the results obtained show the remarkable proximity in the relative indicators of the economically inactive persons' distribution by age in the countries compared. This conclusion is entirely applicable to the dynamics of this structure – both to the direction and to the pace of its change until the end of the reference period.

The particularities encountered in the evolution of their age structure in Bulgaria refer to the high level of the absolute reduction in the overall number of inactive people in working age and the number of persons from the youngest and the pre-retirement age groups. In Bulgaria, this positive tendency toward an absolute reduction of the number of people outside the labour market is accompanied by two other adverse tendencies which are unfavourable for the country's socio-economic development. On the one hand, it is only Bulgaria among the compared countries that has registered an absolute reduction in the labour force over the reference period. On the other hand, the share of those unwilling to work among the inactive

persons in working age in the country is very high (88% of the men and 91% of the women in working age[16]).

Finally, it is worth mentioning that the educational structure of inactive population in the analysed countries also features a remarkably expressed similarity, growing even stronger by the end of the period. It shows high shares of people of lower educational levels and a relatively small share of those with higher education. Also, all analysed countries record trends toward a reduction in the absolute number of low educated inactive persons and a lower decline in the number of those with secondary education. Indicative for Bulgaria and Greece is the large increase in the share of the inactive people with secondary education at the expense of the decrease in the indicators for persons with low education.

In conclusion, it should be noted that the results of the analysis fully confirm the analysed trends as key to the development of demographic parameters of the labour force and the working-age population in the period 2001–2019, and not only in Bulgaria. Currently, the reproduction of the labour force is expanded in three of the compared countries (Sweden, Hungary and Czechia), simple in Greece and shrinking (reduced) in Bulgaria only. It is a process in the context of reduced reproduction of the working-age population in all countries, although with different rates of decrease. Moreover, it is accompanied by demographic ageing and other unfavourable trends, such as the growing share of young people in the inactive population and the poor educational structure of the inactive population.

The observed negative trends in the country impose an urgent need to stimulate the labour force's reproduction. This requires providing the necessary preconditions for increasing economic activity and employment (based on economic restructuring) among all age groups of the workforce with a focus on young and middle-aged groups, more efficient use of available labour force and labour resources, and improving the quality indicators of human capital through education and life-long training. Measures to promote the demographic reproduction of the labour force can also have a broadly positive effect on a number of problems of the total population (emigration, fertlity, morbidity, mortality, etc.), on the speed of economic development and other key processes for the country's development.

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

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GOOD PRACTICES IN THE FIELD OF CORPORATE SOCIAL RESPONSIBILITY (COMPARATIVE ANALYSIS FOR BULGARIA, ROMANIA AND SERBIA)[4]

Many companies in the market today face the challenge of finding an effective way to fulfil their role as good corporate citizens – companies that "do well by doing good". The authors of the study consider the Corporate Social Responsibility as a practically applicable method to achieve this balance. The study provides a comparative analysis between companies recognized as socially responsible in Bulgaria, Romania and Serbia, by presenting the main aspects of the initiatives that lead to these companies to be identified as a benchmark in the implementation of CSR policies. On this basis, the authors of the study: (1) outline key areas of CSR in the countries concerned by defining similarities and differences in the scope and the content of the initiatives that companies initiate and/or engage in; (2) highlight good practices in the field of CSR, where there is a possibility for transfer of know-how among companies from the three countries; (3) identify areas with underdeveloped potential in which companies in the countries concerned can focus their efforts and resources in order to optimize their engagement in the field of CSR. The results of the conducted analysis are compared with the point of view of consumers who take both the roles of beneficiaries of the effects of socially responsible behaviour of companies and of active participants in market relations, having the power to motivate and require companies to be conscious corporate citizens. The purpose of the comparison is to find unused positioning opportunities through specific actions related to CSR in specific consumer segments and/or to outline opportunities for optimizing communications in this direction.
Keywords: sustainable development; Corporate Social Responsibility; corporate social initiatives; social responsibility awards; qualitative research
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Introduction to the Methodological Framework of the Research

The idea that the successful companies of the future will be the ones that "do well by doing good" is not new to the scientific and business community. It has been consistently one of the milestones in the focus of public debates at all major social, political and economic forums all around the world. The Covid-19 pandemic has only accelerated the need to validate this business model. As Dankova (2012) commented the philosophy "doing well by doing good" could be seen as a contemporary interpretation of the views of two of the founders of the concept of Corporate Social Responsibility (CSR) in the United States – Andrew Carnegie and Julius Rosenwald. Dankova (2012) explains that the former believes that in order to do good, companies must do well, while Rosenwald insists that in order to do well, companies must do good. Dankova (2012) also specifies that while Carnegie insists on the social responsibility of wealth and considers successful business as a prerequisite for charity and CSR commitment, Rosenwald defends the exact opposite thesis – CSR commitment is a prerequisite for a successful business. In the context of contemporary market conditions, we should not consider the two phenomena as being in a causal relationship, but perceive them as complementary functions in the work of business organizations. The latter are committed to creating a better world and, at the same time, to achieving good financial results by defending the interests of all stakeholders (Euromonitor International, 2020, p.13).[5]

The practical approach to achieve this is to integrate the concept of CSR into the overall corporate strategy of business organizations. We can find an argument for this in Kotler's statement (2011, p.2) "in the business world, good is associated with CSR". The latter is considered one of the pillars of modern and prosperous economies (Bulgarian Network for Corporate Social Responsibility, 2020) and is defined as a successful business strategy for ensuring sustainable development, which has diverse and wide-ranging aspects of manifestation.

The study of the latter is important and **brings added value for both – representatives of science and business – due to several facts. First:** The topic of sustainable development is characterized by indisputable relevance and ideologically, its implementation is identified as a priority in the policies of all countries in Europe, it is no coincidence that achieving sustainability is among the priority goals in the strategy "Europe 2030". However, different historical, social and economic developments place European countries in different dimensions regarding the practical implementation of the idea of sustainability. Bulgaria, Romania and Serbia are among the countries that are just beginning to realize the importance of corporate citizenship and the need for its active practising as a step towards achieving sustainable development. In this sense, it is useful to take a "snapshot" of the market in the three countries and to see whether, how and to what extent companies are working towards sustainability by applying the concept of CSR. **Second:** Segmenting the market on the basis of consumers' attitudes towards responsible corporate actions would reveal the potential for growing a CSR mindset in less mature markets such as Bulgaria, Romania and Serbia.

[5] However, it should be noted that with the declaration of the global COVID-19 pandemic, this understanding has changed and evolved to the idea that the goal of sustainability in all dimensions of social and economic life should be considered a priority for companies including even before the realization of profit – "Purpose over Profit".

Furthermore, it can highlight the differences between the three countries as well as their common traits. Such an analysis is valuable in terms of policymaking and can be used to transform business practices. **Third:** Identifying the benchmarks of CSR in the three countries can serve as a basis for transferring good practices in the field and thus help the successful implementation of CSR.

With regard to the afore-mentioned potential fields of added value, **the aim of the study is** to analyze the scope and content of socially responsible initiatives in the afore-mentioned three countries /Bulgaria, Serbia and Romania/ and based on their comparison with consumer perceptions of their importance to make recommendations for improving the effectiveness of corporate social responsibility programs. To fulfil the aim, there are defined the following **four research tasks**: **(1)** to outline key areas of CSR in the countries under consideration, defining similarities and differences in the scope and content of the initiatives that companies initiate and/or engage in; **(2)** to compare the adopted practices for reflecting the corporate social responsibility with the opinions of the consumers for its essence and significance; **(3)** to highlight good practices in the field of CSR, where there is an opportunity for transfer of know-how between companies from the three countries; **(4)** to identify areas with underdeveloped potential, in which the companies from the considered countries can refocus their efforts and resources in order to optimize their engagement in the field of CSR and its communication.

In order to perform the mentioned research tasks, a desk study and content analysis of the information on CSR initiatives published by companies that are awarded as a benchmark in the field of CSR in the three countries – Bulgaria, Romania and Serbia are performed. As such, there are selected companies that are cited as examples of socially responsible business in competitions organized at the national level (Bulgaria – "Responsible Business Awards" presented annually by the Bulgarian Business Leaders Forum; Romania – CSR Romanian Awards competition, organized by CSR media and Serbia – "National CSR Award" organized by the Serbian Chamber of Commerce).

The results of the content analysis are further compared with the point of view of consumers. For this purpose, there is conducted a qualitative survey in the period July-August 2019, which includes a total of 14 respondents from Bulgaria, Romania and Serbia.

It is important to emphasize that the presented research is emphatically empirical and mainly aims to compare good practices in the field of CSR in the three countries considered, serving as a guide for professionals working in the field on the potential for continuity of socially responsible behaviour practices applied in other countries. In this sense, the theoretical part only introduces the topic, does not claim to be exhaustive, but only provides requires awareness and competency of the reader regarding the nature of the concepts of CSR, Social Responsibility, Sustainable Development, Corporate Citizenship.

At its core, the philosophy of sustainable development is about achieving a dynamic and competitive knowledge-based economy that pursues economic and social goals in balance with the requirements of protecting and improving the quality of the environment and which seeks to preserve the necessary potential and resources for the needs of future generations. It can be seen as a priority for facing environmental and social issues (Linnenluecke et al., 2017; Toni et al., 2018) but as Georgieva (2012) points out, we should not see sustainable

development as a constraint on economic growth, but on the contrary, it is a balanced trinity of economic, social and environmental goals.

The practical approach to achieve this balanced triad is possible through collaboration at different levels that involve policymakers, the business, individuals and society at large. Companies can assist sustainable development by adopting the principles of Corporate Citizenship and CSR (Savitz, Weber, 2006, p. 23). Both concepts stress on the need for a broader social accountability, but while CSR is more focused on the ethical obligation of companies to go beyond their legal requirements and serve the society for building a better world, Corporate Citizenship reinforces the view that a corporation is an entity with status equivalent to a person (Waddell, 2000). This points at the fact that companies are a vital part of the society, because they control vast resources and thus can affect other entities in fundamental ways. Namely, because they exercise this kind of crucial influence, they incur a responsibility to use those resources in ways that are good not just for their stockholders alone but for society in general (Post et al., 1996, p. 43). Empirical studies (Savitz, Weber, 2006, p. 23) claim that companies that successfully integrate the latter into their overall business strategy are able to achieve an effective balance between their own interests and the public demand for sustainable development models. These companies are positioned as socially responsible because they take care of the interest of a vast number of stakeholders among which are employees, customers, communities, suppliers and shareholders, to name but a few. This idea is related to the need for a broader stakeholder-oriented focus of the firm instead of the general market orientation which brings the customer to the centre of the business ecosystem (Ferrell, 2010). As suggested by Kotler (2010, p. 40), in the new economic reality, companies' profits are formed precisely as a result of consumers' assessment of "their contribution to the good of humanity". It is characteristic of socially responsible companies, though, that their contribution to society and social well-being is the basis of their economic stability and growth. This corresponds to the philosophy that companies "should do well by doing good" and it will pay off through the choices of their customers. Socially responsible companies successfully meet this challenge by taking the position of active participants in both the market and social space.

The afore-mentioned guides the choice of companies positioned as socially responsible to be the **object of study.** Under "positioned as socially responsible" there is meant, both activities in the field of CSR, including communication (identified by content analysis) and the reception of these activities by end-users (established through a series of in-depth interviews). A unifying feature for socially responsible companies is the existence of a clearly formulated CSR policy/strategy and striving for its effective implementation. These companies are aware that the long-term sustainable survival and success of business organizations require them to take responsibility for their impact on all of their interested parties (Stefanova, 2018, p. 20, 28-29) and this is exactly their social responsibility.

What distinguishes these companies is the way they materialize their CSR engagement. The latter is manifested in initiatives of different nature, scope and intensity of implementation. They serve as a starting point for a comparative analysis between the companies awarded as socially responsible in Bulgaria, Romania and Serbia. Preceding the analysis, there are identified the main aspects of the manifestation of the initiatives, due to which these companies are pointed as a benchmark in the field of CSR.

As already mentioned, a desk study and content analysis of the information on CSR initiatives published by companies that are awarded as a benchmark in the field of CSR have been conducted. The results of the content analysis for the three countries are presented in tabular form, which reflects the main aspects of the manifestation of CSR initiatives of the companies included in the study. The starting point for differentiating the areas of manifestation of CSR initiatives is the conceptual essence of the Carroll pyramid, which covers the hierarchy of the four basic levels of corporate responsibilities – economic, legal, ethical and philanthropic, as well as the range of key areas of activity in the field of CSR, due to which the companies are classified as socially responsible (Carroll, 2003, p. 40). On this basis, the authors of the study formulate a total of seven aspects of the manifestation of CSR initiatives, pointed in Table 1,2,3 as: **(A)** Quality/safety of the manufactured products/services provided; **(B)** Environmental protection; reducing the environmental footprint; efficient use of natural resources; **(C)** Campaigns in support of the local community; **(D)** Campaigns in the field of education; **(E)** In-house CSR campaigns; **(F)** CSR campaigns aimed at business partners and **(G)** CSR campaigns of a philanthropic nature /charity, cause-related marketing, promotion of causes, volunteers work of employees for the benefit of the local community/.

As already mentioned, the results of the content analysis are further compared with the point of view of consumers in their role of beneficiaries of the effects of socially responsible behaviour of companies, but also in their role of active participants in market relations, which have the power to motivate and require companies to be conscious corporate citizens. The qualitative survey encompasses a total of 14 respondents from Bulgaria, Romania and Serbia who are selected purposefully to cover all profiles defined on the basis of a preliminary study conducted by the authors (Kraleva, Ivanov, 2019; Kraleva, Ivanov, 2020, pp. 24, 66-78). Thus, the sample includes users selected according to seven criteria related to the following variables: (1) gender, (2) nationality, (3) income satisfaction, (4) sensitivity to social problems, (5) experience as volunteers, (6) experience from participation in protests, (7) participation in donation actions or frequency of individual donations.

There is developed a general scenario for conducting the interviews by common thematic areas. One of them is about CSR and the aspects of its manifestation in Bulgaria, Serbia and Romania. The results of the qualitative research make it possible to compare the CSR activity of companies with the knowledge and level of consumer awareness of the latter by identifying possible GAP areas between the understanding of business organizations for social responsibility /expressed in the implementation of various CSR initiatives/ and consumers' understanding of what socially responsible business behaviour implies.

Survey Findings and Discussion

A comparative analysis of good practices in the field of CSR in Bulgaria, Romania and Serbia has been conducted. Under "good practices", the authors consider all activities carried out by the companies that identify the behaviour of good corporate citizens and show the active commitment of organizations to do well by doing good. The companies are examined by categories, in which they are distinguished from the respective institutions in the three countries, where each institution has a unique methodology based on a set of metrics for

evaluating the activities of companies in each category. There is no unified approach to systematizing the categories and this is normal given the different social, economic and political developments in each country, as well as the different attitudes and degrees of implementation of the CSR concept. The aspects of the comparative analysis are unified in relation to the categories (A-G) that the authors of the study have derived. This allows comparability of the analysis on the one hand and gives an opportunity to identify and transfer good practices between the countries concerned. The latter are an object of discussion in the conclusion.

Bulgaria

In Bulgaria, there is a high level of commitment of companies with CSR. This is shown by the data from the first specialized study on the state of CSR in the country (Stefanova, 2019). The survey is conducted among 300 of the largest companies in Bulgaria. About 67% of them indicate that they have a high or very high degree of commitment to CSR. This result is not surprising given the fact that in 82% of respondents' commitment to CSR is stated at the level of mission/vision of the business organization (Stefanova, 2019).

The scope of the present study includes companies in which the strategic CSR orientation has a strong practical realization. In particular, the objects of comparative analysis are CSR practices of business organizations, pointed as examples of responsible business by the Bulgarian Business Leaders Forum (Bulgarian Business Leadership Forum, 2020). This is the leading business association in the country, promoting the values of CSR. Every year, the association organizes national "Responsible Business Awards", which aim to promote a social responsible business behaviour in Bulgaria.

Table 1 presents the main aspects of the manifestation of CSR initiatives of the companies awarded in 2019 in six categories, also presented in Table 1. The analysis focuses on the content published on the corporate websites of the companies in the section "sustainable development/CSR policy". It is important to specify that the objects of study are the Bulgarian versions of corporate sites and the information disclosed on them. This is due to the fact that at the global/international level, all the considered companies have developed a CSR strategy, but the initiatives through which it finds practical implementation in certain areas differ according to the countries of manifestation[6].

The content analysis covers a total of 19 companies (Table 1), taking into account some specifics in the implementation of their CSR initiatives.

The "Choose to help" charity initiative of Raiffeisenbank was established in 2009. Bank employees/clients donate funds for the realization of various health, social, cultural and environmental causes. In 2020, the initiative was launched earlier with the aim of supporting hospitals that are at the forefront of the fight against the coronavirus.

[6] An exception to this comment is the company L'Oreal Bulgaria which does not support the Bulgarian version of its corporate website. The analysis reflects only the initiative of the company for which it is awarded among the winners of awards for responsible business in Bulgaria in 2019.

The philanthropic aspect of CSR of Lidl Bulgaria is implemented through several projects, whereas the main focus is on protecting the environment and improving the quality of life of the local community. "You and Lidl for a better life" is the company's largest socially responsible initiative. The initiative supports socially significant projects of civil society organizations throughout the country and aims to help people in different regions of the country to lead a better and more fulfilling lifestyle by investing in 4 areas: education, environment, culture and historical heritage and an active lifestyle.

Table 1

CSR initiatives – aspects of manifestation – Bulgaria

Company	CSR initiatives – aspects of manifestation						
	A	B	C	D	E	F	G
Investor in society							
Raiffeisenbank							✓
Lidl Bulgaria	✓	✓	✓		✓	✓	✓
HPE Bulgaria	✓	✓	✓	✓	✓		✓
Investor in knowledge							
Coca-Cola HBC Bulgaria	✓	✓	✓	✓		✓	✓
PwC Bulgaria	✓	✓	✓			✓	✓
L'Oreal Bulgaria				✓			✓
Nestle Bulgaria	✓	✓	✓	✓	✓	✓	✓
Cause-related marketing award							
Fantastiko							✓
A1	✓	✓	✓	✓	✓		✓
Avon Cosmetics Bulgaria		✓					✓
Best social policy of a small or medium enterprise							
Esetere Bulgaria			✓	✓			✓
Eurofootball[7]							✓
Astelas Pharma	✓	✓	✓	✓	✓	✓	✓
Investor in human capital and working conditions							
Citibank Europe, Bulgaria branch	✓	✓		✓			✓
VIVACOM	✓	✓	✓	✓	✓		✓
Telenor	✓	✓	✓	✓	✓		✓
Environmental investor							
Coca-Cola HBC Bulgaria	✓	✓	✓	✓		✓	✓
Dundee Precious Metals Krumovgrad	✓	✓	✓	✓	✓		✓
Kaufland Bulgaria	✓	✓	✓		✓		✓

For the manifestation of the philanthropic aspect of CSR, HPE Bulgaria has local groups of employees who support various charitable causes entirely on a voluntary basis. One of these groups is "The Cause" – a team of volunteers who organize various initiatives to address key social issues in Bulgaria.

[7] At the time of preparing the comparative analysis, the activity of the company Eurofootball was suspended. We comment only on the occasion of the initiative, for which the company was awarded among the most responsible for 2019 in the category "Best social policy of a small or medium enterprise".

As part of the winners in the second category, "Investor in Knowledge", Coca-Cola HBC Bulgaria is an active corporate citizen; they initiate and participate in many initiatives of different content and scope. The company was awarded as a leader in this category because of the Youth Empowered program, which aims career guidance of young people in the country.

The company PwC Bulgaria was also awarded in the category "Investor in Knowledge". The reason for this is the competition initiated in support of young Bulgarian teachers – "The most important lesson". The competition aims to support future Bulgarian teachers and their successful realization in the field of education in Bulgaria.

L'Oreal Bulgaria was awarded third place in this category because of the scholarship program "For Women in Science" initiated by the company. This is an international joint project of L'Oréal and UNESCO, which has been running since 1998 and honours the achievements of young researchers in recognition of their scientific achievements. The program presents global awards "For Women in Science", international scholarships and national and regional scholarships. Since its founding, the initiative has supported more than 3100 female scientists – PhD and postdoctoral students – in 117 countries, including Bulgaria.

Nestle Bulgaria is among the winners of awards for responsible business in Bulgaria for 2019 in the category "Investor in Knowledge" because of the campaign "Nestle needs young people". The initiative has a global character and through it, the company seeks to help hundreds of thousands of young people to prepare for work by providing them with opportunities for scholarships, internships, career development. The goal is 10 million young people around the world to gain access to economic opportunities by 2030.

In the next category – "Cause-related marketing" – Fantastico excels in the first place for its project in support of women social entrepreneurs – "My mother is a superhero". This is a joint initiative of Fantastico and the "Mayko Mila Foundation", which aims to provide support to families of children with disabilities. Fantastico lends a hand to mothers of children with disabilities who are looking for a second job so they can enjoy the "first one" caring for their child.

A1 was awarded in the same category – "Cause-related marketing" for the free application "Watch ads with a cause through A1 SmartAD". In support of the measures taken to limit the spread of coronavirus, the company has developed another successful form of cause-related marketing by announcing that it donates 1% of the value of each transaction made through the A1 Wallet to the Ministry of Health.

Avon Cosmetics Bulgaria was once again awarded in the category "Cause-related marketing" for its successful campaign – "Avon against breast cancer". Through the sale of pink charity products, the company accumulates significant financial resources, which it donates to support the cause (providing free preventive examinations; purchase of equipment for hospitals in the country; together with the "One of 8" Foundation, providing free psychological, legal, informational and practical support directly to the affected women, their relatives and families).

The company "Esetere Bulgaria" EOOD (a member of the SC Dobrich) was awarded first place in the category "Best social policy of a small or medium enterprise" because of its

comprehensive CSR program for mentoring and work of people from vulnerable groups and more specifically for the joint projects of the company with the association IDEA – Social Tea House Varna, and the foundation "St. Nicholas the Wonderworker" in Dobrich. The company's support for the Social Tea House allows the creation of a place that, over the years, has provided mentoring and first jobs to over 25 young people, a third of whom are now growing their careers independently. With the project "Wonderful Garden", implemented in partnership with the Foundation "St. Nicholas the Wonderworker" in Dobrich, the company supports the production and distribution of plants and working conditions of over 20 people with intellectual disabilities.

Two more companies were awarded in the same category: Eurofootball for its long-standing program in support of young "Sports Talents" and Astellas Pharma for – " Men's Health" – a campaign, aiming to raise the awareness among men about prostate cancer.

Citibank Europe, Bulgaria Branch won the first place in the category "Investor in human capital and working conditions" due to the great success of the program "Rinker Youth Challenge". The latter aims to support the development of entrepreneurial thinking and leadership skills among young people, to inspire and prepare them for the successful realization of their business ideas and to help them in the first and most difficult steps in their entrepreneurial endeavour.

Vivacom was awarded in the same category – "Investor in Human Capital and working conditions" for its successful summer internship program.

Like the other two companies in the telecommunications sector (A1 and Vivacom), Telenor also demonstrates an active commitment to its CSR program. The company was awarded in the category "Investor in human capital and working conditions" in connection with its initiative for professional development of people with disabilities "Open Mind Bulgaria".

In addition to the category "Investor in knowledge", Coca-Cola HBC Bulgaria ranks first in the category "Investor in the environment". It has been honoured for the "My Green City" waste-free world initiative. This is the company's largest environmental initiative which aims to contribute to improving the environment by focusing on afforestation and forest protection.

Dundee Precious Metals Krumovgrad is also a winner of a prize in the category "Investor in the environment" with the project "Turtles near the mine Ada Tepe – mission possible." The project is in line with one of the main values of the company – environmental protection and biodiversity and aims to protect the populations of two species of turtles (thorn and thorntail turtle) listed in the Red Book of Bulgaria as globally endangered. Other highlights in the company's environmental responsibility program include: non-greenhouse gas emissions; energy resources management; management of domestic and wastewater and preservation of the land quality.

Kaufland was awarded in the category "Environmental Investor" for its contribution to Bulgarian nature. In particular, the company is actively developing their commitment to environmental protection in several areas: 1) use of energy-efficient technologies; 2) introduction of sustainable workwear for all employees in hypermarkets; 3) introduction of environmental standards in the textile and footwear /Kaufland has set as a target until 2020 to discontinue the use of any harmful chemicals in the manufacture of garments, home

textiles and shoes under private label company; 4) commitment to modern and energy-efficient construction and 5) pursuing an active recycling policy in order to reduce the environmental footprint of excessive use of plastics.

The conducted analysis shows that regardless of the category in which the companies in question are awarded, the majority of them has a well-developed CSR policy and is engaged in the implementation of various initiatives in the seven areas of their socially responsible behaviour. The leading position among the latter is the philanthropic aspect of CSR policies of companies. 100% of all awarded organizations initiate and/or participate in donation campaigns, marketing related to the cause, promotion of the cause, volunteer work for the benefit of the local community.

The other areas in which the companies are actively engaged (approximately +/- 70% of them) are: 1) guaranteeing the quality/safety of the products/services provided; 2) environmental protection, reduction of the ecological footprint and efficient use of natural resources; 3) organizing campaigns in support of the local community (improving welfare and improving the quality of life). Slightly lower is the percentage of companies (around 63%) that are engaged in campaigns in the field of education (improving its quality; fight against youth unemployment; stimulation of scientific and research activity). Only half of the surveyed companies have in-house CSR campaigns. The lowest percentage of companies (32%) have CSR campaigns aimed at business partners.

Nestle and Astellas Pharma can be distinguished as a benchmark for which the content analysis shows that the implementation of the CSR policy of the companies is related to commitment in all areas.

The content analysis shows another feature as well. In the context of the global pandemic of COVID-19, a new aspect in the socially responsible behaviour of companies (valid for 80% of the examined organizations) is related to their efforts to overcome and reduce the adverse health, economic and social effects of the spread of the virus. Organizations develop large-scale corporate philanthropy by donating funds to the Ministry of Health and/or hospitals to purchase drugs and specialized medical equipment, as well as to support first-line physicians and to provide financial support of those, affected by the spread of the infection. Telecommunication companies in Bulgaria (A1, Telenor and Vivacom) are among the most effective participants in promoting the cause of social distance by positioning a permanent reminder message on the display of its subscribers “Stay home”. Avon is also committed to promoting another cause of great public importance – the prevention of domestic violence against women – through the “Isolated but not alone” campaign. Kaufland is a benchmark company in terms of conducting internal company policy and introducing a series of measures to protect the health of employees and provide a safe environment for work in the service in retail outlets. PricewaterhouseCoopers (PwC) is working to address the economic consequences of the pandemic by offering a business expert diagnostic tool to address the challenges of COVID-19.

All commented activities are published on the corporate websites of the companies and given the epidemiological situation and the forecasts for the imposition of a new “normality” in social, community and economic life, it can be assumed with a high probability that these

activities will become a common element of socially responsible behaviour of business organizations and will enter the system of their CSR reporting.

Although in Bulgaria there is no regulatory imperative for the preparation of CSR reports and many companies do not have such, we can recommend to businesses to make this a regular practice following the example of international companies represented on the Bulgarian market /some of which are commented in this report/. Effective communication and promotion of corporate CSR policies will also lead to a better overall understanding of the concept of CSR among end-users.

In this regard, the results of the qualitative research conducted by the authors show that for the respondents from Bulgaria, the applicability of the concept of CSR is characterized by a higher degree of abstraction and uncertainty. Of course, all interviewees are familiar with the term CSR and have a strong (or entirely) positive attitude to the idea of socially responsible business behaviour, but find it difficult to determine what scope it has and what areas it affects. For some of them, these are actions of companies aimed directly at *"disadvantaged people"* and are mainly expressed in specific activities, such as *"for example, providing heat, clothing and not to give money…"* (P5). For others, CSR is expressed only in actions aimed at the employees of the companies themselves, because *"social activities are state commitments"* (P6). There are also those who see CSR as a strategy for better communication and positioning of the brand. In this regard, P3 notes that CSR is *"a good thing, as long as it is not just words.*" This statement actually describes most accurately the attitude of the interviewed Bulgarians to the concept of CSR – in its essence it is something positive, which, however, in Bulgarian conditions is more declarative in nature and is used by companies mainly for communication/image purposes. Respondents' scepticism also extends to the existence of a link between CSR and the environmental impact of companies' actions. For P3, such an effect can only be seen if companies: *"do not pollute the environment … in any way. To change their fleet with electric cars, send their employees on vacation in Bulgaria; do team building in the mountains. By making donations to the city or restoring polluted and abandoned monuments… "*.

This idea is shared by the other respondents as they see the meaning of the efforts of the companies in two directions – *"By recycling their garbage. To produce various things from recycled products"*(P1) and by engaging in specific cleaning activities in the area where they work (P5), or in other words, to invest in reducing the environmental footprint of their activities. Regarding the social effect of CSR, however, all respondents from Bulgaria agree that companies can do nothing to solve social problems, except through sponsorship, and specific programs aimed at educating adolescents (P3, P4 and P7).

Despite the generally sceptical attitude towards the application of CSR on the Bulgarian market, the respondents are adamant that companies active in the direction of CSR have a market advantage over their competitors, *"only if people know"* (P3 and P5), *"but only among engaged users"* (P4). For others, however, such a relationship does not exist (P2), although earlier in the interview it was stated: "*If I know* [that they have socially responsible behaviour], *I will buy products from such a company instead of another. But I don't fully trust such a company"*.

Based on the opinions derived from the qualitative survey, it can be summarized that consumers expect companies to apply a comprehensive approach to the implementation of CSR policy of companies, taking into account the interests of all interested parties. The results of the content analysis made in the context of business organizations prove the existence of such a complex approach in the socially responsible behaviour of companies. This means that there is no discrepancy between consumers and businesses in terms of the conceptual understanding of the nature of CSR and the forms and scope of its practical implementation, but there is a discrepancy /GAP/ in terms of what consumers expect and what companies have already implemented as a CSR commitment. This can be taken as a sign of information and communication asymmetry between the two parties.

In this regard, the interviewed respondents from Bulgaria indicate that CSR could bring a competitive advantage to companies, but under two conditions – (1) if companies invest continuously in the communication of CSR with their target users and (2) if they target this communication to the segment of socially engaged consumers. This further proves the relevance of the authors' earlier recommendation for the need to effectively communicate and promote company CSR policies. On the one hand, this will balance the commented asymmetry, and on the other hand, it will create an opportunity to build positive associations with regard to the brand/company, and hence a positive image. Communication builds trust between the company and all interested parties; it creates commitment; increases the legitimacy of the organization; works to enhance its reputation and encourages other companies to follow the example of the "good corporate citizen". The latter is particularly important for building a sustainable and successful business network of companies that are resistant to turbulent changes in the external environment caused by events such as COVID-19.

The creation of such a network presupposes the existence of a high level of awareness and competence among the people in the business, engaged in the practical implementation of the CSR programs. In this regard, another recommendation can be made to the business – to organize more training in companies from different industries and this should happen, on the one hand at the top management level, to justify the inclusion of CSR engagement in strategic priorities of the organization, and on the other hand – at all other levels of the corporate hierarchy to ensure a conscious commitment of employees to this different philosophy of doing business.

Exactly the lack of sufficient training in CSR, and hence the lack of relevant knowledge, as well as the lack of qualified human resources in the field, are among the main obstacles to the implementation of CSR in Bulgaria, according to the first specialized study on the state of CSR in the country (Stefanova, 2019). The same study shows that in the corporate hierarchy CSR specialists find a place as "agents of change", but their potential is not yet developed and not used enough. Changing this status quo can help more companies reorganize their processes, reformulate their mission, vision and values, and position themselves as good corporate citizens.

Romania

The understanding imposed in Bulgaria on the need to implement CSR in business is shared on a conceptual level by companies in neighbouring Romania. More and more business organizations in the country are witnessing processes of redefining the corporate mission, vision and values and refocusing the corporate strategy by integrating the principles and practices of socially responsible behaviour. It is considered that this process is more typical for companies with a longer market history /compared to startups where such a reorganization is often an insurmountable challenge/. It is widely believed that all this is a kind of expression of the common desire to promote the concept of CSR at the public level in Romania. In this regard, the results of the in-depth interviews conducted among end-users in Romania are also indicative. The latter has a very precise understanding of the nature of CSR; they link CSR actions to sustainability. Although some of the interviewees share that these actions are recognizable only if they have a direct connection with the environment and, more precisely, with the environmental footprint that companies leave, for the majority of respondents this is not a sufficient condition to identify a company as a good corporate citizen. Consumers expect the business to take a comprehensive and consistent approach to fulfilling its commitment to sustainable development. This, in turn, implies that the socially responsible business model should become a standard of conduct for companies, requiring the latter to reconsider their approach and to refrain from sporadic and inconsistent participation in CSR activities, through individual humanitarian or environmental campaigns (Racoti Vasile, 2020).

A positive sign in this direction is the fact that in Romania, unlike in Bulgaria, the first steps have been taken to regulate the practices of CSR reporting, which is a prerequisite for the implementation of commitments in connection with the latter to become more consistent. Currently, this process affects companies that operate with an average of more than 500 employees during the financial year. They are required to submit a non-financial statement containing information on aspects of their socially responsible behaviour. It is believed that this stimulates companies to sustainably behave as active corporate citizens. Like in Bulgaria, the good examples in this direction are distinguished annually by annual awards for CSR. The present study examines the companies that won first place in 2020 in the ten prize categories, presented in table 2 (CSR Romanian Awards, 2020).

Similarly to the analysis of the Bulgarian market, an analysis of the content published on the corporate websites of the companies in Romania in the part “sustainable development/CSR policy” is made. Again, the national (in this case – Romanian) versions of the corporate websites and the information disclosed to them. In order to compare the results of the analysis, the framework of the same comparison table is used (Table 2).

The content analysis takes into account some specifics in the implementation of CSR initiatives by companies (Table 2).

At Orange România, the greatest emphasis in CSR is on education, and in particular on digitalization in this area. The #SuperCoders campaign (a project of the Orange group, which is being developed simultaneously in several countries in Europe and Africa) is extremely successful. Within #SuperCoders, children between the ages of 10 and 13 participate in programming seminars accompanied by specialized trainers.

Table 2

CSR initiatives – aspects of manifestation – Romania

Company	CSR initiatives – aspects of manifestation						
	A	B	C	D	E	F	G
CSR campaign on social media							
Orange Romania	✓	✓	✓	✓			✓
Community support							
HARTMANN Romania	✓		✓				✓
In-house CSR campaign							
Fortech			✓	✓	✓		✓
CSR in education							
Flanco Retail				✓			
Cause related marketing							
PENNY Market	✓	✓	✓	✓	✓		✓
Digital innovation in the field of CSR							
URSUS BREWERIES		✓	✓				✓
Environment							
Coca-Cola HBC Romania	✓	✓	✓	✓		✓	✓
Cross-sectorial partnership							
Azomures	✓	✓	✓	✓		✓	✓
Health							
MOL Romania	✓	✓	✓				✓
Employer support							
CEZ Romania		✓	✓	✓			✓

HARTMANN România was awarded in the "Community Support" category. Although the company does not register specific activities in all areas of CSR, it can be summarized that it has the behaviour of an active corporate citizen. The overall strategy and behaviour of the organization, the products and solutions that it produces and offers on the market are aimed at improving the health and quality of life of people, supporting vulnerable groups. The company is in the process of continuous analysis of health care and search for ways to improve treatment and health outcomes, both in the professional sector and at home.

Fortech is a leader in the technology market in Romania, in particular in the field of software product and application development. The company was awarded for its "In-house CSR campaign" – "Nothing Breaks Like a Heart. Restart One" (an initiative for the purchase of defibrillators, organized in a creative way – in the form of a competitive game between the company's teams, in which each victory generates funds to support the initiative).

Flanco Retail was awarded in the category "CSR in education". The company is one of the few that does not disclose its commitments in the field of CSR on its corporate website. It was awarded for its participation in the initiative "Nouă Ne Pasă" ("We care") – a campaign in the field of education, which aims to build centres for post-secondary activities in rural schools to support students throughout the period until the completion of their secondary education and matriculation exams. The idea is in this way to reduce the drop-out of children from school, to increase the opportunities for building knowledge, skills and competencies

in them, which is a prerequisite for them to be better prepared for the labour market, more competitive, and this, in turn, would reduce the risk of youth unemployment.

PENNY Market is also actively developing its CSR policy in various areas. On the company's website, they are presented in 4 categories: 1) "Social participation"; 2) "Staff"; 3) "Energy, climate and environment"; 4) "Green products". The company was awarded in the category "Cause-related marketing" for the initiative "Care for Romania", the focus of which is environmental protection.

The company URSUS BREWERIES develops and implements its CSR policy by several major projects presented in details on the website of the business organization. The project for which the company was awarded first place in the category "Digital Innovation" is related to the development and launch of the mobile application "Zero La Mie", which aims to ensure safe and responsible driving. Its features allow drivers to test their ability to drive, including offering an option for alcohol testing. Its implementation creates conditions for safer traffic, which is an important aspect for improving the quality of life of society.

Coca-Cola is a leader in the "Environment" category among Romanian companies. In Bulgaria, the company is also a leader in this category. This can be explained by the fact that environmental protection is a strategic priority for the business organization at the global level, which finds its projection through essentially different initiatives in different countries. In Bulgaria, the emphasis is on afforestation and forest protection, while in Romania, the focus is on recycling.

The company Azomures was awarded first place in the category of "Cross-sectorial Partnership" because of the successful collaborations with companies from other fields and industries on the implementation of projects and initiatives with a socially responsible nature.

As for MOL România, awarded in the category "Health", from the information presented on the company's website /not available in English/ we see that the company was awarded in the first place for an act of charity with a very positive effect in terms of improving the quality of life of the local community – the company invested 425 000 euros in the construction of a helicopter pad at the Marie Curie Hospital in Bucharest. The creation of such a facility would increase the possibility of providing quality and timely hospital care to those in need.

In the category "Employer Support", CEZ România was awarded first place for the project "Good Generators", which has the character of volunteer work for the benefit of the community. In particular, every year the CEZ Group in Romania encourages its employees to get involved, by proposing future solutions, in solving social problems in their communities of origin. Through internal competition, "Good Generators" adds a plus to the sustainable development of communities and creates a connection with citizens and local action groups.

The comparative analysis shows that in Romania, like in Bulgaria, companies have the behaviour of active corporate citizens who initiate and/or participate in many CSR campaigns with different aspects of manifestation. There are two areas that can be identified as priorities in the CSR policy of the companies: 1) support to the local community in the context of improving welfare and improving the quality of life (in 90% of organizations); and 2) philanthropic initiatives, in this number of donation campaigns, marketing related to the

cause, promotion of the cause, volunteer work for the benefit of the local community (again in 90% of the organizations). Environmental protection programs and campaigns in the field of education are the other priority areas on which a large percentage of the analyzed companies (70%) focus their efforts in the context of fulfilling the commitments under their CSR policy. The activities for guaranteeing the quality and safety of the produced products/ provided services are an element of the socially responsible behaviour of the companies in 60% of them. Similar to the situation in Bulgaria, the percentage of companies that have CSR campaigns aimed at business partners is the lowest (20%). The picture is similar with regard to internal CSR campaigns – 20% of the analyzed organizations in Romania develop similar activities.

The percentage distribution of the companies' engagement in the various directions of socially responsible behaviour almost completely corresponds to the situation in Bulgaria, which is not at all surprising. Both countries are members of the European Union and part of the common European Economic Area. In this sense, they align their market behaviour with the requirements of the community for which Sustainable Development is among the priority objectives. However, despite the afore-said, some good practices in the field of CSR can be identified, which are observed in the Romanian market and which have not yet been imposed in Bulgaria, but can be transferred as know-how and model of behaviour in the companies of our country market:

- *The introduction of mandatory reporting regarding the commitments of companies in the field of CSR.* At this stage, this is regulated for a certain category of companies in Romania and is a desirable practice in Bulgaria. Transferring it to a mandatory component of the reporting of business organizations would have a number of positives which have already been the subject of comment.
- *Differentiation of CSR practices in the digital environment.* It is noteworthy that the CSR Awards in Romania have two categories that focus on the manifestation of CSR in the digital environment – "CSR campaign on social media" and "Digital innovation in the field of CSR". On the one hand, it should be borne in mind that the digital environment, unlike the conventional market environment, allows companies-generated content (including information about their CSR activities) to reach faster and to a wider range of users such as move the latter more efficiently through the user funnel (from the stage of Awareness through that of Engagement and Consideration to Conversion). In the context of CSR, this effect is particularly pronounced in the presence of a segment of "sophisticated customers"[8], and this segment can be considered inherent in the modern market environment given the fact that the concept of consumer "sophistication" is derived as one of the leading global trends in consumer behaviour in 2019 (Euromonitor International, 2019). On the other hand, the digital environment essentially allows CSR practices of companies to be implemented in a larger scope and volume and to be better metrified, which multiplies the positive effect of their implementation. In Bulgaria, some

[8] In another study, the author empirically confirms the existence of a positive relationship between CSR practices of companies and the behaviour of "sophisticated" customers, in particular in the field of consumer loyalty and in a real market environment. GEORGIEVA, M. *The role of socially responsible branding in customer relationship management.* Dissertation work. UE-Varna, 2019.

companies take advantage of the digital environment in implementing their CSR policy, but observations show that this is not yet a widespread practice.

- *Stimulating the intersection partnership in the implementation of CSR initiatives.* It is noteworthy that companies from different sectors of the Romanian economy unite to implement certain CSR practices (in this regard, a special category has been established in the form of CSR awards in Romania) – a model of market behaviour with underused potential in Bulgaria. Changing this status quo would increase the opportunities for integration of good practices and resources at the national level, which in turn is a prerequisite for maximizing the positive effects of socially responsible behaviour of participating companies.
- *Recognition and differentiation of the role of the CSR specialist as an independent profession.* As already noted, there is a shortage of qualified human resources in the field of CSR in Bulgaria and this is emerging as one of the main obstacles to the full implementation of the concept in the country. In contrast, in Romania, the importance of this profession is recognized by the business. This is evidenced by the established category of awards for responsible business in the country which distinguishes the efforts of specialists in the sector for development and good management of socially responsible behaviour of companies (there are categories for a leader in CSR, SEO and a vlogger). Almost 30 years ago, Goodpaster (1991) pointed out in his study that the conscience of a corporation is a logical and moral continuation of the conscience of its principals. In this sense, modern companies can be expected to behave as good corporate citizens only when these organizations are headed by professionals in the field of CSR with sufficient competence, knowledge and experience in the field.
- *Separation of the efforts for protection and improvement of the public health as an independent component in the CSR policy of the companies.* The content analysis shows that in the majority of the companies in Romania, the efforts in the field of healthcare are among the priority activities in the socially responsible behaviour of the companies – a situation that is also observed in Bulgaria. The importance of the effects of this behaviour in overcoming and reducing the adverse health, economic and social consequences of the spread of COVID-19 is an argument to recommend that it become a mandatory component of CSR policy and accountability.

Serbia

The third country, on which the comparative analysis of CSR practices of companies awarded as socially responsible is focused, is Serbia. The country is of particular interest given the fact that, unlike Romania and Bulgaria, Serbia is not a member of the European Union, which can be interpreted as a prerequisite for identifying significant differences in the results of the analysis. What the data from a study (Stanisavljević, 2017, pp. 373-380) conducted in 2017 show is that the "pressure" that various interest parties exert on Serbian companies to implement socially responsible behaviour and work in the direction of achieving the goals of Sustainable Development is incomparably smaller than the situation in developed countries. This is complemented by the fact that socially responsible companies, companies that actively behave as good corporate citizens, do not receive sufficient recognition in the

domestic market in Serbia and are not necessarily seen as a role model in business. At the same time, however, companies' CSR policies are of interest to potential investors in Serbia, for whom the contribution of business organizations to the achievement of certain social and environmental goals is equally important with the achievement of certain economic results. The desire to attract more and more foreign investment in Serbia puts companies in the country in front of the objective need to recognize CSR as a mandatory element of their business behaviour. The fact is, however, that this is an established practice, especially for large companies in Serbia, which are for the most part representative offices of international corporations. The latter initiate, organize, implement essentially different initiatives, the results of which are presented in the form of a CSR report. For Serbian companies, like for Bulgarian ones, this practice is voluntary. Moreover, the results of the cited study (Stanisavljević, 2017, pp. 373-380) show that the weakest point in the CSR systems of Serbian companies is related to the so-called non-financial reporting or, more specifically, with the preparation of CSR reports (observed in very few business organizations). Most companies publish their activities and initiatives in this area on their corporate websites. The information published there is also the subject of analysis in the present study.

Following the example of Bulgaria and Romania, with regard to Serbia, a content analysis of the information published on the corporate websites of the companies in the country in the part "sustainable development/CSR policy" is made, as again the object of study are the national (in this case – Serbian) versions of corporate sites and the information disclosed on them. The scope of the study includes the companies which were awarded the "National CSR Award" in 2019 by the Serbian Chamber of Commerce. The categories in which companies compete are differentiated according to the size of the latter: large companies, medium-sized companies, small and micro-companies.

The scope of the present study covers the organizations ranked first, second and third in each of the presented three categories. Again, in order to compare the results of the analysis, the framework of the same comparison table is used (Table 3).

Table 3

CSR initiatives – aspects of manifestation – Serbia

Company	CSR initiatives – aspects of manifestation						
	A	B	C	D	E	F	G
CSR award in the large companies category							
Tarket, Backa Palanka	✓	✓	✓			✓	
DM DROGERIE MARKT DOO, Belgrade	✓	✓			✓		✓
Telekom Srbija, Belgrade				✓		✓	✓
CSR award in the medium-sized companies category							
TeleGroup d.o.o., Belgrade							✓
Specijalna bolnica ČIGOTA®, Zlatibor			✓				
Vega IT Sourcing d.o.o, Novi Sad		✓			✓		✓
CSR award in the small and micro companies category							
Infostud 3 d.o.o., Subotica			✓	✓			✓
Neofyton d.o.o., Novi Sad		✓					
Youth Education Center, Nis			✓				

The content analysis takes into account some specifics in the implementation of CSR initiatives by companies, presented in Table 3.

The company Tarket, Bačka Palanka, has been awarded a national prize for CSR for its comprehensive approach to the application of CSR. The overall philosophy and way of doing business in the organization, all processes, as well as the final products that are produced and offered on the market, are consistent with the desire to ensure sustainable development. The company has a practice in the field of social accountability; publish a report with similar content, which is audited by an independent third party.

In the case of DM DROGERIE MARKT DOO, Belgrade, it is noticeable that the Serbian version of the company's website contains very little information in the "Social Responsibility" section compared to the scope of the company's CSR policy at the international level. The activities of the organization in the indicated areas are reported. A little more detailed information is provided regarding the philanthropic aspect of the company's CSR – the form of a charity initiative that raises funds for a children's clinic is presented.

Telekom Srbija, Belgrade, on the other hand, is an active corporate citizen; it initiates, participates in and develops essentially different initiatives with a socially responsible character. The emphasis in CSR policy of the organization is placed on campaigns in the field of education, support for Startup initiatives and donation campaigns. The company has a tradition in preparing and publishing social reports.

TeleGroup d.o.o., Belgrade, does not have a section "Sustainable development/CSR policy" on the company's website. Only information about the company's participation in raising and donating funds in connection with the fight against the spread of COVID-19 in Serbia has been disclosed.

Information is also missing in the case of ČIGOTA® Special Hospital, Zlatibor. However, it can be said that this company has reason to be awarded a national award for CSR because of the overall philosophy of doing business and the positive effect that the organization has to improve the quality of life of people, in particular in terms of their health. This is a specialized clinic with over 25 years of experience, which implements a specially developed program for the treatment of metabolic disorders and thyroid problems. Globally, both types of disorders are identified as some of the "modern diseases" of humanity, with which the latter is actively fighting.

Vega IT Sourcing d.o.o., Novi Sad, mainly focuses its CSR engagement in practices with a philanthropic nature – donation campaigns; volunteering of employees in support of various causes, marketing related to the cause. Another aspect in the socially responsible behaviour of the organization is the care for the environment, realized through the initiative "GreenIT", related to the planting of trees and the creation of a green urban environment. The company also has a very well-developed internal CSR policy.

The main priority in the CSR policy of Infostud 3 d.o.o., Subotica is the development of the society, improvement of its well-being and quality of life; in particular, the company seeks to support the technological and economic development of the people of Serbia. Another point of reference in the organization's socially responsible behaviour is the desire to improve

the quality of education in Serbia. The company promotes the process of integrating the formal and non-formal education system, as well as the development of practical skills among young people. It supports the introduction of innovations in the field of education. Regarding the philanthropic aspect of CSR, the company's efforts are focused on defending a specific cause related to the preservation of Serbia's identity, with an emphasis on preserving the national language and reducing the use of foreigners.

At Neofyton d.o.o., Novi Sad, like other of the distinguished companies, the organization's website lacks a section "Sustainable development/CSR policy". Information in connection with CRS is published as an element of the section "Goals and Values" of the company. It is stated that among the leading priorities for the organization is the protection of the environment with an emphasis on ensuring energy efficiency.

The published information regarding the CSR policy is also scarce on the website of the company Omladinski edukativni centar, Niš. It is only stated that the organization supports initiatives that seek to improve the quality of life of people in social, economic, cultural and everyday life.

The comparative analysis shows that, similar to the situation in Bulgaria and Romania, companies in Serbia focus their efforts on philanthropic initiatives (including donation campaigns, cause-related marketing, cause promotion, volunteering for the benefit of the local community) in the implementation of its CSR policy – in particular, this finding is valid for 55% of the surveyed companies. The other two areas in which the most serious activity is observed by the organizations are related to the support of the local community in the context of improving the well-being and improving the quality of life (in 44% of the companies) and environmental protection – in the same percentage of organizations.

Environmental protection has also been identified by end-users interviewed in Serbia as a priority commitment to the CSR policy of business organizations. All respondents in the country share the general opinion that companies should be concerned about the environmental footprint that their activities leave on the environment. P12 describes his understanding of CSR, extending its scope not only to environmental protection but also to the impact of branded products on consumer health and the quality of manufactured products. P14 specifies that CSR includes not only actions for environmental protection, but also all activities from production to distribution of products, which must be carried out in an environmentally responsible manner. However, the authors of the study specify that although for the respondents from Serbia, the socially responsible behaviour of the organizations presupposes activities aimed at reducing the environmental footprint, these actions would have a market effect only if they are communicated to segments with sensitivity to topics related to ecology.

Unlike Bulgaria and Romania, where companies place a strong emphasis on the production and supply of quality/safe products/services and where organizations initiate and participate in a number of campaigns in the field of education, in the companies in Serbia which we considered these aspects of socially responsible behaviour are not identified as a priority for companies in the implementation of their CSR program. Only 22% of the analyzed companies have such activities. The same is the percentage of organizations that have CSR campaigns aimed at business partners, as well as those that implement in-house CSR

campaigns. With regard to the last two areas commented, the situation in Serbia can be defined as similar to that in Bulgaria and Romania.

The content analysis of the information on the websites of the companies examined in Serbia shows that the latter publish much less in terms of volume of information than the companies analyzed in the other two countries. It impresses, however, that unlike in Romania, on the website of each company, the information is available in English, which makes it easier to understand for external interested parties. This can be interpreted as a reference to the already made a comment on the interest of international investors in aspects of socially responsible behaviour of companies in Serbia and the desire of the latter to position themselves as good corporate citizens, and in this sense, as reliable investment partners. In any case, the recommendation addressed to Bulgarian companies can also be addressed to Serbian ones – for normative regulation of the need for social accountability in business.

What can be borrowed as a good practice from Serbia is the differentiation of companies into large, medium, small and micro companies, both in distinguishing their efforts in the field of CSR (by awards) and when analyzing the activities of organizations in this sphere. Such segmentation is reasonable in terms of ensuring comparability both in terms of results achieved and in terms of efforts. Different scales of companies imply different strategic goals, different prioritization of the latter and different financial framework in terms of their implementation. Even if all companies declare a desire to work towards achieving "Sustainable Development", large and medium-sized companies are those that have the potentially highest chance to take a series of measures to achieve the latter practically.

Based on the analysis conducted in Bulgaria, Serbia and Romania, it could be concluded that the understanding that the companies of the future "must do well by doing good" seems to be actively shared by both end-users and business representatives in those countries. The results of the conducted qualitative research among consumers from the three countries show that there are reasons to classify the latter as "sophisticated" consumers[9] and in this sense they have a good level of knowledge of the essence of CSR as a concept, as well as high expectations and requirements for the forms and areas of its practical implementation. More specifically, the authors found out that in all three countries, there are segments of consumers who are sensitive and informed on the topic of CSR, who expect companies to act in this direction, but who are also strongly sceptical about the motives of business organizations to implement policies in the field of CSR. In terms of that, the results of the study identify the presence of information and communication asymmetry, but also give specific recommendations for overcoming it.

The results of the content analysis of the information published on the corporate websites of the companies awarded as benchmarks in the field of CSR in the three countries in the part "sustainable development/CSR policy", show that regardless of the category of the business organizations the majority of them have a well-developed CSR policy and are engaged in the

[9] The concept of the "sophisticated consumer" and in particular regarding its applicability on the Bulgarian market can be found discussed in detail by Stanimirov and Georgieva in the study "Profiling customers by the criterion "sustainable consumption" (Stanimirov, Georgieva, 2019, pp. 3-17).

implementation of essentially diverse initiatives in the seven areas of their socially responsible behaviour.

The leading position among the considered areas has the philanthropic aspect of the CSR policies of the companies. The extremely high percentage of all distinguished organizations initiate and/or participate in charitable campaigns, marketing related to the cause, promotion of the cause, volunteer work for the benefit of the local community. The lowest percentage is of companies that have CSR campaigns aimed at business partners, as well as those that conduct in-house CSR campaigns. These summaries are equally valid for Bulgaria as well as for Serbia and Romania.

Conclusion

In conclusion, it could be stated, that despite the existing regional differences, due to some extent to the different socio-political and economic context in which the three countries are located, in all of them, the analyzed companies behave like active corporate citizens. What is more, the conclusions of the content analysis by country make it possible to identify benchmark practices in the implementation of CSR, which can be transferred as know-how and which show that work in this area has potential that is yet to develop and from which both large companies and smaller business organizations in the market should profit. More precisely, several good practices have been identified that can be transferred as know-how between the three countries considered: (1) the introduction of mandatory reporting on companies' CSR commitments; (2) differentiation of CSR practices in the digital environment; (3) stimulating the cross-sectorial partnership in the implementation of CSR initiatives; (4) recognition and differentiation of the role of the CSR specialist as an independent profession; (5) differentiation of the efforts for protection and improvement of the public health as an independent component in the CSR policy of the companies – especially in the situation with COVID-19; (6) differentiation of CSR commitments and activities depending on the size of business organizations and last but not least (7) effective communication and promotion of corporate CSR policies. The latter is particularly important for building a sustainable and successful business network of companies that are resistant to turbulent changes in the external environment.

These good practices, derived from the study, potentially, taking into account all regional economic and social specifics, can be transferred as benchmark practices to other countries that are still actively developing their CSR policy. In addition, the research approach applied in the research process can be adapted for the purposes of other studies, including other countries, where the comparison of business and consumer perspectives will create a field for identifying other good practices and/or other areas with potential for future development in the context of CSR.

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
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POSITIONING OF BEE PRODUCTS FROM THE RUSE REGION[2]

The study finds that there is a serious positioning problem for bee products from the Ruse Region – strong competitive pressure, product parity and difficult differentiation. This makes positioning extremely important to their success, but also – very difficult. It was found that the region, with its natural, ecological, cultural and historical factors, as well as territorial specialisation based on these factors, is the bearer of authentic uniqueness, which is the foundation for differentiation and positioning of the bee products and services produced on its territory. Branding of bee products from the Ruse Region plays a key role in differentiating them. It can be based on natural factors, sorts, standards, technologies, domain name, brand. From the natural factors and the certified technologies, the leading positions of Bulgaria in Europe in respect to biodiversity and biotechnology in the beekeeping sector shall be used, because they ensure high biological value and quality of the bee products from the Ruse Region. Brands shall also be based on them, and the domain name plays a key role in the positioning on online markets. Positioning can also be based on marketing tools, which play an important role in differentiating competitors as well as consumer perceptions and associations. Positioning on organisational markets shall emphasise the functionality of regional apiculture products by nature (biodiversity, ecology, quality), and on consumer markets- to emphasise a single basic concept – health.
Keywords: region; differentiation; branding; positioning
JEL: M31; Q13

Following the segmentation and determining of the target markets for bee products in the Ruse Region (Lyubenov, 2020a), it is necessary to determine the approaches to accessing and positioning on them. Considering the intense competition that regional bee products face on their international and national, organisational and consumer target markets, they are in dire need of solutions in these areas. Trends in brand growth and market fragmentation, which is also valid for bee products, make the issues addressed extremely important and relevant. In the current context of intense competition and parity among competitors, the responses regarding access to target markets and positioning are of strategic importance.

In fact, the basic idea of positioning is that competitors' products must differ from each other, which requires that the competitive structure of the markets of bee products be analysed. To

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this end, we can analyse the three types of competition between products in a given market (Myers, 1996) – product superiority, product differentiation and product parity. Product superiority is based on a unique product, and it provides the best positioning capabilities. In product differentiation, the product is different and has one or more specific characteristics that make it better than the competing products in a given category. Product parity is characterised by similar products that do not have significant and tangible differences between them.

Bee products with product superiority and product differentiation have the best positioning opportunities. For example, the most expensive bee honey in the world at a price of 5000 euros per kilogram is Elvis Honey from Turkey (https://www.obekti.bg, 04.05.2019). It is gathered in an 1800-meter-deep cave near the town of Artvin in the Sarikair valley, located in northeast Turkey. The mineral-rich cave further enriches the honey, making it unique. Manuka honey is estimated at about $ 400 per kilogram (https://profit.bg, 09.01.2018). It has antibacterial properties, the most important antibacterial component being methylglyoxal, which has a much higher concentration than other types of honey. Manuka honey comes from the nectar of a bush of the same name, which grows wild in some areas of New Zealand and Australia.

Kotler (1994) provides a different view of the competitive structure of the market, which looks at four levels of competition based on the degree of product substitution – brand and branch competition, generic and form competition. Brand competition considers as competitors the organisations offering similar products to the same consumers at similar prices. In branch competition, competitors are all organisations that produce the same product or class of products. The form competition considers as competitors all organisations that satisfy one and the same need. In generic competition, all organisations that compete for the money of the same consumers are competitors.

Analysing the competitive structure of markets for bee honey, we can conclude that the main competitors of regional bee honey through brand competition are all offering similar honey to the same consumers at similar prices. The branch competition includes all bee honey producers in the world. The form competition also includes competing substitutes for bee honey – artificial and natural, such as sugar, stevia and many others. The generic competition also includes competitors from food and beverage, who compete for the money of honey consumers. For the first two levels, regional bee honey has product parity. In terms of the third and fourth level, it is one of the most imitated products in the world and is not a staple food, i.e. no primary role and importance for consumers.

The positioning of the regional bee honey and other bee products on the organisational and consumer markets would be very easy if they were much better than their competitors for at least one parameter, but as we found out, there is no such parameter. Bee products are also characterised by one of the main problems of agricultural products – difficult differentiation (Lyubenov, 2016). Given that they are under intense competitive pressure and in a state of product parity, there is a serious positioning problem. This makes positioning extremely important to their success, but at the same time, it is so difficult. The first steps in this direction are to segment and define the target markets for apiculture products from the Ruse Region, which is done (Lyubenov, 2020a) and follows their positioning.

As we have already established, bee products are subjected to strong competitive pressure in the conditions of product parity. This is true for the Bulgarian bee products, including those from the Ruse region. Bulgaria's northern neighbour- Romania is the largest producer of bee honey in the EU, and Bulgaria's southern neighbour – Turkey is second in the world. In addition to being among the largest producers, they also have similar geographical conditions for production with the conditions in Bulgaria. This makes the positioning of bee products from the Ruse region even more important and strategic. In accordance with the defined positioning problem, the research is structured in three parts – the first refers to the regional identity, the second one- the differentiation of regional bee products, and the third one – the approaches for their positioning.

Regional Identity of Bee Products

The annual production of honey in the world ranges from 1.6 to 1.8 million tons. Today, China is the world leader with an annual production of more than 450-500 thousand tons of honey, followed by the EU with about 240-270 thousand tons. Bulgaria ranks 10th in the EU in production, with about 10 thousand tons of honey per year (Lyubenov, 2020a). The main product of global and Bulgarian beekeeping is honey, and the other bee products are produced in significantly smaller quantities, but the leaders in the category of honey are most often leaders in other bee products – royal jelly, wax, etc. Although in quantitative terms the Bulgarian beekeeping is not among the leading producers of honey and bee products, it has serious grounds to claim the high quality of its bee products.

The Bulgarian beekeeping sector is not in the Top 10 of the global producers of bee honey and other bee products, but is in the Top 10 in the EU for the production of conventional bee honey. More importantly, it is in the Top 3 in the EU and in the world in the number of certified organic bee colonies, and about 1/3 of Bulgarian beekeeping is organic (Agricultural Report, 2018), which practically makes Bulgaria a member of the club of major European organic and ecologically-oriented beekeeping sectors. In addition, Bulgaria is one of the countries in Europe with the highest biodiversity (https://bg.wikipedia.org, 12.06.2019). The national beekeeping sector, as well as the one from Ruse region, do not use the abovementioned facts to their benefit, therefore they are not differentiated, but depersonalised on a regional scale.

The unique Bulgarian honey has been known in Europe since the 9th century. There is information about the export of honey and beeswax to Byzantium from the reign of Khan Omurtag (814-831). Later, the Bulgarian honey and beeswax, called "Chera Zagore", was known in the medieval Italian republics. The Florentine chronicler Pegolotti wrote about them, and the Vatican decreed that the candles for the papal liturgies shall be made only of Bulgarian wax. Bulgaria is called the "Pharmacy of the Lord" because it ranks third in the world in the wealth of medicinal plants after Afghanistan and India. In Bulgaria, there are herbs that are not found anywhere else in the world (www.standartnews.com, 15.04.2021). Bulgarian bee products have been valued as high-quality products since ancient times because they originate from a natural environment with high biodiversity.

Although Bulgaria is among the top countries in terms of biodiversity in Europe (www.bgfermer.bg, 29.05.2018) and the third richest country in Europe in terms of forest biodiversity (https://news.bg, 12.10.2014), it is not in the Top 20 of the countries with the greatest biodiversity in the world, as these are the countries in the tropical regions and especially in the rainforest ecosystems (https://bg.wikipedia.org, 16.06.2019) which are home to about 50-70% of all plant and animal species on Earth. Bees play an important role in biodiversity through the eco-systemic pollination service, and the great biodiversity of honey medicinal plants in Bulgaria, respectively in the Ruse region, ensures the high-quality regional bee products, which today remains unappreciated due to depersonalisation of the regional origin.

The Zagore region is mentioned as part of the Bulgarian state at the beginning of the VIII century and is located in North-eastern Thrace, south of the Balkan Mountains. It is located to the South-east of the present day of Stara Zagora, and the Strandzha region is to the South-east from it. The Strandzha region is a unique natural habitat that favours the production of unique bee products. This has allowed, after more than ten years of efforts by the local beekeeping community and with the support of state institutions in 2019, to register in the European Register of Protected Designations of Origin (PDO) and Protected Geographical Indications (PGI) the regional honey as a PDO "Strandzha manna honey" / Manna honey from Strandzha". The Ruse region is located in North-eastern Bulgaria within the Danube Plain, bordering the Danube River to the North.

The Ruse region is an integral part of the Danube region, which is the largest macro-region in Europe. It covers 14 countries (Germany, Austria, Slovakia, the Czech Republic, Slovenia, Hungary, Croatia, Serbia, Bosnia and Herzegovina, Montenegro, Romania, Bulgaria, Moldova and Ukraine) where nearly 200 million people live, and in the districts around the Danube live more than 50 million people. Along the Danube and in the immediate vicinity are 5 European capitals – Vienna, Bratislava, Budapest, Belgrade and Bucharest, and the river itself is a Trans-European transport corridor. The Danube river is the main element of the macro-region, according to which the European Union (EU) has developed a strategy that forms its identity and image, in line with the European and the national values of individual countries.

It should be noted that the implementation of the Strategy for the Danube region, adopted ten years ago, by Bulgaria and the Ruse region, faces a number of difficulties due to the regional division of the country, which does not unite the northern regions of the Danube plain into one large Danube region – an idea that remained unfulfilled by Bulgaria's regional ministry. While in Germany, Austria and even in Serbia, some of the richest regions are on the banks of the Danube, in Bulgaria, the opposite is true. The region is also less competitive compared to the neighbouring Romanian regions, and trade relations with them are weak, also in the field of beekeeping. To some extent, this deprives the Ruse region of full support in terms of European and national policies for the formation of regional identity.

The identity of the Danube region, and in particular of the Ruse region as part of Bulgarian territory, does not conflict with the otherwise contradictory regional Balkan identity, which traditionally produces the current image of both Bulgaria and the other Balkan countries. The Danube identity of the Ruse region derives from the characteristics of the territory and not from the characteristics of a regional institution or the state as abstract organisational

subjects. It does not contradict the existing current Balkan identity and image, due to the attachment of Bulgarians to the land. Therefore, for the Strandzha region and the Ruse region, the territorial characteristics with their nature, history, culture and traditions have an important role in positioning the beekeeping and its products.

The Ruse region is part of the Danube plain, which occupies about 1/3 of the territory of Bulgaria. The natural region of the Danube Plain is divided by the Yantra river into two parts – Western and Eastern. Along the southern riverbanks of the Danube, the Ruse region is located between the delta of the Yantra River and the Brashlyanska lowland. The southwestern part of the Ruse region falls in the Western and the rest of it- in the Eastern part of the Danube plain. The basin of the river Rusenski Lom is located in the district of Ruse. Since 1970 it has been declared a natural park being a natural complex having ecological, historical and cultural value. The precious gem of the park are the birds, some of which are endangered on a European scale or included in the Red Book of Bulgaria. This demonstrates the excellent conditions for the development of insects and respectively of honey bees.

The average altitude in the Ruse region is 176.3 m, the relief is predominantly flat and hilly, with optimal conditions for beekeeping. The relatively small differences in altitude between individual municipalities show the presence of optimal conditions for the development of beekeeping in the whole district. The region has a significantly higher average annual temperature amplitude of 25°C, which is higher than the one in Bulgaria as a whole. The territory of the whole Ruse region is rich in melliferous and pollen plants, which provide excellent conditions for the development of beekeeping. The region has rich forest vegetation with acacia and linden in the Lipnik park near Ruse, Borovo municipality, etc. (Lyubenov et al., 2020b), which provide diverse and high-quality grazing for beekeeping in the region.

Ruse is one of the average regions in terms of territory and population in Bulgaria – its area is about 3% and the population is about 2.5% of the national indicators. Over the last decade, the population and its contribution to the national economy have been steadily declining – about 2.5% of the country's GDP (Lyubenov et al., 2020b). The Ruse region is in the Top 5 of the regions with the largest number of bee colonies. The registered beehives in the region are about 43000, which is 4.95% of the 867,560 beehives in Bulgaria. The Ruse region produces about 1300 tons of honey (Lyubenov, 2019), which is 13% of the domestic production (10000 tons), respectively a similar part of the realised economic effect of pollination – over 130-200 million BGN / year. The region specialises in the production of bee honey.

The Ruse region has a leading position in Bulgaria in terms of organic beekeeping. The relative share of organically bred bee colonies is more than 40%, which is higher than the national level at 27.6% (Agricultural Report, 2020). Organic beekeeping in the Ruse region is concentrated in the group of professional farms with more than 150 bee colonies. This is due to the favourable geographical conditions for its development, and the lack of major industrial pollutants. Data on regional beekeeping show that the average yield of honey from beehives is significantly higher than the one at the national level – more than twice, due to the significantly better natural conditions and the larger relative share of professional farms.

The region has significant biological, production and educational potential – there are two universities with agricultural orientation and an institute of agriculture and seed science at

the Academy of Agriculture. The cross-border nature of the region and the cross-border transport corridors, and also the Danube river, provide easy access to foreign markets. The region has a rich history and centuries-old traditions, crafts, festivals, culture, etc., also related to beekeeping. The Rusenski Lom river valley is an established international tourist destination due to its unique nature, registered UNESCO World Heritage sites and developed tourist routes. This offers opportunities for a symbiosis between tourism and beekeeping, i.e. development of api-tourism.

The healthy bee products from the Ruse region combine very well with tourism, which allows the formation of more complex products with higher added value, less dependence on seasonality and achieving higher and sustainable prices. Api-tourism will form local markets and short supply chains for bee products and services. It will diversify beekeeping farms, assuring more stable and higher incomes for them. Api-tourism will contribute to the preservation and development of small settlements with limited employment opportunities, creating yet another opportunity. It has the potential to significantly increase the consumption of regional bee products and other products in the local economy. There are solid prerequisites for positioning the Ruse region as a destination for api-tourism.

The region has a rich history and centuries-old traditions, crafts, festivals, culture, etc., also related to beekeeping. Beekeeping in the Ruse region is one of the most developed in Bulgaria, with excellent natural and geographical conditions. This historical, natural, human and other potential allows successful positioning of the region as a beekeeping area, and as a tourist destination for api-tourism. The natural resources of the region, the bee colonies and their products, the applied beekeeping practices and traditions, form a solid resource base for creating a regional brand. The latter will guarantee good environmental and cumulative effects for the region, will increase the demand not only for goods and services from beekeeping, but also for many foods, beverages and other products of the local economy.

The main characteristics of each region, including these of the Ruse region, are a starting point for achieving competitiveness by differentiating based on the uniqueness of the region which is very difficult to copy. The differentiation on regional basis can be achieved through: 1) natural and ecological factors (climate, relief, natural environment); 2) cultural and historical factors (local traditions and way of life, identification with the region); 3) territorial specialisation based on the previous two factors. This requires differentiation of the Ruse region by emphasising the unique characteristics of the region – history, nature, culture, traditions, specialisation in organic beekeeping, and formation of a positive image of the region and branding on their basis.

To date, beekeeping farms in the Ruse region do not use the region as an authentic and unique indicator of origin. The lack of a proactive policy regarding the regional origin of bee products leads to the fact that other countries producing honey take advantage of it by mixing their honey with another one and presenting it as Bulgarian honey. Bulgarian honey and bee products are characterised by rich biological content and high quality, as they are the result of rich biodiversity and a relatively clean environment. That is why Bulgarian honey is often sold as a raw material and is used as an improving agent for honey produced in other countries. Changing the information about the origin of honey, by mixing, repackaging and manipulation, leads to a negative image of Bulgarian honey.

Differentiation of Regional Bee Products

Positioning is preceded by segmentation, targeting and differentiation (Andonov, 2014). Differentiation is the third stage of the procedure after the first two stages have been completed. Successful positioning requires preliminary differentiation of bee products from their competitors. Differentiation is the creation of tangible and intangible differences in one or more of the product's attributes that distinguish it from its main competitors (Lilien, Rangaswamy and Bruyn, 2007). This is the stage where regional bee products need to be prepared for positioning in the minds of consumers. It has to be decided what will be different from the competitors and what will be similar to them. The set characteristics determine how and where they will position themselves in relation to competitors.

The approach to entering the target markets is related to positioning, as it is the next stage after segmentation and targeting. It takes into account the trends and stages of development, the size and service opportunities of market segments. Approaches to access target markets lead to a different kind of differentiation between consumers and competitors, which plays an important role in positioning. Kotler (2002) defines five main models for entering target markets – focus on one segment, selective specialisation, product specialisation, market specialisation and full market coverage. Lyubenov (2014) summarises the approaches in three categories- mass (undifferentiated), concentrated and multiple marketing through selective, product and market specialisation.

The chosen approach for entering the target markets preventively differentiates regional bee products against consumers and competitors. A priori it sets the degree of differentiation between them. It determines the value provided to consumers through the degree of uniqueness and quality, as well as the specialisation of the production of regional bee products, their modifications and variations, and respectively- their prime cost. The approach for entering the target markets sets the specialisation, respectively the quality and the prime cost of the regional bee products, i.e. differentiation and profitability. Derived from the approach for entering the target markets is the marketing toolkit, which also has to do with differentiation and positioning, but it will be analysed it in the next section.

Mass marketing allows a relatively poor differentiation of bee products from the Ruse Region to their competitors and substitutes, as well as to the ever-increasing diversity of consumers. Concentrated marketing allows for better differentiation of regional bee products from competitors and consumers due to their homogeneous nature in a given segment. Differentiation of regional bee products on the basis of certain modifications allows for better prices. Multiple marketing implies the highest degree of differentiation through product, market and selective specialisation. Overall, better differentiation options also allow for better positioning of regional bee products.

In mass marketing, the degree of differentiation from consumers is very low, because the whole market is served by the same type of marketing tools. The low differentiation significantly limits the possibilities for positioning in relation to different groups of consumers. The concentrated marketing is expressed as specialisation in one market segment, which leads to a higher degree of differentiation compared to other segments and consumers. In multiple marketing, the specialisation expands to different segments and the differentiation

deepens. The marketing toolboxes for the different approaches to enter the target markets are different and, as a result, a different type of differentiation and respectively different positioning opportunities are realised.

The differentiation of agricultural products, including bee products, is difficult due to the large heterogeneity of their quantity and quality in time and space, as well as their character as raw materials. To this, we can add their natural origin, forming a uniform design, which also makes it difficult to differentiate them. Overcoming these difficulties in differentiating regional bee products requires their branding. A solid basis for their branding are legally protected intellectual products (Lyubenov, 2015) – inventions, new sorts and breeds, geographical indications (GI) and traditional specialty foods (TSF), brands, company names, domain names, technologies, know-how, certification to a certain standard.

Another approach to differentiating regional bee products is the region, which is the basis for building a regional brand (DanuBee), which must become recognisable on local, national and international markets. This requires the formation of horizontal relationships between beekeeping farms, and vertical relationships with other sectors (crop production, industries, services – tourism, etc.) at the regional level – the Ruse region. This brand can combine all regional bee products (honey, beeswax, pollen, propolis, royal jelly, etc.) by using the leading position of honey, which occupies more than 90% of their value, to stimulate the development of other bee products. The brand will allow greater penetration of regional bee products in local, national and international markets.

The regional brand of the beekeeping sector in the Ruse region should be oriented towards branding the region as a destination for api-tourism, relying on both a symbiosis with tourism and a symbiosis with brands of regional legally protected products. This will improve the visibility of bee products and services from the Ruse region at regional, national and international levels. The complex and positive image of the regional bee products in symbiosis with the same one in tourism will allow greater penetration in offline and online markets, especially in the catering sector, where it will attract foreign tourists and business customers. The regional brand will significantly improve the position of regional bee products and services on international markets.

The differentiation of regional bee products through branding must consider the organisational and consumer markets. Organisational markets value the pragmatic benefits of bee products, such as quality and price. Consumer markets are subject to consumers' emotions, which is why they are influenced by many other factors. Differentiating for the organisational markets are the legally protected intellectual products that guarantee quality – inventions, sorts, breeds, know-how and certification to a certain standard. For consumer markets, intellectual products such as GI, TSC and brand, which characterise bee products with high added value, have a differentiating role. The domain name is applicable for differentiation on both markets.

The trademark may be the same as the company name, and the domain name may also contain the company name and the trademark. The company name, domain name, GI and TSF cannot be licensed. The advantage of the brand is that it can be licensed, which allows for wider commercialisation through franchising, which is an extended version of licensing, and respectively, of differentiation. On the other hand, the brand, company name and domain

name only promise a certain quality, while GI and TSF guarantee it. The domain name provides very good opportunities for fast, cheap, interactive and personalised global access to customers, respectively to global and much more precise differentiation.

The most widely used application for differentiation of regional bee products in the consumer markets is the brand, and with a much narrower application are the GI – designation of origin (DO) and geographical indication (GI), taking into account natural, technological and other restrictions on their creation. There is only one protected designation of origin (PDO) in Bulgaria – Strandzha Mana Honey/Mana Honey from Strandzha, and many brands. The most widely used application for differentiating organisational markets is the certification to a specific standard – most often organic. It is based on the use of a strictly defined technology and specific know-how. It improves online sales opportunities, the use of a domain name and a company name.

Strong differentiation between products provides great opportunities for competition, and vice versa – poor differentiation provides small opportunities for competition (Andonov, 2014). Therefore, branding regional bee products will improve their differentiation and competitiveness. Regional farms face serious difficulties in branding bee products due to the lack of financial resources, competences, etc. Bee product brands are created mainly by processors and traders, and inventions, sorts and breeds – by specialised institutes and global multinational companies. Overcoming these difficulties requires integration into horizontal and vertical plans of beekeeping farms through associations, cooperatives, clusters, etc.

Approaches to Positioning Regional Bee Products

The basic requirements for creating effective positioning strategies are (Andonov, 2014) – uniqueness, significance and credibility. Regional bee products can be positioned on their target markets based on different approaches to differentiation from consumers and competitors, but they must be unique, significant and credible.

The basic principle of positioning is that regional bee products and their brands must differ in some way from their competitors. Therefore, it is necessary to find or create a unique characteristic. It is important to perceive this characteristic as significant by its potential users. The latter insist mostly genuine, with a clear origin and ecologically clean, including also organic bee products. The Strandzha region is a proven natural habitat that provides the production of unique bee products. This made it possible, after continued efforts by the local beekeeping community and with the support by the state institutions in 2019, to register the PDO “Strandzha Mana Honey”/“Mana Honey from Strandzha”.

In the Ruse Region, mainly nectar honey is produced, which should be clearly emphasised as being produced in a country that is among the first in Europe in respect to biodiversity. The Ruse Region has a great biodiversity of medicinal, melliferous and pollen plants. More than 700 species of higher plants have been registered in the Rusenski Lom Nature Park. The average altitude of 176,3 meters and the markedly hilly terrain are the conditions, that provide a variety of bee feeding in respect to quantity and quality. Due to its rich biodiversity, the organic bee honey and others bee products from the Ruse Region contain a considerable

amount of valuable biological components. The region has thousands of years of tradition in the production of bee honey and other products related to them.

Regional honey and bee products from the Ruse Region have many and most diverse competitors – artificial and natural sweeteners, etc., which form fierce competition, including brand competition. Positioning is therefore crucial to their success. It is necessary to use this unique feature that sets them apart from their competitors. You need differentiation as clear and as complete as possible to be recognisable and noticeable. To this end, the uniqueness of the nature in the region and the leading positions of the country and the region in Europe on biodiversity and medicinal plants, which ensure high biological value, and respectively high quality of the bee products produced in the Ruse Region, should be used.

Regional apiculture products need to be differentiated not only on the basis of uniqueness but also in a way that is meaningful to their consumers. The best option for them, and their brands, is to have a unique characteristic that is both meaningful and attractive to consumers. Bulgaria is a leader in Europe for biodiversity and medicinal plants, and the Ruse Region has similar characteristics. The environment for producing regional bee products is of high biological value, which is significant for consumers, and they will be ready to pay a higher price for them. This should be used to build a positive attitude in consumers towards regional bee products in order to assist other differentiating attributes in their positioning.

In addition to being unique and meaningful, the positioning must also be credible to consumers. The more logical it sounds, and the greater the evidence for positioning is, the more plausible it is. For example, the claim of Bulgaria's leading position in the EU on biodiversity, medicinal and melliferous plants, respectively in the Ruse Region, which has similar characteristics, is trustworthy, because there is solid scientific evidence, which is available online. Therefore, it will be reliable for consumers that in the Ruse Region, there is an economic and geographical environment for the production of bee products of high biological value. This positioning claim of "*biodiversity and quality*" is in unison in terms of uniqueness, significance and credibility.

Before approaching the positioning (Myers, 1996) of regional bee products and respectively of their brands, clear answers to the following questions are needed: has any competitor already taken this positioning in the minds of the people? Are the characteristics selected or the benefits that we will point out really important to consumers? What objective evidence could support the positioning idea? Can we fulfil our commitments and our advertising promise? Do users, including potential users, believe that we can fulfil our promise? What should we do to support the positioning claim and make it even more credible? How much promotional effort will be required to be able to achieve sustained positioning in the minds of consumers from the selected target markets?

The answers to the questions stated above allow us to analyse the positioning statement – *Bulgaria's leadership positions, including those of the Ruse Region in Europe, for biodiversity and medicinal plants, ensure high biological value and quality of their bee products.* It is not known that there is a competitor who has claimed and therefore taken this position in the minds of consumers. The highlighted characteristics and benefits are important to consumers. There is objective evidence in favour of the positioning idea. The stated engagements through advertising and other communication activities are feasible.

Consumers will be convinced that the promise is fulfilled through a certificate of organic production, that will make it trustworthy and credible. There is a need to reiterate one and the same positioning theme of "biodiversity and quality".

There are three generic strategies (Andonov, 2014), which are applicable to a varying extent for positioning regional bee products on their target markets, so that they can be perceived as more valuable and preferred over their competitors: 1) our product is unique and the only one that has a specific characteristic; 2) our product is different; 3) our product is similar and has the same functionality as the competitors', but at a lower price. The generic strategies are applicable not only at the product level, but also at the company and regional level. We have already noted the uniqueness of the region, which is applicable to the first and second generic strategies. Regional bee products with low added value – raw materials and others, are most applicable to the third basic strategy.

The Strandzha Mana Honey/Mana Honey from Strandzha PDO can undoubtedly be said to be unique. Some of the regional nectar honey and bee products can also be claimed to be different because they are of higher quality. The other part should be said to have the same functionality as the competitors' because they are not inferior to them in respect to quality. It should be noted that, on the one hand, regional bee products are not inferior in quality to competitive ones, but on the other hand, they are produced in an environment rich in herbs and biodiversity, they are of higher quality, i.e. have some relative product superiority. The competitive bee products benefit from greater strategic superiority through better integration that improves quantity, sorting, branding and positioning.

The international target markets for regional bee products are predominantly organisational. A differentiating factor for these markets is their production in an environment with high biodiversity, which provides higher quality. Its disadvantage is the presence of competitors who are global leaders in biodiversity and production of bee products, such as India, Mexico and Brazil, which necessitates branding of bee products from the Ruse Region. International organisations, which buy regional bee products and re-export them at higher prices, invest in quality raw materials in order to realise profit. This indicates that regional bee products must be positioned at higher prices through branding by sorts, country and region of origin, bio standards, etc.

International markets for bee products are characterised by intense and fierce price competition. The big producers of bee honey are mainly positioned by price – they offer similar bee products with the same functionality but at a lower price. Regional apiculture products continue to compete on this basis, but it is not profitable for them, given their leadership in Europe on biodiversity and quality. They need to be re-positioned as being different and of better quality than their competitors. Differentiation in this direction requires branding on the basis of legally protected intellectual products that guarantee quality – inventions, melliferous sorts, country and region of origin, technology, know-how and certification to a certain standard – bio and others.

The current national organisational target markets for regional bee products are dominated by wholesale exporters, which account for more than 80% of demand, and therefore possess a monopoly power. They buy regional organic honey at prices very close to conventional ones. National consumer organisations buy even regional organic bee products at low prices

and then export them at higher prices. They associate them with an investment in quality raw materials in order to make a profit. Therefore, regional beekeeping farms need to be re-positioned to form their own target markets – offline and online auctions for organic and conventional honey. Branding should be by sorts, standards, technology, know-how, domain name.

Bulgarian online users are dynamic, mobile and having a high standard of living. They have a limited amount of free time and are oriented towards a healthy lifestyle and nutrition. That is why they associate bee products with a healthy and balanced diet. These users are looking for branded bee products with GO, trademark and biological certificate, and domain name plays a major role in positioning them. In contrast, offline consumers prefer to buy unbranded bee honey and bee products directly from producers, with a clear origin, guaranteeing quality at relatively lower prices. They are associated with the health and prevention of colds. The company name, the sort, and technology play an important role in their positioning.

The national traditional offline consumer markets for bee products are characterised by a significant supply of unbranded regional bee products, which are more difficult to differentiate from competing counterparts. Modern trade offers foreign branded honey, as well as a considerable amount of its branded substitutes and analogues. Online markets also offer branded bee products, as well as branded honey substitutes and analogues. It is necessary to differentiate regional bee products through a branding as being better than their competitors. Trademarks and domain names can mainly be used for this purpose, because they achieve symbiosis and synergistic action for organic bee products.

Approaches to positioning regional bee products can be focused either on consumers or on competitors. Both approaches use associations between product benefits and consumer needs. A key factor in positioning them is communicating the benefits they offer and differentiating them from competitors. Different positioning strategies may be used in relation to these goals. Acker and Shansby (1982) propose six different strategies: positioning by product attributes, by price/quality, by way of use, by product class, by consumer type, and by competitive positioning. Aaker and Mayers (1987) added yet another strategy – positioning by cultural symbols.

Positioning by product attributes requires taking a different position from the competitors by offering a specific characteristic or benefit to the consumers. This positioning strategy is difficult to implement for most bee products because they have a uniform natural design that also forms similar product attributes. It is applicable only to unique bee products such as PDO “Strandzha Mana Honey”/“Mana Honey from Strandzha”, manuka honey, etc. Positioning by price/quality can focus on the high biological value and quality of regional bee products – created in an environment with high biodiversity and offered at a very competitive price, which is better than competitive ratios with lower prices.

Positioning by way of use refers to a specific way of use or application. Regional bee honey is very suitable for the prevention of respiratory diseases, as well as for colds and flu, because it is created in a country and its region, which is a leader in Europe for medicinal plants (herbs) and biodiversity. Positioning by product class considers the presence of competing substitutes outside the product class of honey. Sugar is a typical example of honey. It is a much cheaper alternative to it, but at the same time is much unhealthier. Replacing sugar

with bee honey will reduce health problems and extend the life expectancy of consumers. Regional honey should be positioned as a healthier alternative to sugar.

Creating a strong association between consumers and bee products is positioning by consumer type. Such a positioning association can be made between bees and consumers with a dynamic lifestyle, oriented towards healthy and balanced nutrition. Positioning relative to a competitor is most often based on differentiation against a specific competitor. For regional bee honey, competitive positioning may be applied against competitors from countries with inferior biodiversity and quality. Positioning by cultural symbols relies on associations between them and a particular country. Suitable for positioning regional bee products are symbols of the richness and biodiversity of the region – herbs, melliferous plants, traditions and culture.

Katrandzhiev (2007) proposes a typology of positioning strategies following the model by Michael Porter of base corporate strategies – differentiation, cost leadership and focus. Eight positioning approaches are within the framework of the differentiation strategy: by product category, by product characteristic, by competitor, by country of origin, by price/quality ratio, distribution positioning, star positioning, and symbiose positioning. In the cost leadership strategy, the positioning approach is based on low cost. In the focus strategy, there are three positioning approaches – by benefit or problem for the consumer, by application/use, and by user type. Below we will analyse only those that do not duplicate the previous ones.

Country of origin positioning is related to the "made in" effect. It concerns the relatively sustainable image that certain countries have in beekeeping. Bulgaria has this image, also as being one of the global leaders in organic beekeeping (www.bgfermer.bg, 14.04.2016). This can also be used for positioning regional organic bee products. Consumers, including foreigners, have a strong preference for regional bee products, associating them with some regional uniqueness – culture, herbs, etc. Distribution positioning is associated with the establishment of associative relationships between distributor and producer. The distributor of regional organic bee honey can be positioned together with the region and the bio-certificate of the producer.

Regional bee products can also be successfully positioned by celebrities. This is especially appropriate when famous athletes, artists, doctors, pharmacists, api-therapists, scientists, etc. are favoured by the targeted consumers of bee products. Symbiotic positioning is present when one bee product uses the image of another product from another product category. Since antiquity, bees have been a symbol of hard work and bee honey, as their creation, has been a symbol of abundance. This symbiosis is well-suited for positioning – "The bee honey from the Ruse Region is the product of hard-working bees and the leadership of Bulgaria and the region for biodiversity in Europe, and not form industrial production, as with many of its substitutes."

By analogy with star positioning in an offline environment, this approach can be successfully implemented in online positioning through influencers – influencing persons. It should be noted that, unlike the similar offline positioning approach, influencers are not necessarily celebrities such as actors, journalists, singers and others. An influencer can be anyone who attracts through their publications the attention of many people. They are the most visible and influential personalities on social networks with thousands of followers, which is why

they play an important role in positioning. They can reach a wider range of potential consumers as well as a more narrowly defined and specific segment or niche.

Influencers, which are continued consumers of organic honey from the Ruse Region – producers, scientists, api-therapists, etc., should be used whenever possible. In order to obtain better results from influencers, one has to cooperate with them in the long run, as well as to avoid those that promote a lot of different brands. Influencers provide an opportunity to effectively reach targeted consumers, create original content, and build trust faster and easier with potential online consumers. It should be considered that the use of influencers has some risks and other dangers, characteristic of PR – incorrect way of presenting the product and its brand, legal issues regarding sponsorship and use of copyrighted business content, difficult control, etc.

Bee products are suitable for positioning by benefit for the consumer given their nutritional, medicinal, ecological, technical and other properties (Lyubenov, 2020), which provide a number of analogous and derivative benefits. The positioning can be based on their therapeutic value and a wide range of health benefits – "Bee products from the Ruse Region are a natural power and a source of health." Global benefits to nature provided by bees through pollination, as well as the benefits to society, can also be exploited, given the assurance of food diversity and food security. The positioning of regional bee products by consumer type can be based on their status – actively sporting, dynamically living, oriented towards healthy nutrition, etc.

Andonov (2014) proposes three additional positioning strategies – belonging to a strategic group, carry-over positioning, and by managing consumer perceptions and preferences.

The involvement of beekeeping farms in cluster-like strategic groups (Lyubenov, 2018b) and others, forms strategic groups that build long-term competitive advantages because they allow the creation of bee products with lower cost and better opportunities for differentiation and focus. This allows positioning on the basis of the corporate identity of a strategic alliance – a cluster, cooperative, association, etc. Another option is Bulgaria's EU membership and the Danube region, which make us a part of an economic and strategic union, a part of its social responsibility for the conservation of biodiversity and the development of organic beekeeping, where Bulgaria, and respectively, the Ruse Region have leading positions.

The carry-over positioning of regional bee products as the best ones in a fictional and intrinsic characteristic is appropriate given their rich material and spiritual nature. The statement "Bee products from the Ruse Region contain the best of the material and spiritual wealth on its territory" can be used in this respect. Positioning by managing consumers' perceptions and preferences is based on provoking primary emotions such as fear, threats to health, life and self-esteem. Consumers face a health problem that they have neglected – today's dynamic lifestyle requires a balanced diet, with healthy regional bee products playing an important role.

According to the author, the positioning of regional bee products can also be based on marketing tools. These tools have an important role to play in differentiating competitors as well as in consumers' perceptions and associations, and respectively, in their level of satisfaction. It is important to note that it is neither possible, nor necessary to achieve

superiority in all marketing tools. The classic marketing tool 4P (product, price, place, promotion) requires to achieve superiority in at least one of its elements. For larger and more complex marketing mixes, such as the 8P, a superiority in at least two of the elements is sufficient. Other instruments require parity.

The positioning on international and national organisational target markets requires that the classic 4P marketing toolkit be modified because promotion has a relatively small impact and significance on them. It plays an important role in the consumer target markets, where it should focus primarily on the preventive and healing properties of bee products. The instrument of productivity and quality plays a stronger role in positioning regional bee products on their organisational markets because it enables differentiation and higher prices than the competitors'. It is also more complex for target consumer organisations for bee products – organic, conventional, etc.

The positioning of regional bee products on their target online markets requires the use of marketing tools such as (https://hbr.org/2013; http://www.free-management-ebooks.com; Lyubenov, 2018a) SAVE – Solution, Access, Value, Education, and 4S – Scope, Site, Synergy, System. SAVE relates to the perceptions, associations and behaviour of online users. 4S identifies key strategic issues for web presence and differentiation from competitors, through a domain name, etc. On the one hand, these marketing tools are differentiating from competitors, and on the other hand – they affect the perceptions and associations of online users and their satisfaction, which is why they play an important role in positioning them on the targeted online markets.

The beekeeping brand is widely used to differentiate consumer markets, but since it is created mainly by processors and traders, it requires the integration of regional beekeeping farms horizontally and vertically. Creating it requires innovation, research and informational activities, and lasting customer relationships. This necessitates the use of marketing tools such as (Karakasheva, Markova, 2005; Lyubenov, 2014) 4I – Investigation, Information, Integration, Innovation, and 4R – Relationships, Retention, Referrals, Recovery. Positioning on consumer markets requires the classic 4P to be enriched with new marketing tools like 4I and 4R.

Conclusion

As a result of the conducted research on the positioning of bee products from the Ruse Region, conclusions can be drawn in several main areas:

Firstly, on the positioning and the regional identity of bee products:

- regional bee products are accompanied by a fundamental problem for agricultural products – difficult differentiation. Due to the fact that they are under intense competitive pressure and in a state of product parity, a serious positioning problem is defined, which makes positioning extremely important and equally difficult for their success.
- The region with its natural-ecological and cultural-historical factors, as well as territorial specialisation based on them, is the bearer of authentic uniqueness, which is the basis for

differentiation and positioning of bee products and services produced on its territory – api-tourism, etc. It is important for the differentiation and positioning of bee products.

- The leadership of Bulgaria and the Ruse region in Europe in respect to medicinal plants (herbs) and biodiversity, as well as in organic beekeeping, make it possible that one positioning scheme is being brought to the fore and is repeated – the leading positions in Europe on biodiversity and biological technologies ensure the high organic value and quality of regional bee products.

Secondly, on the differentiation of regional bee products:

- The approach for entering the target markets a priori sets the degree of differentiation of the segments and among them. It determines the degree of specialisation of regional beekeeping farms, respectively the quality and cost of their products, as well as their differentiation and profitability. Mass marketing has the lowest degree of differentiation, and multiple marketing- the most in-depth differentiation.
- The region is the basis for the differentiation of regional bee products, also by forming a regional brand (DanuBee) which unites all regional bee products – honey, beeswax, pollen, propolis, royal jelly, etc. It is the basis for differentiation and branding as a destination for api-tourism, through symbiosis with tourism and regional brands of legally protected intellectual products.
- The differentiation of regional bee products is based on branding through legally protected intellectual products, which play a key role in market positioning. Their positioning on business markets should be based on their functionality by nature – biodiversity, ecological friendliness and quality, and on consumer markets, there is one basic concept – health.
- Branding leads to the differentiation of regional bee products, which in turn leads to better profitability. The ability to manage consumer perceptions of their brands is easier to achieve and even cheaper than changing the characteristics of the product, which may not be perceived as something positive by consumers.

Thirdly, on the positioning of regional bee products:

- repositioning towards higher prices of regional bee products on their international and national target markets as different as and of higher quality than the competitors' by branding on the basis of legally protected intellectual products that guarantee quality – inventions, melliferous sorts, Europe's biodiversity leadership and organic beekeeping, technology, know-how and certification to a certain standard.
- the differentiation of regional bee products on the target online markets should be based on branded bee products with a trademark and organic certificate, and the domain name plays a key role in their positioning. Positioning on target offline consumer markets requires branding considering the presence of many branded competitors and substitutes for bee honey. Regional apiculture products need to be differentiated by branding as having higher quality than the competitors' through brands and domain names that are most widely used.

- influencers can be used for the online positioning of regional bee products. Unlike the similar offline positioning approach, they are not necessarily celebrities. They can also be manufacturers, renowned specialists, api-therapists and others. They are the most visible and influential personalities on social networks, which is why they play an important role in the online positioning of regional bee products.
- the positioning of regional bee products can also be based on marketing tools, which play an important role, both in differentiating them from competitors and in consumer perceptions and associations. Positioning requires superiority in at least one of the four elements of the marketing toolkit, or at least two if it includes eight tools. Other instruments require parity. Positioning through the marketing toolkit provides a logical connection and a transition from tactical to a strategic level.
- for positioning on the international and national organisational target markets of regional bee products, a marketing tool of type 4P is appropriate – product, price, place, productivity and quality. Positioning on target online markets requires marketing tools such as SAVE – Solution, Access, Value, Education, as well as 4S – Scope, Site, Synergy, System. For positioning on the consumer markets, the classic 4P should be complemented by 4I – Investigation, Information, Integration, Innovation, and 4R – Relationships, Retention, Referrals and Recovery.

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SUMMARIES

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EFFICIENCY OF HEALTHCARE SYSTEMS IN THE FIRST WAVE OF COVID-19 – A TECHNICAL EFFICIENCY ANALYSIS

In this novel paper, we make use of a non-parametric method known as Data Envelopment Analysis (DEA) to analyse the 31 most infected countries during the first 100 days since the outbreak of the COVID-19 coronavirus for the efficiency in containing the spread of the virus – a question yet to be answered in the literature. Our model showed 12 of the 31 countries in our sample were efficient and 19 inefficient in the use of resources to manage the flattening of their COVID-19 contagion curves. Among the worst performers were some of the richest countries in the world, Germany, Canada, the USA and Austria, with efficiency between 50 and 60 per cent – more inefficient than Italy, France and Belgium, who were some of those hardest hit by the spread of the virus.
Keywords: Pandemic; COVID-19; Flattening the Curve; Data Envelopment Analysis; Non-Pharmaceutical Interventions; Healthcare; Technical Efficiency; Healthcare system efficiency barometer
JEL: C6; D2; I1

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THE RELATIONSHIP BETWEEN ENVIRONMENTAL QUALITY AND ECONOMIC GROWTH: AN EMPIRICAL INVESTIGATION APPLIED TO THE CASE OF ALGERIA (1970-2019)

The aim of this paper is to study the existence of an environmental curve for the case of Algeria using the two-degree polynomial function presented in the linear and semi-log-linear and log-linear form in order to detect the effect of international trade and people on environmental quality. To reach our goal, we have structured our paper around two elements: Firstly, we will present a brief review of empirical and theoretical literature on the relationship between economic growth and the quality of the environment. Secondly, we will deal with the empirical study evaluating the impact of the issue of CO_2 on economic activity. We have found that the environmental Kuznets curve (EKC) exists in Algeria and the GDP per capita and the population have a positive impact on the emission of the CO_2. Furthermore, trade openness has a negative impact. In addition, there is a stable long-term relationship between emissions of CO_2 and the others various explanatory variables (GDP per capita, international trade and population).
Keywords: environmental quality; environmental Kuznets curve; economic growth; population; international trade; trade openness; environmental pollution; autoregressive distributed lag
JEL: C12; C22; Q56

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DEA EFFICIENCY APPROACH IN COMPARING MACROECONOMIC PERFORMANCE OF EU AND BALKAN COUNTRIES

The past two decades have witnessed the emergence of various types of crises – financial, economic and even health crises affecting adversely the economic development of countries worldwide. This has highlighted the role of public revenue and public spending as drivers for both economic recovery and the achievement of economic policy goals such as price stability, high economic growth and low unemployment. Despite the potential of fiscal policy to influence economic development, more active use of public spending and hence its increase does not always result in increased well-being and better macroeconomic performance of countries. This study examines the macroeconomic performance of countries from the European Union (EU) and Balkan countries over the period from 2004 to 2019. For the purposes of assessing macroeconomic performance and public spending efficiency, it uses Data Envelopment Analysis (DEA), a non-parametric method for estimating technical efficiency through the use of a single input – public spending as a percentage of GDP, and several macroeconomic indicators as outputs. Our findings indicate a decrease in the efficiency of the countries under examination and larger differences in terms of macroeconomic performance during the crisis years 2009 and 2012. Moreover, countries with more significant public spending in GDP terms tend to be less efficient than others, that have lower public spending levels.
Keywords: efficiency; public sector expenditure; fiscal policy; DEA
JEL: E61; E62; E10

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DYNAMICS OF ENERGY CONSUMPTION AND ECONOMIC GROWTH: A PANEL ESTIMATION OF NET OIL IMPORTING COUNTRIES

This study revisits the relationship between energy consumption and economic growth in twelve net oil importing countries that are divided between two panels, namely, low net oil importing countries and high net oil importing countries for the data from 1971 to 2014. The study estimates a panel vector error correction model (VECM) and panel variance decomposition analysis and it is found that: Firstly, the carbon emission is an important factor in the interlinkage between the growth and energy. The economic growth evidently appears to drive energy consumption. Further, the carbon emission increases with an increase in economic growth and energy consumption and this inference could be drawn in the case of both groups of countries. But its magnitude is more pronounced in low oil importing countries. Secondly, a uni-directional causal relationship running from economic growth to energy consumption is detected and hence supports conservation hypothesis regardless of the level of oil import dependency of the countries. It implies that energy conservation policies do not negatively impact the economic growth of the oil importing economies. Therefore, countries, irrespective of the level of net oil import, are suggested to pursue a low carbon economy through sustainability practices, preferably in high carbon density sectors such as constructions and infrastructure, industries and power. This paper contributes to the literature by initiating the discussion on the energy-economy nexus in net oil importing economies by incorporating environmental factor.
Keywords: energy use; economic growth; carbon emission; net oil importing countries; GDP, CO2; Panel VECM
JEL: C23; E01; Q56

Teodora Peneva

GREEN DEAL'S IMPACT ON ENERGY POVERTY IN BULGARIA

With no definition of energy poverty in Bulgaria and with obligations for decentralisation and decarbonisation of the energy sector, our country is entering a period of new commitments related to the Green Deal. What measures will the government take for these purposes in the households' sector, and how will this affect energy poverty levels? Will the measures have a significant effect on reducing energy poverty levels and take us out of the top position for this indicator in the EU? The article attempts to answer these questions by assessing the impact of a set of policies to reduce energy poverty among households, using anonymous data on energy income and expenditure from the 2017 Survey of Household Budget Surveys with a sample of 2950 households.
Keywords: green deal; policies; energy poverty
JEL: I32; I38; P36; P46; P48

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DETERMINANTS AND MODELS OF COMPETITIVE PERFORMANCE OF SMES IN AN INTERNATIONAL BUSINESS ENVIRONMENT: COMBINING MACRO-LEVEL AND FIRM-LEVEL ANALYSES

The article is targeted at exploring determinants associated with the internationalization process and related performance of Bulgarian enterprises. Examined are data on a macro-level such as national and European statistical data and export data for comparative purposes, as well as firm-level determinants and measures. Thus, the study conducted as part of a research project integrates and builds on previous research of the authors, with an addition of a macro perspective. By providing a macro viewpoint and longitudinal perspective on internationalization modes, it attempts to enrich the understanding of the internationalization of SMEs mostly explained by individual and organizational determinants. The empirical sample includes 500 Bulgarian enterprises, both family and non-family, with diverse internationalization patterns and performance. Findings show that export is characterized by a relatively stable contribution for economic growth, balanced geographic scope, but an unfavourable structure where this contribution is mostly made by low value-added goods, low share of high technology export, and low share of firms' export sales. The typical international involvement of Bulgarian SMEs is by less complex and resource-intensive modes following both reactive and proactive motives. Their international performance is characterized by a low degree and scope of internationalization and preference of geographically and culturally proximate target markets.
Keywords: internationalization; competitive performance; determinants; models; macro-level; firm-level; individual-level; SMEs
JEL: D22; M16; L25; L26

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LIFE CYCLE: FORMATION, STRUCTURE, MANAGEMENT

The article aims to define the management mechanism of complex, open dynamic systems with human participation. The following parts of the system life-cycle were identified and unified in the theoretical scope: general and specific compositional elements of repeating changes, marginal index boundaries, the dynamics of the compositional elements of the life-cycle, the key points of the change in the character of the index dynamics. In the practical scope, two common trends of socio-economical system life-cycle management are considered. The first trend is the regulation of the comprising element ratio, which provides the increase in the duration of the maximally effective performance of a functioning system. The second trend is the regulation of the reproduction time of a new system. The systems life cycle aspects are investigated in almost all sciences and studied within many disciplines in the field of higher education. Therefore, deepening the mastery of scientific and methodological foundations of the life cycle of a complex open dynamic system is useful for any subject in everyday and practical activities. A human being – in the formation of own human capital. Families – when it is formed, the birth of children, the distribution of income and expenses. Companies – for efficient business activities. As well as local communities, local self-government bodies, public authorities and global entities within their profile activities. The results of the research provide the possibility of the development of applicable mechanisms for effectiveness and stability enhancement of managerial and entrepreneurial operation in business projects.
Keywords: life cycle; cyclicality; system; structure; management; human being
JEL: A13; B40; D91; E39; P00

Kremena Borissova-Marinova

DEMOGRAPHIC DEVELOPMENT AND LABOUR FORCE: DEPENDENCIES AND KEY CHANGES

This study systematises the fundamental dependencies between demographic development and labour force and identifies key changes in the labour force in the country over the last two decades. A theoretical model was presented featuring the formation of the labour force focusing upon demographic factors. The place of reproduction of labour force among the systems of public activities and the classification of factors impacting it were defined by applying a system approach. Some leading tendencies in the evolution of the labour force in the country during the period 2001-2019 were featured. To achieve a fuller and more objective evaluation, an international comparison was made, including four European countries: Greece, Hungary, Czechia and Sweden. The analysis includes some indicators of general and age-specific levels of economic activity, working-age population replacement rates and the age and educational structures of the labour force and inactive persons.

The received results testify that the tendencies, observed in Bulgaria, are close to those, registered in the selected European countries over the reference period. There is, however, a number of particularities and specificities of their manifestation in the country and these are key or the reproduction of the labour force in Bulgaria.
Keywords: labour force reproduction; generational model; economic activity levels; labour force ageing; economically inactive population’s structures
JEL: J11; J21; J18

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GOOD PRACTICES IN THE FIELD OF CORPORATE SOCIAL RESPONSIBILITY (COMPARATIVE ANALYSIS FOR BULGARIA, ROMANIA AND SERBIA)

Many companies in the market today face the challenge of finding an effective way to fulfil their role as good corporate citizens – companies that "do well by doing good". The authors of the study consider the Corporate Social Responsibility as a practically applicable method to achieve this balance. The study provides a comparative analysis between companies recognized as socially responsible in Bulgaria, Romania and Serbia, by presenting the main aspects of the initiatives that lead to these companies to be identified as a benchmark in the implementation of CSR policies. On this basis, the authors of the study: (1) outline key areas of CSR in the countries concerned by defining similarities and differences in the scope and the content of the initiatives that companies initiate and/or engage in; (2) highlight good practices in the field of CSR, where there is a possibility for transfer of know-how among companies from the three countries; (3) identify areas with underdeveloped potential in which companies in the countries concerned can focus their efforts and resources in order to optimize their engagement in the field of CSR. The results of the conducted analysis are compared with the point of view of consumers who take both the roles of beneficiaries of the effects of socially responsible behaviour of companies and of active participants in market relations, having the power to motivate and require companies to be conscious corporate citizens. The purpose of the comparison is to find unused positioning opportunities through specific actions related to CSR in specific consumer segments and/or to outline opportunities for optimizing communications in this direction.
Keywords: sustainable development; Corporate Social Responsibility; corporate social initiatives; social responsibility awards; qualitative research
JEL: M31

Lyubomir Lyubenov

POSITIONING OF BEE PRODUCTS FROM THE RUSE REGION

The study finds that there is a serious positioning problem for bee products from the Ruse Region – strong competitive pressure, product parity and difficult differentiation. This makes positioning extremely important to their success, but also – very difficult. It was found that the region, with its natural, ecological, cultural and historical factors, as well as territorial specialisation based on these factors, is the bearer of authentic uniqueness, which is the foundation for differentiation and positioning of the bee products and services produced on its territory. Branding of bee products from the Ruse Region plays a key role in differentiating them. It can be based on natural factors, sorts, standards, technologies, domain name, brand. From the natural factors and the certified technologies, the leading positions of Bulgaria in Europe in respect to biodiversity and biotechnology in the beekeeping sector shall be used, because they ensure high biological value and quality of the bee products from the Ruse Region. Brands shall also be based on them, and the domain name plays a key role in the positioning on online markets. Positioning can also be based on marketing tools, which play an important role in differentiating competitors as well as consumer perceptions and associations. Positioning on organisational markets shall emphasise the functionality of regional apiculture products by nature (biodiversity, ecology, quality), and on consumer markets- to emphasise a single basic concept – health.
Keywords: region; differentiation; branding; positioning
JEL: M31; Q13