DIGITALES ARCHIV

Jurcevic, Marija (Ed.); Čiković, Katerina Fotova (Ed.); Ribeiro, Humberto Nuno Rito (Ed.)

Conference Paper

Economic and social development : 93rd International Scientific Conference on Economic and Social Development - "Green Economy & Sustainable Development" : book of proceedings : 10-11 March, 2023

Provided in Cooperation with:
Varazdin Development and Entrepreneurship Agency

Mitglied der

ZBW Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Leibniz-Gemeinschaft

Economic and Social Development

93rd International Scientific Conference on Economic and Social Development –
"Green Economy & Sustainable Development"

Book of Proceedings

Editors:
Marija Jurcevic, Katerina Fotova Cikovic, Humberto Ribeiro

10-11 March, 2023

Varazdin Development and Entrepreneurship Agency and **University North**
in cooperation with
Faculty of Management University of Warsaw
Faculty of Law, Economics and Social Sciences Sale - Mohammed V University in Rabat
ENCGT - Ecole Nationale de Commerce et de Gestion de Tanger - Abdelmalek Essaadi University
Polytechnic of Medimurje in Cakovec

Editors:
Marija Jurcevic, University of Zagreb, Croatia
Katerina Fotova Cikovic, University North, Croatia
Humberto Ribeiro, University of Aveiro, Portugal

Economic and Social Development

93rd International Scientific Conference on Economic and Social Development –
"Green Economy & Sustainable Development"

Book of Proceedings

10-11 March, 2023

CONTENTS

EXCESSIVE PERFORMANCE TARGET AND PERFORMANCE OF MARKETING STAFF IN TURBULENT BANKING ENVIRONMENT - CASE OF SELECTED BANKS, AKURE METROPOLIS, ONDO STATE, NIGERIA

Omonigho Tonia Okhankhuele
*Department of Business Administration, Federal University of Technology,
Akure, Ondo State, Nigeria
otokhankhuele@futa.edu.ng; omotonia2013@gmail.com*

Joshua Olusegun Adetayo
*Department of Management Accounting,
Obafemi Awolowo University, Ile-Ife, Nigeria
adetayosegun2002yahoo.com*

ABSTRACT

This paper recognized the importance of attainable performance target in stimulating the desire and commitment of workers to perform their duties effectively. The paper examined the factors militating against the effectiveness of performance appraisal; appraised the extent of attainability of the set performance target, evaluated the performance of the marketing staff of the banks using the banks' key performance indices; and assessed the effect of excessive performance target on the staff' performance. The paper sought answers to research questions by employing survey design and purposive sampling technique to select the banks and respondents. Data was collected from 51 respondents with the help of structured questionnaire and personal interview. The respondents consisted of the marketing staff of the selected banks. Data were analyzed with descriptive statistic (mean average and standard deviation) and Pearson Product-Moment Correlation Coefficient (PPMCC). The study revealed that the performance targets were excessively high and, in most cases, unattainable. There was a negative relationship between the high-performance target and three of the four performance indices (-.780, -.534 and -.661) used by the bank, and positive but weak relationship with one of the performance indices (.230 - ability to work harder to meet target). However, the level of significance of between .000 and .044 which were lower than the table value of 0.05 were attained between the dependent and independent variables. Therefore, the study concluded that, there was a negative but significant relationship between excessive performance target and performance of marketing staff of selected banks. The paper recommends a review of the performance target used to appraise the staff and ensure they are attainable in order to stimulate the interest and commitment of the staff towards improving their performances and attaining the banks' goal.
Keywords: Excessive, Marketing staff, Performance, Performance Target

1. INTRODUCTION

Performance appraisal though a very controversial but an indispensable human relations instrument (Ibeogu & Ozturen, 2015; Karim, Haque, Dona & Moniruzzaman, 2015; Apak, Gümüs, Öner and Gümüş, 2016, Daniel & Ibrahim, 2019) for managing employee performance effectively (Selvarajan, Singh & Solansky, 2018) plays significant role in effectively managing human resources in firms (small and large) all over the world (Boswell and Boudreau, 2002; Apak *et al.*, 2016). Performance appraisal is a formal process by which employees are assessed by a judge (usually a supervisor or manager) (DeNisi & Murphy, 2017) who evaluates the performance of an employee along a specified set of dimensions, allocates scores to the evaluation, and notifies the employee of his or her formal rating (DeNisi & Murphy, 2017).

Performance appraisal is defined as a systematic process that helps to evaluate past and current employees' performance and identifies employee's potential for further growth and advancement within the organization's career ladder (Igbojekwe & Ugo-Okoro, 2015). It is used to assess the results of an employee's work with the aim of giving the employee a justified reward for his efforts, recognition, job security, career planning, assurance, selection for training and development, service quality, staff promotion, among others (Samuel, Omisore & Atajeromavwo, 2014; Heywood, Jirjahn & Struewing, 2017). It involves assessing employees on how well they carry out their jobs in accordance with the set performance standards (Gichuhi, Abaja & Ochieng, 2012). Also, making the feedback on the quality and level of their performance available to the employees (DeNisi & Pritchard, 2006). Performance appraisal assists managers to determine the gap between actual and desired performance and disparity in employees' performance between actual and desired can be removed by imparting vital training which stimulates employees to improve their performances and attain organizational competitiveness (Shaharyar, Baloch, Tariq, Mushtaq & Mushtaq, 2014). A variety of decisions relating to employee's potential for promotion, salary increase, growth, career advancement and development within organizations is partly based on performance appraisal (Igbojekwe and Ugo-Okoro, 2015; DeNisi & Murphy, 2017; Njuguna & Maende, 2017). Employees' performance can be referred to as an activity in which a person is able to achieve the task allocated to him or her effectively, subject to the usual limitations of judicious use of the resources available (Adetayo, Ajani, and Olabisi (2014). The importance of performance appraisal in human resource management has drawn the attention of several human resource scholars to studying the intricacies of performance appraisal within organisations. While some studies (Bernot, Cernic, Lokar, Terbovsek, Petric & Zajc, 2014; Karim *et al.*, 2015; AL-Sinawi, Piaw & Idris, 2015; Wanjala & Kimutai, 2015; Njuguna & Maende, 2017; Mulwa & Weru, 2017; Khan, Khan & Khan, 2017; Raghunathan & Sastry, 2018; Rahahleh, Alabaddi & Moflih, 2019; Daniel & Ibrahim, 2019) revealed that performance appraisal has positive effects on employees' satisfaction, motivation, retention, raising staff capabilities, productivity, and performance. Other studies (Ibeogu & Ozturen, 2015; Kyeremeh & Pimpong, 2018) show that performance appraisal does not arouse employees' motivation, satisfaction, job or career, and desire to give in their best to achieving the goals and objectives of institutions and organisations. However, it has been observed that performance appraisal can motivate and influence employees to improve their performances when it is honest and allows for leader member exchange (Selvarajan *et al.*, 2018) and when it disinters fairness (interactive, distributive, and procedural fairness) (Burton, Sablynski & Sekiguchi, 2008; Selvarajan *et al.*, 2018). Managers are fundamentally held accountable for being unfair in their performance ratings due to biases including political influences and liking (Selvarajan *et al.*, 2018). Explaining the disparities in the results of the above authors' studies, Raghunathan and Sastry (2018) disclosed that, selected workers can find performance appraisals to be intimidating and threatening if not well planned and designed. It can also lead to punitive measures where employees that are not productive may be dismissed or demoted when they fail to meet their targets (Apak *et al.*, 2016; Njuguna & Maende, 2017). Also, when employees view the method of appraisal to be made up of halo errors, prejudice, lack objectivity, unfair or made up of too high-performance standard to be met, this could trigger stress and anxiety (Banks & Roberson, 1985; Fisher, Schoenfeldt, & Shaw, 2006). When employees are stressed, they become worried, unhappy, tired, angry, have headache and weak (Adetayo *et al.*, 2014). This can have a negative effect on their performance. Performance appraisal could also be viewed as a negative tool which causes apprehension among employees and that which employers use to deal with employees or force them to over work themselves to the detriment of the employees and advantage of the organizations. On this ground, Daniels (1999) referred to performance appraisal as useless, evil, a step of firing process, while Mackey and Johnson (2000) stated that performance appraisal can demotivate

employees and leave a bad impression on the good once. Thus, Cowandy (2014) and Wanjala and Kimutai (2015) asserted that, performance appraisal can only be an effective instrument in measuring employee performance when it is perceived to be objective and fair, hence Ibeogu & Ozturen (2015) affirmed that satisfaction with performance appraisal system can only be attained if the employees perceive it to be positive and results in awards, pay rise, training and development, promotion and other monetary incentives, benefits and insurance. AL-Sinawi *et al.* (2015) also concluded that an adverse performance appraisal can have an adverse consequence on an employee's sense of communication, interpersonal relationships, motivation, self-worth, performance, and support for organizational goals. These past studies, reveal a gap in literature on the effect of excessive performance target on the performance of marketing staff in banks. This study was carried out to fill this gap. The focus of this paper therefore, is to contribute to the existing literature on the effect of performance appraisal on employees' performance. In Nigeria, up to the year 2004, the banking sector was carrying out its services without serious monitoring. Some banks would go into liquidation without fully compensating their clients. According to Soludo (2007) the banking sector in Nigeria then were bankrupt, liquidated, comprised operational and structural weaknesses and the only way to upturn their performances was to execute a more pragmatic reform. Thus, the Bankers' committee and Board of the Central Bank of Nigeria (CBN), having realized the situation in the Nigerian banking sector, approved the procedure to follow in restructuring the sector, on 6th July, 2004. This process was to speed up consolidation in the banking industry and aid banks to meet up with the officially approved capital base of ₦25 billion by December 31st 2005 from a minimum capital base of 2 billion Naira. In order to accomplish the ₦25 billion capitalizations, banks were permitted to acquire other banks or merge (Obamuyi, 2010). The consolidation exercise was completed by reducing the banks from eight-nine (89) to twenty-five (25) in 2006 and at the end of December 2007 the number was reduced to 24 banks when Stanbic Bank Plc merged with IBTC Bank to form Stanbic IBTC Bank Plc. (Soludo, 2004; Central Bank of Nigeria (CBN), 2011; Oluitan, Ashamu & Ogunkenu, 2015; Akpansung and Gidigbi, 2014). However, merger is still ongoing in the Nigerian banking industry making the total number of existing banks in Nigeria to fluctuate every year. In the struggle to survive, pressure is continually placed on bank workers especially the marketing staff to meet up with the banks' excessive annual set standards which is majorly in monetary form. The bank workers' performances are therefore appraised based on the banks' key appraisal indices - ability to motivate clients to deposit huge amount of money with their banks, and the extent of withdrawals made by these clients by cheques and across the counters, and through the Automatic Teller Machines (ATM) yearly. This situation has made performance appraisal in this industry as a tool for measuring the performance of workers to take a new dimension where the workers must meet up with the excessive set standards or shown a red flag – get dismissed. What is the effect of this excessive performance target being used as a tool for measuring employees' performance under this hostile environment? Established in 1894, as the Bank of British West Africa, First bank which is one of the last old generation banks operating in Nigeria was renamed First bank of Nigeria Limited in 1979. First bank has its head quarter at 35, Marina, Lagos, Nigeria. The bank has 760 branches approximately and subsidiaries across Middle African countries and the United Kingdom (UK). It also has a web of representative offices in Abu Dhabi, Beijing, Paris and Johannesburg. The bank was transformed into a public company in 1970 and enlisted on the Nigerian Stock Exchange in 1971 (First bank of Nigeria Limited, 2016; 2019; & www.firstbanknigeria.com) The bank has five branches (Alagbaka, Federal University of Technology, Akure, Oba Adesida Road, Oja-Oba Market and Oke Aro) in Akure metropolis. Unity bank PLC., which is the largest merger and consolidation bank in the Nigerian banking industry history, originated in 2006, following the Central Bank of Nigeria (CBN)'s mandate for the Nigerian banks to be recapitalized.

The bank comprised (9) financial institutions. Unity bank has its head office at 785, Herbert Macaulay Way, Central Business District, Abuja, while the head office annex is at 290A Akin Olugbade Street, Victoria Island, Lagos. The Bank has over 242 business offices across the 36 States and Federal Capital Territory (Unity bank PLC, Corporate profile; Ohwovoriole, 2017). Unity bank has three branches (Alagbaka, Oyemekun Road, and Oba Adesida) in Akure Metropolis. Access Bank Plc. was established as a private limited liability company on the 8th of February 1989, but started functioning on the 11th of May 1989. The Bank was transformed into a public limited liability company on the 24th of March 1998 and had its shares listed on the Nigerian Stock Exchange on the 18th of November 1998. Access Bank was given a universal banking license by the Central Bank of Nigeria on the 5th of February 2001. The bank merged with Diamond Bank in late March 2019. It operates through a web of over 600 branches and service outlets in three continents and 12 countries. The Bank has its headquarter, in Victoria Island, Lagos, Nigeria (Access bank's consolidated and separate financial statements for the year ended December 2017, Access Bank PLC. Corporate profile). Access bank has three branches (Alagbaka, Oyemekun Road and Ado Owo Road) in Akure Metropolis. These three banks specialize in commercial Banking, foreign exchange operations, retail banking, international banking, corporate finance, provision of money market products and services, granting of loans and advances, equipment leasing, among others.

2. THE SPECIFIC OBJECTIVES OF THE STUDY ARE TO:
1) examine the factors militating against the effectiveness of performance appraisal in the target area;
2) appraise the extent of attainability of the set performance target in the study area;
3) evaluate the performance of the marketing staff of the selected banks using the banks' key performance indices; and
4) assess the effect of excessive performance target on the staff' performance.

3. STATEMENT OF THE PROBLEM
Performance appraisal has been viewed as an indispensable but sometimes evil human relations instrument for appraising employees' performance effectively. Despite several researches on the effect of appraisal on employees' performance, its effect on the performance of marketing staff in Nigerian banks where excessive performance target is set has not been assessed. Hence the need for this study.

4. LITERATURE REVIEW
4.1. Importance of performance appraisal
Yearly performance review measures how far and how well employees carry out their jobs, and suitability for training or promotion. Thus, it helps to locate the weaknesses and strengths of an individual and specifies how such weaknesses can be overcome and strengths may best be made use of (Mullins, 1999). Performance appraisal makes instruments available for workers who have the believe that they have control over their environment, to attest their value and accomplish their goals (Heywood *et al.*, 2017). It has a significant and valued place in human resource management, and also has the power to empower employees to develop their professional and personal skills (Bernot *et al.*, 2014). Performance appraisal systems are presumed to stimulate employees to struggle hard to accomplish set targets, objectives and goals so that they will be rewarded (Njuguna & Maende, 2017). When performance appraisal is not carried out in a firm, the consequence is low job performance of workers (Daniel & Ibrahim, 2019). Although some workers may find performance appraisals to be intimidating or threatening (Raghunathan & Sastry, 2018), with good planning and design, performance appraisals can be productive and rewarding for supervisors/managers and employees.

When performance appraisals are visibly connected with rewards and recognition, there is likelihood that it would be beneficial for employees' productivity, motivation and retention (Raghunathan & Sastry, 2018).

4.2. Factors that affect performance appraisal in an organization
Irregular standards for human resource performance appraisal, tribal sentiment, emotional status of assessors, delay in appraisal processes, among others are the crucial factors that affect the conventional employees' performance appraisal styles in firms (Samuel *et al*., 2014). When those to be appraised observe that the system for carrying out the appraisal is unfair, the feedback is erroneous or that the feedback sources are unconceivable, they are likely going to ignore the feedback they get (Longenecker & Fink, 2017). Feedback is least useful when it is untrue, incorrect or biased as a result of politics or favoritism. Alam and Singh (2020) affirmed that negative feedback can threaten employees' self-esteem and make them to have negative feelings that can lead to the deterioration of their performances instead of increasing it, especially when the evaluation of an employee's performance reflects gaps between desired and expected performance. Also, negative performance distorts the realization of personal goals like increase in pay or career advancement of employees and this can create conflict between the employee and the appraiser and lead employees to become defensive and react negatively (Alam and Latham, 2019). Moreover, where a lot of employees view performance appraisal as being an obligatory organizational procedure, but do not palpably see how it affects their insight towards their career or job (Ibeogu & Ozturen, 2015), this feeling affects employee's attitudes towards performance appraisal. In addition, acute stress and arousing negative experiences impair executive function but enhances response inhibition and updating (Shields, Sazma & Yonelinas, 2016). Such finding high-points the consequent effect of a threatening appraising situation (Newman, Liddell, Beesley, & Most, 2020). An aggrieved employee who is appraised may not accept the feedback on his performance and may respond to his feedback in a hostile way, with the feeling that he has been unfairly treated. In such a situation, he may refuse to engage effectively in a conversation that has to do with his understanding the reasons behind his performing below standard and the creation of an action plan to solve the performance issue with his supervisor (Vardi & Weitz, 2004; Alam & Singh, 2020). Moreover, sometimes conflicts relating to personality takes place. Under this situation, some supervisors may not relate well with their employees. This may result to personal prejudice which could overturn the appraisal process in a case where the prejudice is massive (Selvarajan and Cloninger, 2012). Also, unwillingness to confront subordinates with the truth, poor design of performance appraisal system, lack of consideration of the organizational culture and time pressure are some of the problems associated with performance appraisal process (Selvarajan & Cloninger, 2012). Some managers may rate the performance of their subordinate to be very high due to their wanting to disclose that the work under their responsibilities is going on very well or not having the capability to prove to their subordinates that their performances merit certain rating (Ibeogu & Ozturen, 2015). Murphy & DeNisi (2008) summed it up by saying that the factors which affect employees' performance appraisal include: the acceptance of the system used for the performance appraisal, the appraisal purpose, the relationship that exist between the appraiser and the employee, the national culture norms, among others.

5. THEORETICAL FRAMEWORK
The theory underpinning this study is the Affective Events Theory (AET). Propounded by Weiss and Cropanzano (1996), AET explains how emotions or feelings and moods at workplaces affect job satisfaction and consequently, job performance of workers. The belief behind AET is that human beings are emotional and their behaviour is directed by emotions.

Hence, positive emotional events along with negative once within workplaces have psychological effect on workers' job satisfaction which in consequence affect their performance. According to Sypriewska (2013), an employee builds confidence and takes part actively in the success of a firm when appropriate work environment is created for him and when he is appraised positively. This theory is related to this study because it explains how anxiety, tension, fear, for the ability of employees to meet up with outrageous performance target can lead to psychological breakdown and depression of employees and consequently affect the employees' commitment, job satisfaction and performance.

6. MATERIALS AND METHODS
6.1. Study area
The study area, Akure Metropolis is located in South-Western Nigeria. Akure Metropolis comprises Akure North and Akure South Local Government Areas of Ondo State, Nigeria. Ondo State was carved out from the former western state in 1976, when the Federal Republic of Nigeria's number of states were increased from twelve (12) to nineteen (19). Akure city has coordinates: 7°15'0"N 5°11'42"E and a population of 484,798 (National Population Census, 2006). The State lies between latitude 6° to 8° North and 5° East of Greenwich. The State has tropical rainforest in far north, humid tropics with swampy areas in the extreme south and dry savannah up lands in the northern parts of the state. The state occupies a total area of 15,500 sq. m with a population of 3,460,877 (National Population Commission, 2006).

Figure 1: Map of Nigeria Showing Ondo State, Akure North and Akure South Local Government Areas (LGAs) which constitute Akure Metropolis (Sources: Wikipedia)
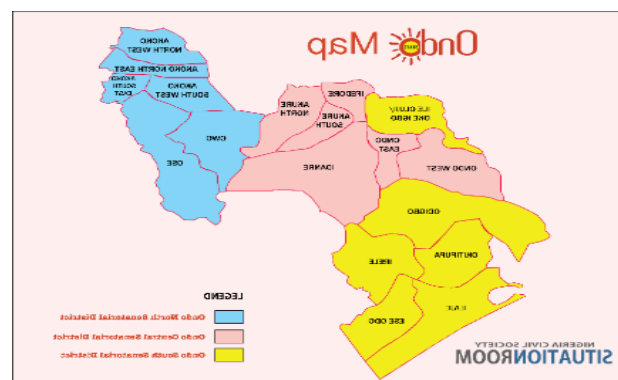
Figure 2: Map of Ondo State, showing Akure North and Akure South LGAs (Sources: Wikipedia)

6.2. Method

Survey design and purposive sampling technique were used in this study. The population of the study was 174 employees of the three banks. Fifty-three (53) copies of structured questionnaire were distributed to elicit information from sample (marketing staff of the banks), however, only 51(96%) copies of structured questionnaire were retrieved from the marketers. Data were analyzed with descriptive statistic (mean average and standard deviation) and Pearson Product-Moment Correlation Coefficient (PPMCC) was used to measure the strength and direction of the linear relationship between the dependent and independent variables. Cronbach Alpha was used to test for the reliability of the research instrument, and the coefficient of 0.727 was attained, which shows that the result is high and appropriate for social science. The research instrument was validated by experts in the fields of personnel management and marketing. Nevertheless, pilot test was also carried out by administering 11 (20%) of the total copies of questionnaire distributed to marketers in a branch of Guarantee Trust Bank and Zenith Bank each within Dugbe, Ibadan, Oyo State, Nigeria. In the process of running the pilot test, the suitability of the measuring instrument to measure what it was expected to measure was tested and corrections were effected in the questionnaire before it was administered to the respondents.

7. RESULTS AND DISCUSSION

7.1. Socio-demographic characteristics of the respondents

Table 1 shows the summary of the Socio-demographic distribution of the respondents. The table disclosed that the female respondents 27 (52.9%) were higher than the male respondents 4 (47.1%). This implies that female markers in the study area were more than the male marketers. Furthermore, 33 (64.7%) of the respondents had B.Sc./HND, 13(25.5%) had M.Sc., while the remaining 5 (9.8%) were Ph. D certificate or related degree holders. Also, the result revealed that most of the respondents 31 (60.8%) were single, while the remaining 20 (39.2%) were married. In addition, respondents were distributed across different age groups. Sixteen – 16 (31.4%) of the respondents were between age group 20 – 29 years, 26 (51.0%) were between age group 30 – 39 years, while 9 (17.6%) were between age group 40 – 49 years. The reason for this might not be far from the fact that people within 20 to 39 years are perceived to be agile and have enough energy to scout around for customers. Moreover, 28 (54.9%) of the respondents had 1 – 4 years of experience in the bank, 14 (27.5%) had 5 – 9 years of experience while the remaining 9 (17.6%) had 10-14 years of experience. In addition, 22 (43.1%) of the respondents were marketing staff of First Bank Nigeria Limited, 14 (27.5%) were marketing staff of Unity Bank Plc. While the remaining 15 (29.4%) were marketing staff of Access Bank Plc.

Table following on the next page

Characteristics	Frequency (n=51)	Percentage (%)
Gender		
Male	24	47.1
Female	27	52.9
Level of Education		
B.SC/HND	33	64.7
M.SC	13	25.5
PHD and OTHERS	5	9.8
Marital Status		
Single	31	60.8
Married	20	39.2
Age (Years)		
20 - 29	16	31.4
30 - 39	26	51.0
40 - 49	9	17.6
Years of Experience		
1 – 4	28	54.9
5 – 9	14	27.5
10 - 14	9	17.6
Bank	22	
		43.1
First Bank		
Unity Bank	14	27.5
Access Bank	15	29.4
Department		
Marketing	51	100

Table 1: Distribution of socio-demographic characteristics of the respondent
(Source: Field Work 2020)

7.2. Factors militating against the effectiveness of the performance appraisal carried out by the selected banks

Table 2 shows the distribution of the factors militating against the effectiveness of the performance appraisal carried out by the selected banks. The table disclosed that, the factor that mostly militate against the effectiveness of the performance appraisal carried out in the selected banks is excessively high-performance target to be met with mean average of 4.94, followed by management basing their appraisal majorly on subordinates' ability to meet up with monetary target, without much consideration on past performance and other criteria with mean average of 4.59, and the use of computer software for appraisal is not humane with mean average of 4.71. This implies that, the respondents agree that the predetermined standard performance set by their management, which is mainly in monetary form is rather too high to be attained easily. This means that the respondents perceived that the set standard is excessively high and very difficult to attain, as revealed on table 5 where most of the respondents (94.12%) rated the target to be very high. Also, a lot of the respondents (86.28%) view the use of computer software to appraise them as not humane. On the other hand, absence of compensation after appraisal was the least rated factor (mean average of 1.57) militating against the effectiveness of the performance appraisal by the respondents, followed by biased reward system with mean average of 2.25 and absence of provision for performance feedback with mean average of 2.75. This means that, the respondents are adequately compensated without bias when their performances meet up with the set standard or surpasses it. Also, they are given feedback. However, the interview carried out with some of the respondents revealed that the respondents view the feedback system as, rude, shocking and unfair.

One of the respondents stated:

"You get to know the feedback on your performance on the computer. You resume work to find out that your access (in form of a code or password) is withdrawn. Thus, when you try to get access to the computer by typing in your code when you resume work in the morning, you will not be able to. When an employee is sacked, only a month's salary is given in lieu. The marketing staff are mostly affected. Once you are "red flagged" (given a warning), you become apprehensive and this negatively affects your concentration, health, attitude to work, and performance."

This view on the experience of negative feedback is one of the factors identified by Alam and Singh (2020) who affirmed that negative feedback can threaten employees' self-esteem and make them to have negative feelings that can lead to the deterioration of their performances instead of increasing it. Also, Alam and Latham (2019) asserted that negative performance feedback distorts the realization of personal goals like increase in pay or career advancement of employees and this can create conflict between the employee and the appraiser.

Factors militating against the effectiveness of the performance appraisal carried out by the selected banks	Very High	High	Moderate	Low	Very Low	Mean
Management basing their appraisal majorly on subordinates' ability to meet up with monetary target, without much consideration on past performance and other criteria	35(68.63%)	11(21.57%)	5(9.80%)	0(0%)	0(0%)	4.59
Absence of Compensation after appraisal	0(0%)	0(0%)	3(5.88%)	23(45.10%)	25(49.02%)	1.57
Absence of provision for performance feedback	1(1.96%)	2(3.92%)	37(72.55%)	5(9.80%)	6(11.77%)	2.75
Biased reward system	5(9.80%)	4(7.85%)	5(9.80%)	22(43.14%)	15(29.41%)	2.25
Favoritism of supervisors	5(9.80%)	3(5.88%)	9(17.65%)	22(43.14%)	12(23.53%)	2.35
Excessively high-performance target to be met	48(94.12%)	3(5.88%)	0(0%)	0(0%)	0(0%)	4.94
The use of computer software for appraisal is not humane	44(86.28%)	2(3.92%)	3(5.88%)	1(1.96%)	1(1.96%)	4.71
The appraisal system is autocratic	9(17.65%)	14(27.45%)	15(29.41%)	8(15.69%)	5(9.80%)	3.27

Table 2: Distribution of the factors militating against the effectiveness of the performance appraisal carried out by the selected banks
(Source: Field Work 2020)

7.3. Extent of Attainability of the Predetermined Performance Target
Table 3 shows the distribution of the extent of attainability of the predetermined performance target set by management of the selected banks. The table reveals that 5 (9.8%) respondents agreed the performances target set by the banks' management was moderately attainable, 44(86.3%) affirmed that the target is lowly attainable, while 2(3.9%) agreed that the target is not attainable. There was no respondent that agreed that the target was either very highly attainable or highly attainable. This result indicates that the set performance target by the bank's management from the view of the respondents is hardly attainable. This is against one of the attributes of an objective which states that an objective must be attainable. When employees know that an objective is hardly or not attainable they will not have the drive to put in their entire energy to strive towards the attainment of such objective. This result is in agreement with that obtained from the personal interview held with some of the marketing staff of the selected banks. These staff agreed that the performance target given to the marketing staff is usually above 200 million naira, which is usually difficult for them to attain within the period of evaluation.

One of the staff stated:
"As a result of the high-performance target set for them to attain, the job security for the marketing staff in Nigerian banks is next to nothing. It is only lucrative for the sons, daughter, relatives or friends of the elites or rich men. The reason is that, they are the once who are able to convince their dads, mums, uncles aunties, friends or other relatives to deposit money in their banks, and their relatives would do that in order: (i) to secure the jobs of such employee; (ii) enable the employee to earn commission on the money they deposit. Thus, employment of marketing staff in Nigerian banks nowadays is no longer on merit. It is on who the potential employee knows or is related to in the society. In some cases, a rich man's son is accosted by bank management to come and work in its bank in order to use him or her as a contact to woo his or her family to deposit money in the bank. It is very difficult for an employee from an average or poor family no matter how intelligent he or she is, to survive as a marketing staff because, he or she can hardly meet up with the yearly above 200 million naira target all the time".

Another employee who spoke about the method of appraisal in his bank stated:
"The method is merciless. Even where you performed very well during previous appraisal period, when you performed below the monetary target after two subsequent period, you are sacked".

A female marketing staff stated:
"To retain this job, I have engaged myself in some immoral acts in order to meet up with my targets. Some clients would schedule our business meeting in a hotel room. I am just using this job as a stepping stone to getting another job. There is no job security for marketing staff in a Nigerian bank anymore except you are from the wealthy circle".

This result is in agreement with that of Adetayo *et al*. (2014)'s study on an overview of the effects of job stress on employees' performance in Nigeria tertiary hospitals, where it was asserted that, firms that do not implement strategies to lessen employees' stress may find their employees looking elsewhere for better opportunities

Very Highly Attainable	Highly Attainable	Moderately Attainable	Lowly Attainable	Not Attainable	Total
0(0%)	0(0%)	5(9.8%)	44(86.3%)	2(3.9%)	51(100%)

Table 3: Distribution of the extent of attainability of the predetermined performance target set by management of the selected banks
(Source: Field Work 2020)

7.4. Performance of the marketing staff of the banks using the banks' key performance indices as   rated by the respondents
Table 4 reveals the performance of the marketing staff of the banks using the banks' key performance indices as rated by the respondents. The table disclosed that, the mean average of the Respondents' rating of their performances based on the performance indices is generally low. The index with the lowest mean average (1.627) was the ability of the respondents to maintain customers' account with minimum withdrawals from ATM/Cheque/across counter within the period of appraisal, while the highest of the mean average (2.608 which was equally not encouraging) was the respondents' ability to get new customers to deposit money. This result indicates that, even when the respondents find it difficult to get their clients to deposit money with the banks, it is more difficult for the respondents to encourage the customers to

maintain customers' account with minimum withdrawals from ATM/Cheque/across counter within the period of appraisal. This has a lot of negative effect on the result of their appraisal. This result is in agreement with the result of the interview held with some of the respondents.

One of the respondents stated:
"Yes, performance appraisal helps me to work harder to reach my target. However, when you fail to meet your target once and you are "red flagged", you know you are close to your way out. This grips me with fear and anxiety, makes me to loose focus, have sleepless nights, affects my relationship with my family negatively, and it has even led to my being hypertensive like some of my other colleagues. All these feelings affect my performance negatively."

This result is in line with that of Daniels (1999) who referred to performance appraisal as useless, evil and a step of firing process. It is also in agreement with some authors who see performance appraisal as a negative tool which causes apprehension among employees. Also, some employers use performance appraisal to deal with employees who they feel are not in good terms with them or force employees to over work themselves to the detriment of the employees and advantage of the organizations.

S/N	Performance Indices/ Respondents' rating of their performances based on the performance indices	Very High	High	Moderate	Low	Very Low	Mean
1	Getting new customers to deposit money	5(9.80%)	2(3.92%)	19(37.26%)	18(35.29%)	7(13.73%)	2.608
2	Ability to maintain customers' account with minimum withdrawals from ATM/Cheque/across counter within the period of appraisal	0(0%)	1(1.96%)	3(5.88%)	23(45.10%)	24(47.06%)	1.627
3	Ability to work harder to meet target	1(1.96%)	2(3.92%)	11(21.57%)	17(33.33%)	20(39.22%)	1.961
4	Ability to convince existing customers to remain loyal to the bank	1(1.96%)	2(3.92%)	8(15.69%)	16(31.37%)	24(47.06%)	1.824

Table 4: Distribution of the performance of the marketing staff of the banks using the banks' key performance indices as rated by the respondents
(Source: Field Work 2020)

7.5. Correlation Analysis between Excessively High-Performance Target and Performance of the Marketing Staff of Selected Banks using the Respondents' Rating of their Performances Based on the Banks' Performance Indices
Table 5 reveals the correlation analysis between excessively high-performance target and performance of the marketing staff of the selected banks using the respondents' rating of their performances based on the banks' performance indices and their rating on too high-performance target to be met on table 5.

- **Test Statistics = Pearson Correlation**
- **Confidence Level = 95%**
- **Significant Level = 5% (0.05)**
- **Decision Rule =** The study revealed that there was a negative relationship between the excessively high-performance target and three of the four performance indices (getting new customers to deposit money (-.780), ability to maintain customers' account with minimum withdrawals from ATM/Cheque/across counter within the period of appraisal (-.534) and

ability to convince existing customers to remain loyal to the bank (-.661)) used by the bank. However, there was a positive but weak relationship between one of the performance indices (increases the respondents' ability to work harder to meet target (.230). Nevertheless, the level of significance of between .000 and .044 which were lower than the table value of 0.05 were attained between the dependent and independent variables. Therefore, the study concluded that, there was a negative but significant relationship between excessively performance target and performance of marketing staff of the selected banks in Akure Metropolis, Ondo State, Nigeria. This result is in agreement with the studies of Banks and Roberson (1985) and Fisher *et al*. (2006) who asserted that, when employees view the method of appraisal to be made up of halo errors, prejudice, lack objectivity, unfair or made up of too high-performance standard to be met, this could trigger stress and anxiety and affect the employees' performance negatively.

The result is also in agreement with those of Kyeremeh and Pimpong (2018)'s study on performance appraisal and staff commitment in higher education which disclosed that performance appraisal practices used in the study area did not inspire the employees to put in their best to accomplish the goals and objectives of the institution. Also, Lupien, Maheu, Tu, Fiocco and Schramek (2007)'s study on the effects of stress and stress hormones on human cognition, implications for the field of brain and cognition and Shields *et al*. (2016)'s study on the effects of acute stress on core executive functions, a meta-analysis and comparison with cortisol which revealed that when performance appraisal is surrounded with threatening situations it can result to stress, anxiety or both. This can weaken executive functioning which may have an adverse effect on performance. Likewise, Adetayo *et al*. (2014)'s study on an overview of the effects of job stress on employees' performance in Nigeria tertiary hospitals affirmed that job stress reduces the work life quality and performance of employees. However, this study is not in agreement with Rahahleh *et al*. (2019)'s study on the impact of performance appraisal on employee performance in banks operating in the South of Jordan, Khan *et al*. (2017)'s study on the impact of performance appraisal on employee's performance including the moderating role of motivation: a survey of commercial banks in Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan, Wanjala & Kimutai (2015)'s study on the influence of performance appraisal on employee performance in commercial banks in Trans Nzoia County – Kenya and Mulwa and Weru (2017)'s study on the influence of performance management system on employee performance in commercial banks in Kitui Town, Kitui County, Kenya. These studies disclosed that performance appraisal increased employees' performance in their study areas.

| S/N | Performance Indices | Excessively high-performance target to be met | | | | |
		Mean	SD	Pearson Correlation	Sig (2 tailed)	N
1	Getting new customers to deposit money	2.608	.321	**-.780**	**.005**	51
2	Ability to maintain customers' account with minimum withdrawals from ATM/Cheque/across counter within the period of appraisal	1.627	.759	**-.534**	**.013**	51
3	Increases my ability to work harder to meet target	1.961	.296	**.230**	**.044**	51
4	Ability to convince existing customers to remain loyal to the bank	1.824	1.046	**-.661**	**.000**	51

Table 5: Correlation analysis between excessively high-performance target and performance of the marketing staff
(Source: Field Work 2020)

8. CONCLUSION AND RECOMMENDATION

This study revealed that the banks' management base their appraisal majorly on subordinates' ability to meet up with monetary target and the monetary performance targets set for the marketing staff of the banks were excessively high and hardly attainable. These were the main factors militating against the effectiveness of appraisal system of the banks. The study also disclosed that there was a negative relationship between the excessively high-performance target set for the marketing staff and the performance of the staff, represented with the 4 key performance indices of the banks. The Pearson Correlation coefficients of -.780, -.661, -.534 were recorded for 3 of the relationships while the Correlation coefficients for the relationship between high-performance target and increase in the staff' ability to work harder to meet the target was .230 (positive). This indicated that, the excessively high-performance target, to some extent, actually pushed the staff to work harder in order to attain their targets, however, the positive relationship was weak. The study also found out that there was a significant relationship between the excessively high-performance targets and the performance of the staff, with the level of significance ranging from 0.000 to .044 against each performance index. These levels of significance were less than 0.05 therefore, the null hypothesis H_0 was rejected while the alternate hypothesis was accepted. Therefore, the study concluded that excessive performance target has a significant but negative relationship with the performance of the marketing staff of the selected banks in Akure Metropolis, Ondo State, Nigeria. The paper recommends a review of the performance target to make it more attainable in order to stimulate the interest and commitment of the staff towards improving their performances and attaining the banks' goal.

LITERATURE:

1. Access Bank (2017). Access bank's consolidated and separate financial statements for the year ended December 2017.
2. Access Bank Plc, Corporate Profile – Available at: www.accessbankplc.com.
3. Adetayo, J. O., Ajani, J. O. & Olabisi, O. (2014). An overview of the effects of job stress on employees' performance in Nigeria tertiary hospitals. *ЕКОНОМИКА*, 60(4), 139-153.
4. Akpansung, A, O. & Gidigbi, M. O. (2014). Recent banking reforms in Nigeria: Implications on sectoral credit allocation and economic growth. *International Journal of Business and Social Science,* 5(13), 91-104.
5. Alam, M., & Latham, S. D. (2019). It's not my fault: Employee response to negative performance feedback. *Organizational Dynamics*. https://doi.org/10.1016/j.orgdyn.2018.11.005 in press.
6. Alam, M., & Singh, P. (2020). Performance feedback interviews as affective events: An exploration of the impact of emotion regulation of negative performance feedback on supervisor–employee dyads. *Human Resource Management Revie,* Article in Press. Avilable at: www.elsevier.com/locate/hrm. Accessed on 25/03/2020.
7. AL-Sinawi, S., Piaw, C. Y., & Idris, A. R. (2015). Factors influencing the employees' service performance in Ministry of Education in Sultanate of Oman. 7th world conference on educational sciences, (WCES-2015), 05-07 February 2015, Novotel Athens Convention Center, Athens, Greece. *Procedia - Social and Behavioral Sciences*, 197, 23 – 30. Available online at www.sciencedirect.com. Accessed on 15/03/2020.
8. Apak, S., Gümüs, S., Öner, G., and Gümüş, H. G. (2016). Performance appraisal and a field study. 5th International conference on leadership, Technology, Innovation and Business Management. *Procedia - Social and Behavioral Sciences*, 229, 104 – 114. Available online at www.sciencedirect.com. Accessed on 25/03/2020.
9. Banks, C. G. Roberson, L. (1985). Performance appraisers as test developers, *Academy of Management Review*, 10, 128–142.

10. Bernot, M., Cernic, L., Lokar, K., Terbovsek, R., & Petric, M. M., & Zajc, Petric (2014). The annual performance appraisal interview – a tool for employee development *Poster Sessions/European Journal of Oncology Nursing*, 18S1, S23–S59.
11. Boswell, W. R., Boudreau, J. W. (2002). Separating the developmental and evaluative performance appraisal uses. *Journal of Business and Psychology*, 16 (3), 391–412.
12. Burton, J., Sablynski, C., & Sekiguchi, T. (2008). Linking justice, performance, and citizenship via leader–member exchange. *Journal of Business and Psychology,* 23, 51–61.
13. Central Bank of Nigeria CBN (2011). Development finance. Available at: http://www.cenbank.org/Devfin/smefinance.asp. Accessed on 2/3/2020.
14. Cowandy, C. J. (2014). The impact of fair performance appraisal to employee motivation and satisfaction towards performance appraisal – A case of PT. XYZ. *iBuss Management*, 2(2), 21-28.
15. Daniels, A. (1999). *Bringing out the best in people*. McGraw- Hill companies
16. Daniel, C. O. & Ibrahim, A. U. (2019). Influence of performance appraisal management on employees' productivity. *Global Scientific Journals*, 7(3), 701-709.
17. DeNisi, A. S. & Pritchard, R. D. (2006). Performance appraisal, performance management and improving individual performance: *A motivational Framework. Management and Organization Review*, *2*(2), 253-277.
18. DeNisi, A. S., & Murphy, K. R. (2017). Performance appraisal and performance management: 100 years of progress? *Journal of Applied Psychology, 102*, 421–433. Available at: https:// doi.org/10.1037/apl0000085. Accessed on 15/03/2020.
19. First bank of Nigeria Limited (2016; 2019). First bank of Nigeria Limited, annual reports and accounts
20. First bank profile's website: www.firstbanknigeria.com. Accessed on 23/4/2020.
21. Fisher, C., Schoenfeldt, L. F., & Shaw, J. B. (2006). *Human resources management*. Boston: Houghton Mifflin Company.
22. Gichuhi, A. W., Abaja, P. O. & Ochieng, I. (2012). Effect of performance appraisal on employee productivity; A case study of supermarkets in Nakuru Town, Kenya. *Asian Journal of Business and Management Sciences* 2(11), 42-58.
23. Heywood, J. S., Jirjahn, U., & Struewing, C., (2017). Locus of control and performance appraisal. *Journal of Economic Behavior and Organization,* 142(C), 205-225. Available online on www.sciencedirect.com. Accessed on 24/03/2020.
24. Ibeogu, P. H., & Ozturen, A. (2015). Perception of justice in performance appraisal and effect on satisfaction: Empirical findings from Northern Cyprus banks. 2nd global conference on business, economics, management and tourism, 30-31 October 2014, Prague, Czech Republic. *Procedia Economics and Finance*, 23, 964 – 969. Available online at www.sciencedirect.com. Accessed on 20/03/2020.
25. Igbojekwe, P. A. & Ugo-Okoro, C. P. (2015). Performance evaluation of academic staff in Universities and Colleges in Nigeria: The missing criteria. *International Journal of Education and Research*, 3(3), 627- 640.
26. Karim M. M., Haque, M. E., Dona, P. D. & Moniruzzaman, M. (2015). Performance appraisal system of employees of private banking sector in Bangladesh: A case study on National Bank Limited. *International Journal of Advanced Multidisciplinary Research (IJAMR),* 2(3), 77-81.
27. Khan, Z., Khan, A. S. and Khan, I. (2017). Impact of performance appraisal on employee's performance including the moderating role of motivation: a survey of commercial banks in Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. *Universal Journal of Industrial and Business Management*, 5(1), 1-9.
28. Kyeremeh, D. D. & Pimpong, M. (2018). Performance appraisal and staff commitment in higher education. *Asian Research Journal of Arts and Social Sciences*, 7(2), 1-14.

29. Longenecker, C., & Fink, L. (2017). Lessons for improving your formal performance appraisal process. *Strategic Human Resource Review*, 16(1), 32-38.

30. Lupien, S. J., Maheu, F., Tu, M., Fiocco, A., & Schramek, T. E. (2007). The effects of stress and stress hormones on human cognition: Implications for the field of brain and cognition. *Brain and Cognition,* 65(3), 209–237.

31. Mackey, K. & Johnson, G. (2000). *The strategic management of human resources in New Zealand.* Auckland: Irwin/McGraw-Hill.

32. Mullins, L. (1999). *Management and organizational behavior.* 5th Edition London: Financial Times/Pitman Publishing.

33. Mulwa, M. N., & Weru, J. M. (2017). The influence of performance management system on employee performance in commercial banks in Kitui Town, Kitui County, Kenya. *International Journal of Humanities and Social Science,* 7(6), 44-57.

34. Murphy, K. R., & DeNisi, A. (2008). A model of the appraisal process. In A. Varma, P. S. Budhwar, & A. DeNisi, *Performance Management Systems. A Global Perspective.* New York: Routledge. pp. 81-94.

35. National Population Census (2006). Census of the Federal Republic of Nigeria.

36. Newman, V. E., Liddell, B. J., Beesley, T., & Most, S. B. (2020). Failures of executive function when at a height: Negative height-related appraisals are associated with poor executive function during a virtual height stressor. *Acta Psychologica,* 203, 1-9. Available on www.elsevier.com/locate/actps. Accessed on 27/03/2020.

37. Njuguna, W. K. & Maende, C. (2017). Performance appraisal systems and employee productivity in commercial banks in Nairobi County, Kenya. *International Academic Journal of Human Resource and Business Administration,* 2(4), 329-346.

38. Obamuyi, T. M. (2010). Firms' performance and lending constraints in Nigeria. *Journal of Entrepreneurship*, 19(2), 179-190.

39. Ohwovoriole, O. (2017). *Analysis: Unity bank must raise equity to maintain convalescence. Nairametrics. Available at:* https://nairametrics.com. Accessed on 23/4/2020.

40. Oluitan, R. O., Ashamu, S. O. & Ogunkenu, O. S. (2015). The effect of recapitalization on bank performance in Nigeria. *International Finance and Banking. Macrothink Institute, (*2)1, 79-90.

41. Raghunathan & Sastry, N. S. & K. (2018). A study of performance appraisal and employee's performance by measuring the latest role of motivation in an organization. *International Journal of Trend in Research and Development*, 5(6), 26-32.

42. Rahahleh A. H., Alabaddi, Z. A., and Moflih, M. A. (2019). The impact of performance appraisal on employee performance in banks operating in the South of Jordan. *International Journal of Human Resource Studies*, 9(4), 77- 94.

43. Samuel, O. W., Omisore, M. O., & Atajeromavwo, E. J. (2014). Online fuzzy based decision support system for human resource performance appraisal. M*easurement*. pp. 1-23. Accepted but not published Manuscript. Available on www.elsilvier.com. Accessed on 27/03/2020.

44. Selvarajan, T. T., & Cloninger, P. A. (2012). Can performance appraisals motivate employees to improve performance? A Mexican study. *The International Journal of Human Resource Management*, 23(15), 3063---3084.

45. Selvarajan, T. T., Singh, B., & Solansky, S. (2018). Performance appraisal fairness, leader member exchange and motivation to improve performance: A study of US and Mexican employees. *Journal of Business Research*, 85, 142–155. Available at: www.elsevier.com/locate/jbusre. Accessed on 14/03/2020.

46. Shaharyar, M., Baloch, M. A., Tariq, M. A., Mushtaq, S. & Mushtaq, A. (2014). Impact of performance appraisal on employee performance. *Journal of Resource Development and Management*, 3, 22-24.

47. Shields, G. S., Sazma, M. A., & Yonelinas, A. P. (2016). The effects of acute stress on core executive functions: A meta-analysis and comparison with cortisol. *Neuroscience & Biobehavioral Reviews*, 68, 651–668.

48. Soludo, C. C. (2004). Consolidating the Nigerian banking industry to meet the development challenges of the 21st century. An address at special meeting of the bankers committee, Abuja, July 6, 2004.

49. Soludo, C. C. (2007). Macroeconomic, monetary and financial sector developments in Nigeria. Abuja: CBN.

50. Sypniewska, B. A. (2013). Evaluation of factors influencing job satisfaction. Poland: Vizja Press and IT

51. Unity Bank Plc, Corporate Profile – Available at: www.unitybanking.com. Accessed on 23/4/2020.

52. Vardi, Y., & Weitz, E. (2004). Misbehavior in organizations: Theory, research and management. Mahwah, NJ: Lawrence Erlbaum.

53. Wanjala, M. W. & Kimutai, G. G. (2015). Influence of performance appraisal on employee performance in commercial banks in Trans Nzoia County – Kenya. *International Journal of Academic Research in Business and Social Sciences*, 5 (8), 332-343.

54. Weiss, H. M., & Cropanzano, R. (1996). Affective events theory: A theoretical discussion of the structure, causes and consequences of affective experiences at work. *Research in Organizational Behavior*, 18, 1–74.

55. Wikipedia: Map of Nigeria Showing Akure, Ondo State, and Akure North and South Local Government Areas

RELATIONSHIPS BETWEEN SUSTAINABILITY DIMENSIONS IN GREECE

Ivan Todorov
South-West University "Neofit Rilski", Ivan Mihailov str. 60, Blagoevgrad, Bulgaria
ivank.todorov@swu.bg

Sophia Mirchova
South-West University "Neofit Rilski", Ivan Mihailov str. 60, Blagoevgrad, Bulgaria
sophia_mirchova@abv.bg

Ruska Krasteva
South-West University "Neofit Rilski", Ivan Mihailov str. 60, Blagoevgrad, Bulgaria
roussi_bozkova4@yahoo.gr

ABSTRACT
Sustainability, or sustainable development has three aspects: economic, social and environmental.The level of economic development is shown by a nation's standard of living or purchasing power and is measured by the real per capita output.Social resilience is indicated by income inequality and quantified by the Gini coefficient.Environmental sustainability isapproximated by the amount of greenhouse gas emissions per capita. The objective of this research is to empirically study the relationships between the degree of economic development, socialresilience and environmental quality in Greece.This objective has been accomplished by deriving the original and the environmental Kuznets curves for Greece.The original Kuznets curve displays the connection between the level of economic development (real GDP per capita) and social stability (the Gini coefficient), whereas the environmental Kuznets curve illustrates the link between the degreeof economic development and the level of environmental degradation.The relationships between the standard of living and income inequality,on the one hand, and the standard of living and environmental degradation, on the other hand, have been both investigated by an ordinary least squares (OLS) regression. The empirical results from the research show that in Greece the rise in social resilience and environmental quality is accompanied by a fall in the living standard (the purchasing power per capita).It is advisable that Greek policymakers shift the Kuznets curves to the right in order to achieve a better trade-off between the living standard, on the one hand, and income inequality and the quality of environment, on the other hand.The original Kuznets curve may be shifted to the right by changing the type Green tax system from consumption-based to hybrid.The environmental Kuznets curve can be moved to the right by investments in low-carbon economy, which contribute to "green" economic growth.
Keywords: *Greece, sustainable development, Kuznets curves*

1. INTRODUCTION

Sustainability, or sustainable development has three facets: economic, social and environmental.The real GDP per capita, which shows a nation's purchasing power or living standard, can be used to measure economicsustainability.As a proxy for social resilience the income inequality, which is shown by the Gini coefficient, may be employed.Environmental sustainability (quality) may be assessed by amount of the greenhouse gas emissions per capita. The purpose of this research is to empirically analyze the relationships between the three dimensions of sustainable development: economic stability, social resilience and environmental quality.This goal has been achieved by deriving the original and the environmental Kuznets curves for Greece.

The original Kuznets curve depicts the connection between the level of economic development (realGDP per capita) and social resilience (the Gini coefficient), whereas the environmental Kuznets curve describes the link between the per capita purchasingpower and the quality of environment. In the first section of the paper, the theoretical fundamentals of sustainabledevelopment have been outlined.In the second section, the empirical research on the Kuznets curves for Greece have been reviewed.In the third section, the association betweenthe purchasingpower per capita and income inequality has been empirically studied.In the fourth section, the relationship between thedegreeof economic development and environmental quality in Greece has been empirically investigated.In the conclusion, the empirical results from this study have been discussed and policy recommendationson sustainable development in Greece have been made.

2. THEORETICAL FUNDAMENTALS OF SUSTAINABLE DEVELOPMENT

During the past centuries people always used the Earth's natural resources to satisfy their vital needs.The industrial, technological and digital revolution started from 1780 and continued until today resulted in the gradual but ever-increasing intensification of the exploitation of natural wealth in an uncontrolled manner, as the finite possibilities of the environment to reproduce itself had not been recognized.This was realized essentially in the last thirty years, when the serious effects of human activity on the environment and feedback on the man himself were felt.This is how the search for a model that would ensure the sustainability of the natural system in perpetuity, without stopping the development course of human society began. Firstly, the concept of the sustainable development or with other words sustainability enters the environmental movement silently, but without being named in the 1960s (Flogaiti E.2009, p. 77).This was the period when a great number of environmentalists and scientists started to argue that the way the planet is being used is not well for the human, but also for other species that people are reducing or even exterminating (Miller G.T., 1999, p.4).In 1972 the first report named "The limits of growth" was made in an international level by a group of industrialists, but also scientists, the well-known group of Rome.In this report, it is emphasized that the bad situation in finite resources was a consequence of the exponential growth of the world's population, as well as of industries, but and resource depletion.There was a conclution that if measures are not taken, the magnitude of environmental degradation that will be caused, will be such that it will threaten the existence of people on planet Earth (Labrianidis L. , 2001, p.210).At the level of institutions, the concept of Sustainable Development was coined at the United Nations Conference on the Human Environment, which took place in Stockholm in 1972 Important, however, for the development of the subject was the Convention held by the member states of Europe in 1974 (Germany, France, Italy, Netherlands, Belgium, Luxembourg, Denmark, Ireland, United Kingdom) in which they recognized the need for a common environmental policy in Europe, while supporting with a Declaration the integration of environmental policy, both in spatial planning and economic policy (Siouti, 2003, p. 15).In 1983 the World Commission on Environment and Development (WCED) known as the Brundland Commission is formed by the United Nations, which aimed to formulate proposals and elaborate strategies related to the removal of the contradiction between environmental protection and economic development. The Brundland Commission publishes in 1987 a report with the title "Our common Future" and gave the following definition "sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their needs.It contains within it two key concepts: a) the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and b) the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs" (WCED, 1987, p. 41).

The next step was the Rio – Declaration in 1992 where the parts succeded to define a common strategy for environment protection and worked on four main areas:1.Incorporating environmental concerns and development into policy, planning, and management levels; 2. establishing an effective legal and regulatory framework; 3. making effective use of economic tools, market incentives, and other financial incentives; 4. Establishing integrated systems for economic and environmental accounting. Thus,three non-binding texts were adopted (the Rio Declaration on Environment and Development, the non-legally binding Declaration of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Forest Types and Agenda 21) and two international treaties (the Convention on Biological Diversity and the UN Framework Convention on Climate Change) (Magliveras K., 2004, 135). The Convention on "Biological diversity", was a practical tool for organizingthe principles of Agenda 21, which according to Tsaltas G. (2004, p. 101) is perhaps the most important international text of its category, since it managed for the first time to compare all the global problems of environmental management with those of development, always in the light of its sustainable dimension, a dimension which will be the subject of intense reflection ever since in the context of a series of consecutive international meetings.The Convention acknowledges that biological diversity is about more than just plants, animals, and microorganisms and their ecosystems; it is also about people and their need for shelter, fresh water, clean air, and medicine. The next important stop for the international community to make commitments regarding the protection of the environment was the World Conference on Sustainable Development held in Johannesburg in 2002.In Johannesburg the aim was to give impetus to the process, as progress in implementing the Rio principles had been slow.The quantitative targets reached by Johannesburg, the specific timetables and credible control mechanisms were firstly to reduce by 2015 to half the number of people on Earth who do not have access to basic nutrition and drinking water, secondly to restore fish stocks to sustainable levels until 2015, thirdly the significant reduction of the planet's biodiversity losses until 2010 and fourthly the shift within a decade of a significant percentage of energy production by traditional means to energy production from renewable sources.The conference resulted in the adoption of the Johannesburg Declaration on sustainable Development,where no specific ways of implementing sustainable development are contained, but a record is made of those groups for whom sustainable development is particularly important: least developed countries and small island developing countries, indigenous peoples, as well as women. Furthermore, the declaration lists those factors that threaten the sustainable development of peoples and which must be given priority: hunger, the occupation of territories by other states, armed conflicts, organized crime and terrorism, corruption, illegal drug, arms and human trafficking, xenophobia and hatred, infectious diseases, etc. From this long list, sustainable development is now identified with the elimination of all those causes that are created by the individuals themselves and that plague humanity. The only correlation made with international law is the confirmation of adherence to the principles of the UN Charter and international law(Magliveras K., 2004, 142). In the years that followed numerous conferences as well as international agreements marked the dialogue around the environment and sustainable development. At lastit is worth mentioning the 2030 Agenda. In 2021, the UN General Assembly adopted Resolution 75/280 to convene an international meeting entitled "Stockholm+50: a healthy planet for the prosperity of all – our responsibility, our opportunity", in Stockholm on 2 and 3 June 2022 to commemorate the 50 years since the United Nations Conference on the Human Environment. This report has been prepared following the decision of the Senior Officials of the UN Environment Management Group to submit a contribution to Stockholm+50 that provides a UN systemwide perspective on delivering on the vision of the 1972 Stockholm Declaration and achieving the 2030 Agenda for Sustainable Development.

The suggested areas of focus andaccelerated action including by the UN system towards a healthy planet for the prosperity of all couldinclude:
1) Resetting humanity's relationship with nature
2) Creating resilience on a planetary and human scale
3) Addressing the triple planetary crisis synergistically
4) Adopting and implementing a human rights-based approach to ensure that no one is left behind
5) Promoting a sustainable and inclusive recovery
6) Catalyzing transformative actions for adaptation and sustainability
7) Reinvigorating multilateralism and enhancing partnerships. (Unated Nations, 2022)

Apart from the abovelegal road of sustainability to perceive the theoretical fundamentals of sustainable development, there should be taken into account the three main zones of influence, the so-called "Three Pillars of Sustainability" and the corresponding aspects of it consisting ofsocial, economic and environmental sustainability. These three interconnected factors, when combined and put into practice, can lay a strong foundation for a sustainable world from which everyone will profit. Sustainability is very often treated as an inherent goal of all nations and cannot be an isolated phenomenon (Kiryakova-Dineva T, Chankova Y, 2020, p. 282). Each of them is a complex, dynamic, self-organising and evolving entity in its own right, making the coupled system one of tremendous complexity (Spangenberg J., 2005). The general definition is that social sustainability means the capacity of social systems such as the country to operate at definite levels of social well-being.Operationalizing social development progress is very challenging. While some variables (such as income, diseases, and homicide rates) are available from pertinent institutions and are objective, others (such as satisfaction, participation, relationships, and happiness) are purely subjective and can only be gathered declaratively. In order to assess social sustainability, declarative, quantitative, qand uestionnaire-based studies are necessary (Biczynska, 2015, p. 120). Amartya Sen, a Nobel laureate emphasized democracy and human rights as key for sustainable development and provides the following dimensions for social sustainability:

- Equity - The community gives all of its members, especially the weakest and poorest, the same opportunities and outcomes.
- Diversity - the neighborhood supports and fosters diversity.
- Interconnected/Social cohesions: The community offers formal, informal, and institutional connections within and outside the community through processes, systems, and structures.
- Quality of life - the community ensures that the basics are met needs and promotes a good quality of life for all members at an individual level, group level, as well as at the level of the community itself (e.g. Health, housing, education, employment, and security).
- •Democracy and government: democratic procedures and transparent, more accountable government structures are provided by the community.
- Maturity - the person accepts the duty of ongoing improvement and development through broader social aspects (such as communication channels, societal norms, indirect education, and philosophical pursuits).(Fort Collins Social Sustainability, 2016)

Regards to environmental sustainability Herman Daly, one of the first proponents of ecological sustainability, approached the problem from the standpoint of preserving natural capital. In 1990, he suggested the following: 1. Project waste generation rates should not be higher than the environment's ability to absorb them (sustainable waste disposal); 2. For resources that are renewable, sustainable yield means that the rate of harvest should not exceed the rate of regeneration;3. The creation of renewable alternatives for nonrenewable resources should be required in a similar amount as their depletion.

This list has received widespread support. It is possible to condense the list into a precise definition. Environmental sustainability is the ability to produce pollution at rates that can be sustained over an extended period of time while also harvesting renewable resources. If they cannot last forever, they are not sustainable (Herman Daly, 1990). The ability of an economy to sustain a specific level of economic production over the long term, is the general definition of economic sustainability. The central concept is how companies stay in business.In other words, the financial line refers to the potential that a business should havein order to remain active or generally to survive in the business world.Economic sustainability is linked to production efficiency and economic growth when it is weak. Thus, economic sustainability entails employing various strategies for optimally utilizing existing resources in order to achieve a responsible and beneficial balance over the long term. These three pillars together comprise sustainable development, which cannot be effectively achieved if any one of them isn't functioning properly. The system as a whole is not sustainable if one of the pillars is weak. Consequently, the environment, economy, and society are interdependent. Public and private actors should not act in isolation. Their actions must take into account the interaction of the three aspects of the relationship. The concept of sustainable development goes beyond the concept of environmental protection. Economic well-being and solidarity are required in modern society in order to satisfy our material and non-material needs. The effects of today's actions must be projected in the future. It should be ensured that future generations will be able to meet their needs. Sustainable development requires long-term changes in production and consumption patterns. The goal is to protect the environment and natural resources, satisfy human needs and help progress and development. Global interdependence must be taken into account, as the balance is essential in today's global society.

3. REVIEW OF EMPIRICAL STUDIES ON KUZNETS CURVES FOR GREECE

The Kuznets curves for Greece have been the subject of numerous empirical research in the economic literature. Using the appropriate econometric tools, Kotroni E., Kaika D., and Zervas E. investigate the short and long term relationships between GDP, CO_2 emissions, and gross energy use over the period (1960–2014). According to Kaika and Zervas (2013), the rapid economic expansion of developing economies will cause global CO_2 emissions to keep rising. When CO_2 emissions are taken into account as a type of environmental deterioration, the EKC hypothesis of Dinda, Kaika, and Zervas (2013) is neither rejected nor confirmed. Another study by Zervas, Poulopoulos, and Philippopoulos (2006) focuses on how CO_2 emissions have changed as a result of the introduction of diesel passenger automobiles in Greece. The econometric approach utilized, the presumptions made, and the country or countries Kaika and Zervas (2013) analyzed show the dynamic relationships between the relevant variables and how they may change based on the time period used. Since there were multiple economic cycles (growth, stagnation, and recession) between 1960 and 2014, the situation in Greece is rather odd. The Environmental Kuznets Curve (EKC) has been empirically explored by Shafic and Bandyopadhyay (1992) and Grossman and Krueger (1995) for a variety of contaminants that follow an inverted U-shaped curve in relation to income. According to these research, economic growth and CO_2 emissions have a surprisingly positive association, suggesting that as income increases, so do CO_2 emissions. According to Stern et al. (1996), the EKC hypothesis is true for pollutants with a localized, perceivable impact and a low cost of treatment. Acaravci and Ozturk (2010) and Jaunky (2011) tested whether there is a relationship between GDP and CO_2 emissions using the Generalized Method of Moments and ARDL (autoregressive-distributed lag), with the conclusion being EKC evidence for various nations, including Greece. They are looking at Greece's energy use, CO_2 emissions, and economic growth between 1960 and 2005 to corroborate an EKC-pattern. Jaunky (2011) uses panel data approaches to solely look at the income-CO_2 emissions nexus in Greece from 1980 to 2005.

Hatzigeorgiou et al. (2011) use times series approaches to incorporate the energy intensity as an additional explanatory variable into their income-CO2 emissions model for the years 1977–2007, but they do not use an EKC estimate model. The dynamic relationships in Greece between economic growth, environmental quality, and health are analyzed by C. Katrakilidis, I. Kyritsis, and V. Patsika. Their research uses Kuznets-type models, a number of co-integration approaches, and Granger causality tests to explore the dynamic interdependence between economic activity, health quality, and environmental deterioration for Greece throughout the period of 1960–2012. The findings show that there are significant causal relationships between income, CO2, and infant mortality. The relationship between environmental sustainability and economic growth has been supported conceptually and practically by numerous authors. According to Hondroyiannis et al., 2002, the increase of real GDP is larger than the growth rates of total energy consumption and total CO2 emissions, although the industrial sector's energy consumption is still relatively modest. Since the middle of the 1970s, Greece's industrial, service, and household sectors have all experienced large increases in energy consumption. Because of this, the use of private vehicles, electrical appliances, and air conditioning systems during the summer months has increased, which has improved living conditions in Greece (Rapanos and Polemis, 2006). Asteriou and Hall (2011) investigate the stationaryness of endogenous series. All endogenous series are converted into logarithmic form, allowing the series to be normalized and acquire a linear trend. All endogenous series must be stationary or integrate at the same order in order to pass the Johansen co-integration test; otherwise, the findings could be erroneous. In this situation, it is essential to identify the ideal VAR lag length that minimizes the Schwarz (SC) criterion and passes the tests for the residuals' normality, autocorrelation, and heteroscedasticity. The Environmental Kuznets Curve (EKC), which assumes that an inverted U-shaped curve can be used to depict improved environmental quality, is still probably the most widely used method. In his original analysis, Kuznets (1955), suggested that urbanization is a contributing element when examining the relationship between income disparity and economic growth. While highly relevant as an exogenous variable in previous studies, the impact of urbanization has not been examined in the instance of Greece. In their test relationship, Shahbaz et al. (2014) add urbanization as an exogenous variable and draw the conclusion that it raises CO2 emissions in the United Arab Emirates. In a panel of 147 nations, Liobikien and Butkus (2019) draw the conclusion that urbanization has a "positive but not substantial influence on GHG emissions." Urbanization as an exogenous variable in research like those by Dogan and Turkekul (2016) and Farhani and Ozturk (2015) does not support evidence in favor of an EKC-pattern. To evaluate whether urbanization has a substantial impact on CO2 emissions between 1960 and 2014, the urbanization rate is added as an exogenous variable, following prior studies like (Shahbaz et al., 2014; Liobikien and Butkus, 2019). The radical increase in per capita GDP can be attributed to the 1973 oil crisis, the 1974 political transition in Greece from a dictatorship to a democracy, or a combination of the aforementioned reasons. According to research by Al-mulali et al. (2012), urbanization in Greece increases energy use and transportation energy consumption, which is a trend in many high- and middle-income nations. It is possible to say that the implementation of policies aimed at Greece's optimal energy use might result in economic growth with lower CO2 emissions through the use of renewable energy sources, bettering the transport system in major cities, and policies able to increase energy efficiency. Greece's policymakers should use tactics from the Paris Climate Change Agreement to reduce CO2 emissions, such as sponsoring initiatives to mitigate climate change. Contrarily, increasing emissions brought on by economic growth may have negative effects at manufacturing sites, according to the pertinent literature (Pearson 1994; Stern, Common and Barbier, 1996). As a result, their causal relationship may be interactive.

There is evidence that some pollutants follow an inverted U-curve with respect to income, as reported by Seldenand Song (1994) and Grossman & Kruger (1995). Suri& Chapman (1998), Agras and Chapman (1999), and Torras& Boyce (1998) contend that EKC can be viewed as a significant variable that would be absent in the absence of (spatial intensity of economic activity, political rights, income inequality, education, trade, etc.). There is no question that the local population's health issues are a result of environmental degradation (Gagadharan and Valenzuela, 2001; Tea and Greenstone 2003; Jarrett et al. 2005). A less productive labor force will result in slower growth because they won't be able to boost productivity. To prevent the false regression issue, it is necessary to determine the integration features (number of unit roots) of the examined variables at the beginning of the empirical study. The well-known Augmented Dickey-Fuller Test (ADF) (Dickey and Fuller, 1979), the Phillips and Perron test (Phillips and Perron, 1988), which is more reliable with disorders of heteroscedasticity and serial correlation, as well as the ADF-GLS test Elliott, Rothenberg, and Stock (Elliott, Rothenberg, and Stock 1996), which has higher statistical power, were all used to test for the presence. In conclusion, we can state that a decline in the standard of health is caused by the environment. This could have a negative impact on growth and result in a decline in long-term productivity. Therefore, adequate environmental protection initiatives should be included in development policies. Social well-being, not just per capita income, must be the fundamental goal of governmental policy there (Gowdy 2005). The major goal of Nuno Carlos Leito's (2013) manuscript is tao investigate how the environmental Kuznets curve (ECK) and globalization relate to Portugal, Spain, Greece, and Ireland between 1980 and 2010. The results provide credence to the hypothesis that, on average, energy consumption and CO_2 emissions are positively correlated. Regional differences in the euro zone, particularly in Portugal, Spain, Greece, and Ireland, are demonstrated by Leito's (2012) analysis of the current economic and financial crisis in the European Union. The relationship between CO_2 and per capita income in industrialized countries was examined by Moomaw and Unruh in 1997. (OECD countries). Between 1970 and 1980, they discovered an inverted U-shaped pattern. The Black Sea Economic Cooperation (BSEC) countries are examined in the paper by Enay Sarac and Aykut Yaglikara utilizing the variables of energy consumption and CO_2 emissions per capita income for the years 1992 to 2012. According to the EKC hypothesis, the results of this study, which is being done for the BSEC countries, will show that there is a connection between environmental pollution and economic growth.

4. EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE LEVEL OF ECONOMIC DEVELOPMENT AND SOCIAL SUSTAINABILITY

4.1. Methodologyand data

The relationship between the degree of economicdevelopment and social resilience in Greece has been studiedby an ordinary least squares (OLS) regression, which includes the following variables:

- **GDPPC$_t$** – percentage rate of change of the real GDP per capita in Greece in year **t** compared to year **t-1**;
- **GINI** –percentagerate of change the Gini coefficient in Greece in year **t** compared to year **t-1**.

The explained variable is **GINI,** whereas the explanatory variable is **GDPPC.**To capturea probable non-linearityof the link between the twovariables, the square of **GDPPC** also participates in the regression equation. Annual Eurostat data for the period 2004–2021 have been used in the study.

4.2. Results

The group unit root tests indicate that as a group **GDPPC** and **GINI** are stationary at level (see Table 1), which allows the direct application of the OLS approach.

Table 1: Group Stationarity Tests on the Level Values of GDPPC and GINI

Method	Statistic	Probability	Cross-sections	Observations
Null:Unitroot(assumesindividualunitrootprocess)				
Im, Pesaran and Shin W-stat	-2. 42239	0. 0077	2	33
ADF-Fisher Chi-square	12. 8642	0. 0120	2	33
PP-Fisher Chi-square	11. 3590	0. 0228	2	34

Source: Prepared by the authors

The link between **GDPPC** and **GINI** is described by Equation (1):

GINI = C(1) + C(2)*GDPPC + C(3)*GDPPC^2 + Error(1).

The output from the estimation of Equation (1) is displayed in Table 2.The significance of **GDPPC^2**implies the existence of non-linearitybetween the living standard and income inequality, while the insignificance of **GDPPC** hints ata lack oflinearity between the level of economic development and social resilience.

Table 2: Output from the Estimation of Equation (1)

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-1. 358568	0. 647162	-2. 099268	0. 0531
GDPPC	0. 027590	0. 114591	0. 240770	0. 8130
GDPPC^2	0. 043371	0. 018239	2. 377992	0. 0311

Source: Prepared by the authors

The value of the coefficient of determination (R-squared = 0. 2968) suggeststhat 43. 38% from the variation of the dependent variable can be explained by changes in the independent variable in Equation (1).Theprobabilityof the F-statistic of 0. 07points that the regression model adequately reflects the relationship between the dependent and the independent variable at a significance level of 0. 1. The residuals in Equation (1) are normally distributed (see Figure 1), serially uncorrelated (see Table 3) and non-heteroskedastic (see Table 4).The Ramsey test (RESET) indicates a lack of errors in the specification of Equation (1) (see Table 5).The results from the CUSUM test (see Figure 2) show that Equation (1) is dynamically stable.

Figure following on the next page

Figure 1: Test for Normal Residual Distribution in Equation (1)

Series: Residuals	
Sample 2004 2021	
Observations 18	
Mean	-1.73e-16
Median	0.077238
Maximum	3.305465
Minimum	-4.656485
Std. Dev.	2.002406
Skewness	-0.560419
Kurtosis	2.871604
Jarque-Bera	0.954572
Probability	0.620465

Source: Prepared by the authors
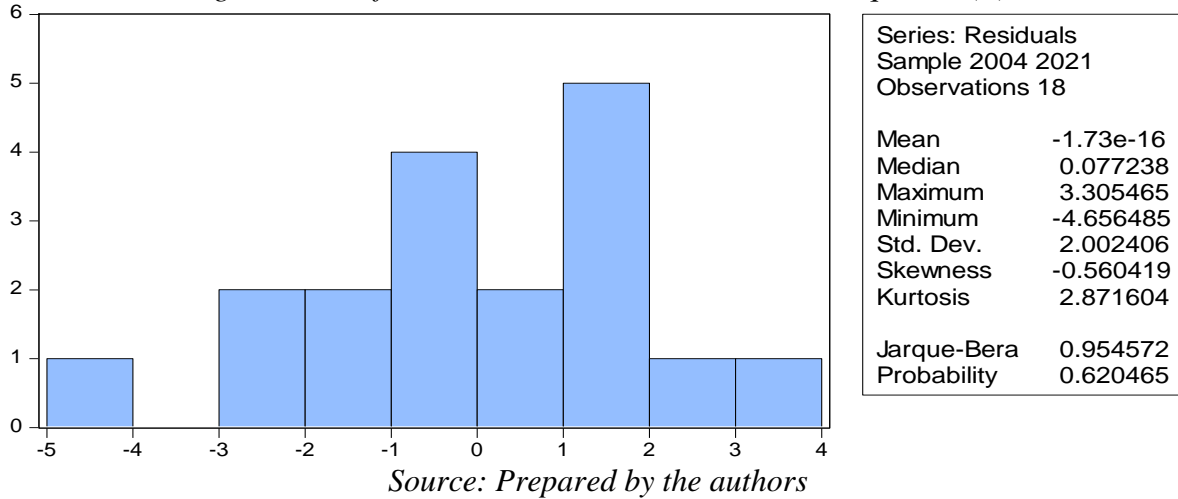
Table 3: Test for Serial Correlation of the Residuals in Equation (1)

F-statistic	1. 180844	**Probability F(2,13)**	0. 3379
Observations R-squared	2. 767300	**Probability Chi-Square(2)**	0. 2507

Source: Prepared by the authors

Table 4: Test for Heteroscedasticity of the Residuals in Equation (1)

F-statistic	1. 785552	**Probability F(2,15)**	0. 2016
Observations R-squared	3. 461285	**Probability Chi-Square(2)**	0. 1772

Source: Prepared by the authors

Table 5: Regression Specification Error Test on Equation (1)

	Value	**Degree of freedom**	**Probability**
t-statistic	0. 125725	14	0. 9017
F-statistic	0. 015807	(1,14)	0. 9017
Likelihood ratio	0. 020312	1	0. 8867

Source: Prepared by the authors
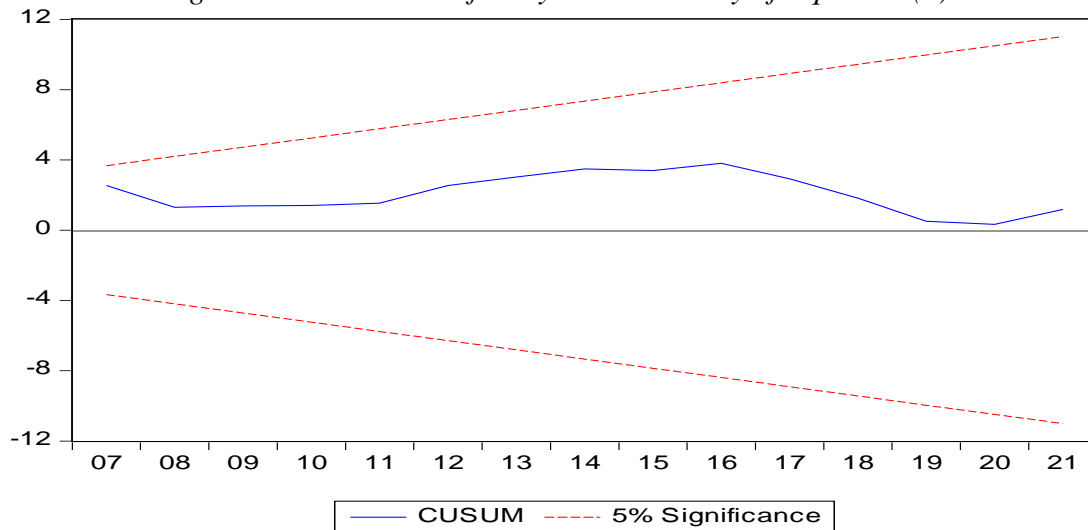
Figure 2: CUSUM Test for Dynamic Stability of Equation (1)

Source: Prepared by the authors

The original Kuznets curve for Greece for the period 2004-2021 (see Figure 3) has been derived by Equation (1).This curve indicates that in Greece during 2004-2021 the peak of social resilience (the lowest percentage rate of change of the Gini coefficient of about -1. 36%) was reached in 2016 at a percentage rate of change of the real GDP per capita of approximately -0. 06%.

Figure 3: The original Kuznets curve for Greece for the period 2004-2021
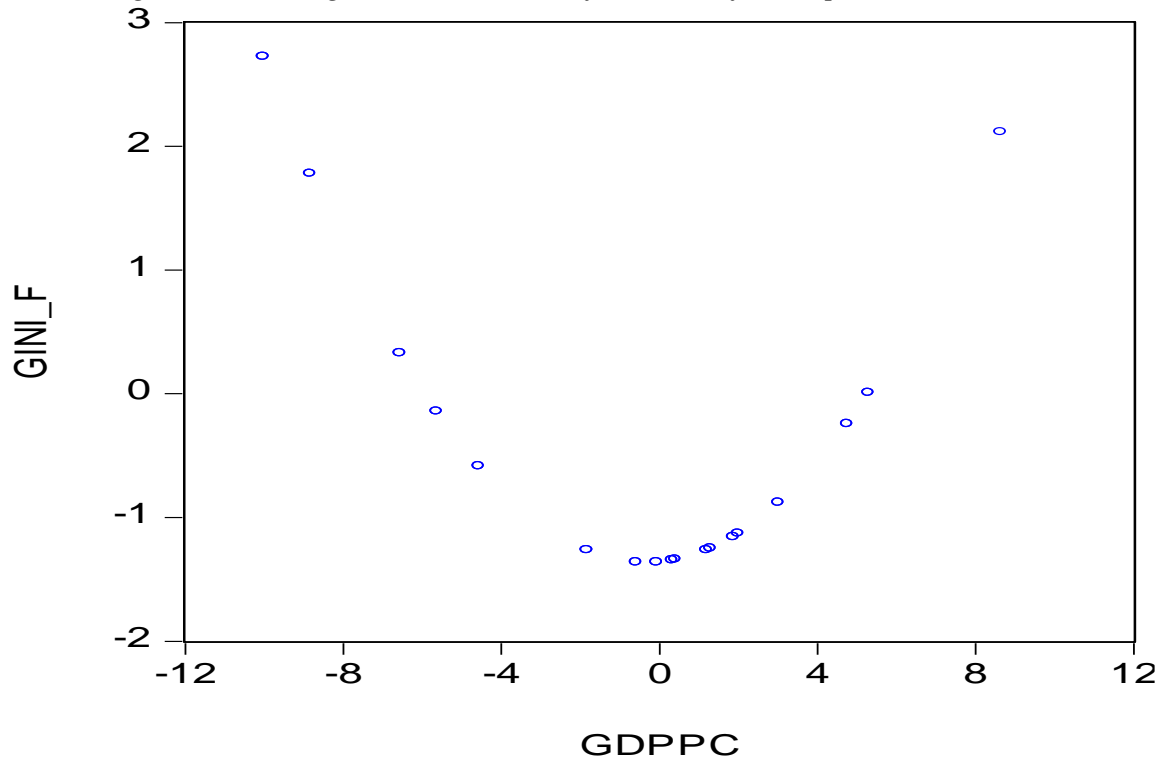
Source: Prepared by the authors

5. EMPIRICAL INVESTIGATION OF THE RELATIONSHIP BETWEEN THE DEGREE OF ECONOMIC DEVELOPMENT AND ENVIRONMENTAL QUALITY

5.1. Methodologyand data

The relationship between the per capita purchasingpower and environmental quality in Greece has been explored by an ordinary least squares (OLS) regression, which involves the following variables:

- **GDPPC$_t$** – percentage rate of change of the real per capita GDP in Greece in year **t** compared to year **t-1**;
- **GGEPC -** percentage rate of change of amount of the greenhouse gas emissions per capita in Greece in year **t** compared to year **t-1**.

The dependent variable is **GGEPC,** while the independent variable is **GDPPC.**To account for a possible non-linear relationship between the dependent and the independent variable, the square of **GDPPC** is also included in the regression model.

Annual Eurostat data for the period 2001–2020 have been used in the study.

5.2. Results

The group unit root tests show that as a group **GDPPC** and **GGEPC** are stationary at firstdifference (see Table 6 and Table 7), which demandsthe use of the first differences of the variables whenapplying the OLS approach.

Table 6: Group Stationarity Tests on the Level Values of GDPPC and GGEPC

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chut*	1. 42014	0. 9222	2	38
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0. 18627	0. 4261	2	38
ADF-Fisher Chi-square	3. 30493	0. 5082	2	38
PP-Fisher Chi-square	3. 13745	0. 5351	2	38

Source: Prepared by the authors

Table 7: Group Stationarity Tests on the First Differences of GDPPC and GGEPC

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chut*	-3. 38528	0. 0004	2	36
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3. 82816	0. 0001	2	36
ADF-Fisher Chi-square	20. 2152	0. 0005	2	36
PP-Fisher Chi-square	20. 2075	0. 0005	2	36

Source: Prepared by the authors

The relationship between **GDPPC** and **GGEPC** is expressed by Equation (2):

D(GGEPC) = C(1) + C(2)*D(GDPPC) + C(3)*D(GDPPC)^2 + Error(2).

The results from the econometric estimation of Equation (2) are shown in Table 8. The significance of the square of **GDPPC** at a 0. 1 level means that the degree of economic development has a non-linear effect on environmental quality in Greece.

Table 8: Results from the Econometric Estimation of Equation (2)

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	0. 326418	1. 180465	0. 276516	0. 7857
D(GDPPC)	-0. 173863	0. 345717	-0. 502906	0. 6219
D(GDPPC)^2	-0. 092202	0. 049623	-1. 858063	0. 0817

Source: Prepared by the authors

The value of the coefficient of determination (R-squared = 0. 2016) implies that 20. 16% from the variation of the dependent variable can be explained by changes in the independent variable in Equation (2). The residuals in Equation (2) are normally distributed (see Figure 4), serially uncorrelated (see Table 9) and non-heteroskedastic (see Table 10). The Ramsey test (RESET) indicates a lack of errors in the specification of Equation (2) (see Table 11). The results from the CUSUM test (see Figure 5) show that Equation (2) is dynamically stable.

Figure following on the next page

Figure 4: Test for Normal Residual Distribution in Equation (2)

Series: Residuals	
Sample 2002 2020	
Observations 19	
Mean	3.59e-16
Median	-0.493422
Maximum	7.923460
Minimum	-6.917367
Std. Dev.	4.198065
Skewness	0.326105
Kurtosis	2.027482
Jarque-Bera	1.085509
Probability	0.581145

Source: Prepared by the authors
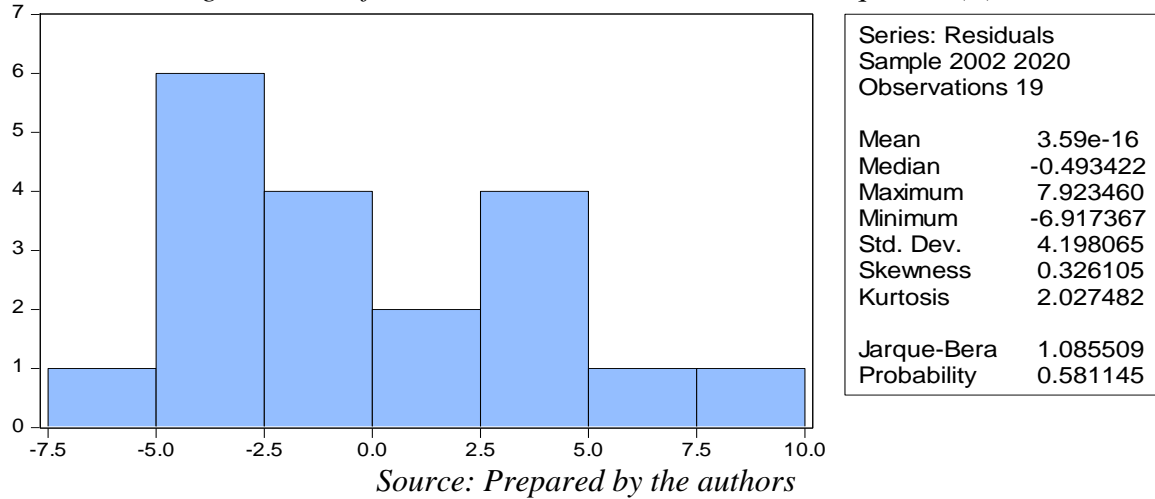
Table 9: Test for Serial Correlation of the Residuals in Equation (2)

F-statistic	3. 190425	**Probability F(2,14)**	0. 0722
Observations R-squared	5. 948533	**Probability Chi-Square(2)**	0. 0511

Source: Prepared by the authors

Table 10: Test for Heteroscedasticity of the Residuals in Equation (2)

F-statistic	0. 990039	**Probability F(2,16)**	0. 3932
Observations R-squared	2. 092398	**Probability Chi-Square(2)**	0. 3513

Source: Prepared by the authors

Table 11: Regression Specification Error Test on Equation (2)

	Value	**Degree of freedom**	**Probability**
t-statistic	0. 605182	15	0. 5541
F-statistic	0. 366246	(1,15)	0. 5541
Likelihood ratio	0. 458338	1	0. 4984

Source: Prepared by the authors
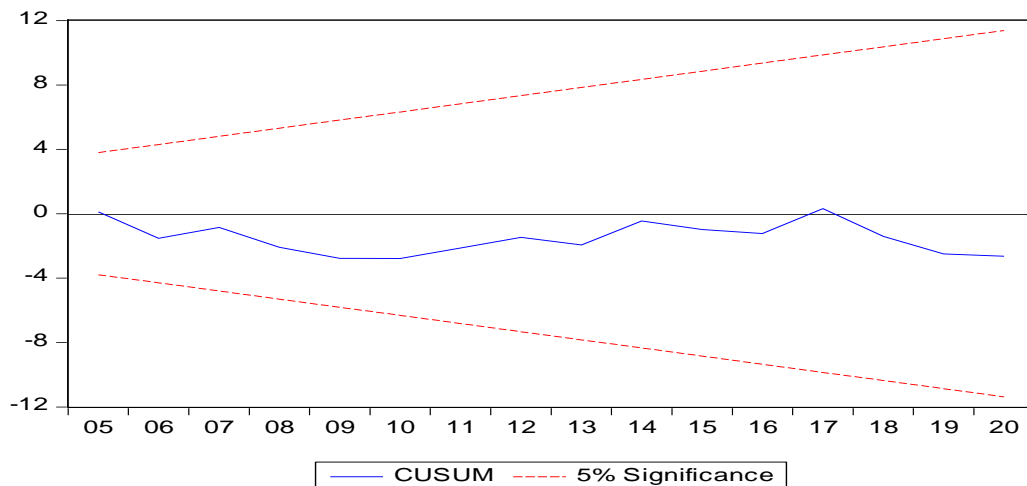
Figure 5: CUSUM Test for Dynamic Stability of Equation (2)

Source: Prepared by the authors

The modified (environmental) Kuznets curve for Greece for the period 2001-2020 (see Figure 6) has been derived by Equation (2).This curve indicates that the peak of environmental degradation in Greece during 2001-2020 was in 2010, when the percentage rate of change of the amount of greenhouse gas emissions per capita grew by 0. 41% and the percentage rate of change of real GDP per capita fell by 1. 06% compared to 2009.

Figure 6: The environmental Kuznets curve for Greece for the period 2001-2020
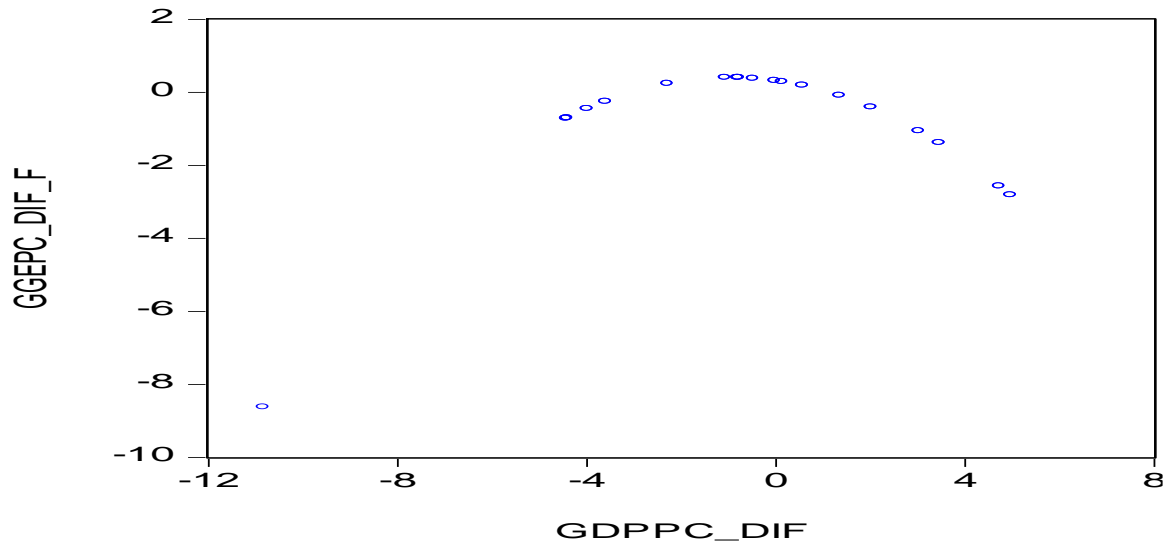
Source: Prepared by the authors

6. CONCLUSION

The empirical results from this research show that the peak of social sustainability in Greece for the period 2004-2021 was in 2016, when income inequality (the Gini coefficient) dropped by 1. 36% in comparison with 2015.However, the rise in social resilience in 2016 was accompanied by a fall in the standard of living (real per capita output) of 0. 06% (see Figure 3).It is alarming that in Greece an increase in social sustainability is accomplished at the expense of a decline in the living standard.It is recommended that the original Kuznets curve be shifted to the right by a transition from a consumption-based to a hybrid tax system in Greece. The empirical results also indicate that the quality of the environment in Greece during 2001-2020 aggravated most in 2010, when the percentage rate of change of the amount of greenhouse gas emissions per capita rose by 0. 41% in comparison to 2009.It is disturbing that this maximum of environmental degradation was combined with a loss of purchasing power of 1. 06%.Greek policymakers should do their best to shift the environmental Kuznets curve to the right by achieving "green" economic growth through investments aimed at a transition to a carbon-neutral economy.

LITERATURE:

1. Asteriou, D., Hall, S.G. (2011), Applied Econometrics. 2nd ed. London, United Kingdom: Palgrave Macmillan. p.512.
2. Biczynska E., (2015), Measuring the social component of sustainable development in the cities. The case of Medellin, Colombia, Barometr Regionalny, tom 13, NR1, file:///C:/Users/Dell/Downloads/br39_17_biczynska_en.pdf , (accesses 21.01.202)
3. Delivering on the vision of the 1972 Stockholm Declaration and achieving the 2030 Agenda for Sustainable Development, https://unemg.org/wp-content/uploads/2022/06/UNEP_E MG_Delivering-on-the-vision-of-the-1972-Stockholm-Declaration-Rev3.pdf (accessed 18.01.2023)

4. Dickey, D.A., Fuller, W.A. (1979), Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74, 427-431.
5. Dickey, D.A., Fuller, W.A. (1981), Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica, 49, 1057-1072.
6. Dinda, S. (2004), Environmental Kuznets curve hypothesis: A survey. Ecological Economics, 49, 431-55.
7. Fort Collins Social Sustainability (2016), Community wellness, equity and inclusion, Community prosperity, housing, Strategic plan, https://www.fcgov.com/sustainability/pdf/SocialSustainability_FINAL_web-ready_reduced.pdf (accessed 21.01.2023)
8. Grossman, G.M., Krueger, A.B. (1995), Economic-growth and the environment. Quarterly Journal of Economics, 110, 353-377.
9. Jeronen, E. (2020). Economic Sustainability. In: Idowu S., Schmidpeter R., Capaldi N., Zu L., Del Baldo M., Abreu R. (eds.) Encyclopedia of Sustainable Management. Springer, Cham, https://www.researchgate.net/publication/341277083_Economic_sustainability_Summary, (accessed 21.01.2023)
10. Hatzigeorgiou, E., Polatidis, H., Haralambopoulos, D. (2011), CO2 emissions, GDP and energy intensity: A multivariate cointegration and causality analysis for Greece, 1977-2007. Applied Energy, 88, 1377-1385.
11. Herman E. Daly (1990), Toward some operational principles of sustainable development, Ecological Economics, Vol. 2, Issue 1, Elsevier Science Publishers, B.V. Amsterdam – Printed in the Netherlands, https://www.sciencedirect.com/science/article/pii/092180099090010R, (accessed in 21.01.2023)
12. Hondroyiannis, G., Lolos G.S., Papapetrou E. (2002), Energy consumption and economic growth: Assessing the evidence from Greece. Energy Economics, 24, 319-336.
13. Kaika, D., Zervas, E. (2013a), The environmental Kuznets curve (EKC) theory. Part A: Concept, causes and the CO2 emissions case. Energy Policy, 62, 1392-1402.
14. Kaika, D., Zervas, E. (2013b), The environmental Kuznets curve (EKC) theory. Part B: Critical issues. Energy Policy, 62, 1403-1411.
15. Kotroni E., D. Kaika, E. Zervas (2020), Environmental Kuznets Curve in Greece in the Period 1960-2014, International Journal of Energy Economics and Policy, 2020, 10(4), 364-370.
16. Kuznets, S. (1955), Economic growth and income inequality. The American Economic Review, 45, 1-28.
17. Kiryakova-Dineva, Chankova Y., T., Intercultural-Dialogue-as-a-Tool-for-Maintaining-Sustainable-Partnerships-in-Tourism in book: Handbook of Research on the Role of Tourism in Achieving Sustainable Development Goals (pp.282-299) Publisher: IGI Global, https://www.researchgate.net/publication/346976031_Intercultural-Dialogue-as-a-Tool-for-Maintaining-Sustainable-Partnerships-in-Tourism_2 (accessed 20.01.2023)
18. Miller G. T. (1999), Βιώνοντας στο περιβάλλον II, έκδοση 9η, Μετφρ. Ταλαντοπούλου Μ. , Αθήνα, ΙΩΝ,
19. Moomaw W.R. and G.C. Unruh (1997), Are environmental Kuznets curves misleading us? The case of CO2 emissions, Environment and Development Economics 2:451-463.
20. Nuno Carlos Leitão (2013) "The environmental Kuznets curve and globalization: The Empirical Evidence for Portugal, Spain, Greece and Ireland " Energy Economics Letters, 2013, Vol. 1, No.1, pp.15-23.
21. Polemis, M.L. (2007), Modeling industrial energy demand in Greece using cointegration techniques. Energy Policy, 35, 4039-4050.
22. Rapanos, V.T., Polemis, M.L. (2006), The structure of residential energy demand in Greece. Energy Policy, 34, 3137-3143.

23. Report of the World Commission on Environment and Development: Our Common Future, 1987, https://sustainabledevelopment. un. org/content/documents/5987our-common-future. pdf (accessed in 20. 11. 2023)
24. Şenay SARAÇ, Aykut YAĞLIKARA (2017), Environmental Kuznets Curve: The Evidence from BSEC Countries. Ege Academic Review. Doi: 10.21121/eab.2017225203.
25. Spangenberg J., (2005), Economic sustainability of the economy: Concepts and indicators, International Journal of Sustainable Development, Vol. 8, 1/2. https://www.research gate.net/publication/5107698_Economic_sustainability_of_the_economy_Concepts_and_i ndicators, (accessed 21.01.2023)
26. Stern, D.I., Common, S.M., Barbier, E. (1996), Economic growth and environmental degradation: The environmental Kuznets curve and sustainable development. World Development, 24, 1151-1160.
27. Social, environmental and economic sustainability, https://www.thwink.org/sustain/ glossary/ThreePillarsOfSustainability.htm, (accessed 18.01.2023)
28. The Convention on Biological Diversity, https://www. cbd. int/convention/ (accessed 05. 01. 2023)
29. Thwink, Economic Sustainability, https://www.thwink.org/sustain/glossary/Economic Sustainability.htm (accessed 21.01.2023)
30. Zervas, E., Poulopoulos, S., Philippopoulos, C. (2006), CO2 emissions change from the introduction of diesel passenger cars: Case of Greece. Energy, 31, 2915-2925.
31. Λαμπριανίδης Λ. (2001), Οικονομική Γεωγραφία: Στοιχεία Θεωρίας και Εμπειρικά Παραδείγματα, Αθήνα, Πατάκη, 210.
32. Μαγκλιβέρας Κ. (2004), Η γένεση της αρχής της αειφόρου ανάπτυξης και το διεθνές δίκαιο στο Αειφορία και περιβάλλον. Η Ευρωπαϊκή και Εθνική προοπτική, εκδ. Σιδέρης, Αθήνα.
33. Σιούτη Γ. (2003), Εγχειρίδιο Δικαίου Περιβάλλοντος, Αθήνα-Κομοτηνή, Σάκκουλα, 15-23
34. Τσάλτας Γ. (2004), AGENDA 21 και τοπική αυτοδιοίκηση: Η εφαρμογή της αειφορικής διάστασης της ανάπτυξης στις τοπικές κοινωνίες στο Αειφορία και περιβάλλον. Η Ευρωπαϊκή και Εθνική προοπτική, εκδ. Σιδέρης, Αθήνα.
35. Φλογαΐτη Ε. (2009), Εκπαίδευση για το Περιβάλλον και την Αειφορία. , Αθήνα, Ελληνικά Γράμματα.

PURCHASING POWER, INCOME INEQUALITY AND ENVIRONMENTAL DEGRADATION: THE CASE OF BULGARIA

Ivan Todorov
South-West University „Neofit Rilski", Blagoevgrad, 66 Ivan Mihaylov Str., Bulgaria
ivank.todorov@swu.bg

Gergana Angelova
South-West University „Neofit Rilski", Blagoevgrad, 66 Ivan Mihaylov Str., Bulgaria
gergana.angelova@swu.bg

ABSTRACT
The goal of this paper is to empirically investigate the relationships between the standard of living, income inequality and environmental degradation in Bulgaria. To achieve this purpose, the original and the environmental Kuznets curves for Bulgaria were derived. The empirical results from the research show that in Bulgaria social stability falls as economic stability rises. This calls for tax and incomes policies aimed at mitigating income inequality. It is recommended that progressive income taxation and tax-free minimum income be introduced in order to reduce social instability in Bulgaria. Another conclusion that was drawn from the empirical analysis is that Bulgaria should achieve a real economic growth per capita of at least 5.8% so that a sustainable improvement of environmental quality is accomplished.
Keywords: Bulgaria, Kuznets curves, sustainable development

1. INTRODUCTION
Sustainable development (sustainability) is expressed in three dimensions: economic, social and environmental (ecological). Sustainability of economic development can be measured by the real GDP per capita, which shows a nation's standard of living or purchasing power. Social sustainability may be approximated by income inequality, which is indicated by the Gini coefficient. As an indicator of environmental sustainability the amount of greenhouse gas emissions per capita may be employed. The aim of this paper is to empirically investigate the relationships between the standard of living, income inequality and environmental degradation. To achieve this purpose, the original and the environmental Kuznets curves for Bulgaria were derived. The original Kuznets curve illustrates the link between economic sustainability (standard of living or purchasing power per capita) and income inequality, while the environmental Kuznets curve shows the connection between standard of living and environmental degradation. The paper was structured as follows. In the first section, general introduction into the researched issue was made. In the second section, the theoretical foundations of sustainability and empirical studies on the Kuznets curves were reviewed. In the third section, the link between the standard of living and income inequality was empirically investigated. In the fourth section, the relationship between the standard of living and environmental degradation in Bulgaria was empirically analyzed. In the conclusion, the empirical results from this research were interpreted and advisable macroeconomic policies for sustainable development in Bulgaria were formulated.

2. LITERATURE REVIEW
The World Commission on Environment and Development (1987) defined sustainability as "development, which meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable development has two interrelated aspects – sustainability and development.

Sustainability involves the issues of environmental quality and social stability, whereas development refers to economic growth. According to Kuznets (1955), in the long run economic growth leads to a decrease in income inequality. The relationship between economic growth and income inequality is portrayed by an inverted U-shaped curve known as the original Kuznets curve. A similar curve depicts the link between economic growth and environmental quality. Grossman and Krueger (1995) (cited by Zapata and Paudel, 2009) concluded that enhanced economic development initially causes environment deterioration but there is a turning point at which this deterioration begins to decrease when a certain level of per capita income is reached. The inverted relationship between environmental degradation and economic prosperity is displayed by a U-shaped curve referred to as the environmental Kuznets curve. The term "environmental Kuznets curve" was introduced by Panayotou (1993) and Seldon and Song (1994). The relationships between the dimensions of sustainable development, which are expressed by the two Kuznets curves, are a matter of permanent interest, concern and discussion by academics, policymakers, business people and the general public. Rötheli (2011) studied the determinants of the original Kuznets curve and detected a reverse dependence between income instability and savings rate. Economic development does not necessarily find expression in income stability. Rötheli argued that efficient capital markets lead to a faster increase in total income and lower level of inequality. Usually, the impact of finance on economic growth and income inequality is positive (Levine, 2005; Beck et al., 2007). However, sometimes this impact may be ambiguous (Rousseau and Wachtel, 2011). According to Okun (2015), the conflict between income inequality and economic efficiency is unavoidable. On the one hand, greater equality lowers the incentives for economic efficiency. On the other hand, increased economic efficiency results in greater inequality. The link between economic growth and income inequality is a matter of debate and disagreement among researchers. Piketty (2014) and Mavrov (2021) concluded that in the developed market economies the return rate is higher than the rate of economic growth, which contributes to a greater wealth concentration and income inequality. Ostry et al. (2014) and Stiglitz (2013) argued that greater equality does not decrease economic efficiency but boosts it. There is also an increased scientific interest in the connection between economic development and the deterioration of the environment. Shahbaz and Sinha (2019) reviewed the empirical studies on the environmental Kuznets curve for the period 1991-2017 and concluded that their results and findings Substantially vary due to great differences in methodology, territorial scope and time interval. They recommended that improved and unified methodology and data be used in future studies in order to increase the reliability and comparability of results. Singhania and Saini (2020) found evidence in support of the environmental Kuznets curve hypothesis for a sample of seven developed and developing countries. The authors identified economic growth and energy consumption as the main prerequisites for environmental degradation. Ansari et al. (2020) found out that there is a long-term relationship between carbon emissions, economic growth, and energy consumption in a number of countries having different level of economic development. It was ascertained that the consumption of energy most significantly favours the production of harmful emossions in the long term. The studied countries (the USA, Canada, the UK, France, Spain, Italy, Australia, Iran and Saudi Arabia) could lower their energy consumption and reduce pollution with no detriment to the economy. The environmental Kuznets curve hypothesis was proved for the USA only. Rajpurohit and Sharma (2021) checked the environmental Kuznets curve hypothesis for a sample of five Asian countries (India, Pakistan, Bangladesh, Sri Lanka and Malaysia) over the period 1980-2014 and ascertained that balanced economic development boosts the qauntity of harmful emissions.

However, in the course of time, rapid economic development leads to a drop in these emissions. An empirical study (Alshubiri and Elheddad, 2020) in 32 OECD (Organization for Economic Cooperation and Development) countries reveals that at the initail stage of growth economic development favours the production of CO2. This trend continues until a given value of GDP is registered at which economic development starts to ameliorate the environment. Later on, the reduction of the GDP value starts to cause enviromental degradation again. A different trend was noticed in India. Sajeev and Kaur (2020) found that trade openness was observed to lower carbon emissions only when paired with FDI. Otherwise its impact on carbon emissions was negative. Another research done by Rasool et al. (2020) confirmed the existence of a U-shaped relationship between environmental degradation and economic growth in India over the period of 1971-2014. Sen and Abedin (2021) compared economic growth in India and China and its impact on environmental quality. The research used data on carbon emissions, GDP per capita and energy consumption over the period 1972–2017. The drop in the ecological quality in China will be slower compared to India due to the huge consumption of energy. Similarly, an increase in economic growth after a certain turning point will enhance environmental quality in India faster than that in China. In Bahrain and Saudi Arabia there a U-shaped realtionship between enviromental pollutants and the real per capita output. Bader and Ganguli (2019) advised that all GCC states lessen their dependence on fossil fuels since greater pollution reduces productivity and hinders economic growth. In Turkey, the financial sector development was found to enhance enviromental quality while energy use and economic growth were proven to deteriorate it (Dar and Asif, 2018). Making a comparison between developing and developed countries, Lau et al. (2018) identified a U-shape link between economic develpment and ecological quality only in developed countries where the rule of law is beneficial in this regard. The environmental Kuznets curve hypothesis was challenged for the mining industry in Bulgaria in the municipalities of Krumovgrad, Breznik and Tran by Dimitrova (2019), but no evidence was found in support of the EKC hypothesis in the three analyzed municipalities. The opposite trend was ascertained by Kalchev (2016), who analyzed data on pollution and GDP per capita in Bulgaria for the period 1970-2008. Data on five pollutants were used in the study: carbon dioxide, sulfur dioxide, methane, ammonia, and nitrous oxide. A relationship resembling an Environmental Kuznets Curve was found for all pollutants, except for sulfur dioxide. Unlike Kalchev, Tsiantikoudis et al. (2019) observed the existence of an N-shaped EKC for Bulgaria and advised that afforestation processes be strictly controlled and monitored. To summarize, some studies (Rötheli, 2011; Levine, 2005; Beck et al., 2007; Stiglitz, 2013; Ostry, 2014) proved the existence of the original Kuznets curve, i.e. that economic growth leads to a decrease in income inequality in the long run. Other investigations (Piketty, 2014; Okun, 2015) refuted the original Kuznets curve hypothesis by showing that the raise in per capita GDP does not lower income inequality but boosts it. The empirical results from this paper are similar to the findings of Piketty (2014) and Okun (2015) and different from the inferences of Rötheli (2011), Levine (2005), Beck et al. (2007), Stiglitz (2013) and Ostry (2014). As to the environmental Kuznets curve, many studies (USA, UK, Bahrain, and Saudi Arabia) confirmed its existence. The EKC hypothesis was also supported for India, Pakistan, Bangladesh, Sri Lanka and Malaysia only when an accelerated economic growth rate was observed. On the other hand, there are countries (most of the GCC countries, 32 selected member states of OECD, China, Italy, and Turkey), where no evidence of a U-shaped relationship was found between economic growth per capita and environmental quality. It may be inferred that the empirical investigations on the two Kuznets curves provide contradictory results, which may be explained by differences in their methodologies, time span and territorial scope.

3. EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN PURCHASING POWER (STANDARD OF LIVING) AND INCOME INEQUALITY

3.1. Methodology and data

The relationship between the standard of living and income inequality in Bulgaria was analyzed by an ordinary least squares (OLS) regression, which comprised the following variables:

- **GDPPC$_t$** – growth rate of the real per capita output in Bulgaria in year **t** compared to year **t-1** (percentage);
- **GINI –** growth rate of the Gini coefficient in Bulgaria in year **t** compared to year **t-1** (percentage).

The dependent variable is **GINI,** while the independent variable is **GDPPC.** To account for a possible non-linear relationship between the dependent and the independent variable, the square of **GDPPC** was also included in the regression model.

Annual Eurostat data for the period 2007 – 2021 were used in the study.

3.2. Results

The group unit root tests show that as a group **GDPPC** and **GINI** are stationary at level (see Table 1), which allows the direct application of the OLS approach.

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chut*	-5.49926	0.0000	2	28
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.88147	0.0000	2	28
ADF-Fisher Chi-square	24.5482	0.0001	2	28
PP-Fisher Chi-square	38.6032	0.0000	2	28

Table 1: Group Stationarity Tests on the Level Values of GDPPC and GINI
(Source: Prepared by the authors)

The relationship between **GDPPC** and **GINI** is expressed by Equation (1):

$$\text{GINI} = C(1) + C(2)*\text{GDPPC} + C(3)*\text{GDPPC}\char94 2 + \text{Error.} \qquad (1)$$

The results from the econometric estimation of Equation (1) are shown in Table 2. The lack of statistically significant regression coefficients in Equation (1) means an absence of linear and non-linear effects of the standard of living on the income inequality in Bulgaria.

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-1.706562	1.603536	-1.064249	0.3082
GDPPC	0.718228	0.477965	1.502680	0.1588
GDPPC^2	0.088393	0.102421	0.863034	0.4050
R-squared	0.433827	Mean of dependent variable	1.728462	
Adjusted R-squared	0.339465	Standard deviation of dependent variable	4.909959	
S.E. of regression	3.990487	Akaike info criterion	5.782560	
Sum squared residual	191.0878	Schwarz criterion	5.924170	
Log likelihood	-40.36920	Hannan-Quinn criterion	5.781051	
F-statistic	4.597468	Durbin-Watson statistic	2.283455	
Probability of F-statistic	0.032938			

Table 2: Results from the Econometric Estimation of Equation (1)
(Source: Prepared by the authors)

The value of the coefficient of determination (R-squared = 0.4338) implies that 43.38% from the variation of the dependent variable can be explained by changes in the independent variable in Equation (1). The probability of the F-statistic of 0.032 suggests that the regression model adequately reflect the relationship between the dependent and the independent variable. The residuals in Equation (1) are normally distributed (see Figure 1), serially uncorrelated (see Table 3) and non-heteroskedastic (see Table 4). The Ramsey test (RESET) indicates a lack of errors in the specification of Equation (1) (see Table 5). The results from the CUSUM test (see Figure 2) show that Equation (1) is dynamically stable.

Series: Residuals	
Sample 2007 2021	
Observations 15	
Mean	-6.51e-16
Median	-0.247436
Maximum	7.063705
Minimum	-4.919134
Std. Dev.	3.694473
Skewness	0.369599
Kurtosis	2.158918
Jarque-Bera	0.783646
Probability	0.675824
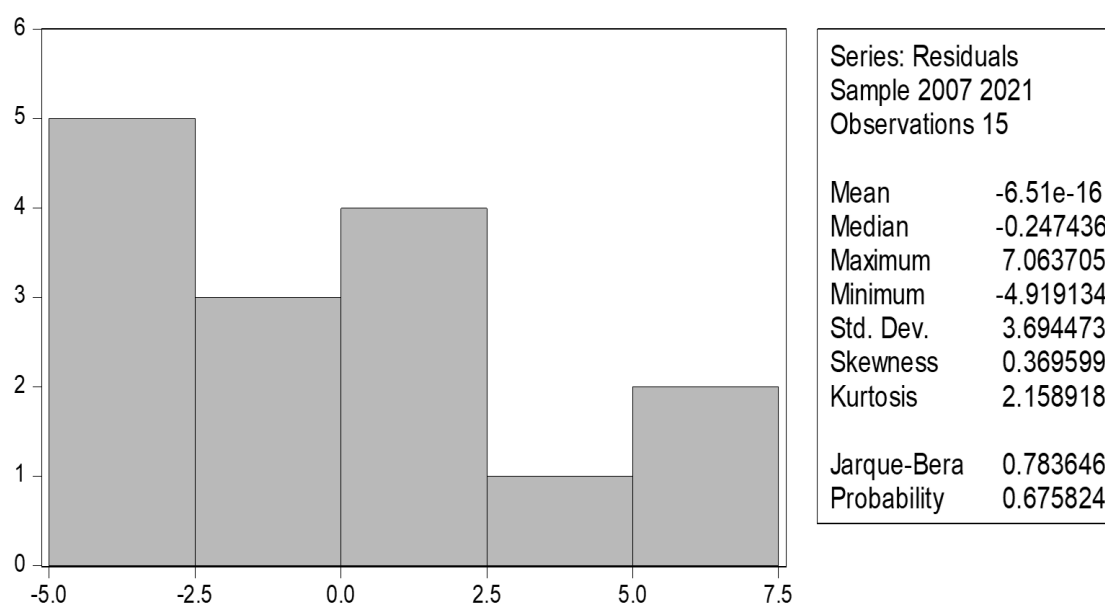
Figure 1: Test for Normal Residual Distribution in Equation (1)
(Source: Prepared by the authors)

F-statistic	0.534576	**Probability F(2,10)**	0.6018
Observations R-squared	1.448825	**Probability Chi-Square(2)**	0.4846

Table 3: Test for Serial Correlation of the Residuals in Equation (1)
(Source: Prepared by the authors)

F-statistic	0.164659	**Probability F(2,12)**	0.8501
Observations R-squared	0.400653	**Probability Chi-Square(2)**	0.8185

Table 4: Test for Heteroskedasticity of the Residuals in Equation (1)
(Source: Prepared by the authors)

	Value	**Degree of freedom**	**Probability**
t-statistic	0.907770	11	0.3835
F-statistic	0.824047	(1, 11)	0.3835
Likelihood ratio	1.083601	1	0.2979

Table 5: Regression Specification Error Test on Equation (1)
(Source: Prepared by the authors)
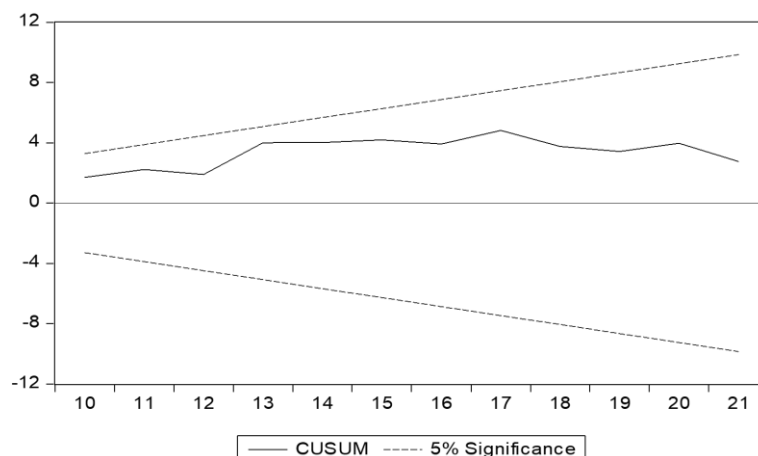
Figure 2: CUSUM Test for Dynamic Stability of Equation (1)
(Source: Prepared by the authors)

The original Kuznets curve for Bulgaria for the period 2007-2021 (see Figure 3) was derived by Equation (1). This curve indicates that in Bulgaria during 2007-2021 the rise in the standard of living (economic stability) is accompanied by an increase in the income inequality (social instability).
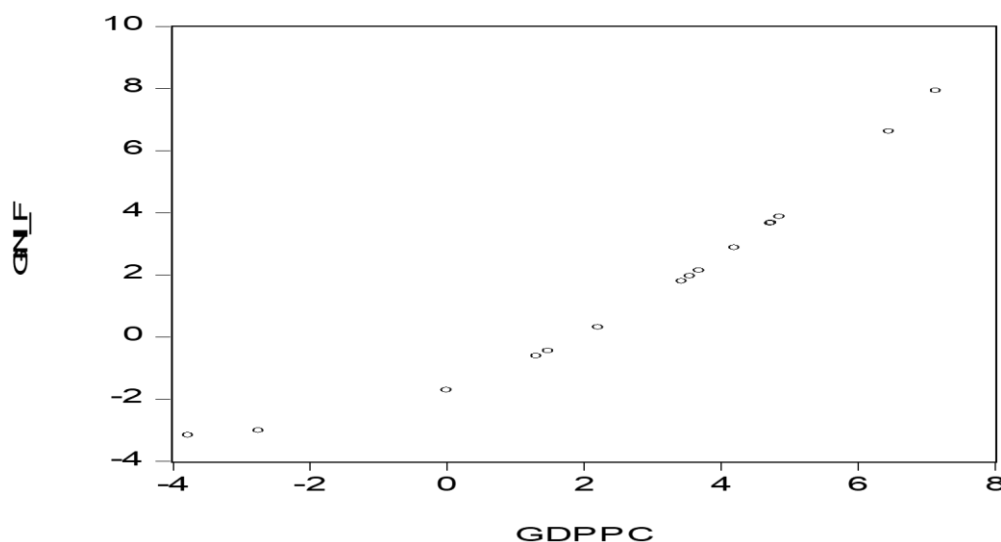
Figure 3: The original Kuznets curve for Bulgaria for the period 2007-2021
(Source: Prepared by the authors)

4. EMPIRICAL INVESTIGATION OF THE RELATIONSHIP BETWEEN PURCHASING POWER (STANDARD OF LIVING) AND ENVIRONMENTAL DEGRADATION

4.1. Methodology and data

The relationship between the standard of living and environmental degradation in Bulgaria was examined by an ordinary least squares (OLS) regression, which comprised the following variables:

- **GDPPC**$_t$ – growth rate of the real per capita output in Bulgaria in year **t** compared to year **t-1** (percentage);
- **GGEPC -** growth rate of the greenhouse gas emissions per capita in Bulgaria in year **t** compared to year **t-1** (percentage).

The dependent variable is **GGEPC,** while the independent variable is **GDPPC.** To account for a possible non-linear relationship between the dependent and the independent variable, the square of **GDPPC** was also included in the regression model.

Annual Eurostat data for the period 2001 – 2020 were used in the study.

4.2. Results

The group unit root tests show that as a group **GDPPC** and **GGEPC** are stationary at level (see Table 6), which allows the direct application of the OLS approach.

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chut*	-1.74856	0.0402	2	37
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.78043	0.0375	2	37
ADF-Fisher Chi-square	9.92040	0.0418	2	37
PP-Fisher Chi-square	12.2923	0.0153	2	38

Table 6: Group Stationarity Tests on the Level Values of GDPPC and GGEPC
(Source: Prepared by the authors)

The relationship between **GDPPC** and **GGEPC** is expressed by Equation (2):

$$GGEPC = C(1) + C(2)*GDPPC + C(3)*GDPPC^2 + Error. \qquad (2)$$

The results from the econometric estimation of Equation (2) are shown in Table 7. The presence of statistically significant regression coefficients in Equation (2) means that the standard of living has both linear and non-linear effects on environmental degradation in Bulgaria.

Variable	Coefficient	Standard Error	t-Statistic	Probability
GDPPC^2	-0.225924	0.097128	-2.326058	0.0326
GDPPC	2.577912	0.593273	4.345237	0.0004
C	-3.839957	1.850087	-2.075555	0.0534
R-squared	0.578746	Mean of dependent variable		0.399740
Adjusted R-squared	0.529187	Standard deviation of dependent variable		7.261275
Standard error of regression	4.982385	Akaike info criterion		6.187176
Sum squared residual	422.0107	Schwarz criterion		6.336535
Log likelihood	-58.87176	Hannan-Quinn criterion		6.216332
F-statistic	11.67785	Durbin-Watson statistic		2.598362
Probability of F-statistic	0.000644			

Table 7: Results from the Econometric Estimation of Equation (2)
(Source: Prepared by the authors)

The value of the coefficient of determination (R-squared = 0.5787) implies that 57.87% from the variation of the dependent variable can be explained by changes in the independent variable in Equation (2). The probability of the F-statistic of 0.000 suggests that the regression model adequately reflects the relationship between the dependent and the independent variable. The residuals in Equation (2) are normally distributed (see Figure 4), serially uncorrelated (see Table 8) and non-heteroskedastic (see Table 9). The Ramsey test (RESET) indicates a lack of errors in the specification of Equation (2) (see Table 10). The results from the CUSUM test (see Figure 4) show that Equation (2) is dynamically stable.
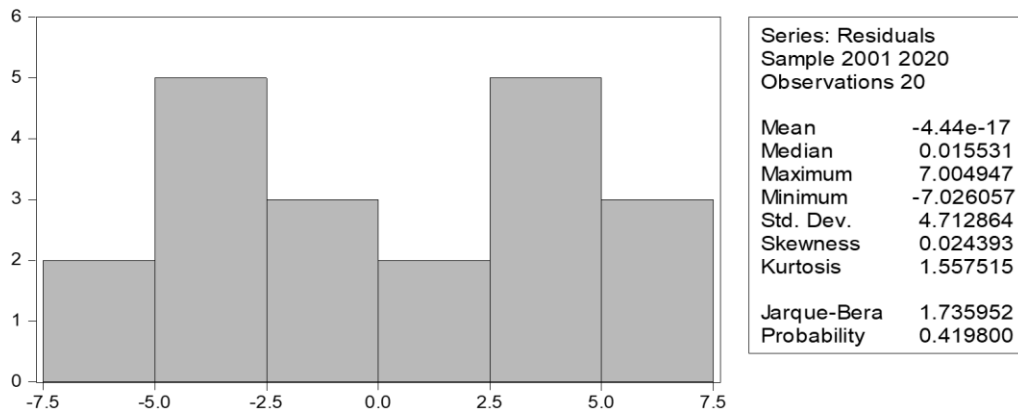
Figure 4: Test for Normal Residual Distribution in Equation (2)
(Source: Prepared by the authors)

F-statistic	2.218756	Probability F(1,16)	0.1558
Observations R-squared	2.435683	Probability Chi-Square(1)	0.1186

Table 8: Test for Serial Correlation of the Residuals in Equation (2)
(Source: Prepared by the authors)

F-statistic	0.015313	Probability F(1,17)	0.9030
Observations R-squared	0.017099	Probability Chi-Square(1)	0.8960

Table 9: Test for Heteroskedasticity of the Residuals in Equation (2)
(Source: Prepared by the authors)

	Value	Degree of freedom	Probability
t-statistic	0.238025	16	0.8149
F-statistic	0.056656	(1,16)	0.8149
Likelihood ratio	0.070695	1	0.7903

Table 10: Regression Specification Error Test on Equation (2)
(Source: Prepared by the authors)
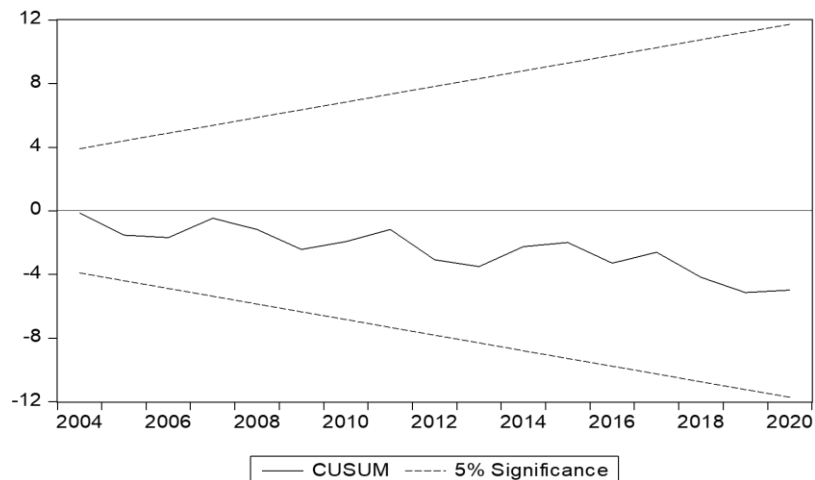
Figure 5: CUSUM Test for Dynamic Stability of Equation (2)
(Source: Prepared by the authors)

The modified (environmental) Kuznets curve for Bulgaria for the period 2001-2020 (see Figure 6) was derived by Equation (2). This curve indicates that the environmental quality in Bulgaria decreases with the increase in the standard of living till the growth rate of the real per capita output reaches 5.8%. After this turning point, the rise in the purchasing power per capita is accompanied by an increase in the quality of environment (a decline in the growth rate of greenhouse gas emissions per capita).
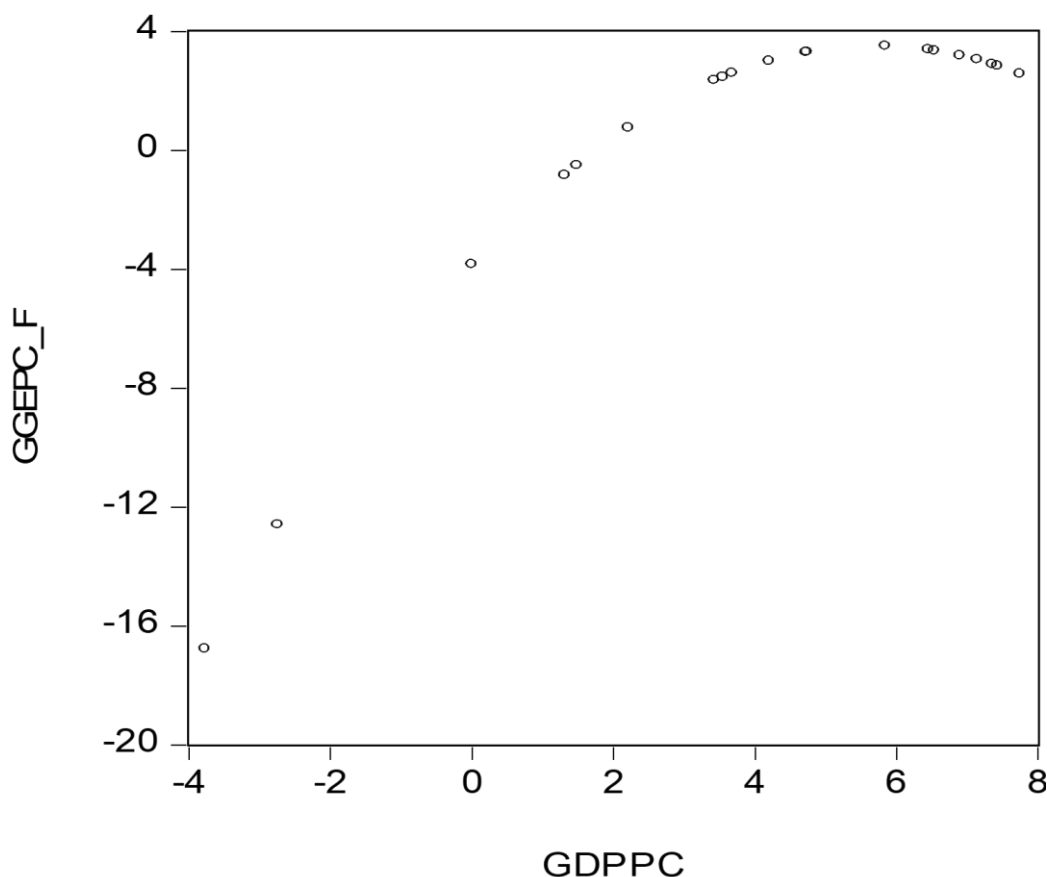
Figure 6: The environmental Kuznets curve for Bulgaria for the period 2001-2020
(Source: Prepared by the authors)

5. CONCLUSION
The empirical results from this research show that in Bulgaria during 2007 – 2021 the rise in the standard of living was accompanied by a fall in social stability or an increase in income inequality (see Figure 3: Original Kuznets curve for Bulgaria). The empirical results also indicate that in Bulgaria during 2001 – 2020 the increase in economic stability (the real GDP per capita) was related to a decline in environmental quality to a certain turning point (annual growth rate of real per capita output of 5.8%). After this turning point, the rise in the living standard resulted in an improvement in the quality of environment (see Figure 6: The environmental Kuznets curve for Bulgaria). It may be inferred that in Bulgaria social stability falls as economic stability rises. This calls for tax and incomes policies aimed at mitigating income inequality. It is recommended that progressive income taxation and tax-free minimum income be introduced in order to reduce social instability in Bulgaria. Another conclusion that can be drawn from the empirical analysis in this paper is that Bulgaria should achieve a real economic growth per capita of at least 5.8% so that a sustainable improvement of environmental quality is accomplished.

LITERATURE:

1. Alshubiri, F. and Elheddad, M. (2020). Foreign Finance, Economic Growth and CO_2 Emissions Nexus in OECD Countries, *International Journal of Climate Change Strategies and Management*, Vol. 12 No. 2, pp. 161-181, https://doi.org/10.1108/IJCCSM-12-2018-0082. Ansari, M.A., Haider, S. and Khan, N.A. (2020). Does Trade Openness Affect Global Carbon Dioxide Emissions: Evidence from the Top CO_2 Emitters, *Management of Environmental Quality*, Vol. 31 No. 1, pp. 32-53, https://doi.org/10.1108/MEQ-12-2018-0205? Bader, Y. and Ganguli, S. (2019). Analysis of the Association between Economic Growth, Environmental Quality and Health Standards in the Gulf Cooperation Council during 1980-2012, *Management of Environmental Quality*, Vol. 30 No. 5, pp. 1050-1071, https://doi.org/10.1108/MEQ-03-2018-0061.

2. Beck, T., Demirguc-Kunt, A. & Levine, R. (2007). Finance, Inequality and the Poor, *Journal of Economic Growth*, Vol. 12 No. 1, pp. 27-49, https://doi.org/10.1007/s10887-007-9010-6.

3. Dar, J.A. and Asif, M. (2018). Does Financial Development Improve Environmental Quality in Turkey? An Application of Endogenous Structural Breaks Based Co-integration Approach, *Management of Environmental Quality*, Vol. 29 No. 2, pp. 368-384, https://doi.org/10.1108/MEQ-02-2017-0021.

4. Dimitrova, L. (2019). Economic Preconditions for the Attitude towards the Environment in the Municipalities of Krumovgrad, Breznik and Tran, *Annual of Sofia University "St. Kliment Ohridski", Postgraduate Students Book* Volume 4, 2019, pp. 295-308, ISSN: 2534-935X, URI: http://hdl.handle.net/10506/2413.

5. Grossman, G. M., & Krueger, A. B. (1995). Economic Growth and the Environment. *Quarterly Journal of Economics*, 110(2), pp. 353–377, https://doi.org/10.2307/2118443.

6. Kalchev, G. (2016). Environmental Kuznets Curve in Bulgaria, In: *International Conference on Interdisciplinary Social Science Studies ICISSS 2016 (Oxford) Conference Proceedings*, FLE Learning, London, pp. 66-71, ISBN: 978-1-911185-02-4.

7. Kuznets, S. (1955). Economic Growth and Income Inequality, *The American Economic Review,* Vol. 45, No. 1, pp. 1-28.

8. Lau, L.-S., Choong, C.-K. and Ng, C.-F. (2018). Role of Institutional Quality on Environmental Kuznets Curve: A Comparative Study in Developed and Developing Countries, *Advances in Pacific Basin Business, Economics and Finance* (*Advances in Pacific Basin Business, Economics and Finance, Vol. 6*), Emerald Publishing Limited, Bingley, pp. 223-247, https://doi.org/10.1108/S2514-465020180000006007.

9. Levine, R. (2005). Finance and Growth: Theory and Evidence, Chapter 12, in Aghion, P. and Durlauf, S. (Eds), *Handbook of Economic Growth,* Vol. 1A, Elsevier B.V., pp. 865-934, DOI: 10.1016/S1574-0684(05)01012-9.

10. Mavrov, H. (2021). The Income Inequality in the Fastest Growing Economies, *Collection of Scientific Paper (1), UNWE*, pp. 401-411, ISSN (online): 2534-8957; ISSN (print): 0861-9344. Okun, A. (2015). Equality and Efficiency: The Big Tradeoff, Brookings Institution Press, Paperback ISBN: 9780815726531, E-book ISBN: 9780815726548.

11. Ostry, J., Berg, A. and Tsangarides, C. (2014). Redistribution, Inequality and Growth, *Revista de Economia Institucional* 16(30), pp. 53-81, DOI: 10.5089/9781484352076.006.

12. Panayotou, T. (1993). Empirical tests and policy analysis of environmental degradation at different stages of economic development. Working paper WP238, Technology and Employment Program, International Labor Office, Geneva, ISBN: 92-2-108796-4.

13. Piketty, T. (2014). Capital in the Twenty-First Century. Harvard University Press, ISBN: 9780674430006.

14. Rajpurohit, S.S. and Sharma, R. (2021). Impact of Economic and Financial Development on Carbon Emissions: Evidence from Emerging Asian Economies, *Management of Environmental Quality*, Vol. 32 No. 2, pp. 145-159. https://doi.org/10.1108/MEQ-03-2020-0043.
15. Rasool, H., Malik, M.A. and Tarique, M. (2020). The Curvilinear Relationship between Environmental Pollution and Economic Growth: Evidence from India, *International Journal of Energy Sector Management*, Vol. 14 No. 5, pp. 891-910, https://doi.org/10.1108/IJESM-04-2019-0017.
16. Rötheli, T.F. (2011). The Kuznets Curve: Determinants of Its Shape and the Role of Finance, *Studies in Economics and Finance*, Vol. 28 No. 2, pp. 149-159, https://doi.org/10.1108/10867371111137148.
17. Rousseau, P.L. & Wachtel, P. (2011). What is happening to the Impact of Financial Deepening on Economic Growth? *Economic Inquiry*, Vol. 49 (1), pp. 276-288, https://doi.org/10.1111/j.1465-7295.2009.00197.x.
18. Sajeev, A. and Kaur, S. (2020), Environmental Sustainability, Trade and Economic Growth in India: Implications for Public Policy, *International Trade, Politics and Development*, Vol. 4 No. 2, pp. 141-160, https://Doi.Org/10.1108/ITPD-09-2020-0079.
19. Seldon, T., & Song, D. (1994). Environmental quality and development: Is there a Kuznets curve for air pollution emissions? *Journal of Environmental Economics and Management*, 27(2), 147–162, https://doi.org/10.1006/jeem.1994.1031.
20. Sen, K.K. and Abedin, M.T. (2021). A Comparative Analysis of Environmental Quality and Kuznets Curve between Two Newly Industrialized Economies, *Management of Environmental Quality*, Vol. 32 No. 2, pp. 308-327. https://doi.org/10.1108/MEQ-04-2020-0083.
21. Shahbaz, M. and Sinha, A. (2019). Environmental Kuznets Curve for CO_2 Emissions: a Literature Survey, *Journal of Economic Studies*, Vol. 46 No. 1, pp. 106-168, https://doi.org/10.1108/JES-09-2017-0249.
22. Singhania, M. and Saini, N. (2020). Revisiting Environmental Degradation and Economic Growth Nexus Using Autoregressive Distributed Lag Approach, *International Journal of Productivity and Performance Management*, Vol. 69 No. 8, pp. 1765-1796, https://doi.org/10.1108/IJPPM-10-2019-0509.
23. Stiglitz, J. (2013). The Price of Inequality, Penguin Books, ISBN: 9780718197384.
24. Tsiantikoudis, S., Zafeiriou, E., Kyriakopoulos, G. and Arabatzis, G. (2019). Revising the Environmental Kuznets Curve for Deforestation: An Empirical Study for Bulgaria, *Sustainability* 2019, *11*(16), 4364; https://doi.org/10.3390/su11164364.
25. Zapata, H.O. & Paudel, K.P. (2009). Functional Form of the Environmental Kuznets Curve, Li, Q. and Racine, J.S. (Ed.) *Nonparametric Econometric Methods* (*Advances in Econometrics, Vol. 25*), Emerald Group Publishing Limited, Bingley, pp. 471-493, https://doi.org/10.1108/S0731-9053(2009)0000025017.

FREE MOVEMENT OF CAPITAL IN THE EUROPEAN UNION

Dasa Panjakovic Senjic
Veleučilište "Lavoslav Ružička" u Vukovaru, Croatia
dpanjakovic@vevu.hr

ABSTRACT
The freedom of movement of capital represents one of the four fundamental economic freedoms on which the internal European market rests. In addition to the freedom of movement of capital, there is also freedom of movement of goods, freedom of movement of persons and freedom of movement of services. The single internal market of the European Union (further: EU) was officially established in 1993, and is considered one of its greatest achievements. The freedom of movement of capital includes regulations in the area of investments, investment funds, deposits, insurance, and dealings with securities, real estate investments, and prevention of money laundering. The questions that will be addressed are related to the movement of capital, the advantage of the movement of capital, the purpose of the movement of capital and the limitations of the movement of capital.
Keywords: freedom of movement of capital, economic freedom, market

1. INTRODUCTION

The freedom of movement of capital has existed since ancient times, but it experienced its full application only with the modified provisions of the Maastricht Treaty in relation to the provisions contained in the Treaty of Rome. The practice of the European Court follows the development of the freedom of movement of capital and its application in general, and in relation to other economic freedoms. The freedom of movement of capital represents one of the four fundamental economic freedoms on which the internal European market rests. In addition to the freedom of movement of capital, there is also freedom of movement of goods, freedom of movement of persons and freedom of movement of services. The single internal market of the European Union (further: EU) was officially established in 1993, and is considered one of its greatest achievements. The freedom of movement of capital includes regulations in the field of investments, investment funds, deposits, insurance, dealings with securities, real estate investments, prevention of money laundering, etc., and some of them will be discussed in more detail in the text of the paper itself.

2. HISTORICAL DEVELOPMENT OF THE FREEDOM OF MOVEMENT OF CAPITAL

The freedom of movement of capital, as a fundamental economic freedom, experienced its full application only with the modified provisions of the Treaty of Maastricht in relation to the Treaty of Rome. The provisions of the Treaty of Rome on the free movement of capital existed formally for the functioning of the internal market. However, in contrast to the continuous development of other economic freedoms, in the provisions of secondary legislation, and especially in the practice of the European Court, the provisions on the freedom of movement of capital were not accompanied by such development. The reason for this is that capital movements are closely related to economic and monetary policy. From the practice of the European Court, one can see this worse position of the freedom of movement of capital compared to other economic freedoms. In the practice of the European Court at that time, the position of the freedom of movement of capital as subsidiary in relation to other economic freedoms was evident. This means that the provisions on the free movement of capital were applied only when the money transfer was not an integral part of the payment for goods or services.

It is obvious that this application had the purpose of avoiding the cumulative or comparative application of the provisions of fundamental economic freedoms, limiting and classifying objects as restrictions on the freedom of movement of goods, services or capital (Bodiroga-Vukobrat, Horak, Martinović, 2011, p. 262). Likewise, the European Court did not interpret the provisions on the movement of capital neither extensively nor by applying the principle of direct effect. The amended provisions of the Maastricht Treaty are a consequence of the harmonization made by Directive 88/361/EEC on the implementation of Art. 67 of the Treaty of Rome, which actually contributed to the complete liberalization of the movement of capital. Namely, the aforementioned Directive enables the implementation of the provisions of the Founding Agreements on the free movement of capital. The following directives are also significant for the area of free movement of capital: Second Council Directive 89/646/EEC on the coordination of legal and administrative regulations relating to the commencement of business and performance of activities of credit institutions, Council Directive 89/299/EEC on the own funds of credit institutions, Council Directive 92/30/EEC on the supervision of credit institutions on a consolidated basis, Council Directive 92/121/EEC on the supervision and control of large exposure of credit institutions to credit risk, Council Directive 93/ 6/EEC on capital adequacy of investment companies and credit institutions and Directive 94/49/EC of the European Parliament and Council on deposit insurance programs. The provisions on the free movement of capital are significant for the operation of the EU's internal financial market, especially bearing in mind the cross-border operations of companies, banks and financial institutions. In addition, the importance of this economic freedom, along with the freedom of business establishment is reflected to a large extent in the area of company law. In fact, each member state tries in its national law to limit the effect on the freedom of business establishment, various types of transactions of companies in the issue and trade of securities, investments, cross-border mergers and acquisitions, etc. In order to achieve the development and operation of the internal financial market, the Founding Agreements enabled integration through fundamental economic freedoms. The development and application of fundamental economic freedoms has largely led to the abolition of EU member states' restrictions and contributed to the harmonization of national rights for the sake of free movement, in this case, especially the freedom of movement of capital and services / the so-called negative harmonization/ (Bodiroga-Vukobrat, Horak, Martinović, 2011, p. 264). In addition to negative harmonization, there is also positive harmonization. Namely, the harmonization of the national rights of the member states was achieved through secondary sources of law, i.e. through positive harmonization. This ensured the implementation of the market concept of a single market.

3. CONCEPT AND CHARACTERISTICS OF FREEDOM OF CAPITAL MOVEMENT
The freedom of movement of capital is one of the four freedoms on which the EU internal market is based. The free movement of capital enables the flow of funds within the EU, facilitates cross-border trade, favors the mobility of workers, facilitates the collection of capital necessary for the start-up and growth of business entities and the functioning of an integrated, open and efficient internal market, which is of interest to all EU citizens. According to the Treaty on the Functioning of the EU, Articles 63 to 66 prohibit all restrictions on the movement of capital and payments between Member States and between Member States and third countries. These are former articles of the Treaty on the European Economic Community: Art. 63. UFEU I art. 56. EEC)

(1) ... all restrictions on the movement of capital between member states and between member states and third countries are prohibited.
(2) … all payment restrictions between Member States and between Member States and third countries are prohibited.

The application of the provisions of the above-mentioned article refers to all cross-border transactions, and not only to transactions between member states, regardless of whether they are imports or exports (Bodiroga-Vukobrat, Horak, Martinović, 2011, p. 264/265). The Treaty on the Functioning of the European Union did not define the freedom of movement of capital, so it was determined by the European Court based on practice. In fact, a broad understanding of the concept of freedom of movement of capital is accepted. Consequently, it is primarily about the cross-border transfer of capital in money and things, i.e. investments. It is stated as the purpose of the freedom of movement of capital preservation of the free internal market when providing countermeasures in connection with the trade in goods and trade in services. The movement of capital means, among other things, the transfer of value, the transfer of capital from one country to another, with the aim of a specific property investment, i.e. direct investment (investing, for example, in real estate), and all this for the purpose of providing short-, medium- and long-term credits, loans , guarantees, guarantees, investments in securities, etc. The movement of capital also implies direct investment in terms of shareholding in trading companies or the acquisition of securities on the regulated securities market. Direct investments are considered to be investments of all types of natural persons or commercial, industrial and financial companies (trading companies), which serve to establish or preserve permanent and direct links between the person who acquired the capital and the entrepreneur or company (trading company) that they received capital for carrying out economic activity. In relation to those companies (trading companies) that have the status of joint-stock companies, the share has the nature of a direct investment when a package of shares of a natural person, another company (trading company) or any other owner, enables the shareholder, either on the basis of the provisions of national legislation, which refer to joint-stock companies, whether otherwise, to effectively participate in the management of the company or in its supervision (Bodiroga-Vukobrat, Horak, Martinović, 2011, p. 268).

3.1. Freedoms of the internal market of the European Union

One of the greatest achievements of the EU is the creation of the internal market, which is based on four freedoms: freedom of movement of goods,freedom of movement of persons,freedom of movement of services i freedom of movement of capital. The single market is the core of today's EU. Within the single European market, goods, people, services and capital move as freely as within a single country. In practice, these rights have the following meanings: individuals: the right to live, work, study or retire in another member state, consumers: increased competition leads to lower prices, a wider choice of goods and a higher level of protection of consumer rights, companies: opportunities to start a business across borders much easier and cheaper. Freedom of movement of goods - means that member states may not set up obstacles to trade in goods that have been legally produced and placed on the market in another member state. This freedom includes the abolition of customs duties and taxes with equal effect, the adoption of a common customs tariff towards third countries, the prohibition of quantitative restrictions and measures with equal effect, and the reform of state monopolies. The aim of these measures is to integrate the markets of the member states and ensure the free movement of goods, similar to that within the territory of one state. Control of goods crossing the internal borders of the member states ended on January 1, 1993. Freedom of movement of persons - means that EU citizens can freely move, reside and work in any EU member state. In the broadest sense, the freedom of movement of persons derives from the provisions governing European citizenship, which in principle gives the right to move and reside freely on the territory of any member state.

In more detail, it means that an EU citizen has the right to move, settle and get a job in any of the member states, without being exposed to discrimination based on their citizenship. Freedom of movement of services - enables economic entities to freely provide services throughout the EU, regardless of the member state in which their business headquarters are located. Thus, for example, banks or insurance companies can provide services throughout the EU, and citizens can choose the most favorable service offered on the internal market. In more detail, the freedom of movement of services allows business entities (natural or legal persons) that provide services in one of the member states to offer their services on a temporary basis in other EU member states, without having to settle there for business purposes. Thus, free business establishment enables business entities (natural or legal persons, i.e. trading companies, craftsmen and freelancers) to perform economic activities in a stable and continuous manner in one or more EU member states. This also refers to the freedom to open representative offices, representative offices or branches on the territory of other member states. Freedom of capital movement - Freedom of capital movement means the removal of obstacles in the movement of capital and payments within the EU, but also in the EU's relationship with third countries (more on the freedom of capital movement in the text of the paper).

3.2. Restrictions on the freedom of movement of capital

With all four fundamental economic freedoms, discrimination against suppliers, buyers and products from other member states is prohibited. The prohibition does not only refer to the prohibition of discrimination based on a person's nationality, but also to indirect discrimination, which, regardless of nationality, mostly affects non-citizens. Based on the practice of the European Court, it was concluded that due to the realization of fundamental economic freedoms, measures restricting freedom of movement are prohibited. The provisions of the founding agreements apply to all participants on the market equally. All measures that make it difficult or prevent the circulation of capital are prohibited, and any form of discrimination is expressly prohibited. On the other hand, there are justifications, that is, exemptions from restrictions on the freedom of movement of capital. Member states are left with certain rights with regard to the area of tax law, financial market regulation and the area of statistical data collection. Discrimination on the basis of nationality can only be justified by reasons of protection of the public interest or public security.

4. CONCLUSION

Fundamental economic freedoms are the core of European law. The part of European law that refers to fundamental economic freedoms is an organism that is constantly developing, and the jurisprudence of the European Court often plays a decisive role in its application, interpretation and development. In the legal system of the EU, in the legislative sense and in practical action, entrepreneurial and market freedom are the basis of the economic structure. The following reasons are often cited as an advantage of the free movement of capital: it enables the flow of funds within the EU, facilitates cross-border trade, favors the mobility of workers, facilitates the collection of capital necessary for the start-up and growth of business entities, and the functioning of the EU internal market. The free movement of capital contributes to the realization of an open, integrated, competitive and efficient financial market and structure of financial services throughout the EU, removing restrictions on capital movements, both within the EU and between member states and third countries. The freedom of movement of capital also brings the optimal allocation of funds and the creation of an efficient and competitive financial market and encourages other freedoms, the free movement of goods, people and services.

LITERATURE:

1. Bodiroga-Vukobrat, N., Horak, H., Martinović, A., Fundamental economic freedoms in the European Union, Inženjerski biro d.d., Zagreb, 2011.
2. Mihaljek, D., Free movement of capital, real estate market and tourism: boon or trouble for Croatia on the way to the European Union?, Croatia's accession to the European Union: meeting the challenges of negotiations, Institute for Public Finance: Fiedrich Ebert Foundation, Zagreb, 2005. , p. 181-222.
3. Freedom of movement of capital - National program of the Republic of Croatia for joining the European Union, http://www.poslovniforum.hr/eu/eu13.asp, (September 14, 2022).
4. What does membership in the European Union bring, http://www.smz.hr/site/images/stories/eu/clanstvoeu.pdf, (September 14, 2022).
5. Internal Market - EnterEurope - Guide to information about the European Union, http://www.entereurope.hr/page.aspx?PageID=102, (September 14, 2022).
6. freedom of movement of capital - EU - referendum, http://www.eu-referendum.hr/eu_i_mi/clanstvo04.html, (September 14, 2022).

PROBLEM OF PREDICTION USING THE WELL KNOWN MODEL OF CONTINUOUS CAPITALIZATION

Drago Franciskovic
Polytechnics of Medjimurje, Croatia
drago.franciskovic@mev.hr

ABSTRACT

This paper is presenting a problem that appears when the old well-known model of continuous capitalization, $C(t) = C(0)e^{it}$, is used for the prediction of a future values of quantity $C(t)$. At beginning a simple example is showing problem of prediction where the predicted value is greater than it is supposed to be accordingly to the assumption. The problem is in a misunderstanding of meaning of the parameter i in the exponent of the expression of growth model $C(0)\,e^{it}$. It is wrongly common accepted that this parameter is an annual rate of change or an annual interest rate. Mathematically, it is value of the first derivative of $C(t)$ for $t = 0$. It is also called the force of interest and it is denoted by δ. The connection between a real annual interest rate, i, and accompanying force of interest, δ, is done by equality $\delta = ln(1 + i)$. So that the right expression for mentioned mathematical model of growth is supposed to be $C(t) = C(0)(1 + i)^t$, where an annual interest rate, i, is used.
Keywords: *continuous capitalization, growth model, prediction model, force of interest, interest rate*

1. INTRODUCTION

The aim of this work is to awaken the interest of teachers at universities and polytechnics regarding the underestimated issue of the meaning of the generally accepted formula of continuous capitalization $C(t) = C(0)e^{it}$. The problem is in the interpretation of parameter i. It is widely believed that the parameter i represents the annual interest rate. This problem appears in teaching materials intended for students and a wider audience, but not in materials intended for students of mathematics. It is usually thought that everything in these teaching materials is known and correct, and their content is easily inertly copied and passed on without a critical reflection on its correctness and meaning. However, it is not as it seems, as will be shown in this paper, and therefore one should be careful. The intention of this paper is not to describe why and how the mentioned problem occurred, but only to publicize it and offer a correct formula for continuous capitalization in which the annual interest rate is used as a parameter. More about what led to the this problem can be found in [6] and [7]. Let us consider the well-known formula (function) of continuous capitalization.

$$C(t) = C(0)e^{it}.$$

$C(t)$ is the amount of capital at time $t \geq 0$. The parameter i in the exponent is the annual interest rate, i.e. growth of unit capital within a period of unit length (usually one year). The base of the power is a constant e, the base of the natural logarithm, which is called Euler's number or Napier's constant, $e = 2,7182818285\cdots$.

2. EXAMPLE

Let's look at the following example that shows that the disputed definition is self-contradictory. A young forest with an estimated wood mass of 1000 tons has an annual growth rate (annual interest rate) of 40%. Let's answer the following two questions.

a) What is the estimated wood mass of the forest after five years?
b) What is the estimated wood mass of the forest after one year?

So, we have $C(0) = 1000$, $i = 40\% = 0,40$. The function that predicts the wood mass after t years is given by the expression

$$C(t) = 1000 \, e^{0,4 \, t}.$$

Now we can answer the questions raised.
a) $C(5) = 1000 \, e^{0,4 \cdot 5} = 7389,06$.
b) $C(1) = 1000 \, e^{0,4 \cdot 1} = 1491,82$.

What does it mean that the annual interest rate is 40%?
This means that the increase in wood mass per unit after one year is 0.40, or that the increase in wood mass of 1000 units after one year is 400. Therefore, it should hold that $C(1) = 1400$. But with the use of the observed formula, it is obtained that $C(1) = 1491.82$. This means that the annual increase in wood mass is 49.182%, not 40%.

Is this a contradiction between the observed function of the exponential growth model,

$$C(t) = C(0)e^{it},$$

and the definition of the interest rate? Obviously!

The above function, which assumes a known constant interest rate, is self-contradictory.

A constant annual interest rate is defined as

$$i = \frac{C(t + 1) - C(t)}{C(t)} \, .$$

For the observed function $C(t) = C(0)e^{it}$ then we have that

$$i = \frac{C(t + 1) - C(t)}{C(t)} = \frac{C(0)e^{i(t+1)} - C(0)e^{it}}{C(0)e^{it}} = \frac{\cancel{C(0)e^{it}}\left[e^i - 1\right]}{\cancel{C(0)e^{it}}} = e^i - 1 \neq i \, .$$

It is obvious that for $i > 0$ the equality $i = e^i - 1$ is not possibleand we get that $i \neq i$. So the value of i that was assumed to be the annual interest rate in the observed function $C(t) = C(0)e^{it}$ is not the annual interest rate at all. That's a contradiction!

This contradiction can be avoided if i is replaced by $\ln(1 + i)$ in the contradictory definition of the continuous capitalization function. The reason for this will be explained as follows.

3. CONTINUOUS CAPITALIZATION FUNCTION
The mathematical model of continuous capitalization is the solution of the differential equation

$$\frac{C(t)'}{C(t)} = \delta \, ,$$

where the constant δ is the force of interest (instantaneous interest rate). It is continuous capitalization function (see Benšić M., Benšić G. (2011), [1])

$$C(t) = C(0)e^{\delta t}.$$

This solution is almost the same as the observed disputed function. An important difference is that the exponent of the solution contains the force of interest δ instead of the annual interest rate i as it is in the observed disputed function.

Let's find the constant annual interest rate i corresponding to the continuous capitalization function $C(t)$.

$$i = \frac{C(t+1) - C(t)}{C(t)} = \frac{C(0)e^{\delta(t+1)} - C(0)e^{\delta t}}{C(0)e^{\delta t}} = \frac{\cancel{C(0)e^{\delta t}}\left[e^\delta - 1\right]}{\cancel{C(0)e^{\delta t}}} = e^\delta - 1 \, .$$

Therefore, the relationship between the force of interest δ and the annual interest rate i is

$$\delta = \ln(1 + i) \, .$$

Note that the annual interest rate of the function $C(t) = 1000 \, e^{0,4 \, t}$ is $49.1824\% = e^{0.4} - 1$. For each annual interest rate $i > 0$, it is valid that it is greater than the force of interest δ associated with it, i.e. $i > \delta$. Only for very small values of i is the difference between the values of δ and i very small.

Now it is easy to see what is the reason for the problem with the well-known, often and widely used contradictory definition of the continuous capitalization function $C(t) = C(0)e^{it}$. Its exponent should contain force of interest δ instead of annual interest rate i. By using a contradictory definition, higher future values of the capital are predicted than they should be. Now the continuous capitalization function can be written in the form

$$C(t) = C(0)(1 + i)^t \, .$$

The force of interest δ is the value of the derivative of the function $C(t) = C(0)e^{\delta t}$ when $C(0) = 1$. It is the slope of the tangent of the graph of the function $C(t)$ for $t = 0$.

The following figure shows the growth of initial unit capital $(C(0) = 1)$ with an annual interest rate of $i = 40\%$ (blue colored curve) and with the force of interest of $\delta = 40\%$, i.e. with an annual interest rate of 49.1824% (red colored curve). Yellow lines are tangents to both curves for $t = 0$. It also shows graphical interpretation of values of i and δ.

Figure following on the next page
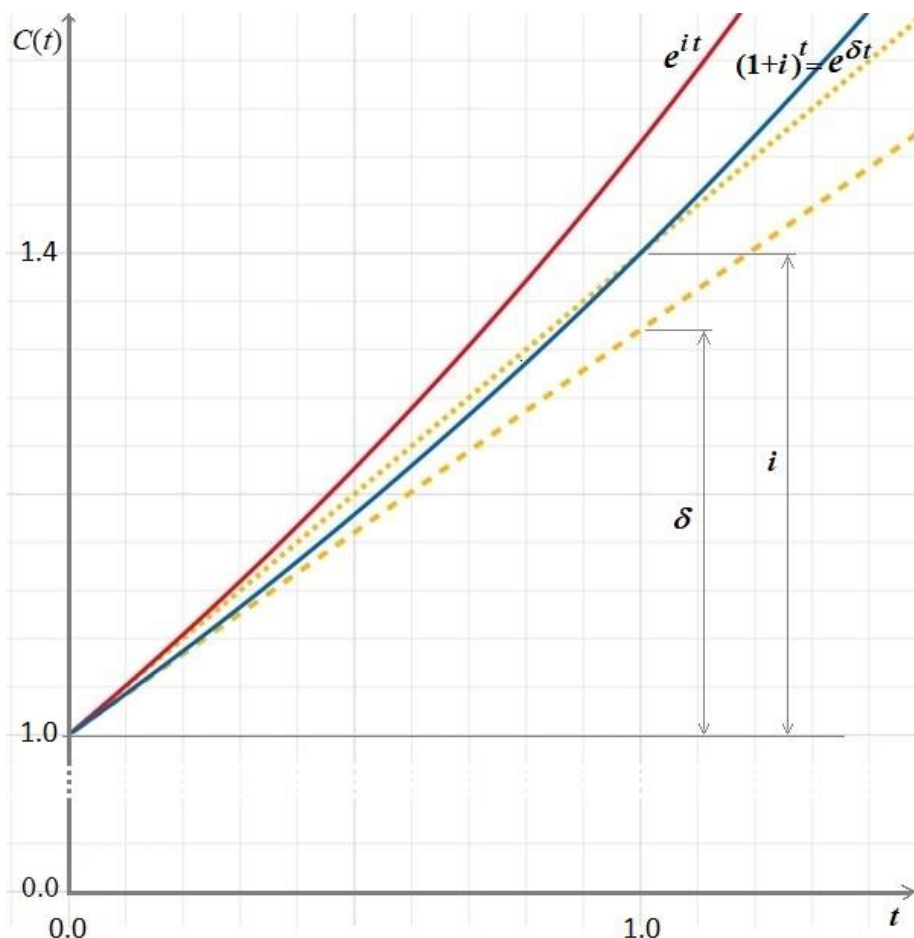
*Figure 1: Graphs of the correct and disputed function of continuous capitalization if C(0)=1.
(Source: autor)*

4. CONCLUSION

The well-known and often used function of continuous capitalization $C(t) = C(0)e^{it}$ where i is the annual interest rate, i.e. i is the annual growth rate of some observed capital does not represent the growth of that capital at all. It gives higher than expected values and is not suitable for predicting the future value of the observed capital. Only in the case when the interest rate i is small enough, the difference is small, so in some cases it could be negligible and such a function could then be used for prediction as a substitute approximate function. If, in the mentioned function of continuous capitalization, the interest rate i were replaced with the intensity of capitalization δ, then it would be suitable for predicting the future value of the observed capital. Since $\delta = \ln(1 + i)$, this means that the continuous capitalization function suitable for predicting the future value of capital for which we know the annual growth rate i has the form $C(t) = C(0)(1 + i)^t$.

LITERATURE:

1. Benšić M., Benšić G. (2011): *Kamatni račun*, Osječki matematički list, vol.11, br. 2, str. 113-126., 2011. Available at: (https://hrcak.srce.hr/80524)
2. Francišković D. (1989.): *Continuous capitalization and debt management* , VII Conference on Applied Mathematics, Osijek, 1989. 67-77. Available at: https://bib.irb.hr/datoteka/ 246837. ContinuousCapitalizationAndDebtManagement3.pdf
3. Francišković D. (1990.): *Generalizacija kontinuiranog ukamaćivanja i strategije otplate duga*, Ekonomska analiza 24 (1990) 2, 179-197. Available at: https://www.library.ien.bg.ac.rs/index.php/ea/article/view/675/556

4. Francišković D. (2020.): *Dimensionless Characteristic of the Interest Rate*, Proceedings of 4th Biennial International Conference "Contemporary Issues in Economy & Technology" CIET, May 29. - 30., 2020. Tonko Kovačević, Ivan Akrap (ur.), Split, Croatia: University of Split, Department of Professional Studies, 2020. p. 50-54. Available at: (https://www.bib.irb.hr/1071283/download/1071283.Dimensionless Characteristic of the Interest Rate.pdf)
5. Francišković D. (2020.): *Gospodarska i financijska matematika*, vlastito izdanje, Koprivnica, Available at: (www.webknjizara.hr/knjige/sveucilisni-udzbenici/gospodarska-i-financijska-matematika-drago-franciskovic)
6. Francišković D. (2022.): *Problemi i zablude u nastavnim materijalima Financijske matematike*, Poučak, u pripremi. Izlaganje s 9. kongresa nastavnika matematike RH, Zagreb, 5. i 6. srpnja 2022.
7. Francišković D. (2022.): *Pregled usporedba i problematika formula kamatnog računa*, Poučak, u pripremi. Izlaganje s 9. kongresa nastavnika matematike RH, Zagreb, 5. i 6. srpnja 2022.
8. McCutcheon J.J., Scott W.F. (1994.): *An Introduction to the Mathematics of Finance*, The Institute of Actuaries and the Faculty of Actuaries in Scotland, 1986, reprint 1994.
9. Muškardin V. (1985.): *Suvremeni pristup financijskoj matematici*, Ekonomska analiza 19 (1985) 1, 75-99. Available at: (https://www.library.ien.bg.ac.rs/index.php/ea/article/view/884/728)

SPATIAL, DEVELOPMENT AND RESOURCE CHARACTERISTICS OF MINERAL ROW MATERIAL MANAGEMENT IN KOPRIVNICA-KRIŽEVCI COUNTY

Melita Srpak
Varazdin County - Department of Physical Planning, Croatia
melita.srpak@gmail.com

Darko Pavlovic
Polytechnic of Međimurje in Čakovec, Croatia
darko.pavlovic@plinacro.hr

Sanja Kovac
University of Zagreb, Faculty of Geotechnical Engineering, Croatia
sanja.kovac@gfv.unizg.hr

Igor Klopotan
Polytechnic of Međimurje in Čakovec, Croatia
igor.klopotan@mev.hr

ABSTRACT
Mineral raw materials are a non-renewable resource important for the Republic of Croatia. In the Koprivnica-Križevci County there are rich deposits of energy minerals – hydrocarbons (oil and gas and geothermal water) and non-energy minerals (for the production of construction materials – technical-construction stone, construction sand and gravel from non-renewable deposits and brick clay. Regarding the exploration and exploitation of mineral raw material, there are certain problems, especially in relation to the environment, given the specifics of these activities. The exploitation of mineral raw material inevitably means a certain degradation of space in relation to the original state, given that the image of space is constantly changing. Although the areas are rehabilitated after the cessation of mining activities (or planned to be rehabilitated according to the rehabilitation project which is an integral part of the documentation for the approval of the exploitation field), the possibilities of using and the purpose of space after exploitation are often limited, especially after gravel and sand exploitation. In this paper, we present the data on the spatial, resource and development characteristics of mineral raw material management in the Koprivnica-Križevci County. This paper provides a list of currently active, planned, inactive, deleted exploitation fields and exploration areas in the Koprivnica-Križevci County.
Keywords: *exploitation fields, exploration area, economy, Koprivnica-Križevci County, mineral raw materials,*

1. INTRODUCTION
Koprivnica-Križevci County is located in the northwest of Croatia and includes the area of the former municipalities of Koprivnica, Križevci and Đurđevac. It covers 1,746 km² (3.1% of the territory of Croatia). According to the official statistical data and the census of 2021, the County has 101,661 inhabitants (Croatian Bureau of Statistics, 2021). Pursuant to this as well as other indicators, Koprivnica-Križevci County is one of the medium-sized counties in Croatia. It is divided into a total of 25 smaller units of territorial administration and self-government, of which there are three cities - Koprivnica (the seat of the County), Križevci and Đurđevac and 22 municipalities (Drnje, Đelekovec, Ferdinandovac, Gola, Gornja Rijeka, Hlebine, Kalinovac, Kalnik, Kloštar Podravski , Koprivnički Bregi, Koprivnički Ivanec, Legrad , Molve, Novigrad

Podravski, Novo Virje, Peteranec, Podravske Sesvete, Rasinja, Sokolovac, Sveti Ivan Žabno, Sveti Petar Orehovec, Virje) (IV Amendments to the Physical Plan of the Koprivnica-Križevci County) as shown in Figure 1.
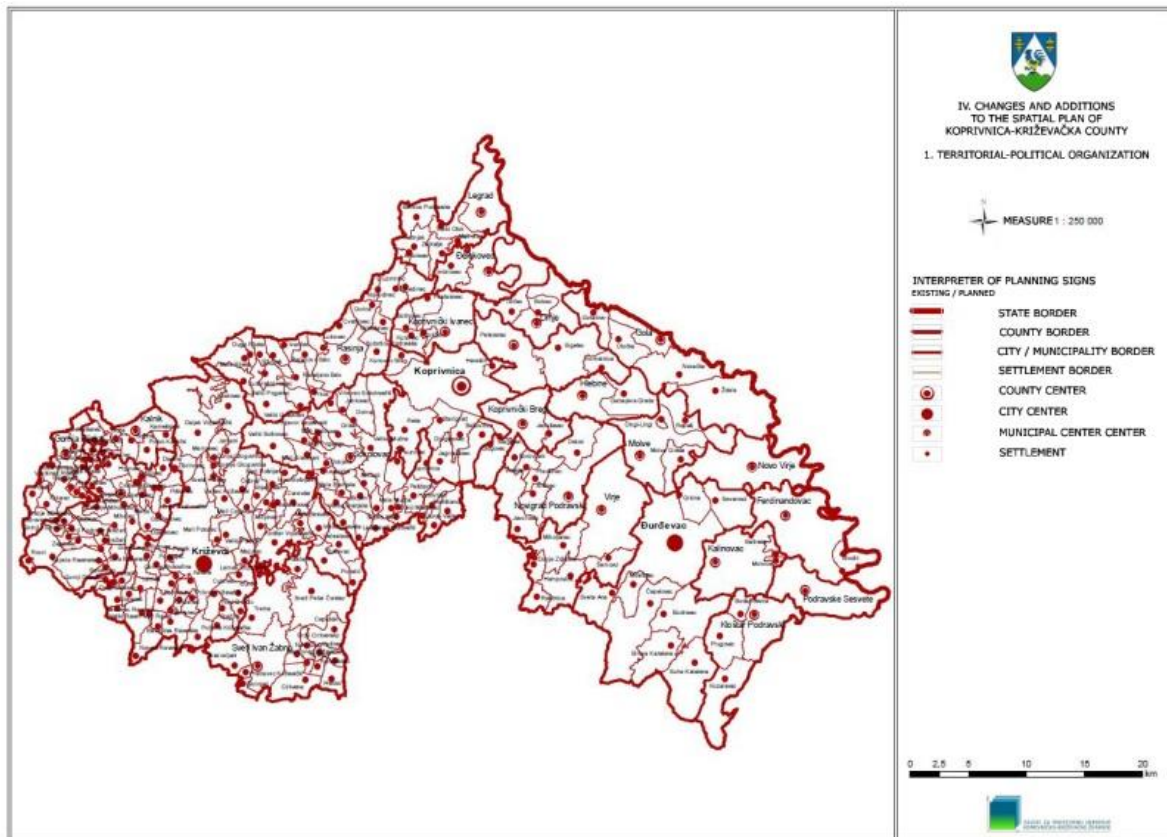
Figure 1: Territorial-political organization of Koprivnica-Križevci County
(Source: Institute for Physical Planning of Koprivnica-Križevci County, 2021)

The natural and geographical features of the County mainly support transport development benefits and we can conclude that it is predominantly a lowland region enabling abundant agricultural production, with significant forest and mineral wealth and opportunities for the development of livestock-breeding, viticulture and fruit growing on the slopes of Bilogora and Kalnik. Mineral raw material is particularly important for the County. The Podravina energy belt, with its rich resources and production of natural gas (Molve) and condensate, makes an important energy base of Croatia. On the example of the Upper Podravina, in the centre of which is located Koprivnica, we can see a transformation of the geographical area from a typical agrarian region to a developed industrial area, and today even to the development of a post-industrial society. Secondary activities were the main factor in breaking down the traditional agrarian structure, while the industrialization processes not only completely changed the structure of the population according to activities, but also brought changes to numerous components of life (Feletar, 2011). According to the data for 2019, provided by FINA, there were 1,993 entities operating in Koprivnica-Križevci County, which generated total revenue of HRK 12.4 billion and employed 18,285 employees. The leading activities are the processing industry with the dominant food industry as well as trade, construction and agriculture. The share of Koprivnica-Križevci County in the gross added value of the Republic of Croatia per activity (in National Classification of Activities (NKD)) in 2017 is shown in Table 1 (Action plan of energy efficiency of Koprivnica-Križevci County for the period 2020 - 2022).

SHARE OF GROSS ADDED VALUE OF KOPRIVNICA-KRIŽEVCI COUNTY IN THE REPUBLIC OF CROATIA BY ACTIVITIES		
NKD		Share in the GDP of the Republic of Croatia (%)
A	Agriculture, forestry and fishing	7.7
B, C, D, E	Processing industry, mining and extraction and other industries	3.0
F	Construction	2.1
G, H, I,	Wholesale and retail trade, transport and storage, accommodation, food preparation and serving	1.4
J	Information and communications	0.3
K	Financial activities and insurance activities	1.5
L	Real estate business	1.8
M, N	Professional, scientific, technical, administrative and auxiliary service activities	1.0
O, P, Q	Public administration and defence, education, health care and social welfare activities	1.8
R, S, T, U	Other service activities	1.3
	Gross added value (basic prices)	2.0

Table 1: Share of gross added value of Koprivnica-Križevci County in the Republic of Croatia by activities
(Source: Energy Efficiency Action Plan of Koprivnica-Križevci County for the period 2020 – 2022)

2. GEOLOGICAL AND GEOMORPHOLOGICAL CHARACTERISTICS OF KOPRIVNICA-KRIŽEVCI COUNTY

The area of Koprivnica-Križevci County is made of deposits belonging to the Mesozoic and Cenozoic eras. From the Mesozoic, only rocks from the Cretaceous period are represented, and they are located in the central part of the Kalnik Mountains. The remaining part of the County is built by the Cenozoic, represented by the Paleogene, Neogene and Quaternary. The Paleogene period is represented by Eocene deposits (E), and the Neogene period by Miocene sediments (M). From the Miocene following stages are present: the Eger and Egenburg stages (M1), then Upper Baden (M42), Sarmatian (M5), Pannonian (M6) and Pontic (M7). The Quaternary period is represented by the Pleistocene and Holocene shown in Figure 2 (Mining and Geological Study of Koprivnica-Križevci County, 2014).

Figure following on the next page
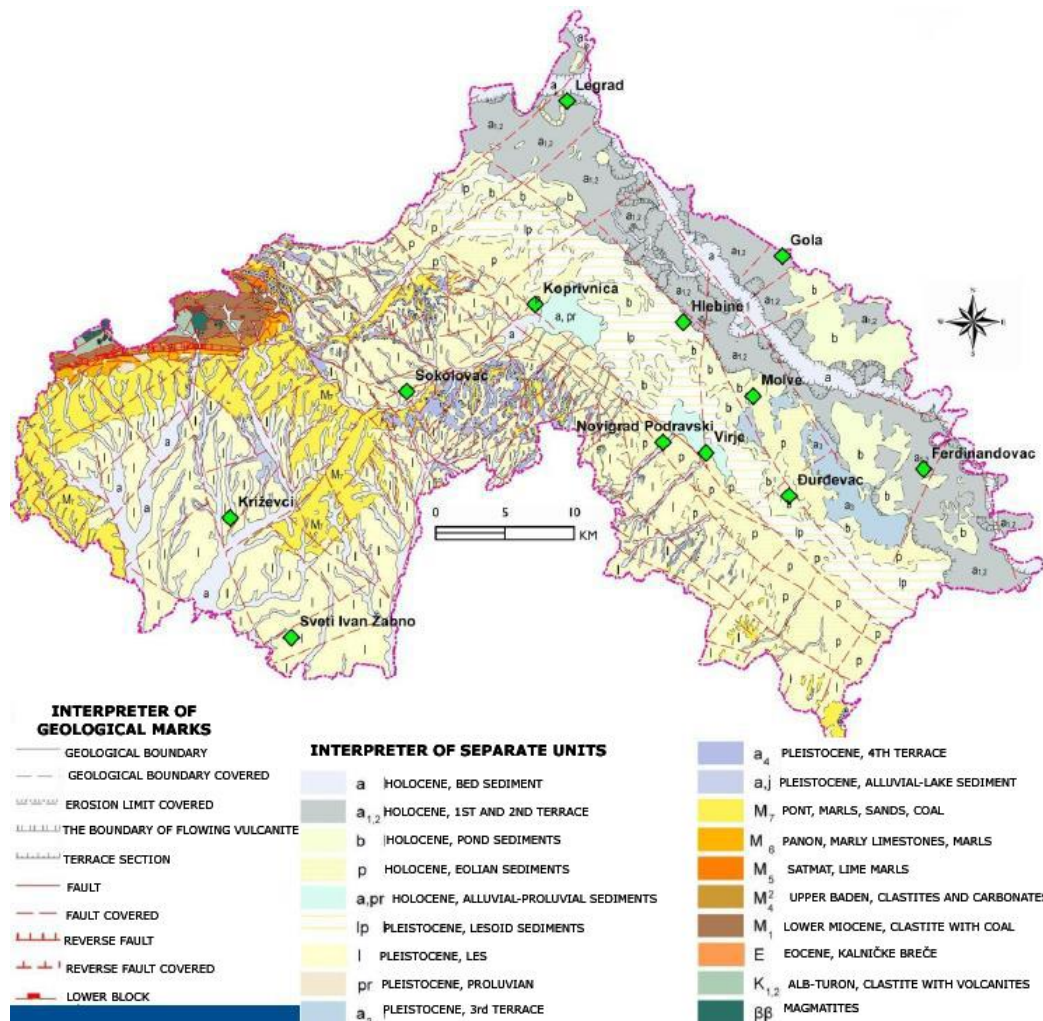
Figure 2: Geological structure of Koprivnica-Križevci County
(Source: Mining and Geological Study of Koprivnica- Križevci County, 2014)

Geomorphologically and genetically, two basic types of relief prevail in the area of Podravina: denudation-accumulation relief (northern slopes of Kalnik and Bilogora) and tectonic-accumulation relief (floodplains and contact terraces). The majority of Podravina, i.e. its lowland part, belongs to this second type of relief, and it is further divided into two parts: the Holocene alluvial plain - floodplains and the terraced Holocene and Würm plain. The widest area of the floodplain is located along the River Drava, but low floodplains can also be found in the narrow valleys of the Drava tributaries, which descend from the slopes of Kalnik and Bilogora towards the River Drava. One of these marshy floodplains is located next to the Koprivnica stream, which flows through Koprivnica town. In these areas, Holocene carbonate soils were formed. They are generally less fertile and more difficult to cultivate. In addition, these streams and brooks that flow from the foothills of Bilogora and Kalnik do not flow directly into the River Drava, but flow along the raised bed of the River Drava for ten kilometres, and flow downstream into the river (D. Feletar and P. Feletar, 2008). The southern part of Podravina includes the second basic type of relief - denudation-accumulation relief, and it consists of the foothills of the northern part of Kalnik and Bilogora. The lower part of that foothill is in contact with the Würm terraces, and refers to the foothill steps, while the higher areas are formed by Quaternary deposits and Tertiary bedrock. The foothills of Kalnik and Bilogora are separated by a synclinal saddle near the Koprivnica stream - the so-called Lepavina Gate. Kalnik horst is built of Mesozoic limestones, and its northern hills are of younger Quaternary age.

On the other hand, the foothills of Bilogora are built of sedimentary rocks from the Miocene and Pliocene - marl, sand, clay as well as clayey and sandy loess. Considering their geomorphological and pedological characteristics, the foothills are among the least populated areas of Podravina, which is characteristic of hilly areas. Nevertheless, they have great significance for the local population. Throughout history, sediments of Pleistocene clays on the northern hills of Bilogora have been used to produce bricks, so the Koprivnica brick factory has been operating there since the end of the 19th century. Also, since the beginning of the 20th century, the number of vineyards and wine cellars has been increasing, so these areas are used more and more intensively in viticulture and cellaring, mostly due to their favourable pedological features (Posavec, 2017). The area along the Drava River is diverse in terms of terrain morphology and geological structure, and based on this assumption, the level of permeability varies from well-permeable sand and gravel to weakly or relatively impermeable clay-marl deposits. The formation of deeper local depressions filled with sand and gravel is influenced by the neotectonic subsidence of the basin (Srpak, 2022). Gravel deposits in the Drava valley represent a large underground water supply area with specific hydrological characteristics, which means that the highest water level of the Drava river is in late spring and summer (May, June and July), and the lowest in winter (January and February) (Tadić and Brleković, 2018).

3. ACTIVE EXPLOITATION FIELDS OF MINERAL RAW MATERIAL IN THE AREA OF KOPRIVNICA-KRIŽEVCI COUNTY

Mineral raw material is a non-renewable resource, important for the Republic of Croatia. In the area of Koprivnica-Križevci County there are rich deposits of energy mineral raw material (hydrocarbons, oil, gas and geothermal water) and non-energy mineral raw material (mineral raw material for the production of building materials, technical construction stone, construction sand and gravel from non-renewable deposits and brick clay). The exploitation of mineral raw material, which was carried out in the 19th and 20th century, and which was abandoned over time, refers to coal in Bilogora and Kalnik. Documents regulating the exploitation of mineral raw material in the area of Koprivnica-Križevci County: The Mineral Raw Material Management Strategy of the Republic of Croatia from 2008 (anticipated as an integral part of the Economic Development Strategy of the Republic of Croatia), which contains the basis for directing and harmonizing economic, technical, scientific, educational, organizational and other measures and measures for the implementation of international obligations for the management of mineral raw material, and the state of mineral raw material managing, safe and reliable supply, rational and purposeful exploitation, sustainable use of mineral raw material, ensuring the protection of nature and the environment in all areas of mining activity, Mining and geological study of the Koprivnica-Križevci County from 2014 and valid physical planning and other prescribed documents prepared based on the Physical Planning Act, the Mining Act, the Act on Exploration and Exploitation of Hydrocarbons and other special regulations, which will plan anticipated needs and a manner of supplying mineral raw material. Mineral raw material is a resource available to the County and their exploitation must be controlled, i.e. the profitability and cost-effectiveness of exploitation of existing natural resources should be re-examined, especially the area where gravel and sand exploitation is planned (River Drava). Exceptionally, the research and exploitation of construction sand and gravel in the area important for the water regime and in the sanitary protection zones of drinking water sources are subject to water regulations, which, reflects in the limited possibilities of planning and using exploitation fields in the area of the inundation belt along the River Drava (Report on the environmental status of Koprivnica- Križevci County 2013-2016, 2019). Along with exploitation, measures to protect that area must be implemented and negative impacts on the environment and landscape must be prevented.

In the Koprivnica-Križevci County, the following non-energy mineral raw material for the production of construction materials were recorded: technical-construction stone, construction sand and gravel from non-renewable deposits and brick clay. Thus, in the area of Koprivnica-Križevci County, the exploration areas were recorded, which are shown in Table 2 and Figure 3.

No.	NAME OF EXPLORATION AREA /EA/	SETTLEMENT	MUNICIPALITY/ TOWN	SURFACE /m²/	TYPE OF MINERAL RAW MATERIAL
EXPLORATION AREAS OF NON-ENERGY MINERAL RAW MATERIAL IN KOPRIVNICA-KRIŽEVCI COUNTY				
1.	EA EXPLORATION AREA "GRAD"	SIGETEC	Peteranec	392,062.00	Construction sand and gravel
2.	EA "ČEPELOVAC" EXPLORATION AREA	ČEPELOVAC	Đurđevac	54,258.00	Construction sand and gravel
3.	EA "LOČICE" EXPLORATION AREA	NOVO VIRJE	Novo virje	37,329.00	Construction sand and gravel
4.	EA "ČEPELOVAC II" EXPLORATION AREA	ČEPELOVAC	Đurđevac	122,882.00	Construction sand and gravel
5.	EA "BRANJSKA" EXPLORATION AREA	VELIKA, MALA BRANJSKA	Sokolovac	199,314.00	Construction sand and gravel
6.	EA "ŽLJEBIC" EXPLORATION AREA	KAMENICA/ STARIGRAD	Sokolovac/ Koprivnica	260,780.00	Construction sand and gravel
7.	EA "TORI 1" EXPLORATION AREA	SIGETEC	Peteranec	210,003.00	Construction sand and gravel
8.	EA "PROSENICA" EXPLORATION AREA	GABAJEVA GREDA	Hlebine	258,257.00	Construction sand and gravel

Table 2: Exploration areas of non-energy mineral raw material
(Source: IV Amendments to the Physical Plan of Koprivnica-Križevci County, 2021)
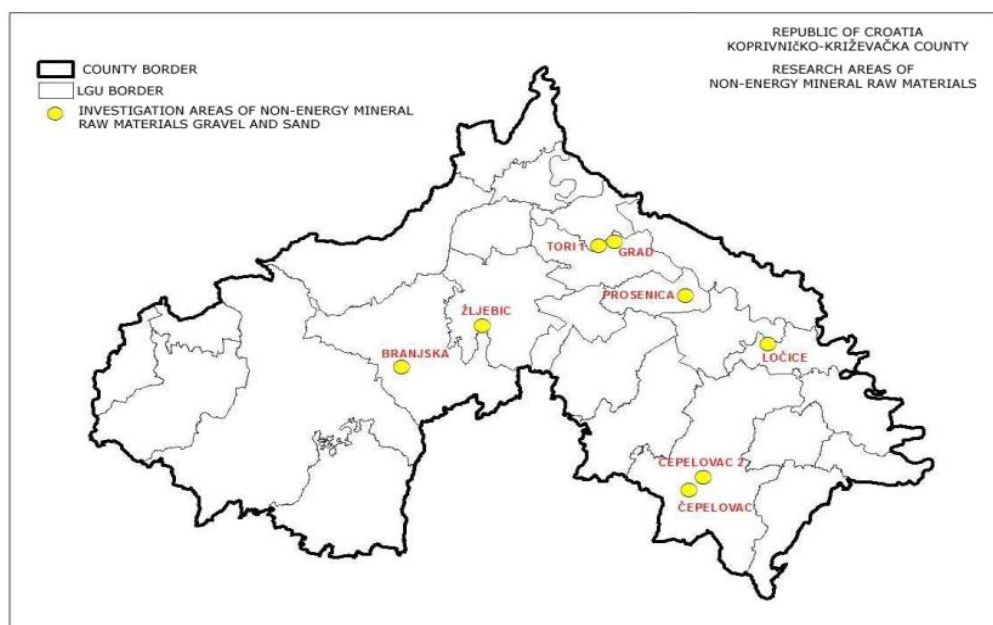
Figure 3: Exploration areas of non-energy mineral raw material
(Source: IV Amendments to the Physical Plan of Koprivnica-Križevci County, 2021)

In the area of Koprivnica-Križevci County, existing exploitation fields of non-energy mineral raw material are recorded, as shown in Table 3 and Figure 4.

No.	NAME OF THE EXPLORATION AREA /EA/	SETTLEMENT	MUNICIPALITY/ TOWN	SURFACE /m²/	TYPE OF MINERAL RAW MATERIAL
**EXPLOITATION FIELDS OF NON-ENERGY MINERAL RAW MATERIAL IN KOPRIVNICA-KRIŽEVCI COUNTY**					
1.	"AUTOPUT" EF	BOTOVO	-	51,351	Construction sand and gravel
2.	"DRAGANCI" EF	KALINOVAC	KALINOVAC	107,816	Construction sand and gravel
3.	"GAT" EF	ĐURĐEVAC	ĐURĐEVAC	569,821	Construction sand and gravel
4.	"INZULA" EF	ČINGI LINGI	MOLVE	172,460	Construction sand and gravel
5.	"JAGNJEŽĐE 2" EF	LEGRAD	LEGRAD	874,857	Construction sand and gravel
6.	"KETER" EF	BOTOVO	DRNJE	451,777	Construction sand and gravel
7.	"MEKIŠ" EF	PODRAVSKE SESVETE	PODRAVSKE SESVETE	75,623	Construction sand and gravel
8.	"MLADJE" EF	BOTOVO	DRNJE	335,285	Construction sand and gravel
9.	"MLAĐ 1" EF	BOTOVO	DRNJE	591,113	Construction sand and gravel
10.	"OTOK" EF	SIGETEC	PETERANEC	86,498	Construction sand and gravel
11.	"POD BRESTOM" EF	SELNICA PODRAVSKA	LEGRAD	78,804	Construction sand and gravel
12.	"PROSENICA I" EF	GABAJEVA GREDA	HLEBINE	501,643	Construction sand and gravel
13.	"SEKULINE" EF	MOLVE GREDE	MOLVE	75,273	Construction sand and gravel
14.	"SEVEROVCI" EF	ĐURĐEVAC	ĐURĐEVAC	424,204	Construction sand and gravel
15.	"ZLATNO JEZERO" EF	SIGETEC	PETERANEC	177,727	Construction sand and gravel
16.	"ŽLJEBIC" EF	KAMENICA	SOKOLOVAC	135,993	Construction sand and gravel
17.	"GAŠPAR-SJEVER" EF	LEGRAD	LEGRAD	59,610	Construction sand and gravel
18.	"KLARA" EF	NOVIGRAD PODRAVSK	NOVIGRAD PODRAVSKI	76,281	Construction sand and gravel
19.	"VOJNOVEC" EF	VOJNOVEC KALNIČKI	KALNIK	429,361	Technical and construction stone
20.	"GUŠĆEROVEC" EF	GUŠĆEROVE	SVETI PETAR OREHOVEC	115,823	Brick clay
21.	"HOTI" EF	GABAJEVA GREDA	HLEBINE	83,542	Construction sand and gravel
22.	"HRUŠKOVEC IV - JAZVINE" EF	BORJE	KALNIK	43,871	Technical and construction stone
23.	"TORI" EF	SIGETEC	PETERANEC	130,536	Construction sand and gravel
24.	"VIDAK" EF	ĐELEKOVEC	ĐELEKOVEC	130,235	Construction sand and gravel
25.	"GORNJE GRMLJE" EF	SELNICA PODRAVSKA	LEGRAD	83,565	Construction sand and gravel

Table 3: Existing exploitation fields of non-energy mineral raw material for the production of construction material: technical-construction stone, construction sand and gravel from non-renewable deposits and brick clay
(Source: IV Amendments to the Physical Plan of Koprivnica-Križevci County, 2021)
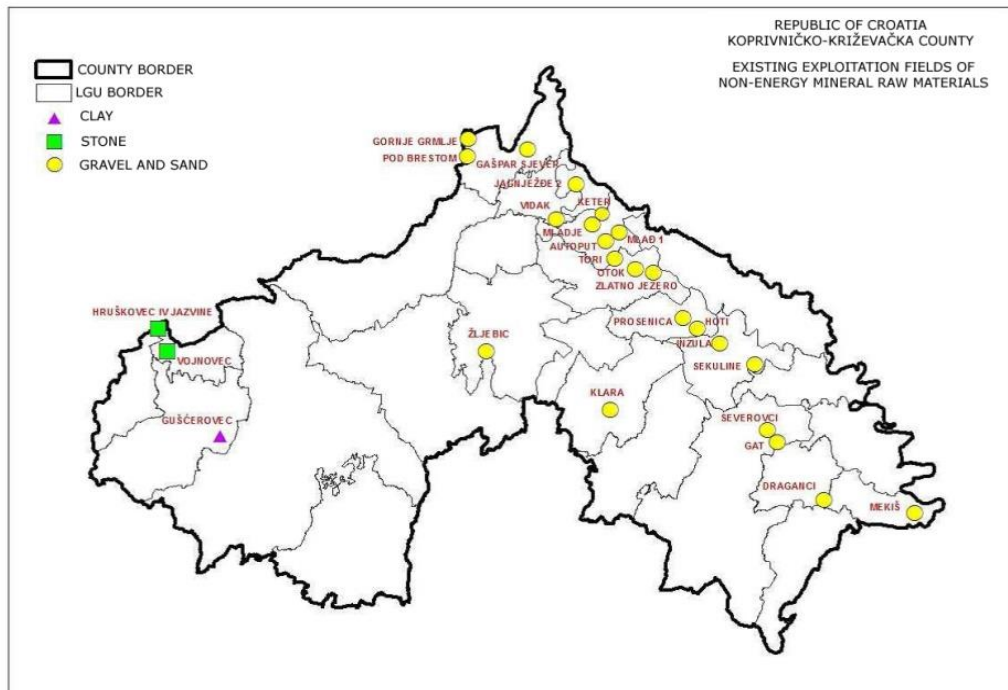
Figure 4: Existing exploitation fields of non-energy mineral raw material for the production of construction material: technical-construction stone, construction sand and gravel from non-renewable deposits and brick clay
(Source: IV Amendments to the Physical Plan of Koprivnica-Križevci County, 2021)

Given that the activities of exploration and exploitation of mineral raw material are important for the State, they are planned in accordance with the regulations in the field of physical planning in the State Spatial Development Plan, and until its adoption they are planned in county physical plans (Srpak et al., 2021). Therefore, Table 4 and Figure 5 of the IV Amendments to the Physical Plan of Koprivnica-Križevci County show the planned exploitation fields of non-energy raw material in Koprivnica-Križevci County.

PLANNED EXPLOITATION FIELDS OF NON-ENERGY MINERAL RAW MATERIAL IN KOPRIVNICA-KRIŽEVCI COUNTY					
No.	NAME OF EXPLOITATION FIELD/ EF/	SETTLEMENT	MUNICIPALITY/ TOWN	SURFACE /m²/	TYPE OF MINERAL RAW MATERIAL
1.	PLANNED "SEKULINE 1" EF	MOLVE GREDE	MOLVE	226,604.00	Construction sand and gravel
2.	PLANNED "LEŠČARE" EF	SRDINAC	NOVIGRAD PODRAVSKI	79,592.00	Construction sand and gravel
3.	PLANNED "KRČEVINE" EF	BUDANČEVICA	KLOŠTAR PODRAVSKI	195,188.00	Construction sand and gravel
4.	PLANNED "PESKI" EF	KALINOVAC	KALINOVAC	333,030.00	Construction sand and gravel
5.	PLANNED "HAMBARI" EF	MOLVE	MOLVE	237,091.00	Construction sand and gravel
6.	PLANNED "LEDVENIČKO POLJE" EF	KUZMINEC	RASINJA	185,670.00	Construction sand and gravel
7.	PLANNED "VIDAK 1" EF	ĐELEKOVEC	ĐELEKOVEC	111,852.00	Construction sand and gravel

Table 4: Planned exploitation fields of non-energy mineral raw material in Koprivnica-Križevci County
(Source: IV Amendments to the Physical Plan of Koprivnica-Križevci County, 2021)
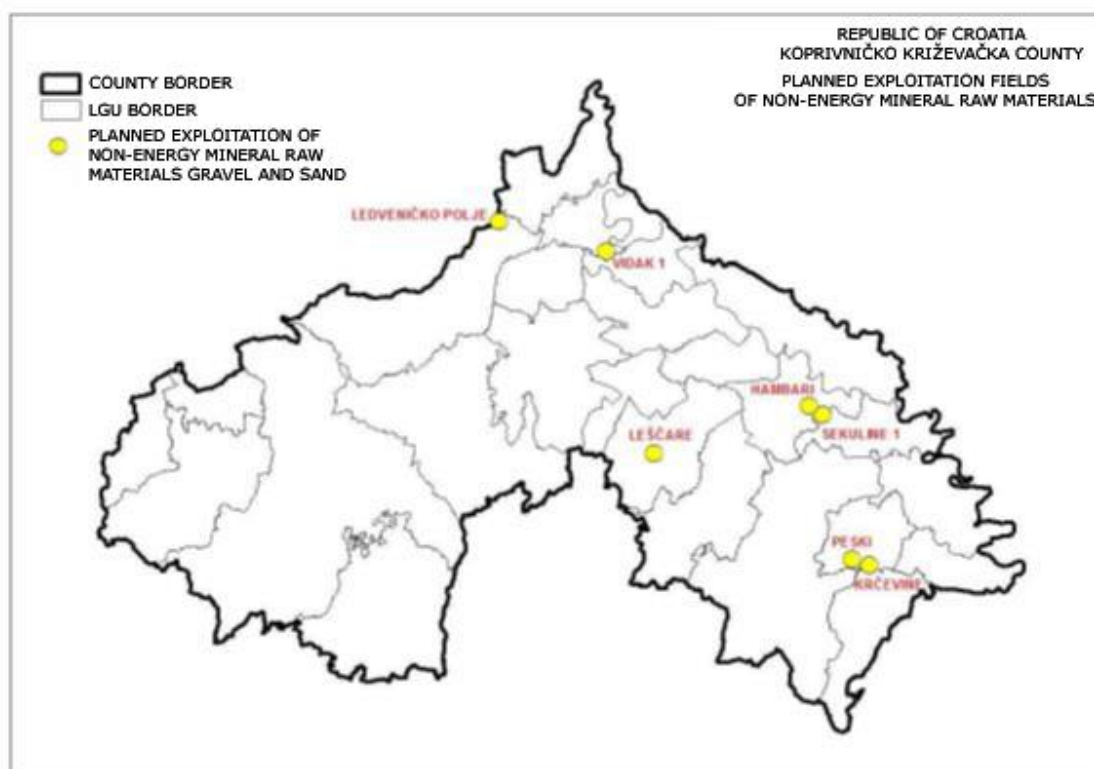
Figure 5: Planned exploitation fields of non-energy mineral raw material
(Source: IV Amendments to the Physical Plan of Koprivnica-Križevci County in 2021)

Permits, approvals and concessions for the exploration and exploitation of mineral raw material, as well as the prescribed procedures for assessing the impact on the environment and nature, as well as the information system on the exploration and exploitation of mineral raw material are coordinated in the prescribed manner by the competent state bodies for mining, physical planning, as well as environmental protection and nature protection. Physical plans treat the exploitation of mineral raw material as a transitional period (regardless of the long-term nature of the exploitation) and in these documents, as a rule, the final purpose of the space is determined (mainly sports and recreational purposes in the areas of gravel and sand exploitation, economic purposes – production zones in the areas of the exploitation of stone, clay, etc., possibly for tourist purposes, etc., and where this is not realistic or expedient, recultivation or leaving it to natural succession is defined) (Srpak and Pavlović, 2020). Based on the provisions of the Mining Act (OG 56/13, 14/14, 52/18, 115/18 and 98/19) today 19 active exploitation fields are registered in the Single Information System of Mineral Row Materials of the Republic of Croatia and 1 exploration area of mineral raw material (Table 5, Figure 6).

Table following on the next page

NO.	FIELD NAME	NAME OF AUTHORIZED ENTITY	LGU (Town/ municipality)	TYPE OF MINERAL RESOURCE	AREA OF THE FIELD (ha)	VALIDITY PERIOD OF THE DECISION	CONCESSION
				EXPLOITATION FIELDS OF KOPRIVNICA-KRIŽEVCI COUNTY			
1.	VOJNOVEC EF	RADNIK d.d.	Kalnik Municipality	Technical construction stone	43.36 ha	26.04.1984 - 31.12.2052	31.12.2019- 27.11.2033
2.	GUŠĆEROVEC EF	RADNIK d.d..	Sveti Petar Orehovec Municipality	Brick clay	11.58 ha	18.09.1987 - 31.12.2033	05.12.2016- 05.12.2027
3.	ŽLJEBIC EF	HRVATSKE ŠUME d.o.o.	Sokolovac Municipality	Construction sand and gravel	13.94 ha	31.07.1990 - 31.12.2030	14.09.2021- 31.12.2028
4.	POD BRESTOM EF	PAVLIC- ASFALT- BETON d.o.o.	Legrad Municipality	Construction sand and gravel	7.71 ha	12.06.2009 - 31.12.2050	07.07.2021- 03.09.2037
5.	GORNJE GRMLJE EF	BEDNJA d.o.o.	Legrad Municipality	Construction sand and gravel	8.13 ha	19.12.2016 - 31.12.2040	17.06.2019- 31.12.2025
6.	GAŠPAR SJEVER EF	ŠARAN 2 owned by Marijan Gašpar	Legrad Municipality	Construction sand and gravel	5.96 ha	05.06.2014 - 31.12.2050	30.12.2014- 31.12.2024
7.	JAGNJEŽĐE 2 EF	IGMA d.o.o.	Legrad Municipality	Construction sand and gravel	87.48 ha	12.11.2002 - 31.12.2031	29.10.2013- 01.09.2029
8.	VIDAK EF	BETON- LUČKO d.o.o.	Đelekovec Municipality	Construction sand and gravel	12.9 ha	08.06.2015 - 31.12.2058	12.01.2021- 31.12.2055
9.	MLADJE EF	IGMA d.o.o.	Drnje Municipality	Construction sand and gravel	33.53 ha	25.07.2008 - 31.12.2035	29.05.2017 - 28.05.2025
10.	KETER EF	IGMA d.o.o.	Drnje Municipality	Construction sand and gravel	45.177 ha	05.07.1999 - 31.12.2025	
11.	AUTOPUT EF	MARIN MONT d.o.o.	Drnje Municipality	Construction sand and gravel	5.1 ha	30.11.2006 - 31.12.2024	11.05.2018- 31.12.2023
12.	MLAĐ 1 EF	ŠARAN 2 owned by Marijan Gašpar	Drnje Municipality	Construction sand and gravel	54.94 ha	11.10.2005 - 31.12.2059	22.01.2021- 31.12.2035
13.	TORI EF	PARON d.o.o.	Peteranec Municipality	Construction sand and gravel	32.5 ha	09.12.2004 - 31.12.2052	09.06.2020- 31.10.2023
14.	OTOK EF	GM GOLUBIĆ owned by Danijel Golubić	Peteranec Municipality	Construction sand and gravel	8.65 ha	15.11.2001 - 31.12.2028	29.05.2018- 31.12.2028
15.	ZLATNO JEZERO EF	ZLATNO JEZERO d.o.o. in bankrupcy	Peteranec Municipality	Construction sand and gravel	17.75 ha	27.03.2007 - 31.12.2045	10.02.2020- 10.03.2023
16.	PROSENICA I EF	IGMA d.o.o.	Hlebine Municipality	Construction sand and gravel	49.62 ha	31.07.1989 - 31.12.2036	04.03.2015- 04.03.2032
17.	KLARA EF	BAGARIĆ d.o.o.	Novigrad Podravski Municipality	Construction sand and gravel	7.64 ha	20.05.2014 - 31.12.2035	31.12.2014- 31.12.2021
18.	SEVEROVCI EF	SEGRAD-IVA d.o.o.	Đurđevac Town	Construction sand and gravel	42.42 ha	28.05.2009 - 31.12.2052	29.03.2013- 29.03.2023
19.	MEKIŠ EF	GRANULATI- DRAVA d.o.o.	Podravske Sesvete Municipality	Construction sand and gravel	7.5 ha	30.12.2013 - 31.12.2026	03.03.2014- 03.03.2026

Table 5: List of exploitation fields with a type of mineral resource, solutions and concession in the area of Koprivnica-Križevci County
(Source: Data processed by the author based on the data from the Ministry of Economy and Sustainable Development)

Figure following on the next page
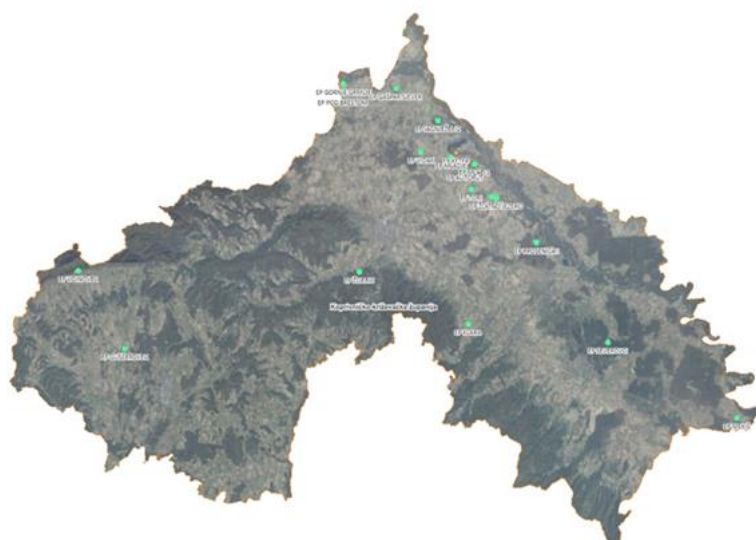
Figure 6: Exploitation fields of non-energy mineral raw material
(Source: Data processed by the author based on available data from the Ministry of Economy
and Sustainable Development)

4. INACTIVE EXPLOITATION FIELDS AND EXPLORATION AREAS OF MINERAL RAW MATERIAL OF KOPRIVNICA-KRIŽEVCI COUNTY

According to the data of the Ministry of Economy and Sustainable Development, the Mining Directorate in Koprivnica-Križevci County, 6 inactive exploitation fields with a total area of 119.51 ha were recorded (Table 6).

INACTIVE EXPLOITATION FIELDS IN THE AREA OF KOPRIVNICA-KRIŽEVCI COUNTY							
NO.	FIELD NAME	NAME OF AUTHORIZED ENTITY	LGU (Town/ municipality)	STATUS	TYPE OF MINERAL RAW MATERIAL	AREA OF THE FIELD (Ha)	DECISION VALIDITY PERIOD
1.	PAULO VAC EF	THE REPUBLIC OF CROATIA	Veliko Trojstvo Municipality, Đurđevac Town	Inactive	Brick clay	18.13 ha	17.11.1998 -06.09.2017
2.	HOTI EF	THE REPUBLIC OF CROATIA	Hlebine Municipality	Inactive	Construction sand and gravel	8.35 ha	26.01.2004 - 24.02.2017
3.	INZULA EF	THE REPUBLIC OF CROATIA	Molve Municipality	Inactive	Construction sand and gravel	17.32 ha	30.12.1997- 01.03.2017
4.	SEKULINE EF	THE REPUBLIC OF CROATIA	Molve Municipality	Inactive	Construction sand and gravel	7.53 ha	12.07.2001- 03.02.2020
5.	GAT EF	THE REPUBLIC OF CROATIA	Đurđevac Town	Inactive	Construction sand and gravel	56.99 ha	18.12.2013- 18.12.2013
6.	DRAGANCI EF	THE REPUBLIC OF CROATIA	Kalinovac Municipality	Inactive	Construction sand and gravel	10.8 ha	12.07.2017- 12.07.2017
TOTAL:						119.12 ha	

Table 6: Inactive exploitation fields in the area of Koprivnica-Križevci County
(Source: Data processed by the author based on the data from the Ministry of Economy and Sustainable Development)

5. DELETED EXPLOITATION FIELDS AND EXPLORATION AREAS OF MINERAL RAW MATERIAL IN THE AREA OF KOPRIVNICA-KRIŽEVCI COUNTY

Based on the Mining Act, the mining economic entity is responsible for the damage to nature and the environment caused by the performance of mining works on the exploitation field. During the performance and after the completion or permanent suspension of the performance of the mining works the mining economic entity is obliged to carry out rehabilitation of the area where the mining works were carried out, to implement security measures in order to prevent danger to people, property, nature and the environment and to report about this to the mining inspection and the environmental protection inspection, which issue certificates on the implementation of the mentioned measures. After this the concession grantor issues a decision on the deletion of the mining economic entity as the authorized entity of the exploitation field from the Register of exploitation fields and can also take a decision on deleting an exploitation field from the Register of exploitation fields. In the area of Koprivnica-Križevci County 12 exploitation (coal) fields were registered that were deleted from the Register of exploitation fields. The total area of deleted exploitation fields was 5,280,431ha shown in Table 7.

DELETED EXPLOITATION FIELDS IN THE AREA OF KOPRIVNICA-KRIŽEVCI COUNTY							
No.	FIELD NAME	NAME OF AUTHORIZED ENTITY	LGU (Town/ municipality)	STATUS	TYPE OF MINERAL RAW MATERIAL	AREA OF THE FIELD (Ha)	DECISION VALIDITY PERIOD
1.	VOJAKOVAČKI KLOŠTAR EXPLOITATION FIELD (EF)	BILOGORSKI RUDNICI, Koprivnica	Križevci Town	Deleted	Coal	802,7	18.08.1960-02.09.1968
2.	VOJAKOVAČKI EF	KRIŽEVAČKI UGLJENOKOPIV	Križevci Town, Sveti Ivan Žabno Municipality	Deleted	Coal	1.564,361	03.09.1985-17.04.1991
3.	CAREV DAR EF	BILOGORSKI RUDNICI, Koprivnica	Križevci Town	Deleted	Coal	72	18.08.1960-22.12.1966
4.	STEVO EF	BILOGORSKI RUDNICI, Koprivnica	Sokolovac Municipality, Križevci Town	Deleted	Coal	492,1	20.04.1961-28.03.1967
5.	LEDVENIČKO POLJE EF	THE REPUBLIC OF CROATIA	Rasinja Municipality	Deleted	Construction sand and gravel	3,91	02.02.2018-05.02.2018
6.	DOBRA NADA EF	BILOGORSKI RUDNICI, Koprivnica	Rasinja Municipality, Sokolovac Municipality	Deleted	Coal	142,38	20.04.1961-30.09.1970
7.	KOPRIVNICA EF	BILOKALNIK-KOPRIVNIČKI UGLJENOKOPI	Koprivnica Town, Koprivnički Bregi Municipality,	Deleted	Coal	984,75	04.12.1984-09.04.1990
8.	BREGI II EF	BILOGORSKI RUDNICI, Koprivnica	Koprivnica Town, Koprivnički Bregi Municipality	Deleted	Coal	290,74	31.05.1961-16.01.1967
9.	BREGI I EF	BILOGORSKI RUDNICI, Koprivnica	Koprivnica Town, Koprivnički Bregi Municipality	Deleted	Coal	512,24	20.04.1961-31.12.1971
10.	PODVIS EF	BILO RUDNICI LIGNITA, Pitomača	Pitomača Municipality, Kloštar Podravski Municipality	Deleted	Coal	249,9	06.01.1965-17.01.1968
11.	STARA KOLONA II EF	BILO RUDNICI LIGNITA, Pitomača	Pitomača Municipality, Kloštar Podravski Municipality	Deleted	Coal	149,65	09.09.1960-22.12.1966
12.	HRUŠKOVEC IV EF	THE REPUBLIC OF CROATIA	Ljubešćica Municipality Kalnik Municipality	Deleted	Technical construction stone	15,7	19.10.2017-20.10.2017
TOTAL:						5.280,431ha	

Table 7: Deleted exploitation fields in the area of Koprivnica-Križevci County
(Source: Data processed by the author based on the data from the Ministry of Economy and Sustainable Development)

Mining reached its peak in the late 1950s and early 1960s. Life was better than today. People were employed, they made money and were satisfied, regardless of the fact that they worked hard in difficult conditions and even overtime (Horvat, 2014). The development of mining and coal exploitation in Podravina is closely related to the construction and development of railways. Since coal in this area was mostly used as an energy source, the existence and development of some coal mines in Bilogora directly depended on orders from state railways. The closing of the Podravina-Bilogora coal mines in the late 1970s and early 1980s was due to several reasons, the most important of which are: the difficulty of exploitation due to the sandy-marly composition of the soil and the high groundwater; low cost-effectiveness of coal mining due to thin layers; and the outdated technical equipment of coal mines (Feletar, 1984). There are no active coal mines in Croatia today, and the Plomin thermal power plant (in the Plomin Bay) is the only active coal-fired thermal power plant in Croatia. The location was chosen due to the former coal mine, topographically and geologically suitable terrain, fresh and sea water supply, and since it is in an area with well-developed sea and land transport infrastructure. In Croatia, many households are still heated with solid fuels, so they also represent potential users, because we can no longer talk about cheap oil and gas. The tradition of mining could be continued only in the case of profitability, which would again have a positive effect on the economic and social situation.

6. CONCLUSION
Mineral raw materials represent a natural resource of interest to the Republic of Croatia and can be exploited only under the conditions and in the manner prescribed by the Mining Act. Today, in the area of Koprivnica-Križevci County, mineral raw materials are exploited with exclusive use in construction: exploitation of construction sand and gravel, technical construction stone, and brick clay, based on the approval, the decision of the competent authority on exploration areas and exploitation fields, that is, the granted concessions for exploitation, and in accordance with the regulations on mining. It is important to emphasize that in the area of Koprivnica-Križevci County, it is necessary to determine realistic possibilities for the exploration and exploitation of mineral raw material in accordance with the needs of the community, so that experts, miners, geologists, biologists, landscape architects, that is, the relevant experts should be actively involved in spatial planning and point out potential locations of activation, so that, based on this, decisions could be made about the priorities concerning the purpose, rehabilitation or conservation of deposits, that is, to ensure the protection of mineral raw material deposits for future generations, and achieve development that encourages humane, sustainable, economical and environmentally acceptable production.

LITERATURE:
1. Energetski institut Hrvoje Požar (2020): *Akcijski plan energetske učinkovitosti Koprivničko-križevačke županije za razdoblje 2020. - 2022*. Zagreb
2. IV. Izmjene i dopune Prostornog plana uređenja Koprivničko-križevačke županije, Službeni glasnik Koprivničko-križevačke županije 3/21, Koprivnica
3. Feletar, P., (2011): *Industrija Podravine-od manufaktura do deindustrijalizacije (Glavne etape i procesi)*, Podravina 10 (20), 115-162.
4. Feletar, D., Feletar, P., (2008): *Prirodna osnova kao čimbenik naseljenosti gornje hrvatske Podravine*, Podravina, 7 (13), 167-212.
5. Feletar, D., (1984): *Industrija Podravine*. Zagreb: Savez geografskih društava Hrvatske.
6. FINA (2019): Analiza financijskih rezultata poslovanja poduzetnika Republike Hrvatske u 2019.
7. Horvat, S. (2014): „*Bilogorski rudnici*" Koprivnica (Pogon Bregi) 1960-ih i 1970-ih, Podravski zbornik 40/2014.

8. Kruk, B., Dedić, Ž., Kruk, Ž., Kovačević-Galović, E., Miko, S., Crnogaj, S., Peh, Z., Avanić, R. (2014): Rudarsko-geološke studije Koprivničko-križevačke županije, Zagreb

9. Posavec, H. (2017): *Socijalno - geografska transformacija Grada Koprivnice*, Diplomski rad, Zagreb

10. Srpak, M. (2022): *Nova metodologija izračuna modela agregiranoga kompozitnoga indeksa za održivo gospodarenje mineralnim sirovinama na primjeru varaždinske županije*, Doktorski rad, Varaždin

11. Srpak, M., Pavlović, D. (2020): *Sanacija zatvorenih i napuštenih eksploatacijskih polja mineralnih sirovina na prostoru Varaždinske županije*, Nafta i plin, 40, 165; 63-72

12. Srpak M., Zeman, S., Knok, Ž. (2021): *Chronological Overview of Management of Raw Minerals in Varazdin County*, Tehnički vjesnik: znanstveno-stručni časopis tehničkih fakulteta Sveučilišta u Osijeku, 28, 3; 1060-1066 doi:10.17559/TV-20200601165001

13. Slukan-Altić, M. (2003) *Podravsko srednjovjekovlje u zrcalu kartografskih izvora*, Podravina, 2(4), 121-132.

14. Tadić, L., Brleković, T. (2018) *Hydrological Characteristics of the Drava River in Croatia.*, The Drava River, Environmental Problems and Solutions. Pečuh: Springer Geography.

15. Upravni odjel za prostorno uređenje, gradnju, zaštitu okoliša i zaštitu prirode Koprivničko-križevačke županije (2019). *Izvješće stanja o okoliša Koprivničko-križevačke županije 2013.-2016. godine*, Koprivnica.

16. Zakon o rudarstvu („Narodne novine", broj: 56/13., 14/14., 52/18., 115/18. i 98/19.)

THE ROLE OF YOUTUBE MARKETING COMMUNICATION IN CONSUMER BUYING BEHAVIOR

Mihaela Holen Rabatic
Domašinečka 4, 10000 Zagreb, Croatia
holen.mihaela@gmail.com

Marina Perisic Prodan
University of Rijeka, Faculty of Tourism and Hospitality Management,
Primorska 46, P.P. 97, 51410 Opatija, Croatia
marinap@fthm.hr

ABSTRACT

Due to increasing competition between companies, marketing communication via social networks is becoming more and more important to meet the needs of companies and users. Marketing communication via social networks is a two-way communication between companies and customers that takes place through a specific Internet service. Given the increasing use of social networks, there is a need to study the basic factors of marketing communication that influence consumer buying behavior. The purpose of this paper is to identify the factors of awareness, knowledge, liking and preferences as the fundamental factors of YouTube marketing communication and to investigate whether there is an influence of YouTube marketing communication on purchase intention. A survey was conducted on a convenience sample of 182 respondents. The research results show that the respondents use YouTube on a daily basis and spend a maximum of two hours per day watching the content. It was found that the respondents have negative attitude towards marketing communication on YouTube and also do not have purchase intention. In addition, respondents prefer as few YouTube ads as possible per video. Since the respondents are active YouTube users, the findings have implications for marketers looking to improve existing digital strategies on social networks.
Keywords: YouTube, marketing communication, social networks, attitudes

1. INTRODUCTION

In the age of globalization and the increasing use of electronic media, traditional forms of marketing are no longer sufficient to satisfy consumers' basic needs when purchasing products and services. For this reason, companies are increasingly using advertising on social networks as an integral part of their communication with consumers. Similarly, advertising affects the creation and reinforcement of the image and authority of a brand, product, or service in the marketplace, enabling market research and learning from consumers, as well as targeted advertising through marketing campaigns (Saravanakumar and Sugantha Lakhsmi, 2012). Nearly 80% of Internet users reported that they purchased a particular product or service as a result of advertising on social networks (Statista, 2021). YouTube is one of the most versatile and interesting marketing platforms today. It is the second most used social media platform in the world (Digital, 2022). With more than two million users visiting it each month and more than one million hours of video content viewed daily, YouTube is one of the largest social networks distributing video content (Chaffey, 2023). In addition, research shows that marketers are using video as the primary form of media as part of their content strategy (Hubspot, 2021). Moreover, YouTube is one of the preferred social networks of influencers to spread their messages (García-de-Frutos and Estrella-Ramón, 2021). For this reason, the question of the effectiveness and impact of advertising on consumers' behavioral intentions via YouTube also arises.

Previous research on YouTube marketing communication and its impact on consumers' buying behavior has been published mainly in the foreign literature (Antiniadis et al., 2019; Anthony et al., 2020; Correa et al., 2020; Duffett, 2017; Duffett, 2019; Lee and Watkins, 2016; Muda and Hamzah, 2021). There is insufficient research on this topic in the domestic literature, and given the growing popularity of this social network, as well as the ubiquitous use of video as a dominant medium in advertising, such research is considered warranted. The present study attempts to fill the research gap resulting from the insufficient research on users' attitudes towards marketing communication on YouTube and the possibility of using the obtained information as a means of improving YouTube communication between companies and potential customers. Three main objectives are pursued with this thesis. The first objective is to identify YouTube usage habits. The second objective is to investigate respondents' attitudes toward the basic factors of YouTube marketing communication, as well as attitudes toward purchase intention and actual purchase. The third objective is to investigate users' attitudes towards YouTube advertising. The paper is divided into five parts. After the introductory part, a brief review of the literature is given. In the third part, the research methodology is explained, followed by the interpretation of the research results. In the conclusion, a synthesis of the entire work is given, focusing on limitations and recommendations for future research.

2. LITERATURE BACKGROUND

Social networks are one of the indispensable tools of digital marketing communication. Due to the increasing use and importance of social networks in marketing communication, the need for their research has arisen. Numerous researchers came to various conclusions and recognised the importance of social networks and consequently the importance of YouTube. The most important content that is distributed through YouTube is the video. Nowadays, video is one of the predominant forms of communication that has become part of people's daily life (Muda and Hazmah, 2021). Its effectiveness and widespread use has also been recognised by marketers who began to use it to achieve the company's communication goals. Video is a very effective online marketing content whose use can shorten the time of the buying process and increase the number of conversions (Duffett, 2019). With the increasing availability of mobile technology, video advertising is becoming accessible to a wider audience, and its ease of implementation into a marketing campaign stands out. Research shows that video posts are one of the most successful tools for engaging consumers and are at the top of tactics for digital marketing campaigns (HubSpot, 2021). Video advertising can be done on any digital marketing tool that supports the format, but the most popular platform for video content and advertising is YouTube. Both consumer attributes and products or services influence specific stages of attitude that consumers go through when making a purchase decision, starting with the pre-purchase stage, moving through the during-purchase stage, and ending with the post-purchase stage (Lemon and Verhoef, 2016). Attitude is described as the tendency of people to evaluate an object with a certain degree of favorability or unfavorability (Eagly and Chaiken, 1993), while attitude toward advertising is a tendency to respond positively or negatively to marketing communication stimuli (Duffett, 2017). User attitude consists of three components (Duffett, 2020): (1) the cognitive phase, in which consumers learn of the existence of a product or service, i.e., create awareness of it and acquire knowledge about it; (2) the affective phase, in which consumers develop certain emotions toward the product or service and show a preference for it; (3) the behavioral phase, which affects the consumer's belief that the purchase of a particular product or service is useful and is followed by the purchase of the product or service itself. According to Duffet (2017), the cognitive stage consists of awareness of the brand, product, or service, i.e., the degree of spontaneous or conscious recollection of it, and knowledge about the brand, product, or service, i.e., the consumer's ability to describe essential characteristics of the product or service.

The same author states that the affective phase consists of liking for the brand, product, or service, i.e., a positive attitude toward them, and preference, i.e., the extent to which the consumer has a positive attitude toward the brand, product, or service compared to the competition. The behavioral stage consists of purchase intention, i.e., the likelihood that the consumer will purchase a particular product or service, and the actual purchase of the product or service. This theory of splitting user attitudes assumes that positive attitudes toward advertising lead to similar attitudes toward the products and services offered, which positively influence purchase intention (Duffett, 2017; Duffett; 2020). Over the past decade, research on digital marketing communications and their impact on the consumer buying behavior has intensified. Duffett (2017) found that marketing communication through social networks has a positive impact on the cognitive (awareness and knowledge), affective (liking and preferences), and behavioral (purchase intention) stages of attitude. Although positive, valuation tends to decrease, which ultimately affects the amount of sales generated. Pikas and Sorrentino (2014) demonstrated that the majority of respondents do not have positive attitudes toward advertising on social networks and that they are generally bothered by Internet advertising. Respondents generally do not want to be exposed to marketing communications, both on YouTube and on other social networks, and they concluded that marketing activities on social networks are not effective. However, the ability to ignore advertising on social media such as YouTube does impact the effectiveness of marketing communications on social media. This is also confirmed by the research of Can and Kay (2016), who studied the affective, cognitive, and behavioral attitudes of social network users toward advertising. The results showed that advertising on social networks does influence user behavior to some extent, but not as effectively as expected. Many respondents indicated that they neither like nor consider advertising on social networks. Social network users are also not aware of all forms of marketing communication on social networks. Since YouTube is also recognized as an effective marketing channel, numerous authors saw an opportunity to study the impact of a marketing campaign on the attitudes of users of this social network. Yang et al. (2018) concluded that the aspects of entertainment, frustration level, and information, as well as their credibility, provided by YouTube marketing communications significantly influence users' behavior and their relationship with purchase intention and actual purchase. They found that frustration level is an aspect that negatively affects users' attitudes, and that studies on attitudes toward advertising, both in general on social networks and on YouTube, can help in developing a strategy for digital marketing campaigns. By studying users' attitudes toward YouTube advertising, Antiniadis et al. (2019) concluded that YouTube marketing communication need to be informative and entertaining to increase awareness of brands, products, or services. They also recommend that advertisers reduce the frustration component and the amount of time users are exposed to ads. Since YouTube ads can be skipped, a survey conducted by Picasso and Sorrentino (2014) asked respondents to what extent they agreed with the statement "I always skip YouTube ads." Only 5% of respondents said they do not skip YouTube ads, confirming the conclusions of the above study. Since users' attitudes towards YouTube marketing communication lead to certain behaviors, numerous authors have also studied this relationship. Duffett et al. (2019) demonstrated that the cognitive phases of users' attitude toward YouTube marketing communication positively influence the affective phases of respondents' attitude. This research also confirmed the positive relationship between the brand and users' affection towards the brand. It was also proved that the quality of the information provided by YouTube marketing communication and its interactivity are significantly and positively related to brand awareness and that intrusiveness is insignificant in this case (Anthony et al., 2020). The conducted research showed the importance and certain advantages and disadvantages of using YouTube marketing communication. In the following, the results of the conducted empirical research on the attitudes of YouTube users are presented.

3. RESEARCH METHODOLOGY

Empirical research was conducted to investigate users' attitudes toward YouTube marketing communication and their behavioral intentions. Data were collected in June and July 2021 using a convenience sample of respondents. A structured questionnaire was designed for data collection. In the first question, respondents indicated whether they use YouTube. The second group of questions dealt with the habits of using YouTube. The third group of questions addressed respondents' attitudes toward awareness, knowledge, liking and preferences related to YouTube marketing communication, as well as purchase intent and actual purchase. The questions were adapted from previous research by Duffett (2020) and Duffett et al. (2019). Each statement was rated on a 5-point Likert scale, anchored at (1) strongly disagree and (5) strongly agree. The fourth and fifth groups of questions used a nominal scale to determine how respondents react when presented with a particular YouTube advertisement, as well as the acceptable number of advertisements per video. The questions were adapted from previous research by Yang et al. (2018) and Pikas and Sorrentino (2014). The last group of questions relates to the sociodemographic characteristics of the respondents. Of the total 189 respondents, seven indicated that they did not use YouTube. Therefore, the results of a convenience sample of 182 respondents were processed.

4. RESEARCH RESULTS

In this part, the results of the conducted research are presented. 58.2% of the female respondents and 39.0% of the male respondents participated in the survey, while 2.8% of the respondents did not want to provide information about their gender. In the sample, respondents aged 21 to 30 years predominate (50.5%). They are followed by respondents aged 31 to 40 (22.0%). Respondents with high school diplomas (31.3%) and respondents with university degrees (30.2%) and bachelor's degrees (23.6%) predominate. The majority of respondents (29.1%) have a monthly income of up to HRK 5,000. This is followed by respondents with an average monthly income of up to HRK 8,000 (26.4%) and HRK 2,000 (20.3%). One of the objectives was to determine YouTube usage habits. The results are presented in Table 1.

Description	Respondents	
	Frequency	Percentage
Access		
Mobile device	161	88.5
PC	95	52.2
Other	27	14.8
Experience (years)		
≤ 1 year	2	1.1
2 years	2	1.1
3 years	5	2.7
4 years	5	2.7
≥ 5 years	168	92.3
Frequency of log-on		
Daily	129	70.9
2-4 times a weeko	25	13.7
Once a week	28	15.4
Duration of log-on-(watching YouTube video content)		
≤ 1 hour	86	47.3
2 hours	51	28.0
3 hours	31	17.0
4 hours	7	3.8
≥ 5 hours	7	3.8

Table 1: Youtube usage habits (N=182)
(Source: Research results)

Respondents most frequently access YouTube via smartphones (88.5%) and PC (52.2%). Most respondents have been using YouTube for five years or more (92.3%) and visit it daily (70.9%), while a smaller number of respondents visit YouTube two to four times per week or weekly (29.1%). Half of respondents spend one hour or less per day on YouTube (47.3%), followed by respondents who spend two hours per day (28.0%) and three or more hours per day (24.6%) on YouTube. The next objective was to determine respondents' attitudes toward the basic factors of YouTube marketing communication, as well as purchase intention and actual purchase of products or services advertised on YouTube. The results are shown in Table 2.

Item	Mean	SD
Awareness		
YouTube marketing communication are effective in creating awareness of brands	3.02	1.37
YouTube marketing communication alerts me to new company offerings	3.07	1.32
I have become aware of new YouTube marketing communication	3.97	1.15
YouTube marketing communication get my attention towards certain brands	2.31	1.32
Knowledge		
Ads on YouTube are effective in providing information about brands	2.51	1.23
YouTube marketing communication are a good source of knowledge	2.47	1.28
I use YouTube marketing communication to find new information about products	1.93	1.24
YouTube marketing communication provide me with valuable product knowledge	2.11	1.23
Liking		
YouTube marketing communication has made me like the brands more	1.78	1.09
YouTube marketing communication adds to the enjoyment of using YT	1.46	1.05
YouTube marketing communication are likeable and pleasant	1.67	1.06
YouTube marketing communication are entertaining and fun	1.65	1.08
YouTube has a positive influence on me liking advertised products	1.71	1.12
YouTube marketing communication has made me like the products more	1.66	1.08
Preferences		
I look for products that are advertised on YouTube	1.76	1.08
YouTube marketing communication are relevant to me and my interests	1.83	1.13
Ads on YouTube are effective in stimulating my preference in brands	1.69	1.09
YouTube marketing communication are effective in gaining my interest in products	1.74	1.13
I prefer brands that are promoted on YT	1.62	1.05
YouTube marketing communication have a positive effect on my preference for brands	1.68	1.12
Intention to purchase		
I will buy products that are advertised on YouTube in the near future	1.66	0.97
I desire to buy products that are promoted on YouTube	1.63	1.06
YouTube marketing communication increase purchase intent of featured brands	1.60	1.07
I would buy products that are advertised on YouTube if I had the money	1.71	1.15
Purchase		
I purchase products that are featured on YouTube	1.61	0.99
YouTube marketing communication positively affect my purchase behaviour	1.59	1.06
Ads on YouTube help to make me loyal to the promoted products	1.47	0.98
YouTube marketing communication favorably affect my purchase actions	1.58	1.06
I purchase products that are promoted on YouTube	1.60	1.03

Table 2: Results of descriptive statistics (N=182)
(Source: Research results)

The results show that the respondents mostly disagree with the statements. The variable "Awareness" was given the highest mean score (M=3.09, SD =1.29). The other variables were rated with mean values below 3. In the cognitive phase (awareness and knowledge), respondents are aware of YouTube marketing communication (M=3.97, SD =1.15), but they do not become aware of brands (M=2.31, SD =1.32), do not obtain valuable knowledge about products (M=2.11, SD =1.23), and do not use YouTube as a source of new information (M=1.93, SD =1.24). In the affective phase (liking and preferences), respondents neither express liking for YouTube marketing communication (M=1.66; SD =1.08) nor prefer them

(M=1.72, SD =1.10). In the behavioral phase (purchase intention and actual purchase), respondents neither intend to buy products advertised on YouTube (M=1.63, SD =1.06), nor does YouTube communication increase their purchase intention (M=1.60, SD =1.07). Respondents do not purchase products advertised on YouTube (M=1.60, SD =1.03), YouTube communication does not positively affect their purchase behavior (M=1.59, SD =1.06), and YouTube advertising does not contribute to their loyalty toward advertised products (M=1.47, SD =0.98). One of the objectives was to determine respondents' attitudes toward YouTube advertising. The results are presented in Table 3.

Description	*Respondents*	
	Frequency	*Percentage*
When I see a YouTube ad:		
Ignore or close it immediately	135	74.2
Watch/Read it occasionally	33	18.1
Watch/Read it after appearing too many times	7	3.8
Watch/Read it when I get time	7	3.8
Watch/Read it right away	0	0.0
When I receive a YouTube video ad:		
I don't even look at it	133	73.1
I look at half of the ads	47	25.8
I look at the whole ad	2	1.1
I don't respond to YouTube ads at all:		
Very often	103	56.6
Often	20	11.0
Sometimes	11	6.0
Rarely	13	7.1
Very rarely	35	19.2
I am willing to receive advertisement while watching online video:		
Less than one advertisement a video	156	85.7
Two advertisement a video	22	12.1
Three advertisement a video	2	1.1
Over four advertisement a video	2	1.1

Table 3: Respondents' attitudes about YouTube advertising (N=182)
(Source: Research results)

Of the 182 respondents, 74.2% do not respond to YouTube ads at all, while 18.1% view them only sometimes. It was also found that 73.1% of the respondents completely ignore YouTube ads, while 25.8% of the respondents only see half of the ads. In addition, 67.6% of respondents very often or often do not respond at all to YouTube ads. For most respondents (85.7%), the acceptable number of YouTube ads per video is less than or equal to one ad, while 12.1% of respondents consider two ads acceptable. This indicates that users do not have a positive attitude towards YouTube advertising.

5. DISCUSSION AND CONCLUSION
The survey results show that respondents most often access YouTube via smartphones and desktop computers. A clear majority of respondents have been using YouTube for five years or more, access it daily, and typically spend less than an hour watching YouTube content. These results are consistent with the findings of Antiniadis et al. (2019), who concluded that most users use smartphones to watch videos for less than one hour per day, while laptops are used to watch video content between one and three hours per day. In addition, the research found that respondents do not have a positive attitude toward the basic factors of YouTube marketing communication. These findings are consistent with those of Can and Kay (2016), who showed that marketing communication on social networks influence user behavior to some extent, but not as effectively as expected, and with those of Pikas and Sorrentino (2014), who showed that respondents generally do not want to be exposed to marketing communication on social

networks and that this form of marketing communication is ultimately ineffective. However, Duffett (2017) demonstrated that marketing communication has a positive impact on the cognitive (awareness and knowledge), affective (liking and preferences), and behavioral (purchase intention and actual purchase) stages of consumer attitudes, but these tend to decrease. The research also found that for the majority of respondents, the acceptable number of YouTube ads per video is equal to or less than two, and that they most often ignore YouTube ads and often or very often do not respond to them at all. These results are consistent with the findings of authors Pikas and Sorrentino (2014) and Antiniadis et al. (2019), who concluded that the time users are exposed to YouTube ads should be reduced and that most users skip them. The analysis of the results led to certain conclusions, based on which it can be recommended to adapt YouTube marketing communication to mobile devices, especially smartphones. Moreover, since the majority of respondents have been using YouTube for five or more years and access it on a daily basis, there is a possibility of saturation with YouTube marketing communication, especially YouTube ads. It is therefore recommended to promote influencer marketing and user-generated content. Indeed, it has been proven that consumers trust other consumers' video content more than content published by companies, as UGC does not necessarily have commercial interests (McMahan and Park, 2020). It is also recommended to review current YouTube marketing communication strategies in terms of choosing the communication method itself, segmenting users, and creating the message. Marketers need to provide YouTube marketing communication that deliver relevant and reliable information to users in an entertaining way and give the brand, product or service appropriate positioning and a positive image. It is also recommended to monitor profitability in order to optimize the campaign if necessary. This study has several limitations. The main limitation relates to the sample size, so the research results can only be considered as indicative. Moreover, the research was conducted exclusively with YouTube users in the Republic of Croatia. The next limitation is temporal, as the results were collected within a relatively short period of time. Future research should include respondents from other countries. It is also recommended that the research be conducted over a longer period of time. In order to obtain the most accurate data, future studies should examine the relationship between attitudes and respondents' sociodemographic characteristics. The use of other research methods, such as focus groups or interviews, is also suggested.

LITERATURE:
1. Antiniadis, I., Saprikis, V.S., Karteraki, E. (2019). Consumers' Attitudes Towards Advertisement in YouTube. *Strategic Innovative Marketing and Tourism*, pp. 253-261.
2. Anthony, S.J., Liu, V., Cheng, C., Fan, F. (2020). Evaluating communication effectiveness of YouTube advertisements. *International Journal of Information Research and Review*, Vol. 7, No. 4, pp. 6896-6901.
3. Can, L., Kaya, N. (2016). Social networking sites addiction and the effect of attitude towards social network advertising. *Social and Behavioral Sciences*, Vol. 235, pp. 484-492.
4. Chaffey, D. (2023). *Global social media statistics research summary 2023*. Retrived 25.01.2023 from https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research/

5. Correa, S. C. H., Soares, J. L., Christino, J. M. M., Gosling, M. D. S., Goncalves, C. A. (2020). The influence of YouTubers on followers' use intention. Journal of Research in Interactive Marketing, Vol.14, No. 2, pp. 173-194.

6. Digital (2022). Retrived 20.01.2023 from https://datareportal.com/reports/digital-2022-global-overview-report

7. Duffett, R.G. (2017). Influence of social media marketing communications on young consumers' attitudes. *Young Consumers*, Vol. 18, No. 1, pp. 19-39.

8. Duffett, R.G. (2020). The YouTube Marketing Communication Effect on Cognitive, Affective and Behavioural Attitudes among Generation Z Consumers. *Sustainability*, Vol. 12, No. 12, pp. 1-25.

9. Duffett, R.G., Edu, T., Negricea, I.C. (2019). YouTube marketing communication demographic and usage variables influence on Gen Y's cognitive attitudes in South Africa and Romania. *The Electronic Journal of Information Systems in Developing Countries*, Vol. 85, No. 5, pp.1-13.

10. Duffett, R.G., Petrosanu, D.M., Negricea, I.C., Edu, T. (2019). Effect of YouTube Marketing Communication on Converting Brand Liking into Preference among Millennials Regarding Brand sin General and Sustainable Offers in Particular. Evidence from South Africa and Romania. *Sustainability*, Vol. 11, No. 3, pp. 1-24.

11. Eagly, A.H. Chaiken, S. (1993). *The Psychology of Attitudes*. San Diego:Harcourt Brace Jovanovich CollegePublishers.

12. García-de-Frutos, N., Estrella-Ramón, A. (2021). You absolutely (don't) need this! examining differences on customer engagement components for (anti) haul youtubers' videos. *Journal of Research in Interactive Marketing*. Vol. 15, No. 1, pp. 86-103.

13. HubSpot (2021). *Not another state Of marketing report*. Retrived 15.01.2023 from https://www.hubspot.com/state-of-marketing

14. Lemon, K. N.,Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. *Journal of marketing*, Vol. 80, No. 6, pp. 69-96.

15. Lee, J. E., Watkins, B. (2016). YouTube vloggers' influence on consumer luxury brand perceptions and intentions. *Journal of Business Research*, Vol. 69, No. 12, pp. 5753-5760.

16. Muda, M., Hamzah, M. I. (2021). Should I suggest this YouTube clip? The impact of UGC source credibility on eWOM and purchase intention. *Journal of Research in Interactive Marketing*, Vol 15, No. 3, pp. 441-459.

17. Park, J., McMahan, C. (2020). Exploring Youtube marketing communication among 200 leading national advertisers. *Journal of Promotion Management*, Vol. 27, No. 4, pp. 487-502.

18. Pikas, B., Sorrentino, N. (2014). The Effectiveness of Online Advertising: Consumer's Perceptions of Ads on Facebook, Twitter and YouTube. *Journal of Applied Business and Economics*, Vol. 14, No. 4, pp. 70-81.

19. Saravanakumar, M., SuganthaLakshmi, T. (2012). Social media marketing. *Life science journal*, Vol. 9, No. 4, pp. 4444-4451.

20. Statista (2021). Social media – Statistics & facts. Retrived 9.6.2021. from https://www.statista.com/topics/1164/social-networks/#dossierSummary__chapter1

21. Yang, K. C., Huang, C.H., Yang, C., Yang, S.Y. (2018). Consumer attitudes toward online video advertisement: YouTube as a platform. *Kybernetes*, Vol. 46, No. 5, pp. 840-853.

STATISTICAL DIMENSIONS OF CIRCULAR ECONOMY

Plamen Petkov
Associate professor at Dimitar A. Tsenov Academy of Economics,
Department of Statistics and Applied Mathematics, Svishtov, Bulgaria
p.petkov@uni-svishtov.bg

Krasimira Slaveva
Associate professor at Dimitar A. Tsenov Academy of Economics,
Department of Statistics and Applied Mathematics, Svishtov, Bulgaria
k.slaveva@uni-svishtov.bg

Stela Kasabova
Associate professor at Dimitar A. Tsenov Academy of Economics,
Department of Statistics and Applied Mathematics, Svishtov, Bulgaria
s.kasabova@uni-svishtov.bg

Margarita Shopova
Associate professor at Dimitar A. Tsenov Academy of Economics,
Department of Statistics and Applied Mathematics, Svishtov, Bulgaria
m.shopova@uni-svishtov.bg

Tihomir Varbanov
Head Assistant at Dimitar A. Tsenov Academy of Economics,
Department of Statistics and Applied Mathematics, Svishtov, Bulgaria
t.varbanov@uni-svishtov.bg

Evgeni Ovchinnikov
Head Assistant at Dimitar A. Tsenov Academy of Economics,
Department of Statistics and Applied Mathematics, Svishtov, Bulgaria
e.ovchinnikov@uni-svishtov.bg

ABSTRACT

In the present publication the authors analyse empirically various aspects of the circular economy applying different approaches of statistical analysis. Regarding the measurement of the progress of the individual EU countries in implementing the transition to a circular economy, a dynamic classification of the European Union countries was carried out using multivariate statistical methods such as factor analysis, cluster analysis and discriminant analysis, and the convergence process was analysed according to indicators of the waste management category. The temporal synchronization between the indicators for the characterization of packaging waste in Bulgaria and the European Union was investigated through cross-correlation analysis and dynamics and structure of the generated production and hazardous waste by economic activities and extent of their utilization by economic activities are surveyed by applying statistical methods for the analysis of time series and structural changes and differences. Finally, the regional dimensions of municipal waste generated in the context of the circular economy in Bulgaria are explored using a taxonomic analysis.
Keywords: *circular economy, convergence process, cross-correlation analysis, dynamic classification, multivariate statistical methods, taxonomic analysis, time series*

1. INTRODUCTION

In the conditions of limited natural resources and adverse impacts on the climate as a result of production activity and consumption, it is increasingly imperative to limit the use of non-renewable natural resources and the generation of waste. The circular economy is a model of production and consumption aimed at extending the life cycle of products, which minimizes the waste. The transition from a linear economic model to a circular economy is promoted by a number of pan-European policies in order to achieve sustainable economic development. The conviction of the European Commission is that by developing a circular economy, European enterprises will become more innovative and increase their competitiveness on the world market, and at the same time - all this will be done with care for the environment, reducing the harmful effects on the climate. In their previous studies, using the statistical and econometric methods, covering the largest possible part of the indicators of the circular economy, the members of research team analyzed the countries of the European Union and investigated the regional aspects of the transition from a linear to a circular economy in Bulgaria. The authors took part in a number of forums where they presented results related to: the study of dependencies between indicators of the circular economy, in particular and the green deal (Slaveva, 21-22.10. 2022), and indicators of economic growth (Petkov & Varbanov, September, 2022), environmental pollution in Bulgaria (Kasabova, 21-22.10. 2022) and, in particular, the impact of carbon emissions in Bulgaria and EU coutries (Slaveva, et al., September, 2022), an analysis of the relationship between gross domestic product and waste via Waste Kuznets Curve in Bulgaria (Shopova & Ovchinnikov, 24-25 November 2022), an analysis of the structure of packaging waste in Bulgaria and the EU (Shopova & Ovchinnikov, 21-22.10. 2022), as well as the influence of the educational level of the population in Bulgaria on the degree of recycling of household waste (Petkov, 21-22.10. 2022). In another joint publication, one of the areas of the circular economy, namely waste management, is subjected to a thorough analysis using modern statistical and econometric methods and models (Petkov, et al., 2023). In this publication, the authors extend the scope of their research by empirically analyzing additional aspects of the circular economy or by applying different statistical analysis approaches. Regarding the measurement of the progress of the individual EU countries in implementing the transition to a circular economy, a dynamic classification of the European Union countries was carried out using multivariate statistical methods such as factor analysis, cluster analysis and discriminant analysis, and the convergence process was analyzed according to indicators of the waste management indicators. The temporal synchronization between the indicators for the characterization of packaging waste in Bulgaria and the European Union was investigated through cross-correlation analysis. The regional dimensions in relation to the generated domestic waste in the context of the circular economy have been studied with the help of taxonomic analysis, and by analyzing the dynamics and structure of the generated productive and hazardous waste, the extent of their utilization by economic activities is estimated.

2. DYNAMIC CLASSIFICATION OF EUROPEAN UNION COUNTRIES ACCORDING TO CIRCULAR ECONOMY MONITORING INDICATORS

With the dynamic classification methodology, EU countries are analyzed according to 20 indicators from the four groups (production and consumption, waste management, use of secondary raw materials, competitiveness and innovation) according to Eurostat's monitoring system, through which progress in the transition to a circular economy is monitored. The study covers the period from 2010 to 2019. For each year a cluster analysis is performed and the change in the dynamics of the distinct clusters is tracked, both in terms of their number and in terms of their composition. The specifics of the methodology applied here can be described as follows.

First, factor analysis is used to reduce the initial space of 20 observed indicators by determining hidden (latent) factors that best describe the observed ones. This analysis is applied to indicators in each of the four categories. Second, instead of an object-oriented approach, the traditional one is used here, i.e. for each individual year, depending on the available information, a classic cluster analysis is performed, and finally the dynamics of the changes that have occurred in relation to the essential classifications are tracked. Third, to determine the optimal number of clusters during each year, the combined approach is applied. Besides the use of basic internal criteria, the selection of the optimal number of clusters is carried out by supplementing the analysis with the results of a visual analysis of the obtained dendrograms by applying a hierarchical cluster analysis. After the identification of the final number of clusters, a cluster analysis using the k-means approach is performed on the source data summarized by factor analysis. Finally, the results obtained using the k-means method are validated using the discriminant analysis, and the discriminant functions determine the correctness of the classification performed using the cluster analysis in individual years. Factor analysis is part of the preliminary stage of the research, in which dimensionality reduction of the output matrix with statistical features is carried out using the so-called R-technique. The results show that the observed indicators in the categories "Production and consumption", "Secondary raw materials" and "Competitiveness and innovation" are represented by one latent variable each, and the analyzed 11 indicators of "Waste management" are represented by 2, 3 or 4 latent variables. Ultimately, at the next stage of the process of classifying the EU countries through cluster analysis, between 3 (2019) and 7 latent variables are distinguished in individual years to represent the impact of the initial 20 indicators. After applying the internal criteria for determining the optimal number of clusters in each year, it was found that they could not unambiguously determine the optimal number of clusters. For this, the final conclusions are based on the results of the application of hierarchical cluster analysis and the tree diagrams (dendrograms) obtained with their help. The analysis is based on Ward's procedure and is applied to the squared Euclidean distance matrix. Lastly, the final number of optimal clusters is determined by discriminant analysis applied to results of each years during the analyzed period. With the help of classification functions and the matrices of correctly classified objects (individual countries), it is established that the EU countries can be grouped into five clusters. The proportion of objects correctly classified varied from 77.8% in 2011 and 2014 to 96.3% in 2013. A total of 10 countries fall into the first cluster during the period, and in terms of the number, relative constancy is observed. The number of members has varied from two (in 2015 and 2017) to 9 countries (Belgium, Germany, Spain, France, Italy, Luxembourg, the Netherlands, Austria and Finland) in 2010. A constant member throughout the period is only Germany, and from the rest of the countries, the Netherlands (9 years), Belgium (8 years), as well as Spain and Italy (6 years) can be distinguished with the most presences. Cluster two is the most represented cluster. It includes all countries except Germany. The cluster includes between 4 (2017) and fifteen countries (2019). Finland (7 years), Greece, France, Croatia, Latvia, Hungary and Poland (5 years each) are distinguished with the most participations. A total of 23 countries fall into the third cluster over the years, with the number of members varying from three in 2014 to ten in 2017. Ireland (6 years), Bulgaria and Sweden (5 years each) have participated the most. Nineteen countries fall into cluster 4 in individual years, but their inclusion in the cluster is rather accidental. The number of members varies between one (2012, 2014 and 2019) and six (2017). Eleven countries fall only once, and another 4 - twice. This is the only cluster to which none of the countries can be associated, since there are four countries with the highest number of classifications (3). The fifth cluster again has 19 countries, with members ranging from one (2010, 208 and 2019) to eleven (2014). Only the Czech Republic is included in the group in half of the years during the studied period. Summarizing the information, conclusions regarding the composition of individual clusters can be made in two

directions. In the first direction, EU countries can be included in one cluster. For example, the first cluster includes Belgium, Germany, Spain, Italy and the Netherlands. The second cluster clearly includes Denmark, France, Croatia, Greece, Latvia, Hungary, Poland and Finland, and the third - Bulgaria, Ireland and Sweden. No country can be permanently associated with the fourth cluster, but taking into account the proximity between clusters 3 and 4, Estonia, Lithuania and Portugal can also be included in them together. Only the Czech Republic falls into the fifth cluster. The results of the analysis outline a very dynamic picture among the countries of the European Union regarding the actions taken in the transition to a circular economy. Adopting the intra-community criteria set by the European comission, individual countries develop national strategies and register individual goals, which are fulfilled to varying degrees.

3. STUDY OF THE CONVERGENCE PROCESS BETWEEN EUROPEAN UNION COUNTRIES ON WASTE MANAGEMENT INDICATORS

In this part, the main results of the study of the convergence across the European Union Member States for the period 2012-2019 through the club convergence approach are presented. The methodology developed by Phillips & Sul (2007) when dealing with panel data, known as the *log t*-test, is applied. It is based on a regression equation that tests the null hypothesis of convergence among all units against the alternative for lack of convergence among individual units. Therefore, the rejection of the null hypothesis can mean both overall divergence and convergence only between individual groups of countries. The results of the application of the club convergence approach show that there is no general convergence process among the EU-27 countries regarding all seven key indicators that characterise the waste management activity in the context of the circular economy: recycling rate of municipal waste (RRMW), recycling rate of paper and cardboard packaging waste (RRPCPW), recycling rate of plastic packaging waste (RRPPW), recycling rate of wooden packaging waste (RRWPW), recycling rate of metallic packaging waste (RRMPW), recycling rate of glass packaging waste (RRGPW), recycling of biowaste (RBW). This is established by the negative values of the coefficient *b* (accounting for the rate of convergence) in the estimated regression equations as well as from the *t*-test values that significantly exceed the critical value of $-1,65$. The rejection of the hypothesis of general convergence among the countries included in the analysis is a reason to apply the methodology of Phillips & Sul for the formation of convergent clubs. The test for the existence of club convergence with regard to the indicator RRMW shows that within the EU-27 there are three convergent clubs and a divergent country – Cyprus. The countries forming Club I are characterised by the highest average recycling rate of municipal waste (40.3%), which is 4.8 percentage points above the EU-27 average. The average values for the countries of the other clubs are 24.3% and 12.4%, respectively. The convergence among the countries of the second club is relative, i.e. between growth rates, while in the remaining convergent clubs there is a process of transitional divergence and a phase reversal (Caporale et al., 2019), which is established based on the negative value and statistical significance of the coefficients *b*. Two convergent clubs and two divergent countries are distinguished by the indicator RRPCPW. A process of transitional divergence and phase reversal is established, which is significantly more pronounced among the countries of the first club. Regarding the recycling rate of plastic packaging waste, the number of convergent clubs is again two, and Malta cannot be included in any of them. Club I includes eighteen countries, and the negative value of the coefficient *b* indicates that they are in a process of transitional divergence. The countries of this club are characterised by the highest values of the indicator, whose average value of 45.4% is 4.4 percentage points above the average of the EU-27 countries and 11.9 percentage points more than the average value of the countries from Club II. The number of separate convergent clubs is also identical according to the recycling rate of wooden packaging waste. The number of countries that form individual clubs are nine and eighteen, and the average value of the indicator

is 57.7% and 28.8%, respectively. In both clubs, convergence is relative. The most uneven is the distribution of the countries according to the indicator RRMPW, according to which two convergent clubs are formed. Twenty-three countries are included in Club I, i.e. over 85% of the studied set, and the average value of the indicator differs by only 0.2 percentage points from the EU-27 average. Cyprus stands out as a divergent country, which is expected given the country's significantly higher average percentage of the indicator (98.7%) both compared to the overall average (71.8%) and the average of the RRMPW for each individual country. Three convergent clubs are formed in terms of the recycling rate of glass packaging waste, and Hungary stands out as divergent. The distribution of countries by individual clubs according to this indicator is the most even – eleven, nine and six countries, respectively in Club I, Club II and Club III. The countries with the highest RRGPW are from Club I (81.7%) and with the lowest – from Club III (55.2%), with an EU-27 average of 69.8%. According to this indicator, a relative convergence among the countries of Club II and a transitional divergence between the countries of Club I and Club III is established. The studied totality is the most heterogeneous in terms of the RBW indicator, as the largest number of convergent clubs – four, are identified, while at the same time the presence of divergent countries is not established. The average amount of recycling of biowaste per capita in Club I countries is 99.4 kg. and significantly exceeds the average values both for the countries in the other clubs and for the totality. Relative convergence is established only in Club III (Greece and Latvia), while in the other clubs a process of transitional divergence is present. The Scandinavian countries and the countries of central and western Europe have some of the highest rates of recycling. At the opposite pole are Romania, Malta, Croatia and Cyprus, which are mainly divergent countries or in the clubs with significantly lower values than the average for the European Union. Except for the indicators RRWPW (Club II), RRGPW (Club III) and RBW (Club IV) Bulgaria is included among the countries of convergent Club I. The average values of the individual indicators for the country are close to the EU-27 averages, and in terms of plastic packaging, the country recycles on average 9 percentage points more than the Community. The most clearly expressed is the lag in the recycling of biowaste, which is more than 3 times.

4. CROSS-CORRELATION ANALYSIS OF PACKAGING WASTE INDICATORS IN BULGARIA AND THE EUROPEAN UNION

In this section, we apply cross-correlation analysis (Box, Jenkins, Reinsel, & Ljung, 2015, p. 431) to assess the dynamic relationship between generated and recycled packaging waste in Bulgaria and the European Union over the period 2005 - 2019. We obtained time series for "Waste generated" and "Recycling" from Eurostat (Waste statistics), subsection "Packaging waste by waste management operations". The unit measures of the indicators are kilo tonnes (kt). We present the dynamics of the time series under study in Figure 1. The overall impression from the visual inspection is that all indicators are nonstationary. It is further observable that a straight line can model the trend pattern in the time series. The exception is the indicator of generated packaging waste in Bulgaria, for which a model with a parabolic trend seems the most appropriate. A necessary condition for correctly applying the cross-correlation analysis is that the time series under study should be stationary. We analyse the nonstationarity of the generated and recycled packaging waste through the augmented Dickey-Fuller test. The lag order, determined by the general-to-specific procedure, is 0 for all auxiliary models. For the selection of a particular specification (among "constant and trend", "constant", and "without constant and trend")[1], we use the procedure proposed by Dolado et al. (1990). We perform all tests at a significance level of $\alpha = 0,05$.

---

[1] The general form of the auxiliary model with 0 lags is: $\Delta z_t = \mu + \delta t + \gamma z_{t-1} + \varepsilon_t$.
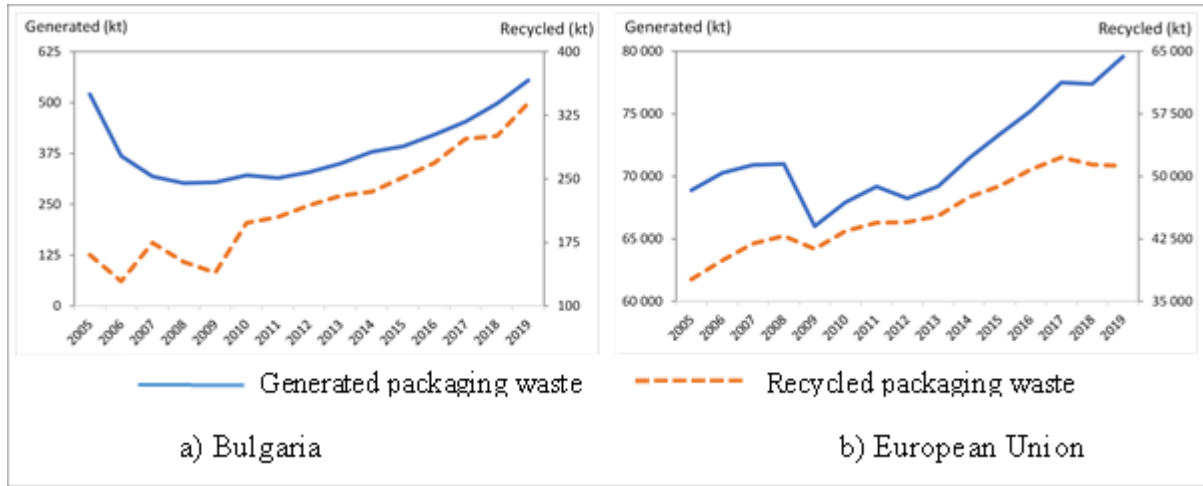
Figure 1: Generated and recycled packaging waste in Bulgaria and European Union in the period 2005-2019
(Source: https://ec.europa.eu/eurostat)

Initially, we test the hypotheses of integration ($H_0: \gamma = 0$) and absence of trend ($H_0: \gamma = \delta = 0$) in a "constant and trend" model specification employing the test statistics τ_t and Φ_3. The empirical values of τ_t for the generated (-7,04) and the recycled (-4,01) packaging waste in Bulgaria are larger in absolute value than the critical value (-3,60). Therefore, we reject the hypothesis of integration of these indicators. Testing for a trend in the auxiliary regression model $\Delta z_t = \mu + \delta t + \varepsilon_t$ yields test statistics of 4,55 and 1,21 for the generated and recycled packaging waste in Bulgaria, respectively. The theoretical value of the test statistic that follows a standard *t*-distribution with 12 degrees of freedom is 2,18. Since the test statistic for the generated packaging waste in Bulgaria is larger than the critical value, there is a parabolic trend[2] in the time series. Such is not present in the time series for recycled packaging waste because the test statistic is smaller than the critical value. For the European Union indicators, we cannot reject the hypothesis of integration as the values of τ_t do not exceed in absolute terms the theoretical limit. The empirical values of Φ_3 (1,53 and 2,91 for the indicators of generated and recycled packaging waste in the European Union, respectively) are smaller than the critical value (7,24). Hence, it is reasonable to proceed to the next stage of the procedure, i.e. testing in a "constant" model specification. The evaluation of $H_0: \gamma = 0$ and $H_0: \gamma = \mu = 0$ for the generated and recycled packaging waste in the European Union by τ_μ and Φ_2 in a "constant" auxiliary model leads to the following statistical conclusions. We cannot reject the integration hypothesis for both indicators. Also, we reject the hypothesis of no constant for the generated waste indicator. The presence of a constant in the auxiliary model for recycled waste, i.e. the presence of a linear trend in the indicator in levels, is also confirmed by the examination of $H_0: \mu = 0$ in $\Delta z_t = \mu + \varepsilon_t$. The empirical value of the *t* statistic (3,00) is greater than the critical value (2,16) at 13 degrees of freedom. At the last stage of the procedure of applying the augmented Dickey-Fuller test, we assess the hypothesis of integration of the indicator of packaging waste generated in the European Union in a "without constant and trend" model. The empirical value (1,49) is not smaller than the critical value (-1,95), which prevents us from rejecting the hypothesis. The overall conclusion from the examination of the nonstationarity of the generated and recycled packaging waste indicators is that the European Union time series are integrated, whereas the time series for Bulgaria are stationary around a trend. In order to conduct the cross-correlation analysis, the following transformations are necessary.

---

[2] The presence of a linear trend in a model of first differences implies a parabolic trend in the original data.

First, the indicators for packaging waste in the European Union are rendered stationary by first differencing. Second, the indicators for packaging waste in Bulgaria are rendered stationary by removing a parabolic and a linear trend for the generated and the recycled waste, respectively. We perform cross-correlation analysis based on the stationary parts of the indicators of packaging waste generated and recycled for Bulgaria and the European Union. Among the estimated cross-correlation coefficients of the time series for generated and recycled waste in Bulgaria, none is statistically significant at a 5% risk of error. This leads to the conclusion that there is no relationship between the two indicators in Bulgaria. The situation in the European Union differs from that in Bulgaria in that the only statistically significant cross-correlation coefficient (0,73) is at lag 0. This points to the reasonable assumption that there is a relationship between generated and recycled packaging waste manifested within the current year.

5. ANALYSIS OF THE DEGREE OF UTILIZATION OF GENERATED INDUSTRIAL AND HAZARDOUS WASTE BY ECONOMIC ACTIVITY

The green economy is based on models underlying the efficiency in the use of resources by minimizing the loss of materials and the generation of waste, but it also involves processing waste and using it as a raw material and building a low-carbon economy. For the period 2007-2020, the total amount of generated industrial waste shows an overall downward trend – from 166605.6 thousand tonnes to 81945.2 thousand tonnes in 2020, with the value for 2020 being twice as small compared to 2007. The decrease compared to 2019 is 33.46%, and the average annual rate of decrease for the period is 3.08%. The waste sent for utilization increased almost 2.5 times, with the average annual growth rate being 7.07%. During the period, the waste sent for disposal increased 1.7 times – from 3524.7 thousand tonnes in 2007 to 5862.8 thousand tonnes in 2020, and the average annual increase for the period is 4%. The exported waste tripled – from 42 thousand tonnes to 125.9 thousand tonnes, with an average annual increase of 8.8%. The dynamics of the generated non-hazardous waste shows a trend of almost 2.4 times as low compared to 2007, with the average annual decrease being 6.62% or 7516 thousand tonnes. Non-hazardous waste sent for utilization increased almost 1.6 times, with the average annual growth rate being 3.48%, or 223.7 thousand tonnes. The average annual growth of non-hazardous waste sent for disposal is 4.2% or 186.3 thousand tonnes. During the analyzed period, exported non-hazardous waste increased 2.3 times – from 35.4 thousand tonnes to 125.9 thousand tonnes in 2007 and to 126.6 thousand tonnes in 2014, and their amount in 2020 is also significant – 119.9 thousand tonnes. Their average annual growth for the period is 3.2% or 6.5%. The results of the test for the presence of a trend using the first-order autocorrelation coefficient (r_1) show that there is a trend for the following time series: total waste generated (y_1), waste sent for disposal (y_2), non-hazardous waste generated (y_3), non-hazardous waste sent for disposal (y_4), exported hazardous waste (y_5). (see Table 1).

	r_1	Trend models	r	R^2	F	Significance F
y_1	0.552	$\hat{y} = 154915 + 4996.1t - 677.88t^2$	0.804	0.646	10.034	0.0033
y_2	0.514	$\hat{y} = 154915 + 4996.1t - 677.88t^2$	0.715	0.511	5.755	0.0195
y_3	0.540	$\hat{y} = 172274 - 5541.1t$	0.759	0.576	16.298	0.0017
y_4	0.998	$\hat{y} = 3029.1 + 1174.6t - 62.047t^2$	0.719	0.517	5.888	0.0183
y_5	0.593	$\hat{y} = 9,843 - 4.1299t + 0.6226t^2 - 0.0246t^3$	0.876	0.767	10.941	0.0017

Table 1: Characteristics of trend models
(Source: National statistical institute and author's own calculations)

During the period, the relative share of non-hazardous industrial waste decreased from 99.5% to 83.1%, but the share of hazardous waste in the total amount of the generated waste from economic activities increased from 0.5% to 16.9%. In the structure of the generated industrial waste, the dominant relative share is the extractive industry, which accounts for between 70% and 85%, followed by the processing industry and the production and distribution of energy and fuels. The relative share of waste intended for utilization from the extractive industry is very low, and at the same time this is the sector in which almost 2/3 of the industrial waste is generated. Significant changes occurred in the structure of waste intended for utilization, in the structure of non-hazardous waste intended for utilization and in the structure of hazardous waste intended for utilization and in the structure of hazardous waste intended for disposal – the integral coefficient of structural changes is between 0.33 and 0.73. Less pronounced changes occurred in the structure of waste from economic activities, non-hazardous waste intended for utilization and non-hazardous waste intended for disposal. During the analyzed period, Bulgaria ranked second in terms of the indicator "generated waste per unit of GDP" in the EU after Estonia and several times exceeded the average values for the EU-27. Bulgaria is better positioned according to the indicator "generated industrial waste per capita", for which the values are lower than the EU average. The analysis of the degree of treatment of waste from economic activities is based on the following indicators: general coefficient of utilization and general coefficient of disposal of waste from economic activities; partition coefficients for waste utilization and waste disposal calculated for non-hazardous waste, for hazardous waste, by economic activity, by type of waste, etc. The waste utilization coefficient varies between 0.8% for 2010 and 10.2% for 2020, and the disposal coefficient of waste from economic activities – from 2.1% to 9.6%, with both indicators having an upward trend. It is found that the sectors with the lowest share in the generation of hazardous waste have the highest values of the coefficient of hazardous waste utilization. At the same time, the extractive industry, which has the highest share in the generation of waste, has the lowest values of the coefficients of waste utilization and waste disposal. The achieved results regarding utilization and disposal of waste from economic activities are insufficient to meet modern standards for environmentally friendly production, efficient use of natural resources and the use of waste as a resource.

6. STATISTICAL ANALYSIS OF MUNICIPAL WASTE GENERATED IN A REGIONAL ASPECT IN THE CONTEXT OF THE CIRCULAR ECONOMY

The differences in regional aspect according to the amount of generated municipal solid waste by district and the possibilities for its reuse are analyzed using the taxonomic analysis. The changes in terms of structure of the municipal solid waste sent for preliminary treatment, for recycling and for direct disposal by district are summarized based on the use of the integral coefficient of structural changes and differences. The study is based on official statistical data of the National Statistical Institute and the Executive Environment Agency of the Ministry of Environment and Water for the period 2011-2020. The indicators and definitions of municipal solid waste comply with the Waste Management Act. NSI provides information on total municipal solid waste and municipal solid waste per capita; on the number, occupied area and residual capacity of landfills and installations for municipal solid waste treatment; as well as on the number of settlements and the relative share of the population served by the municipal waste collection systems (NSI, n.d.). The objectives of the conducted research are divided into two directions: tracking the level, dynamics and structure of the generated municipal solid waste by district in total and per capita for the period 2011-2013 using the taxonomic analysis; and studying the structural changes and differences of municipal solid waste directly deposited, sent for preliminary treatment and sent for recycling for the period 2013-2020. The indicators used in the analysis of generated municipal solid waste by district in total and per capita are: total municipal solid waste and collected municipal solid waste per capita of the population served,

average annual absolute growth, average annual growth rate and an indicator determining the trend through the linear smoothing model for the period 2011-2020. All indicators are included in the observation matrix. As a result of using the taxonomic analysis, some of the factor variables less significant for the analysis are eliminated. After the procedure of standardizing the features and building a distance matrix, the groups with similar features are identified. The final form of the matrix consists of seven factor features defining different aspects of generated municipal solid waste by district and each of them is a typical representative of the group that it defines. The districts are ranked according to the integral estimation obtained for each of them. The research results rank Kyustendil district as leading with the smallest value of the integral estimation. The next four positions are occupied by the districts of Pazardzhik, Lovech, Burgas and Gabrovo having close integral estimation values. These are also the districts that are doing better within the country in terms of policy and measures that are successfully implemented in the collection of generated municipal solid waste. In the other part of the ranking with the maximum integral estimation value is the district of Sofia (capital), which also means the most unfavourable position in terms of the estimated indicators. The integral estimation by district has close values and shows slight differences between the districts in terms of municipal solid waste management. The results of the study of structural changes and differences of municipal solid waste directly deposited, sent for pre-treatment and sent for recycling are presented based on the changes in the structural aspect of the municipal solid waste sent for preliminary treatment, for recycling and for direct disposal by district. The outcome of the analysis is summarized based on the use of the integral coefficient of structural changes and differences. The analysis by structural element in general shows an increase in the relative share of municipal solid waste sent for preliminary treatment at the expense of a decrease in the share of directly landfilled municipal solid waste in 2019 compared to the base year (2013). There is a negative trend in the changes regarding the municipal solid waste sent for recycling – on the whole for the country for the period 2013-2019, the recycling of municipal solid waste in Bulgaria decreased both as a relative share and in absolute units. In order to more effectively manage waste in each municipality, it is necessary to move from the current scheme of collection and treatment of mostly mixed municipal solid waste to a new more efficient way, based on the experience of other European countries. Bulgaria needs to change current practices to new ones, requiring intensive separation at the source, combined with a "municipal solid waste" fee according to the amount and use of a deposit system for beverage bottles and other packaging. Waste management must be continuously improved and turned into sustainable materials management in order to protect, preserve and improve the quality of the environment, protect human health, ensure the reasonable and efficient use of natural resources, promote the principles of the circular economy and reduce the country's dependence on imported resources, thus providing new economic opportunities and long-term competitiveness.

7. CONCLUSION

Summarizing the results obtained, the following general conclusions can be drawn. First, as a result of the conducted dynamic classification of EU countries, it was found that the transition to a circular economy is most advanced in Germany, the Netherlands, Belgium, Spain, Italy and Luxembourg. The differences between the leading clusters and the rest are generally decreasing, but the transition to a circular economy is faster in the clusters assigned an intermediate position, and more slowly in the clusters in the last places. Second, according to each of the indicators included in the analysis, the absence of a process of general convergence and the presence of club convergence between the EU-27 countries during the period 2012-2019 was established. The predominant number of convergent clubs is two, with the exception of the indicators RRMW and RRGPW – three each and RBW – four.

The presence of divergent countries is not established for two of the investigated indicators – RRWPW and RBW. Convergence among countries in four of the clubs formed is relative, while in the others there is a process of transitional divergence and phase reversal. Third, based on the cross-correlation analysis, we find no relationship between generated and recycled packaging waste in Bulgaria from 2005 to 2019. Between these indicators in the European Union for the same period, there is reason to argue that there is a relationship that occurs within the current year. Fourth, the values of the indicators of waste utilization and rendering waste harmless clearly show that in Bulgaria the waste from economic activities is mainly landfilled, and this is associated with additional costs and leads to environmental pollution. The used model of managing waste from economic activities must be changed in order to achieve higher efficiency in using the resources, increasing the share of recycled and reused waste from economic activities so as to meet modern standards for environmentally friendly production and transition to a circular economy. Lastly, the differences in regional aspect in Bulgaria according to the amount of generated municipal solid waste by district and the possibilities for its reuse are analyzed using the taxonomic analysis. The districts are ranked according to the integral estimation each of them has received. The areas that are doing better within the country in terms of policy and measures that are successfully implemented in the collection of generated municipal solid waste are identified. The integral estimation by district has close values and shows slight differences between the districts in terms of municipal solid waste management.

LITERATURE:
1. Box, G. E., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2015). *Time series analysis: forecasting and control (5th ed.)*. New Jersey: John Wiley & Sons.
2. Caporale, G. M., You, K., & Chen, L. (2019). *Global and regional stock market integration in Asia: A panel convergence approach*. International Review of Financial Analysis, 65, 101381.
3. Dolado, J., Jenkinson, T., & Sosvilla-Rivero, S. (1990). *Cointegration and unit roots*. Journal of economic surveys, 4(3), pp. 249-273.
4. Kasabova, S. (2022). *Analysis of carbon emmisions in the atmosphere by pollution sources (in bulgarian)*. International scientific-practical conference "The circular economy in the context of the relationship Industry 4.0 – Society 5.0". Svishtov, 21-22.11. 2022, pp. 318-324.
5. Panopoulou, E., & Pantelidis, T. (2009). *Club convergence in carbon dioxide emissions*. Environmental and Resource Economics, 44(1), 47-70.
6. Petkov, P. (2022). *Econometric estimation of the influence of the education level of the population in Bulgaria on the rate of recycling of domestic waste (in bulgarian)*. International scientific-practical conference "The circular economy in the context of the relationship Industry 4.0 – Society 5.0". Svishtov, 21-22.11. 2022 Svishtov, pp. 104-111.
7. Petkov, P. & Varbanov, T. (2022). *Econometric estimation of the influence of the circular economy on the socio-economic development of the EU countries*. Book of Proceedings – 87th International Scientific Conference on Economic and Social Development. Svishtov, September 2022, pp. 129-139.
8. Petkov, P. et al. (2023). *Waste management in Bulgaria and the European Union - a comparative analysis (in bulgarian)*. Almanac "Scientific Studies" (in press).
9. Phillips, P. C., & Sul, D. (2007). *Transition modeling and econometric convergence tests*. Econometrica, 75(6), 1771-1855.
10. Shopova, M. & Ovchinnikov, E. (2022). *Structure of packaging waste in Bulgaria and Europe (in bulgarian)*. International scientific-practical conference "The circular economy in the context of the relationship Industry 4.0 – Society 5.0". Svishtov, 21-22.10.2022, pp. 318-324.

11. Shopova, M. & Ovchinnikov, E. (2022). *Testing the Waste Kuznets Curve on the Example of Bulgaria.* 28th RSEP International Conference on Economics, Finance & Business, Rome, pp. 64-71. DOI: https://doi.org/10.19275/RSEPCONFERENCES225.

12. Slaveva, K. (2022). *The green deal and economic growth – statistical aspects (in bulgarian).* International scientific-practical conference "The circular economy in the context of the relationship Industry 4.0 – Society 5.0". Svishtov, pp. 299-306.

13. Slaveva, K., Kasabova, S. & Krastev, V. (2022). *Status of emissions of key air pollutants – structure, dynamics, factor influekces and opportunities for reduction.* Book of Proceedings – 87th International Scientific Conference on Economic and Social Development. Svishtov, September 2022, pp. 350-360.

14. Von Lyncker, K., & Thoennessen, R. (2017). *Regional club convergence in the EU: evidence from a panel data analysis*. Empirical Economics, 52(2), 525-553.

15. Waste statistics. (n.d.). Retrieved 20.8.2022, from Eurostat: https://ec.europa.eu/eurostat/web/waste/data/database.

SARS VERSUS COVID-19 IMPACT ON GLOBAL ECONOMIC

Huashuai Zu
Hefei No.8 Senior High School, Hefei, China
hszu1207@yahoo.com

ABSTRACT
SARS and COVID-19 are two serious viruses that significantly affect human society. The pandemics caused by the two viruses both influence the development of the global economy. This essay compares the impact of the two pandemics on the global economy. It first offers an overview of the two pandemics and their economic impacts on the global economy. It then discusses the reasons behind the differences with a focus on four aspects: the differences in the two viruses, cultural effect, time effect, and policy influence. While COVID-19 and SARS appear to be similar, their economic impacts are different.
Keywords: *SARS, COVID-19, pandemic, economic influence, global economy*

1. INTRODUCTION

The recent COVID-19 pandemic has left a dramatic impact on the global society. In particular, global economics bear great damages. However, it is not the first pandemic to have caused a shock to the world economy. About two decades ago in November 2002, SARS, another virus that was even more deadly, hit the world. Both the SARS and COVID-19 pandemics significantly influence the development of global economy with the lockdowns resulting in large economic losses., while there are actually many differences. This paper compares the impact of SARS and COVID-19 pandemic on the global economy. The first two chapters offer a brief overview of the two pandemics and their economic influences on human society. The third chapter explores why there are these differences. Although some argue that SARS and COVID-19 pandemics are similar, their economic impacts are different in many aspects due to the two viruses' different characteristics, cultural effects, time effects, and policy influences.

2. COVID-19 AND ITS ECONOMIC IMPACT ON GLOBAL ECONOMY

Since December 2019, the virus of COVID-19 has become a serious problem that all the people around the world faced. It belongs to the family of coronavirus and was deadly at the beginning of the pandemic. When COVID-19 first spread out, it led to serious problems. Millions of people crowded into the market to buy necessities, causing the further spread of the virus. Schools had to suspend their classes and transform to online education. Numerous restaurants and hotels were forced to close and had to lay off employees. Hospitals were filled with patients suffering from pain and exhausted doctors and nurses. Many families lost their loved ones. People had to wear masks to protect themselves and be isolated from social life. As the virus keeps mutating, it appears to be milder and cause similar symptoms like severe flu. Many took off their masks and declaim that the pandemic is over. However, the virus did not stop its bad impacts. In fact, the virus's influences even have not ceased so far. It left long-lasting impact on global economy.

2.1. Economic Impact

The COVID-19 pandemic has far-reaching and tremendous impacts on the global economy. The World Development Report published by World Bank argues that the COVID-19 pandemic triggered the largest global economic crisis seen in over a century, "as countries enacted unprecedented emergency measures, such as travel bans, mobility restrictions, closure of nonessential businesses, limitations on public gatherings, and mandatory home-based work, that severely affected economic activity (World Bank, 2022, p. 26).

It is estimated that estimated that approximately 90 percent of countries experienced contraction in economic output, and the world economy contracted by about 3 percent in 2020 according to World Bank (2022, p. 26). Also, the number of countries experiencing negative output growth exceeded that of the two world wars and the Great Depression (World Bank, 2022, p. 26). The claim is supported by International Monetary Fund (IMF)'s statistics. IMF estimated that "global median GDP dropped by 3.9 percent from 2019 to 2020: because of the pandemic, which is "the worst downturn since the Great Depression" (Oum, Kates and Wexler, 2022). During the world-wide economic recession, countless companies did not hold up and numerous people lost their jobs.

2.2. Sectors Affected
The COVID-19 pandemic also has a comprehensive impact on nearly all the fields. Tourism was first affected. Since countries closed their boundaries to control the input of the virus from visitors oversea. States and cities also restrict the free flow of people for the same purpose. Sectors closely associated with tourism were then affected, like the hospitality, retail, food service, and recreational industries. Lockdowns, mandatory requirements for social distancing and masking as well as the public's fear of infection further affected those service industries. Hotels, restaurants, and stores were either forced to close their doors for public security or break down as a result of losing customers. In addition, as many people lost their jobs or faced a reduction in incomes, financial insecurity limited their spending power, which led to a declining domestic demand. The financial insecurity brought risks to the financial sectors, as people had trouble paying off their debts, and had to borrow more money to pay their bills. Because of lockdowns and unemployment caused by infections and sequela, industries that involves in-site working and could not go online like manufacturing were hit heavily. Since some had to sell their properties to pay off debts and less had the extra money to buy a house, the real estate sector was also impacted. Even the health care sector that was supposed to benefit from the crisis was also impacted. The repeated infections exhausted medical staff, posing threats to health care institutions.

2.3. Shock on Traditional Economics
During the long COVID-19 pandemic, some old forms of economics, such as the retail trade, were weed out, while some new forms developed, like the online shopping and online education. As discussed above, either voluntary or involuntary, many people were trapped in their homes and reduced outdoor activities during the COVID-19 pandemic. For safety and convenience, people turn to the digital platforms for their demands from purchases to entertainment. Therefore, traditional forms of economics like retail trade lost their customers and have been replaced by the new digital forms. According to the data of the Census Bureau of the United States, "e-commerce sales increased by $244.2 billion or 43 percent in 2020, the first year of the pandemic, rising from $571.2 billion in 2019 to $815.4 billion in 2020" (Brewster, 2022). As for education, due to the COVID-19 pandemic, educational institutions moved their classes to online platforms. Zoom, a video conferencing company, experienced an exponential growth in 2020 during the COVID-19 pandemic based on an article by BBC News (Zoom sees more growth after 'unprecedented' 2020, 2021). Even after the pandemic, many universities keep online education as their options for students.

2.4. Impact on People's Daily Life
The evolution of economic forms is established on COVID-19 pandemic's impact on the convention of people's daily life. The shift from in-store visiting to online shopping discussed above is one of the changes brought by the COVID-19 pandemic.

The pandemic transformed consumer's behaviors, leading customers to prefer online shopping and at-home delivery (Brewster, 2022). The comfort and convenience of those new forms make customers stay in the online comfort zone even after the pandemic, influencing the overall economy. Another major change is on people's dining behaviors. Owing to the COVID-19 pandemic, many people had to eat at home. Home delivery, pick-up, and home cooking became people's preferences. The customers do not return to their pre-pandemic practices because of "two years of lock down habits and a shift to a work-from-home model" based on an article published on Nation's Restaurant News (Fantozzi, 2022). In response to the change, dining hours of restaurants in the United States have been decreasing their hours, even in October 2022 (Fantozzi, 2022).

2.5. Long Recovery
Due to the profound influence of the COVID-19 pandemic, the global economics recover slowly. From the case of in-store shopping and dining in discussed in the chapter above, obviously the recovery of global economics from the shock of the COVID-19 pandemic is hard and slow. It is estimated that the global economy can recover in 2021 (Oum, Kates and Wexler, 2022). However, according to the report of World Bank (2022), only 40 percent of advanced economies, 27 percent of middle-income countries, and 21 percent of low-income countries "recovered and exceeded their 2019 output level in 2021" (p. 2). For that the COVID-19 pandemic was more than two years long, the damage it caused to the global economy was huge, so it is more difficult for global economy to renounce. The vaccine access and coverage also threaten the recovery (Oum, Kates and Wexler, 2022), considering that the variations of the virus is still spreading. In addition, as the COVID-19 pandemic hit many sectors as well as the traditional forms of economics, many companies had to make a transition to embrace the change, which is also time consuming.

3. INTRODUCTION OF SARS
Start in November 2002, SARS was another serious virus that caused many people die. It was also a type of coronavirus like COVID-19. The outbreak of SARS was in China in late 2022. It was first reported in East Asia in February 2003 and then spread to the world based on Centers for Disease Control and Prevention of the United States (Severe Acute Respiratory Syndrome (SARS) Basics Fact Sheet, 2017). Based on the data of the World Health Organization (WHO), SARS infected 8090 people around the world and caused a death of 774 (Severe Acute Respiratory Syndrome (SARS) Basics Fact Sheet, 2017). The symptoms of SARS include high fever, headache, discomfort, body aches, and pneumonia (Severe Acute Respiratory Syndrome (SARS) Basics Fact Sheet, 2017). Although SARS was deadly and greatly affected the global society at the time, its impact on the global economy is highly limited.

3.1. Limited Economic Impact
The impact of the SARS pandemic was really large at first, but the influence was limited because the virus did not last for long and only reach to a few of areas. The SARS pandemic broke out in the late 2002 and was contained in mid-2003 (Seladi-Schulman, 2021). It means that the SARS pandemic only lasted for less than a half year. Based on an article published on Reuters, one of world's most renowned media, it was estimated that SARS caused a global economic loss of $40 billion and a 0.1 percent hit of world gross domestic product in 2003 (Carvalho, 2020). Moreover, the impact of the SARS pandemic is more localized. By the time it was fully controlled, SARC was only found in 17 countries (White, 2020). Despite that it affected the global economy, those 17 countries bore the most damages. Especially, China, the first countries where the virus was found, was impacted mostly. Of about total 8000 infections, nearly 6000 patients were in China (Carvalho, 2020).

Of the impact of SARS on GDP, China bore a loss of about 15 billion, approximately third-one of the global impacts. Clearly, the damage was high at the time, but it did not last for long and only hit several places dramatically.

3.2. Sectors Affected

The economic impact was not merely localized, but limited in only some sectors, like tourism and catering industry in a short period. Since the SARS pandemic lasted for only six months in China and even shorter in the other parts of the world, it only affected a few industries. Using China as the example, the sector that was among the worst hit was retail sales, with a growth of 4.3 percent in May 2003 that was "the slowest pace on record" (Lee, 2020). With lockdowns and the reduction of customers, tourism, hospitality and catering, and services industries were affected. Other areas like the industrial sectors were also affected, but the impact was highly limited. For example, the growth in production in China only decreased from 20 percent to 13.7 percent from January to May 2003 (Lee, 2020).

3.3. Quick Recovery

For that the SARS pandemic was contained in a relatively short amount of time and ended within a few months, the economic recovery time following SARS was also short. Most countries bouncing back to pre-pandemic levels within a few months. China was worst hit with more than 5500 patients, but its economy rebounded soon. The value retail sales returned to a growth of about 8.0 percent in June 2003, and increased back to 10 percent in July 2003, which was as high as that in January 2003 (Lee, 2020). Although the MSCI China index of equity diverged from its global peers after the outbreak of SARS in China, the gap was recovered within only a half year (Carvalho, 2020). For other disease-inflicted countries and other parts around the world, the impact was even milder, and the recovery was thus much easier.

4. REASON BEHIND THE DIFFERENCES

If comparing the economic impact of the COVID-19 pandemic with the SARS pandemic, we can find that the two pandemics have many differences. SARS is more short-lived, so its impact was relatively large at that time, but the impact was limited in only a few areas and the global economy recovered quickly. COVID is more long-lasting with a stronger impact. It not only heavily hit the global economy in almost all the sectors and caused a global economic crisis and recession, but also caused industrial transformation abandoning old forms of economics and the change of the convention of people's daily life. The recovery time needed by the world is extremely long. The pandemic broke out in December 2019, but the world's economy still has not rebounded. Based on a report published by the Organisation for Economic Co-operation and Development in September 2022, the world economy was slowing more than anticipated (Paying the Price of War, 2022). Despite that the global economy was greatly affected by other factors, like the Russo-Ukrainian War, the impacts of the COVID-19 pandemic still lingered (Paying the Price of War, 2022). In my opinion, at least four factors contribute to the differences in the two pandemics' impacts on the global economy.

4.1. Two Different Viruses

While both SARS and COVID-19 belong to the family of coronavirus, they are totally different with varying characteristics. First, the severity is different. While only 20 percent of patients infected by COVID-19 will need to be hospitalized for treatment, about 20 to 30 percent of patients with SARS needed mechanical ventilation, which is a life support beyond normal treatment (Seladi-Schulman, 2021). Second, the capacity to spread of the two viruses is also different. COVID-19 appears to be transmitted more easily than SARS; people who were infected by COVID-19 may pass on the virus in the early stage of the infect, or even before

showing any symptoms, which is rarely seen with a SARS infection (Seladi-Schulman, 2021). The high severity and transmission decide that it was much more difficult to control the COVID-19 pandemic, leaving its economic impacts to be greater and more profound.

4.2. Time Effect
Since the COVID-19 pandemic is much more lasting than the SARS pandemic, the time effect contributes to the differences in their impacts on the global economy. As aforementioned, the outbreak of the SARS pandemic was less than a half year, and it was much shorter in areas other than China. The time period of the COVID-19 pandemic is extended, so it brought a greater disruption to the global economy because the longer the outbreak lasts, the more damage it causes, and the more difficult for the global economy to rebound. Without timely recovery, many companies fell and could not recover. The change of people's behaviors and even wellness challenged many economic sectors, which could not be made up by time. Time effect decides that the impact of COVID-19 would be more expansive and profound than that of SARS.

4.3. Cultural Effect
The attitudes towards the COVID-19 pandemic and the SARS pandemic are different as well. When the SARS pandemic first broke out, it was the first time that the world coped with such a virus. Therefore, the world treated it with fear and caution. The world showed a serious attitude when the disease was reported. For example, in the United States, although only eight people were tested to be infected with SARS, Centers for Disease Control and Prevention made a prompt response and took many actions, including activating the Emergency Operations Center for coordination and response, and initiating a system for "distributing health alert notices to travelers who may have been exposed to cases of SARS" (Severe Acute Respiratory Syndrome (SARS) Basics Fact Sheet, 2017). As for the case of COVID-19, even though governments around the world took drastic measures to control the spread of the virus from lockdowns to social distancing regulations, the truth is it was not treated seriously at first expect China. After China reported the virus and potential risk to the global society, other countries did not take any actions and believed that the virus was not a big deal because of its precedent, SARS. In this way, the world missed the best time and opportunity to contain the spread of the virus, and let it get out of control, leaving tremendous impact on the global economy.

5. CONCLUSION
The SARS pandemic and COVID-19 pandemic are both caused by viruses from the family of coronaviruses and have similar influences, but they actually affect the global economy differently. Although the impact of COVID-19 is extensive and profound covering about all the economic sectors and transforming forms of economics and people's conventions of life, the impact of SARS was limited and localized. The recoveries from the two pandemics also take different lengths of time. The differences can be attributed to the different severity and capacities to spread, time effects, and cultural effects. The analysis illustrates that it is wrong to simply judge the economic impacts of a virus based on its precedent. Each virus is unique and should be treated seriously.

LITERATURE:
1. Brewster, M. (2022) *Annual Retail Trade Survey Shows Impact of Online Shopping on Retail Sales During COVID-19 Pandemic, United States Census Bureau*. Available at: https://www.census.gov/library/stories/2022/04/ecommerce-sales-surged-during-pandemic.html (Accessed: 1 February 2023).

2. Carvalho, R. (2020) 'Factbox: How a virus impacts the economy and markets', *Reuters*, 21 January. Available at: https://www.reuters.com/article/us-china-health-global-markets-factbox-idUSKBN1ZK2HH (Accessed: 1 February 2023).

3. Fantozzi, J. (2022) *Restaurants are still dramatically decreasing their hours, new study shows*, *Nation's Restaurant News*. Available at: https://www.nrn.com/data-research/restaurants-are-still-dramatically-decreasing-their-hours-new-study-shows (Accessed: 1 February 2023).

4. Lee, Y.N. (2020) *4 charts show how SARS hit China's economy nearly 20 years ago*, *CNBC*. Available at: https://www.cnbc.com/2020/02/11/coronavirus-4-charts-show-how-sars-hit-chinas-economy-in-2003.html (Accessed: 1 February 2023).

5. Oum, S., Kates, J. and Wexler, A. (2022) 'Economic Impact of COVID-19 on PEPFAR Countries', *KFF*, 7 February. Available at: https://www.kff.org/global-health-policy/issue-brief/economic-impact-of-covid-19-on-pepfar-countries/ (Accessed: 1 February 2023).

6. *Paying the Price of War* (2022) *OECD*. Available at: https://www.oecd.org/economic-outlook/ (Accessed: 1 February 2023).

7. Seladi-Schulman, J. (2021) *Coronavirus vs. SARS*, *Healthline*. Available at: https://www.healthline.com/health/coronavirus-vs-sars (Accessed: 1 February 2023).

8. *Severe Acute Respiratory Syndrome (SARS) Basics Fact Sheet* (2017) *Centers for Disease Control and Prevention*. Available at: https://www.cdc.gov/sars/about/fs-sars.html (Accessed: 11 February 2023).

9. White, M.C. (2020) *SARS wiped $40 billion off world markets; what will coronavirus do?*, *NBC News*. Available at: https://www.nbcnews.com/business/markets/sars-wiped-40-billion-world-markets-what-will-coronavirus-do-n1122151 (Accessed: 13 February 2023).

10. World Bank (2022) *World Development Report 2022: Finance for an Equitable Recovery*. The World Bank. Available at: https://doi.org/10.1596/978-1-4648-1730-4.

11. *Zoom sees more growth after 'unprecedented' 2020* (2021) *BBC News*. Available at: https://www.bbc.com/news/business-56247489 (Accessed: 1 February 2023).

ONLINE STREAMING E-COMMERCE INFLUENCE ON ECONOMY IN CHINA

Leqi Zhang
Woodside Priory School, California, United States
kzhang26@priorypanther.com

ABSTRACT

Online streaming e-commerce refers to the practice of selling products online via streaming directly to the customers watching the streaming. It gains growing popularity in China in past five years. During the COVID-19 with lockdowns and the sharp decline of in-store visiting, more farmers and retailers began to sell their products online, and more customers turn to the digital platforms and watch online streaming. In this essay, I discuss how online streaming selling becomes popular in China and get supported by the state, and how it contributed to the job market and China's GDP. The analysis shows that online streaming e-commerce plays an important role in boosting Chinese economy.

Keywords: Online streaming, e-commerce, Chinese economy

1. INTRODUCTION

A few days ago, I bought a pack of oranges online because I watched the farmers streaming on the shopping website displaying their oranges that seemed fresh and healthy. The online store was arranged by some farmers from Jiangxi, China. This place is famous for their incredibly sweet oranges. However, in such a place with awesome oranges, people there still do not have a very sufficient life. Most of the farmers in China are poor because they have trouble selling their fruit and vegetables to make a living, but things have changed now. When the COVID-19 pandemic crisis hit China in 2019, offline trading has gradually faded out of people's lives. At the same time, online shopping came in. As long as you have a product and a phone, you are capable to directly sell your products to the broad audience without leaving your areas. The farmers in the rural areas found out that they can sell their fruits and vegetables online, and all they need to do is to advertise their products on their phone. An online streaming flu impacted almost all the people in China during the pandemic. Farmers introduced their crops and displayed how they harvested and how they packed the products. They showed their customers how their packages were before delivery to gain trust that their product was a hundred percent true and fresh, because people tend to trust things they see with their eyes. According to a survey on Chinese TikTok, in 2022, TikTok helped two hundred and sixty thousand farmers to sell their products and the number of orders reached almost seven million. In fact, not just farmers are utilizing online streaming in China. Online streaming e-commerce refers to the practice of selling products online via streaming directly to the customers watching the streaming. Almost people from all economic sectors use online streaming as a tool to boost their businesses or make money. This essay focuses on the influence of online streaming e-commerce on economy in China. It first reviews how online streaming e-commerce grows popular in China and how the Chinese government supports its growth. It then explores how the popularity creates a particular new job and its overall economic impact on China's gross domestic product (GDP). With support from the state, increasingly popular online streaming e-commerce create new job opportunities and boosts Chinese economy.

2. INCREASING POPULARITY OF ONLINE STREAMING

In the past five years, online streaming e-commerce has become increasingly popular in China. Based on Statista, the market size of online streaming is estimated to be 3.49 trillion Chinese yuan (about $51 billion) in 2022 and projected to be 4.92 trillion yuan (about $72 billion) in

2023; and the number was 0.12 trillion yuan (about $1.7 billion) in 2018 (Ma, 2022b). The market size of online streaming increased 41 times in less than five years. The increase does not appear all of the sudden. It is established on Chinese customers' transformation to the online planforms in the past ten years and boosted by the COVID-19 pandemic. The chapter reviews China's transformation to the digital economy and how online streaming e-commerce rose.

2.1. Transformation to the Digital Economy

Although online streaming e-commerce appears to be a new thing, China's transformation to the digital economy started much earlier with the rise of online shopping. Based on a report published by China Internet Information Center, "the number of online shopping users in China reached 361 million by December 2016" (Shou, 2019, p. 149). Before the creation of online streaming selling, the share of Chinese online shopping users rose from 32.7 percent to 51.1 precent by December 2016 (Shou, 2019, p. 149). Yihan Ma (2022c), the Greater China researcher of Statista, states that the demand for online shopping opportunities has rapidly grew in China in the past decade; "the number of online shoppers in China has been increasing exponentially from below 34 million in 2006 to over 466 million users a decade later, enabling this enormous spurt of China's e-commerce sector". These numbers indicate a lasting increase of digital economy. The growth is supported by a number of factors, including the access of high-speed internet, the spread of smart electronic devices like smartphones and tablets, the development of easy-to-use mobile apps, the coverage of infrastructure which facilitates a highly effective and efficient transportation and logistics system, government initiatives encouraging the use of digital payment systems and other supportive policies. The customers also actively transform to the online platforms because of the convenience and low costs. Online shopping is more attractive to customers as it offers a wider range of products than traditional stores. Customers can find anything they need easily by just searching them. Online shopping also allows customers to compare products and find the best deals, which breaks the monopoly of traditional off-line retail sales on prices. By the end of 2021, approximately 81.6 percent of Chinese internet users had online shopping experience (Ma, 2023). Far before online streaming e-ecommerce appears, the majority of Chinese customers has been accustomed to online shopping.

2.2. Rise of Online Streaming E-commerce

The emerging online streaming e-commerce grows in the ground created by the expansion of online shopping and digital payment. The wave of online streaming e-commerce is believed to begin in May 2016 with the arrival of Alibaba's Taobao Live according to a report by McKinsey, world's most influential consulting company (Arora et al., 2021). Taobao is a dominating online shopping platform in China. In 2016, online streaming was not unfamiliar to people and online shopping had become part of many people's life. Taobao, the online shopping giant, creatively combine online livestreaming with online e-commerce, allowing "viewers to watch and shop at the same time" (Arora et al., 2021). It is estimated that the value of China's online streaming commerce increased from $3 billion in 2017 to $171 billion in 2020 (Arora et al., 2021). On Taobao, the number of views of livestreams has exceeded 50 billion. The number will be much larger if adding up views on other platforms, including Chinese TikTok. Besides the ground created by ordinary online shopping, the rapid growth can be attributed to a series of factors, but the major one is the uniqueness of online streaming e-commerce. The report by McKinsey points out that "live commerce is entertaining and immersive, keeping viewers watching longer", and it also "telescopes customer decision journeys from awareness to purchase" (Arora et al., 2021). The customers watching live streaming selling are like watching entertaining shows, and they even do not need to buy anything so as to enjoy the fun. The feature of livestreaming allows a direct, live communication between the merchants and the

customer. Customers can ask any question they have about the product, making the shopping decision process easier. It simulates an in-store experience when customers can talk to the retailers directly. Obviously, online streaming e-commerce offers a shopping experience combining the merits of performance, conventional online shopping, and traditional in-store shopping. The mix of advantages supports its increasing popularity. Another major factor is the COVID-19 pandemic. In order to cope with the pandemic, China took a series of measures, including lockdowns, travelling restrictions, and Health Code system. The flow of people is restricted. Those who prefer traditional in-store shopping were forced to turn to online shopping. Also, as people were trapped at home, the internet and various apps became their primary source for entertainment. In apps like TikTok, online streaming selling live will be prompted to users when they are watching normal short videos, which attracts more people to the new form of shopping. On the other side, farmers, store owners, and producers who have trouble selling their products via conventional channels use online streaming live selling as their remedy. Between May 2021 and April 2022 during the pandemic, over 9 million livestreams were launched TikTok, "selling at least 10 billion pieces of goods, the total sales of which grew 2.2 times year-on-year" (Sun, 2022). Online streaming e-commerce has become a solid part of the digital economy.

3. SUPPORT FROM THE NATION
The rapid growth of online streaming e-commerce can not be achieved without the strong support from the Chinese government. Since the first emergence of online streaming selling, the Chinese government has been a strong supporter of online streaming selling. For merchants and companies, policy support includes subsidies, tax reduction, and revitalization policy, and technical and logistical assistance. For example, under the support of the Chinese government's rural revitalization policy, in the livestreaming events held on Taobao during the annual Harvest Festival, the western region of China gained a sales growth rate of 19.3 percent in 160 key counties (Pandaily, 2022). Being driven by the government guidelines, platforms hold similar events to help farms selling via online streaming. Government's support can also be found in its endorsement for livestreamers. The government endorsed some popular livestreamers as innovators and job creators (Wu, 2022). For customers, the Chinese government has taken actions to ensure that the industry continues to grow and remain competitive in a healthy environment, allowing customers to shop safely. Relevant actions include intensifying regulations on online transactions and helping those who have experienced fraud or other issues, requiring platforms to regulate the merchants' behaviors and offer necessary support to the customers, providing educational resources to inform people of their rights and responsibilities concerning online shopping, and regulating on platform' and merchants' use of customers' personal information. For example, in April 2021, China introduced new regulations on platforms, including requiring them to verify the identity of every livestreamer before each session and establish risk systems to prevent suspicious or illegal marketing tactics (Lu and Hinnant, 2021). The government also growingly "hold live streamers accountable for product quality control, proper reporting of sales numbers, and minors' participation in livestreams" (Wu, 2022). These steps made it easier and safer for people to trust online streaming selling and get engaged.

4. NEW JOB OPPORTUNITIES
The boom in online streaming e-commerce gave birth to a new job, livestreamer. Livestreamers are defined as professional livestream hosts working for online streaming e-commerce, "the salespersons in the age of e-commerce" (Wu, 2022). The number of professional livestream hosts is estimated to be 250000 in 2019 and 1.23 million as of 2020 (Wu, 2022). More and more people choose to join the industry, making the number higher and higher.

It is because that there are less limitations on becoming a professional livestream host. Almost any registered businesses can open an account and promote their products via online streaming (Wu, 2022). From small companies to farmers in the remote regions, everyone can participate in the larger market. Individuals can also be hired by a company as a live stream host or promote and sell manufactures' products on their own streaming channels. Based on a paper published on the CHI Conference on Human Factors in Computing Systems, researchers from Tsinghua University and City University of Hong Kong state that "being an e-commerce livestreamer has become an enticing full-time profession for the young generation, particularly young women from rural or under-developed areas, to earn a living" (Tang et al., 2022, p. 1). Professional livesteamer becomes a popular job along with the rise of online streaming e-commerce. The new era also created many other job opportunities. Individual livestreamer may work alone, but companies and popular livestreamers can hardly deal with all the things with only one or two hosts. Professional livestreamers often need professional marketing teams (Wu, 2022). Popular livestreamers also need others to help with the relevant management, services and the information system issues. For example, a big live streaming selling event needs professional photographers, dressers, lighters, data analysts monitoring background data, software and information engineers dealing with emergent technical issues, and customer services staffs who can timely chat with the customers who could not find their answers in the live because there are too many messages from thousands of viewers. After the live, warehouse and logistics staffs are needed because of the high volume of order. They have to pack the products as soon as possible before customers change their minds. Not surprisingly, Chinese government treats online streaming e-commerce as job creators

5. ECONOMIC IMPACT
The boom in online streaming e-commerce supports the rapid growth of Chinese economy. The economic impact is not limited to the creation of more job opportunities and helping merchants selling more goods. The gross merchandise value of online streaming e-commerce in China grew from 19.64 billion yuan (about $2.87 billion) in 2017 to 3487.9 billion yuan (about $511 billion) in 2022 (Ma, 2022d). The value is effactually reflected on China's GDP. This chapter analyzes the influence of online streaming e-commerce on China's GDP and explores factors contributing to the magic effects. Thriving online streaming e-commerce supports the growth of Chinese economy, and its secrets locates in its powerful mechanism of promoting goods and its positive effect on raising consumption and supply.

5.1. Influence on GDP
Online streaming e-commerce had a significant positive influence on China's GDP growth. Based on the data of World Bank, China's GDP has been continuously rising from 2016 to 2021 (Wrold Bank, no date). Regardless of the COVID-19 pandemic, it increased from $11.23 trillion in 2016 to $17.73 trillion by the end of 2021 (Wrold Bank, no date). China's GDP was 121 trillion yuan (about $18 trillion) according to the National Bureau of Statistics of China (2023). The report by the National Bureau of Statistics of China (2023) highlights the fast growth of online retail sales. The total retail sales of consumer goods was 43,973.3 billion yuan (about $6380 billion), while national online retail sales have a 4.0 percent of growth and reached 13785.3 billion yuan (about $2000 billion) (National Bureau of Statistics of China, 2023). The share of online retail sales in the total retail sales is over 31 percent. Since there are few sources talking about the share of online streaming e-commerce to GDP to China's GDP, we can estimate its contribution by calculation. The share of national online retail sales in China's GDP is 11.39 precent in 2022 based on the data. Based on Statistics, the GMV of online shopping is approximately 13.1 trillion yuan (about $2000 billion) in 2021 (Ma, 2022a). The GMV of online streaming e-commerce is $511 billion as aforementioned (Ma, 2022d).

By dividing the GMV of online shopping by that of online streaming e-commerce, we can get the share of online streaming e-commerce in online shopping, which is about 25 percent. In this way, the share of online streaming e-commerce in overall GDP may be about 2.85 percent. The number appears to be small but marks a major contribution of the sector to overall economy. This does not include contribution made by boosting manufacturing and employment.

5.2. Reason behind the Boost
The huge economic impact of online streaming e-commerce can be attributed to its power in promotion and creating demands. First, online live streaming is effective in promoting goods with lower costs. Since it is convenient to use streaming services and the audience of streaming lives are broader, merchants can expand their customer base, reach new markets, and even sell to those who are not the targeted audience of the product. Also, the use of streaming services and self-marketing helps merchants reduce their costs, creating more profits. The merchants can answer viewers' questions and gain their trust and interest and showcase their products in the way they want. They can flexibly change their strategies and products based on the live data on customer response. These profits eventually become part of China's GDP. Second, as online streaming makes sales smart and effective, it creates demand and consumption. A feature of online streaming e-commerce is that many customers do not intend to buy the products at first. Since watching online streaming sales is treated as a way of entertaining, many people are attracted to certain products in the process of watching live. Merchants can use various ways to stimulate viewers' interest on their products and create demand. This is different from the traditional way that merchants sell to customers based on their demands. Furthermore, merchants use time-limited tactics associated with online streaming, such as one-off coupons, to generate a sense of urgency, creating high conversion rates of 30 percent which is "up to ten times higher than in conventional e-commerce" (Arora et al., 2021). The stimulation of demand and consumption contribute to China's GDP growth.

6. CONCLUSION
Online streaming e-commerce just appears for about six years, it has gained a great popularity and made significant contribution to Chinese economy. The success of online streaming e-commerce can not be separated with China's transformation to the digital economy in the past decade. However, its rapid growth is driven by unique features. Statistics have shown that online streaming e-commerce is a powerful drive of China's national economy by having businesses making more profits, creating more job opportunities, and stimulating demands and consumption. Chinese government, especially local governments, should work to support the development of online streaming e-commerce and let more people get benefited.

LITERATURE:
1. Arora, A. *et al.* (2021) *It's showtime! How live commerce is transforming the shopping experience*, *McKinsey Digital*. Available at: https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/its-showtime-how-live-commerce-is-transforming-the-shopping-experience (Accessed: 3 February 2023).
2. Lu, J. and Hinnant, L. (2021) *China doubles down on regulation of livestream e-commerce · TechNode*, *TechNode*. Available at: http://technode.com/2021/04/23/china-doubles-down-on-regulations-for-livestream-e-commerce-with-new-rules/ (Accessed: 1 February 2023).
3. Ma, Y. (2022a) *E-commerce market GMV in China 2011-2021*, *Statista*. Available at: https://www.statista.com/statistics/1129543/china-e-commerce-market-gross-merchandise-volume/ (Accessed: 3 February 2023).

4. Ma, Y. (2022b) *Market value of live commerce in China 2018-2023*, *Statista*. Available at: https://www.statista.com/statistics/1127635/china-market-size-of-live-commerce/ (Accessed: 3 February 2023).

5. Ma, Y. (2022c) *Number of online shoppers in China 2011-2021*, *Statista*. Available at: https://www.statista.com/statistics/277391/number-of-online-buyers-in-china/ (Accessed: 3 February 2023).

6. Ma, Y. (2022d) *Transaction value of live commerce in China 2017-2022*, *Statista*. Available at: https://www.statista.com/statistics/1188550/china-gmv-of-ecommerce-livestreaming/ (Accessed: 3 February 2023).

7. Ma, Y. (2023) *Penetration rate of online shopping in China 2012- H1 2022*, *Statista*. Available at: https://www.statista.com/statistics/302071/china-penetration-rate-of-online-shopping/ (Accessed: 3 February 2023).

8. National Bureau of Statistics of China (2023) *National Economy Withstood Pressure and Reached a New Level in 2022*, *National Bureau of Statistics of China*. Available at: http://www.stats.gov.cn/english/PressRelease/202301/t20230117_1892094.html (Accessed: 3 February 2023).

9. Pandaily (2022) 'China's Farmers Leverage Village Live-Streaming to Boost Rural Economy', *Pandaily*, 30 September. Available at: https://pandaily.com/chinas-farmers-leverage-village-live-streaming-to-boost-rural-economy/ (Accessed: 1 February 2023).

10. Shou, H. (2019) 'Research on the Operational Risk of E-commerce Security of Commercial Banks in China', in *Proceedings of the 2019 International Conference on Education Innovation and Economic Management (ICEIEM 2019). Proceedings of the 2019 International Conference on Education Innovation and Economic Management (ICEIEM 2019)*, Penang, Malaysia: Atlantis Press. Available at: https://doi.org/10.2991/iceiem-19.2019.12.

11. Sun, C. (2022) *Users of live streaming e-commerce increase*, *China Daily*. Available at: https://www.chinadaily.com.cn/a/202211/24/WS637edee8a31049175432ba87.html (Accessed: 3 February 2023).

12. Tang, N. *et al.* (2022) 'Dare to Dream, Dare to Livestream: How E-Commerce Livestreaming Empowers Chinese Rural Women', in *CHI Conference on Human Factors in Computing Systems. CHI '22: CHI Conference on Human Factors in Computing Systems*, New Orleans LA USA: ACM, pp. 1–13. Available at: https://doi.org/10.1145/3491102.3517634.

13. Wrold Bank (no date) *GDP (current US$) - China*, *The World Bank*. Available at: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CN&start=2016 (Accessed: 3 February 2023).

14. Wu, Y. (2022) *China's Livestream Industry: Impact on Market and Business Strategy*, *China Briefing News*. Available at: https://www.china-briefing.com/news/chinas-livestream-industry-market-growth-regulation-enabling-technology-and-business-strategies/ (Accessed: 1 February 2023).

PRICE DETERMINANTS OF THE CARBON EMISSION ALLOWANCES IN THE EU EMISSION TRADING SYSTEM

Simona Kovachevska-Stefanova
Ph. D Candidate, Ss Cyril and Methodius, University in Skopje
Faculty of Economics – Skopje, Macedonia
kovacevskasimona@yahoo.com

Kiril Jovanovski
Ss Cyril and Methodius, University in Skopje
Faculty of Economics - Skopje, Macedonia
kirilj@eccf.ukim.edu.mk

ABSTRACT
As a consequence of the climate changes occurring at the global level, an international consensus has been reached to limit the global average temperature. To combat climate change, in 2005 the Emissions Trading System of the European Union (EU ETS) was established, limiting carbon emissions. Given the crucial role of the EU ETS scheme and the price signal of the allowances, it is of great importance to analyze the possible price determinants. This paper selects several variables and sets up an econometric model of the Autoregressive Distributed Lag (ARDL)/bound test to examine the impact of the selected variables on the allowance price in the short- and long-term. The analysis results suggest that kerosene futures and economic activity have a statistically significant and positive relationship with allowance prices in the short and long term. The fuel index has a negative relationship, but only in the long run, while the temperature change has a negative relationship in both the short and long run.
Keywords: EU ETS, allowance price, carbon, kerosene futures, ARDL model

1. INTRODUCTION
Climate change has been one of the most unique challenges in recent years. The concern about climate change resulted in setting internationally agreed targets of global average temperature to below 2°C, or around 1.5°C, above pre-industrial levels. The adoption of the Paris Agreement in 2015 created space to undertake certain activities by developed and developing countries to reduce total gas emissions in accordance with country-specific circumstances. However, according to the IPCC Summary for Policymakers, there is the possibility that global warming will reach or exceed 1.5°C in the near term (2021-2040), even for the very low greenhouse gas emissions scenario, which could cause unavoidable increases in climate hazards and risks to ecosystems and humans. This implies that mitigation ambition needs to be scaled up globally. Since carbon dioxide ($CO2$) emissions are the primary driver of global climate change (Ritchie, Roser, and Rosado, 2020), countries have started introducing carbon pricing to combat climate change. In 2005, the European Commission (EC) implemented the European Union's Emissions Trading System (EU ETS) as the first international emissions restriction scheme to be successfully implemented in practice. It is a "cap and trade" scheme for limiting the total amount of greenhouse gases a company can emit. This market operates in all EU countries plus Iceland, Liechtenstein, and Norway, covering around 40 percent of the EU's emissions (including $CO2$, $N2O$, and PFCs emissions) in several sectors including the manufacturing industry, aviation, and power sector (Climate Change, EC 2022). The ETS significantly improved and developed during the 4 phases (from 2005 until 2022). However, certain issues with the price signal and oversupply of emission allowances have been observed.

For the system to be effective in reducing emissions, these problems need to be overcome, and for that purpose, it is of great importance to detect the potential determinants of the allowances price. The paper aims to define the relationship between variables from the energy and economic sectors and global temperature changes. The authors use the ARDL model to examine whether there is an influence of the selected variables on the price of the allowances.

2. DEVELOPMENT STAGES OF THE EU EMISSIONS TRADING SYSTEM

The first pilot phase (2005-2007) was defined under Directive 2003/87/EC, allowing the EU Member States to develop a national plan and decide upon the total quantity of allowances they will allocate. The plans covered emissions originating from the energy sector, production, and processing of ferrous metals, mineral industry, and other activities related to industrial plants for production defined with the Directive. During this period the allowance price exhibited some volatility, in the range of 5 to 30 euros. The price crashed as the publication of the realized emissions from 2005 showed that the market was overly allocated. Following a short recovery in 2007 the allowances were virtually worthless (Hintermann, 2010). The pilot phase showed that the allowances price signal was not market-created, and the emission reduction target was unambitious. As a result, in the second phase (2008-2012) the cap on allowances was adjusted downward. Given the financial and economic crisis, the improved energy efficiency, and the reduced use of coal due to lower gas prices, the emissions reductions in 2009 were greater than expected (EEA, 2010). After 2009, the number of available allowances on the market exceeded the demand creating a large surplus, so the allowances price decreased. EC introduced various measures to reduce the surplus, including the introduction of the Market Stability Reserve (MSR) (ETC CM Report 2022/5). The MSR aims at absorbing the surplus of allowances to ensure market stability and a stronger price signal. At the end of the second phase, i.e. in 2012, the aviation sector, one of the fastest-growing sources of emissions, was included in the EU scheme. For the third phase (2013-2020), according to Directive 2009/29/EC, the emissions cap was significantly decreased to at least 20 percent below 1990 levels or 21 percent below the 2005 levels. The quantity of the allowances was supposed to be reduced by an annual linear factor of around 1.74 percent. In this phase, the allocation method transited from free distribution (grandfathering) to auctioning systems, with a certain portion still available for free allocation. The free allocation was supposed to decrease yearly by equal amounts with an ultimate goal of no free allocation in 2027. Until 2020, only allowances from sectors exposed to a significant risk of carbon leakage were supposed to be allocated free of charge. At the beginning of the fourth phase (2021-2030), EC proposed reaching climate neutrality by 2050, by setting a new target of around 55 percent net reduction of emissions by 2030 compared to 1990, or 61 percent compared to 2005. To achieve this, EC proposed an annual reduction of emissions of around 4.2 percent and a one-off reduction of around 117 million allowances (Climate Change, EC 2022). During these four phases, the ETS significantly developed and improved. According to the ETC CM Report 2022/5, from 2005 to 2021, the total verified emissions decreased by about 36 percent due to the decarbonization trend, i.e. reduced use of coal and lignite for electricity production and increased use of renewable sources. The decrease in emissions in the recent period, from 2020-2021, is also a result of the Covid pandemic, i.e. reduced economic activity. Regarding the source of emissions, the main producer is combustion-related activities. These activities are mostly related to primary energy consumption, meaning the demand for energy by end users and transformation efficiency; and the fuel mix used to transform primary energy into electricity or heat (ETC CM Report 2022/5). Besides this, aviation is a very important sector representing the fastest-growing emissions source. Until 2019, the total verified aviation emissions had a long-term downward trend. During the pandemic (2020-2021) emissions from the aviation sector sharply decreased as many countries closed their borders.

In 2021, emissions in the aviation sector increased by 11 percent compared to 2020, but this level is still 59 percent below pre-pandemic levels (ETC CM Report 2022/5; EEA Report 2022/01). Most of the allowances in this sector are still distributed free of charge, so to influence the reduction of emissions, this sector will have to transition to auction distribution. Given that the combustion-related sectors and aviation represent important sectors in the EU ETS in terms of emissions, this paper selects variables from these sectors to examine if they have an impact on the price of the EUA.

3. LITERATURE REVIEW

Since the EU Emissions Trading System (EU ETS) had been launched in 2005, a substantial amount of studies focused on examining the determinants of the EUA price were published. The relevant literature provides important empirical evidence and explanation of the EUA price movement through various models and variables. Variables are usually divided into three categories: (1) energy sector - prices of coal, oil, natural gas, and electricity, (2) economic activity - economic sentiment and/or industrial production, and (3) weather variables. One of the earliest studies on the EU ETS was conducted by Ellerman et al. (2003), who analyzed the scheme's market design and key features. The study found that the EU ETS had the potential to be a cost-effective policy instrument for reducing emissions and that the use of an emissions cap could create a market for tradable emissions permits. Following the launch of the EU ETS, several studies have examined its effectiveness in reducing emissions. For example, Zhang et al. (2011) analyzed the impact of the EU ETS on carbon dioxide emissions in the power sector, finding that the scheme had led to a significant reduction in emissions from covered installations. Similarly, Schneider et al. (2013) studied the impact of the EU ETS on emissions from the industrial sector and found that the scheme had led to a significant reduction in emissions intensity. Chung, Jeong and Young, (2018) used energy variables (prices of coal, oil, natural gas, and electricity), economic activity variables (industrial production, economic sentiment, and bank lending), weather variables (average temperature and PRE (Precipitation)) and CER (Certified Emission Reduction). They used the Granger causality test, a VECM estimation, and an impulse response function. Their results suggest that the electricity prices have the greatest effect on the allowances prices, while the natural gas price has the least effect. Friedrich et all. (2019) used prices of natural gas, coal and oil as energy variables, the stock index STOXX Europe 50 and 600 as an economic activity proxy, and temperature. They combined time-varying coefficient regression, formal bubble detection, time stamping and crash odds prediction. The results show that coal and gas prices are the most important explanatory variables. Zhao et al., (2018) used MIDAS models to conduct a real-time forecasting procedure considering the prices of coal, crude and gas as energy indicators, and STOXX 50 as a proxy of economic index. According to the results, coal is the best predictor for the movement of carbon prices. Meier and Voss (2020) used a vector auto-regression analysis (VAR) to investigate the influence of gas, coal, electricity, and crude oil prices on the EUA prices. They argue that the EUA prices are significantly influenced by the prices of fuels including crude oil, coal and gas. Li et al., (2021) used a time-varying parameter vector autoregressive (TVP-VAR) model to analyze the impact of oil, gas, electricity, and stock prices on carbon pricing. Their results show that before the second quarter of 2016, when the Paris Agreement was signed, the carbon price was more sensitive to the price of oil, gas, electricity and the stock price, while afterward, the oil price became the most significant determinant. Aatola, Ollikainen and Toppinen (2013) used time series models (OLS, IV and VAR), with several explanatory variables including the electricity, gas and coal prices. Their finding suggests that the price changes of EUA can be explained by energy prices, with the largest influence from the price of electricity.

Lovcha, Perez-Laborda and Sikora (2022) used the Structural Vector Auto-regression model to identify which of the energy sector determinants (including oil, natural gas, coal, electricity prices, and the share of fossil fuels in electricity generation) and economic activity determinants, can explain the carbon pricing. According to the results, most of the price variations can be explained by the analyzed determinants, to a different extent over time. Namely, in the past, there was a larger impact of economic activity and natural gas on the EUA prices, while in recent times the influence of oil, and especially coal prevails. Schumacher et al., (2012) analyzed the impact of energy variables (natural gas, coal and electricity futures), switching price, economic activity (STOXX 600 index), and weather variables (mean/average/maximum temperature) on the EU ETS. They used the Ordinary Least Squares method (OLS) and Instrumental Variable (IV) and proved that the analyzed market fundamentals have a dominant effect on the carbon market, especially energy prices and economic activity as main drivers. Li, Hu and Zhao (2022) used the MSVAR model to investigate the effect of many variables including the price of natural gas, crude oil and coal; a large number of indicators from the bond/stock/exchange markets (including DAX, CAC40, Standard & Poor's 500 Index, EU 3- month and 10-year bond yield etc.). Their finding shows that gas, oil, coal, and DAX are the key determinants of carbon prices. Energy factors have a long-term influence, while economic factors have a short-term impact on the carbon market. Dimos et al., (2020) used a different perspective in their analysis and suggested that the trading volumes from the EUTL and their amount should be used as an explanatory factor for modeling the EUA price too. They used Vector Auto-Regression Analysis to investigate the effect of energy futures prices (coal, natural gas, oil), industrial production index, economic sentiment indicator, transaction volumes and total volume of allowances on EUA prices. Summarizing the results from the relevant literature, the energy variables have the largest effect on EUA prices. Economic activity indicators can also explain some fluctuations, while weather indicators have a smaller or insignificant impact on the prices. Some research papers suggest that other variables (e.g. trading volumes from EUTL) can also be used to explain and forecast EUA prices. Overall, the existing research on the EU ETS has provided important insights into the design, implementation, and effectiveness of this key policy instrument for reducing greenhouse gas emissions in Europe. While the scheme has effectively reduced emissions from covered installations, ongoing research is needed to identify new policy interventions and reforms that could improve its effectiveness and help achieve more ambitious climate goals.

4. DATA AND METHODOLOGY
In this paper analysis, the time series data contain 179 monthly observations from January 2008 to October 2022. For the variables in the model, the following approximations have been chosen:
1) The dependent variable is the European Union Allowance (EUA);
2) Energy sector control variable is represented with the fuel/energy index used as a cumulative index containing the prices of crude oil, natural gas, coal and propane. In addition, data for kerosene futures have been used since the aviation sector was included in the system as one of the fastest-growing sources of emissions starting in 2012;
3) For economic activity determinants we use Industrial Production (IP), STOXX Europe 600 Index and STOXX Europe 50;
4) For temperature variables we use Global Land and Ocean Temperature Anomalies, which represent the difference from an average temperature.

To estimate the long-run and short-run relationships between the chosen variables this study adopts the Autoregressive Distributed Lag (ARDL)/bounds testing cointegration procedure.

The following ARDL model will be estimated to test the cointegration relationship between the variables:

$$\Delta lnEUAt = \sigma lEUAt{-}1 + \delta lnCoalt{-}1 + \theta lnCrudeoilt{-}1 + \vartheta lnESIt{-}1 + \rho lnIPt{-}1 + \gamma lnS600t{-}1 + \tau lnTemt{-}1 + \sum Aj\ lnEUAt{-}1\ p\ j{=}1 + \sum Bi\ lnCoalt{-}1\ q\ i{=}0 + \sum CklnCrudeoilt{-}1\ q\ k{=}0 + \sum DmlnESIt{-}1 + \sum EnlnIPt{-}1\ q\ n{=}0\ q\ m{=}0 + \sum Fl\ lnS600t{-}1\ q\ l{=}0 + \sum GflnTemt{-}1\ q\ f{=}0 + \varepsilon it,$$

where σ, δ, θ, ϑ, ρ, γ, τ are long-run parameters to be estimated, Aj, Bi, Ck, Dm, En, Fl are short-run parameters to be estimated and εit is the white noise vector (disturbance).

The null hypothesis is defined as $H0$: $Aj = Bi = Ck = Dm = En = Fl = 0$, while the alternative hypothesis is defined as $H1$: $Aj \neq Bi \neq Ck \neq Dm \neq En \neq Fl \neq 0$. The null hypothesis suggests that at long run the coefficient equation is equal to zero, while the alternative is the opposite. If we reject the null hypothesis, which will indicate that there is the presence of cointegration, we will specify the error correction model (ECM):

$$\Delta lnEUAt = \alpha ECTt{-}1 + \sum Aj\ lnEUAt{-}1\ p\ j{=}1 + \sum Bi\ lnCoalt{-}1\ q\ i{=}0 + \sum CklnCrudeoilt{-}1\ q\ k{=}0 + \sum DmlnESIt{-}1 + \sum EnlnIPt{-}1\ q\ n{=}0\ q\ m{=}0 + \sum Fl\ lnS600t{-}1\ q\ l{=}0 + \sum GflnTemt{-}1\ q\ f{=}0 + \varepsilon it$$

In order to examine the stationarity of the data, the Augmented Dickey-Fuller (ADF) test is applied (Shershta and Bhatta, 2018; Nkoro and Uko, 2016). The test will help identify whether the time series variables are non-stationary and possess a unit root. The null hypothesis is defined as "there is a unit root", meaning the data is non-stationary. From the results shown in Table 1, all variables are stationary at level I(0) or level I(1). As there is no variable with a level higher than I(1), the Autoregressive Distributed Lag (ARDL) approach would be the most appropriate to be used (Nkoro and Uko, 2016; Kripfganz, and Schneider, 2022).

Variable	At level		At first difference		Order of integration
	Intercept and Trend	P-Values	Intercept and Trend	P-Values	
EUA	0.1901	0.9710	-14.1347	0.0000	I(1)
Kerosene Futures Price	-3.0702	0.0307			I(0)
Fuel/Energy	-2.5174	0.1130	-8.2613	0.0000	I(1)
STOXX 50	-2.2773	0.1805	-11.1911	0.0000	I(1)
STOXX 600	-1.1269	0.7048	-11.8920	0.0000	I(1)
Industrial Production	-2.4728	0.1239	-11.2767	0.0000	I(1)
Temperature	-4.3264	0.0006			I(0)

Table 1: Results of the Augmented Dickey-Fuller (ADF) test
(Source: Authors calculation)

In this study, an automatic lag selection is used. The optimal lag selection is determined by the Akaike Information Criterion (AIC) (Nkoro and Uko, 2016; Kripfganz, and Schneider, 2022). The graph shows that the used model (12987) is strongly preferred as it has the lowest value compared to the rest of the top 20 models.
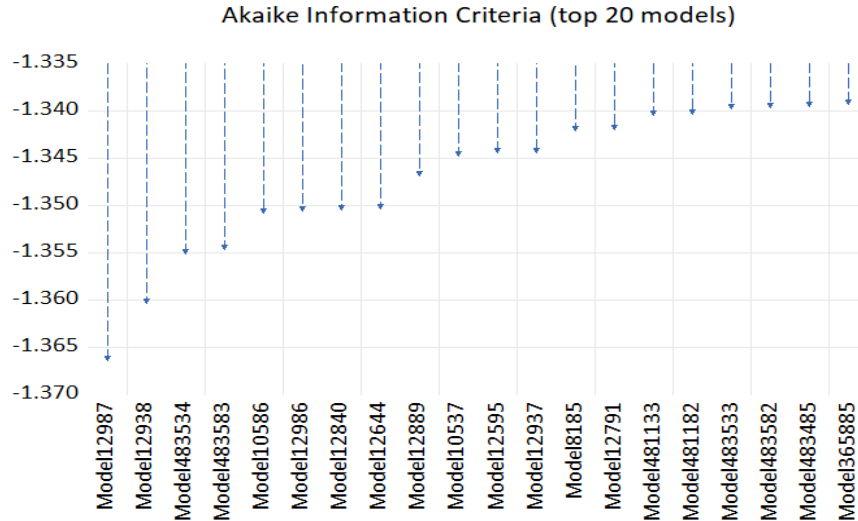
Graph 1: AIC test results
(Source: Authors calculation)

The existence of a long-run relationship of the selected variables is estimated by applying the ARDL long form and bound test. Applying the ARDL model suggests that if the result from the F-statistics is lower than the lower bound (compared with Pesaran et al. (2001)) the null hypothesis cannot be rejected, meaning that there is no long-run relationship between the variables. If it exceeds the upper bound, there is cointegration, and if the result falls within the band, the test is inconclusive. The results show that the F-statistics is 4.430027 and over the upper bound critical threshold. This means that the null hypothesis can be rejected, thus, there is a long-term relationship between the variables.

F-statistics		**4.430027**
Selected lag length criteria		2
Signif. Level	Lower Bound Value I(0)	Upper Bound Value (I)
10%	2.12	3.23
5%	2.45	3.61
2.50%	2.75	3.99
1%	3.15	4.43

Table 2: ARDL Bound test results
(Source: Authors calculation)

The Error Correction Model is applied to examine if there is a short-run impact on the variable. According to the results, at a 5% significance level, the residual term is statistically significant and has a negative sign. The ECM coefficient −0.01 from the table represents a slow speed of adjustment from the short run to the long run, meaning that the process of bringing the short-run disequilibrium to the long-run equilibrium in one year is at a rate of around 1%. The results of the analysis identify the factors that determine the price of EUA (European Union Allowance) futures in the short and long run. The paper finds that the lag of the third difference of kerosene futures, STOXX 50, the fourth lag of the difference of STOXX 600, and industrial production have a significant impact on EUA price in both the short and long run. However, the authors failed to find a strong short-run relationship between fuel and EUA price, and temperature and fuel were found to be negatively cointegrated.

Variable	Coefficient	t-Statistics	Prob.
Short run			
Kerosene Futures Price (-3)	0.5857	3.3022	0.0014
STOXX 50	2.4785	4.7860	0.0000
STOXX 600 (-4)	2.3300	3.7274	0.0003
Industrial Production	1.2563	2.5646	0.0120
Temperature	-0.4524	-4.8570	0.0000
Coint.Eq	-0.0154	-5.7533	0.0000
Long run			
Kerosene Futures Price (-3)	0.5857	3.0065	0.0034
Fuel/Energy	-0.2163	-2.2449	0.0273
STOXX 50	2.4785	4.2256	0.0001
STOXX 600 (-4)	2.3300	3.3199	0.0013
Industrial Production	1.2563	2.3649	0.0202
Temperature	-0.4524	-3.8975	0.0002

Table 3: Results of the ARDL model (long-run and short-run test)
(Source: Authors calculation)

These findings suggest that various factors, including energy futures, stock market indices, and industrial production influence the price of EUA futures. These variables are likely to be correlated with the demand for energy and economic growth, affecting the demand for emissions allowances. The negative cointegration between fuel and EUA price implies that these variables move in opposite directions over time. This could be due to various factors, including the increasing use of renewable energy sources, changes in energy efficiency, and government policies aimed at reducing emissions. The study's failure to find a strong short-run relationship between fuel and EUA price may indicate that other factors, such as unexpected weather events or geopolitical developments, have a more significant impact on short-term price movements. This highlights the importance of understanding the different time horizons and factors that influence the EUA market and the need for ongoing research to refine our understanding of this complex market. Based on the findings of the study discussed, several research propositions could be pursued to deepen further our understanding of the EUA market and its determinants. Some of these research propositions include:

1) Investigation of the impact of non-economic factors: While the study identified several economic factors that influence the EUA price, non-economic factors could be driving price movements in the short and long run. For example, weather patterns or natural disasters could significantly impact the demand for emissions allowances in the short run. Exploring the impact of such non-economic factors on the EUA market could provide a more nuanced understanding of the market dynamics.

2) Examination of the impact of policy changes: The study identified economic factors such as industrial production that impact EUA prices. However, government policies aimed at reducing emissions could also significantly influence demand for emissions allowances. Further research could explore how policy changes, such as introducing a carbon tax or new regulations, affect the EUA market.

3) Analysis of the relationship between EUA prices and carbon offsets: Carbon offsets allow companies to offset their emissions by investing in projects that reduce emissions elsewhere. The price of carbon offsets can be influenced by various factors, including supply and demand dynamics and policy changes. Research that examines the relationship between EUA prices and carbon offsets could provide insights into the broader carbon markets and how they interact.

4) Investigation of the influence of global economic factors: While the study identified the STOXX 50 and STOXX 600 indices as impacting EUA prices, the study focused on the European market. Further research could examine the influence of global economic factors, such as oil price or global GDP growth, on the EUA market.

5) Analysis of the impact of technological developments: Advances in technology, particularly renewable energy, could significantly impact the EUA market. Research could explore how changes in technology affect the demand for emissions allowances and how these impacts may evolve.

Overall, further research into the EUA market could provide insights into the factors that influence this complex market and inform policy decisions related to emissions reduction.

5. CONCLUSION

The EU ETS represents a crucial mechanism for combating climate change. Identifying the determinants that affect the price movement of emission allowances is of great importance, as it can significantly improve the system's functioning and contribute to a better price signal. Most of the emissions originate from the energy system, that is, from the combustion of fuels used for primary energy consumption and transforming energy into electrical and thermal energy. In addition, the aviation sector is a significant and fastest-growing source of emissions. This paper, therefore, analyzes the long-term and short-term relationships between the EUA price and fuel (energy) index, kerosene futures, indicators of economic activity (including STOXX 50, STOXX 600, and industrial production), and global temperature deviations from the average level, i.e., anomalies. According to the results obtained by calculating the Autoregressive Distributed Lag (ARDL)/bound-test econometric model, kerosene futures have a positive and significant impact on allowances price in the short and long term, the fuel index has a negative impact in the long term, while economic indicators have a positive significant relationship in both the long and short term. Climate change, that is, the change in the average global temperature has a negative and significant impact in the long and short term. The main contribution of this study is that it identifies specific factors that significantly impact EUA prices, such as the lag of the third difference of kerosene futures, STOXX 50, the fourth lag of the difference of STOXX 600, and industrial production. Overall, the contribution of this paper is that it provides a more comprehensive understanding of the complex EUA market and its underlying drivers. The findings of this study could have significant implications for policymakers, investors, and other stakeholders interested in the EUA market and could help inform decision-making around carbon pricing and emissions reduction policies. Additionally, the study highlights the need for ongoing research to refine our understanding of this complex market and identify new drivers that may impact the price of EUA futures.

LITERATURE:

1. Aatola, P., Ollikainen, M., & Toppinen, A. (2013) 'Price determination in the EU ETS market: Theory and econometric analysis with market fundamentals', *Energy Economics*, Elsevier, vol. 36(C), pages 380-395.
2. Balietti, A. C. (2016) 'Trader types and volatility of emission allowance prices. Evidence from EU ETS Phase I' *Energy Policy* 98, pages 607-620.
3. Beat, H. (2010) 'Allowance price drivers in the first phase of the EU ETS', *Journal of Environmental Economics and Management*, *Elsevier*, vol. 59(1), pages 43-56.
4. Berrisch, J., Pappert, S., Ziel, F., & Arsova, A. (2022) 'Modeling Volatility and Dependence of European Carbon and Energy Prices', *Papers 2208.14311, arXiv.org*, revised Dec 2022
5. Chung, C., Jeong, M and Young, J. (2018) 'The Price Determinants of the EU Allowance in the EU Emissions Trading Scheme' *Sustainability* 10(11):4009.

6. Demailly, D. and P. Quirion (2008) 'European Emission Trading Scheme and competitiveness: A Case Study on the Iron and Steel Industry', *Energy Economics* 30(4), pages 2009-2027.
7. Dimos, S., Evangelatou, E., Fotakis, D., Mantis, A., Mathioudaki, A. (2020) 'Forecasting EU Allowance Price Using Transactions of Central Entities' *Advances in Ecological and Environmental Research* (ISSN 2517-9454, USA), Vol. 5, Issue 06, pages 187-209.
8. DIRECTIVE 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC ' (2003) *Official Journal* L275, page 23 Retrieved 31.01.2023 from https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:27 5:0032:0046:en:PDF#:~:text=This%20Directive%20establishes%20a%20scheme,and%20 economic%2D%20ally%20efficient%20manner.
9. DIRECTIVE 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community *Official Journal* L 140/63 Retrieved 31.01.2023 from https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:14 0:0063:0087:en:PDF
10. Ellerman, A. D. and B. K. Buchner (2007) 'The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results', *Review of Environmental Economics and Policy* 1(1), pages 66-87.
11. EU Emissions Trading System (EU ETS), 2022, Climate Action. Retrieved 31.01.2023 from 'https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en'
12. Friedrich, M., Fries, S., Pahle, M., & Edenhofer, O. (2019) 'Understanding the explosive trend in EU ETS prices -- fundamentals or speculation?' *Research Papers in Economics.*
13. Georgopoulou, E., Sarafidis, Y., Mirasgedis, S. & Lalas, D. P. (2006) 'Next allocation phase of the EU emissions trading scheme: how tough will the future be?' *Energy Policy* vol. 34(18), pages 4002-4023.
14. Guo, J. et al. (2018) 'How do verified emissions announcements affect the commoves between trading behaviors and carbon prices? Evidence from EU ETS' *Sustainability* no. 9: 3255.
15. Kripfganz, S. and D. C. Schneider (2022) 'ARDL: Estimating autoregressive distributed lag and equilibrium correction models', TUPD Discussion Papers 18, Graduate School of Economics and Management, Tohoku University.
16. Li, P., Zhang, H., Yuan, Y. and Hao, A. (2021) 'Time-Varying Impacts of Carbon Price Drivers in the EU ETS: A TVP-VAR Analysis', *Frontiers in Environmental Science* Vol.9 DOI 10.3389/fenvs.2021.651791.
17. Li, Mf., Hu, H. & Zhao, Lt (2022) 'Key factors affecting carbon prices from a time-varying perspective' *Environmental Science and Pollution Research* 29, 65144-65160.
18. Lovcha, Y., Perez-Laborda, A. and Sikora, I., (2022) 'The determinants of CO2 prices in the EU emission trading system', *Applied Energy, Elsevier*, vol. 305 Issue C.
19. Medina, V., Pardo, Á. & Pascual, R. (2014) 'The timeline of trading frictions in the European carbon market' *Energy Economics* 42, pages 378-394.
20. Meier, J., and Voss, N. (2020) 'Do Commodities Determine the EU Emission Allowances Price?' *ICTERI Workshops*
21. Moreno, B., García-Álvarez, M. T. & Fonseca, A. R. (2017) 'Fuel prices impacts on stock market of metallurgical industry under the EU emissions trading system' *Energy Elsevier* Vol. 125, pages 223-233.
22. Neuhoff, K., K. Keats, K. Martinez, and M. Sato (2006) 'Allocation, incentives and distortions: The impact of EU ETS emissions allowance allocations to the electricity sector', *Climate Policy* 6(1), pages 73-91.

23. Nkoro, E., and Uko, A.K. (2016) 'Autoregressive Distributed Lag (ARDL) cointegration technique: application and interpretation', *Journal of Statistical and Econometric Methods*, 5, pages 1-3.
24. Pesaran, M.H., Smith, R.J. and Shin, Y. (2001) 'Bounds Testing Approaches to the Analysis of Level Relationships, *Journal of Applied Econometrics*, 16, pages 289-326.
25. Ritchie, M., Roser, M. and Rosado, P. (2020) 'CO? and Greenhouse Gas Emissions', Available at OurWorldInData.org. Retrieved 31.01.2023 from 'https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions'.
26. Schultz, E. & Swieringa, J. (2014) 'Catalysts for price discovery in the European Union emissions trading system' *Journal of Banking & Finance* 42, pages 112-122.
27. Schumacher, K., Cludius, J., Matthes, F. (2012) 'Price Determinants of the European Carbon Market and Interactions with Energy Markets' UBA, *Climate Change* 2012/11
28. Segnon, M., Lux, T., and Gupta, R. (2017) 'Modeling and forecasting the volatility of carbon dioxide emission allowance prices: A review and comparison of modern volatility models', *Renewable & Sustainable Energy Reviews*, 69, pages 692-704.
29. Shrestha, M.B., and Bhatta, G.R. (2018) 'Selecting appropriate methodological framework for time series data analysis', *The Journal of Finance and Data Science*, DOI 10.1016/j.jfds.2017.11.001.
30. Sorensen, E. B. (2005) 'Granger Causality', *ECONOMICS* 7395
31. State of the aviation ETS (2021). Retrieved 31.01.2023 from 'https://www.transport environment.org/state-aviation-ets/'.
32. The EU Emissions Trading System in 2021: trends and projections (2022). Retrieved 31.01.2023 from 'https://www.eea.europa.eu/publications/the-eu-emissions-trading-system-2/the-eu-emissions-trading-system'.
33. Toda, H.Y. and Phillips, P.C.B. (1994) 'Vector Autoregressions and Causality: A Theoretical Overview and Simulation Study', *Econometric Reviews* 13, pages 259-285.
34. Trends and projections in the EU ETS in 2022, The EU Emissions Trading System in numbers (2022). Retrieved 31.01.2023 from https://www.eionet.europa.eu/etcs/etc-cm/products/etc-cm-report-2022-05'.
35. Trotignon, R. and A. Delbosc (2008) 'Allowance trading patterns during the EU ETS trial period: What does the CITL reveal', *Climate Report* Issue No 13.
36. Why did greenhouse gas emissions fall in the EU in 2008? (2010), Available at European Environment Agency, Retrieved 31.01.2023 from 'https://www.eea.europa.eu/media/news releases/why-did-greenhouse-gas-emissions#:~:text=This%20was%20mainly%20due%20to,use%20of%20gas%20and%20renewables.&text=In%202008%2C%20almost%2083%20%25%20of,gas%20emissions%20were%20CO2%20related'.
37. Zaklan, A. (2013) 'Why do emitters trade carbon permits? Firm-level evidence from the European Emission Trading Scheme' DIW Berlin Discussion Paper No. 1275.
38. Zhao, X., Han, M., Ding, L. and Kang, W. (2018) "Usefulness of economic and energy data at different frequencies for carbon price forecasting in the EU ETS', *Applied Energy*, *Elsevier,* vol. 216(C), pages 132-141.

THE ROLE OF CRISIS MANAGEMENT IN TOURISM FROM THE ASPECT OF CLIMATE CHANGE

Petar Misevic
Associate Professor at University North, Varaždin, Croatia
pmisevic@unin.hr

Petra Karin
Libertas International University, Zagreb, Croatia
karinpetra52@gmail.com

Marko Akmacic
Libertas International University, Zagreb, Croatia
marko.akmacic@icloud.com

ABSTRACT

This paper presents crisis management in light of climate change and the threat of climate crisis to tourism. The specificity of the paper refers to the argumentative consideration of climate change and the potential risks that the climate crisis poses to global tourism, of which winter and coastal or marine tourism are the most endangered. The implications of the climate crisis for Croatian tourism require activities in the field of crisis management that are reflected in the timely responses of the state, counties, local destinations, hoteliers and the hopes of all tourism professionals, and the provision of appropriate responses, measures and instruments for the preservation of natural resources, and thus contribute to climate change mitigation. The paper presents a hypothesis that reads: "Based on the acquired knowledge about the effects of climate change on tourism, it is possible to establish that it is necessary, without delay, to approach this problem from the point of view of crisis management to recognise the upcoming crisis on time, to draw up management plans promptly, to provide adequate responses and to overcome the consequences with as little damage as possible." The expected results of the conducted research based on the argumentative confirmation of the hypotheses will contribute to the appreciation of the recognition and management of the climate crisis in the tourism industry, emphasising coastal tourism. The theoretical contribution of the work is reflected in the systematic and systematised presentation of theoretical knowledge about climate change and crisis management. In an applicative sense, this paper can serve students and managers in tourist destinations as a template for recognising and dealing with crisis management. Standard statistical methods will be used to analyse and process the collected data using appropriate computer programs.
Keywords: crisis management, climate crisis, crisis in tourism

1. INTRODUCTION

The paper deals with two current phenomena that greatly permeate tourism, the economy, politics and citizens, namely climate change and, consequently, the climate crisis. Tourism is undoubtedly one of the most sensitive and most exposed industries to crises. In addition to these major crises that have had devastating impacts on the tourism industry, there are numerous other events that range from natural disasters and epidemics to terrorist attacks. The crisis that is occurring or will inevitably occur due to climate change differs from all previous crises. Crisis management in tourism should assess risks and be prepared, with developed scenarios of possible answers to the "what if" question and offer concrete solutions. More and more tourist destinations in the world have to deal with climate change-related threats.

Due to these threats, there is a growing need to develop and strengthen the ability of tourism systems to adapt to current and future challenges. From the point of view of Croatian tourism, the most exposed to climate change are winter tourism (skiing and sledging) and coastal tourism, especially the segment related to ports, piers and marinas. At present, the effects of climate change on islands and coastal areas, including storm surges and rising sea levels, are inevitable and, in some regions, are damaging coastal tourism economies. It is therefore crucial that tourism professionals, the local community, ministries and the government promptly change their attitude towards the island and coastal tourism in the light of current and future climate change and establish adaptation measures that include blue space and a focus on the well-being of the local population, education and awareness of the challenges is facing the natural environment. Marine and coastal tourism, as one of the most significant segments of the maritime economy sector and the most significant component of the tourism industry, often leads to controversies related to environmental protection and compatibility with other human activities. Applying economic and tourism concepts oriented towards preserving the environment and natural resources is one option for overcoming problems. The problem of researching the paper's topic has its origin in the undefined and non-uniform understanding of climate change by one political segment, economy, and profit on the one hand and science, the other political segment, the U.N. Organization that endorses corporate social responsibility and civil society associations on the other. Accordingly, the research subject was determined: the climate crisis in tourism, which, like every previous crisis, is a challenge for crisis management in tourism: foresight, planning, response and ways of recovery. The problem of researching the topic of the work has its origin in the undefined and non-unique understanding of climate change by the part of politics, economics, and profit on the one hand and science on the other part of politics, the U.N. Organization that represents socially responsible business and civil society associations on the other. In accordance with the above, the research subject was determined: the climate crisis in tourism, which, like every other crisis, is a challenge in terms of foresight, planning, response and ways of recovery.

2. CRISIS MANAGEMENT AND CLIMATE CRISES IN THE TRAVEL & TOURISM INDUSTRY

Following the reasoning in the introductory part of the paper, it is certain that the causes that precede the onset of a crisis, be it extraordinary adverse events or large-scale disasters, are always reflected in people's health (physical or mental), their material and intangible goods, and feelings (empathy or fear) even when they are not directly affected by the effects of the crisis. This suggests that under the influence of a crisis, either directly or indirectly, a person would put events such as travel, experiences, vacations, recreation... that is, tourism in all its forms, on the back burner. Therefore, it is advisable to ask the question of how adverse events, after being experienced or communicated, affect people. This is the critical issue facing the assessment of preventive and crisis management techniques in tourism. An example may be the study of the effect of nuclear fallout from the 1986 Chernobyl nuclear reactor explosion on Swedish tourism published by Hultkrantz and Olsson (Chernobyl Effects on Domestic and Inbound Tourism in Sweden -- A Time Series Analysis, 1997, p. 239-258). The result of their analysis was the determination that this adverse event had different effects on tourism. While this event significantly impacted incoming tourism, no changes in domestic tourism were observed. In 1991, the *World Tourism Organization* (WTO) examined the effects of the Gulf War on tourism (Special Report on the Impact of the Gulf Crisis on International Tourism, 1991) and undertook a sectoral and regional separation of the observed areas. As a result of the WTO analysis, various significant developments have been defined within regional considerations. They varied not only in their intensity but also in their direction. These include a downward trend, stagnation, and an increase in international arrivals and travel.

Furthermore, the sectional considerations observed that the various market segments reacted differently to the same event. While airlines generally suffered from the consequences of the war, differences could be observed when travelling long distances, which, in comparison, were subjected to a more intense reaction. This was the same for certain travel and hotel categories, which showed more sensitive behaviour, and smaller companies, which were more affected than larger ones. Both studies confirm that a different effect on the same event is possible. The basis for a successful form of crisis management is found in this observation. Not only does it open up an opportunity for concentration and planning of coping measures, but it also indicates that strategic preparations can mitigate the negative consequences of an adverse event.

2.1. General Characteristics of Crisis

The word crisis comes from the Greek word *krisis*, which means discernment/distinction or decision. In the legal jargon, the term was used to describe the difference between the just and the unjust, while in theology, it described the separation of salvation and damnation. Medical terminology used this term to refer to arrested development that was previously continuous. In the sixteenth century, with the revival of classical medicine, the word became part of everyday language. The use of the term "crisis" became evident in all areas of politics, society and the economy, and by the mid-19th century, people were already complaining about its excessive use (Glaesser, 2006, p. 11).

2.2. Negative Events in Tourism

The emergence of a crisis can be traced back to the beginning of specific adverse events. An event that precedes a change in a condition/state from acceptable to unacceptable is called the vital impulse if it is caused by force or an initial event if an act or omission induces it. The vital impulse is the action of a force in a short period, which causes significant changes in the system's state in particular conditions. An initial event is an act or omission that occurs at the most unfavourable moment in the sequence of events and, under special conditions, causes significant changes in the system's state. (Bukša, Frančić, & Bukša , 2015).

CAUSES OF CRISIS IN TOURISM		
WARS AND UNRESTS		**ENVIRONMENT**
The Homeland war 1991-1995		Erika oil tanker disaster in France, 1999
Coup d'état in Gambia, 1994		Earthquake in Umbria, September 1997
Coup d'etat in Fiji, 1987 and 2000		Algae blooms in Rimini, 1989 and 1990
Riots in Los Angeles and San Francisco, 1992		Hurricane Mitch, October 1998
Wars in Libya and Syria in 2011		Etna eruption, 2001
The Ukraine Crisis of 2014		The 2004 Indian Ocean Tsunami
Russian aggression against Ukraine in 2022		Hurricane Katrina 2005
DISEASES AND EPIDEMICS		**TERRORISM, DELINQUENCY**
Legionnaires' disease in Spain, July 2001		Cyanide gas attack in Japan, May 1995
Creutzfeld-Jakob's disease, January 1993		ETA's summer terrorist campaigns, since the 1980s
Foot-and-mouth disease, February 2001		Criminal attacks on tourists in Florida, 1993-94
Anthrax, September 2001		Terrorist attacks in Turkey in the 1990s
COVID-19, 2020		Terrorist attacks of September 11, 2001
TRANSPORT		**POLITICS AND ECONOMY**
Estonia ferry disaster, September 1994		Boycott of Austria, 2000
The crash of Air France - Concorde, July 2000		The financial crisis in Asia, 1997
The railway accident in Eschede, June 1998		GFK 2008
Malaysia Airlines Boeing 777 crash, 2014		Sanctions against the Russian Federation in 2022

Table 1: Primary Forms of Negative Events That Caused Crises in Tourism
(Source: Compiled by the authors based on Internet data)

Adverse events must be comprehensible, and to have an effect, they must be directly experienced or at least communicated in terms of primary and secondary experience. Experience shows that direct perception is of lesser importance. Therefore, particular importance is given to analysing the communication of adverse events and those who participate in the communication process.

2.3. Specifics of Crisis Management in Tourism
The specificities of crisis management in tourism are reflected in identifying essential areas from which adverse events can occur and the system and methods of early warning. Considering these specificities, it is evident that the tourism crisis can be managed only by distinguished experts in the rules and the legality of business in the tourism industry. However, "distinguished experts" do not have to be good organisers or leaders capable of taking risks rationally and with determination to implement anti-crisis measures. Crisis management should distinguish between recognising and dealing with crises. Preventive crisis management aims to take precautions and avoid crises. First, areas that are particularly vulnerable to negative events or of such importance that they should not be exposed to threats must be identified. This internally-oriented identification and assessment of possible problem areas within crisis measures are followed by strategic and operational measures that protect the organisation from the environment. Only then and based on this knowledge, early warning systems should observe the environment of the tourism company to indicate possible changes and enable a quick reaction (internal areas of the company can be the causes of crises, but they should not be considered further because they are the subject of regular management).

2.4. The Climate Crisis and Its Implications for Tourism
The climate crisis is not isolated, but rather a global crisis, and individual justifications of "it's none of our business" it is a "fabrication of various green transition lobbyists ", which, unfortunately, are also followed by the leaders of individual countries, are not substantiated by anything, contrary to the evident and ubiquitous everyday phenomena. This part of the paper will present a series of verified data on climate change and its implications for the population and economy, emphasising tourism in the Mediterranean basin to which we belong. The Mediterranean basin is at the core of the Croatian climate, and the changes taking place in the Mediterranean basin directly impact Croatian tourism.

2.5. Experiences of Crisis Management in Tourism and Application to the Climate Crisis
The tourism industry has been a major beneficiary of the wealth created by the revolutions and generated 10.4% of global GDP by 2018 (WTTC, 2019), with year-on-year growth only briefly interrupted by crisis events such as SARS, the 9/11 terrorist attack on the USA and the global financial crisis of 2007/08. The recovery occurred within a neoliberal global economic production system in which continued economic growth was considered more important than long-term impacts on the global environment. However, recovery from COVID-19 (caused by Severe Acute Respiratory Syndrome 2 (SARS-CoV-2)) is unlikely to follow the pattern of earlier post-crisis recovery. The recovery of the tourism industry after COVID-19 will be linked in the short term to the rate of global economic recovery. The long-term recovery will coincide with transforming the current linear economic production system into a carbon-neutral economic production system and setting new parameters for the future direction of global tourism recovery. While many countries have acknowledged the need to transition to a carbon-neutral economy, most have delayed decisive action. The reluctance to transform the global economy, yet the willingness to respond quickly to COVID-19, points to a critical problem facing the tourism industry and the global community.

It is much easier to respond quickly and decisively to an immediate danger or crisis than to long-term dangers or known future crises. Response to crises on the COVID-19 scale provides insights into opportunities to challenge and change the current global economic status quo. (Prideaux, Thompson, & Pabel, 2022, p. 669). Before COVID-19, many governments had embraced the possibility of a global pandemic but saw little value in funding research and pooling medical resources to cope with a future event of this kind. Similarly, many governments have acknowledged the threat of climate change, but most have hesitated to respond decisively and address the problem. The victory of determination in the war against COVID-19 provides a useful metaphor for the need for decisive action on climate change if that war is to be won.

3. SPECIFICITIES OF CROATIAN COASTAL TOURISM AND CLIMATE CHANGE

According to the data of the Croatian Ministry of Tourism (HTZ, 2022), Croatian tourism generated €9,121.8 million in 2021, which accounted for a high share of 15.9% of the total GDP, employing more than 22,000 employees in the sector. In respect of the counties, the most prominent tourist traffic was in coastal counties, namely: Istria (26.4%), Split-Dalmatia (18.1%), Primorje-Gorski Kotar (17.3%), Zadar (10.2%) and Dubrovnik-Neretva (7.6%). Overall, 79.6% of Croatian tourism consists of marine and coastal tourism. Considering everything elaborated on so far in this paper, it is clear that Croatian tourism is vulnerable to the climate crisis. An additional danger arises from the fact that the Adriatic Sea, as a semi-enclosed sea connected to the Mediterranean Sea, is the target destination for millions of tourists prone to summer migration when the pressure on the environment and the ecosystem, in the current climate conditions, is at the limits of endurance. This simply means that the system would collapse with the onset of an unmanaged climate crisis.

3.1. Climate Change, Blue Economy and Coastal Resilience

Maritime and coastal tourism are interconnected because both depend on the sea and the marine environment. Maritime tourism mainly takes place at sea, e.g. cruising and sailing. In comparison, coastal tourism occurs in coastal areas that include beach and recreational activities, such as swimming and sunbathing, coastal walks and resorts. Marine and coastal tourism has been a trend in Croatia since the beginning of tourism at the end of the 19th century (Rab, Hvar, Korčula, Mali Lošinj, Opatija). In addition to the fact that this tourism segment is the most important in the Croatian tourism economy, coastal and marine tourism is also the most important and fastest-growing economic activity that takes place on the coast and the islands, given that industry has left or is leaving that area (coking plants, ironworks, refineries, mechanical engineering and shipbuilding...). However, rapid development and visible trends point to the possible excessive construction of tourist and recreational facilities to permanently increase the tourist capacity, which is already creating problems, especially in waste and wastewater collection. *The Blue Economy* concept can be applied to support the sustainable development of marine and coastal tourism in terms of effective climate change prevention. The Blue Economy concept aims to ensure the sustainability and availability of resources, ecosystem balance and environmental health and to encourage the efficient use and management of resources. In addition, it can also be applied to the concept of ecotourism (Dimas Tegar & Saut Gurning, 2018, p. 227).

3.2. Maritime and Coastal Tourism

Coastal and maritime tourism, although different forms of tourism – are very closely related due to the element of water/sea. Maritime tourism encompasses a wide range of activities in the deep seas, the most prevalent of which are cruising and sailing. Other recreational water activities and nautical sports (often carried out in coastal waters) are diving, underwater fishing, water skiing, windsurfing, marine park tours, dolphin watching, etc.

Although most marine tourism activities occur in the sea, their accompanying facilities and infrastructure are usually on land. Such facilities can vary between ports and marinas (serving cruises, yachts, etc.), to one-person businesses (e.g. guides, instructors, etc.), medium-sized private companies, or even large corporations (cruise companies, etc.). Coastal tourism is also a form of tourism in which the water/sea element is dominant and is considered the main asset and advantage. Coastal tourism is very closely related to marine (maritime) tourism (since it also includes activities taking place in coastal waters), although it also covers beach tourism and recreational activities, such as swimming and sunbathing, coastal walks, etc. The most prominent and widespread type of coastal tourism is the one related to second homes *(Second Home Tourism,* which first grew into second homes for rent to be commercialised as an apartment, apartment complex, apart-hotel, etc., organised either as part of urban development or within tourist resorts (i.e. together with hotel facilities, etc.), or autonomously (without prior planning). As for coastal tourism, all relevant infrastructure and facilities (hotels, resorts, second homes, apartments, etc.) are located exclusively on the mainland and usually much closer to the coast. Unlike maritime tourism activities linked to cities and urban areas, facilities related to coastal tourism are usually linked to the most precious coastal natural landscapes in the world, where estuaries, wetlands, coral reefs and other sensitive components of the natural ecosystem meet. Human activities affect the quality and quantity of natural resources, such as hotel and resort construction, harbour construction and boating, reef walking, snorkelling and scuba diving, fishing, and land-based pollution and sedimentation. Yachts and cruisers, representing the largest segment of maritime tourism, are responsible for high levels of water pollution (due to waste disposal practices) and air pollution (mainly due to gas emissions from cruise ships). At the same time, other maritime tourism activities (such as day trips, underwater fishing, etc.), due to the spatial pattern they follow (proximity to urban areas and as close to the coast as possible), also contribute to the degradation of coastal waters, especially those located near cities. As for coastal tourism, most of the coastal tourism activities involve the development of second homes and seaside resorts, and the construction pattern is likely to cause damage to the coastal environment. Houses, resorts, hotels and other solid infrastructure contribute to coastal changes, water pollution, and the collapse of freshwater basins, leading to seawater and solid waste penetration. In recent decades, the tendency to build new tourist facilities and infrastructure in the sensitive coastal zone has continued to grow.

3.3. The Sensitivity of Nautical Tourism to the Climate Crisis

The world and its coasts are becoming increasingly urbanised. Almost 40% of the world's population lives within 100 km of a coast, but the United Nations estimates that by 2035 this will rise to between 50 and 75% (World Urbanization Prospects: the 2018 Revision. Key facts, 2019, p. 2). In fact, 13 of the 20 most populated cities in the world are coastal cities with large commercial and recreational ports. Indeed, out of the 71 cities with over 5 million inhabitants, 62% (44) of them are located on the coast, and there is no indication of a slowdown in the urbanisation of coastal areas. One of the consequences of the increased urbanisation of the world's coasts is greater anthropogenic pressure and environmental risks due to the proliferation of commercial and recreational use of coastal waterways. This includes tourism, which is one of the fastest-growing economic sectors in the world (Valdor, 2019, p. 2). The expansion of maritime tourism contributes to cruise ships and ecotourism that operate side by side in many coastal cities, of which Pula, Rijeka, Zadar, Split and Dubrovnik lead the way in the Croatian Adriatic. The population of coastal cities is also becoming more affluent, leading to increased recreational yachting and ownership of other vessels. Globally, marinas are the central infrastructure supporting these nautical activities and are essentially local, regional and national drivers of socio-economic progress.

While marinas provide considerable economic competitiveness and financial success (Kovačić & Silveira, 2018, p. 284), nautical activities (and related infrastructure) may have the potential to influence and possibly degrade the environment and related ecosystem services, such as seabed changes; introduction of invasive species; changes in water and sediment quality or habitat loss. Many regions recognise an increasing number of marinas as a significant environmental stressor. Given the projected increase in recreational and tourist boating in coastal ecosystems and the potential for environmental damage, the debate on the long-term sustainability of this critical sector should be included in any policy debate on globalisation and environmental sustainability. (Valdor, 2019, p. 3).

3.4. Atlas of Croatian Marinas' Environmental Risk and Aquatorium's Quality
The starting point of this empirical part of the research is in the approach described by Gomez et al. (2019, p. 355-365) when mapping environmental risks of water quality in LNT waters along the Spanish coast. When creating their Atlas, the mentioned authors used the *Marina Environmental Risk Assessment (MERA)* model, by which they reviewed the general characteristics of the marinas (including hydro-morphological characteristics, human pressures, environmental conditions and environmental management) and combined these data with readily available information on specific locations of marinas to generate an environmental risk ranking. The procedure is based on the OECD's *Pressure-State-Response* model. (Environmental Indicators. Development, Measurement and Use, 2003) and was used to assess 320 marinas along the Spanish coast and to map the environmental risks of marinas for water quality at the level of the Iberian Peninsula. The Atlas enabled spatial data observation; therefore, regional impacts and multiple marinas can be visualised, providing a better understanding of potential cumulative environmental impacts following human activities in marinas. The implementation of the MERA approach in this paper, although limited in nature, provides the means to characterise and compare marinas, allowing (i) assessment of the scale of marine risk and (ii) the provision of opportunities for developing scale-appropriate management strategies and identifying common characteristics that can increase the success of the management measure.

3.4.1. Methodology for Researching the Preparedness of Croatian Marinas for the Climate Crisis
Empirical research was conducted during July and August 2022 using the survey method via email correspondence. The Croatian National Tourist Board (HTZ, 2022, p. 33) states that the Republic of Croatia has 85 marinas with a capacity of 18,942 berths on the developed coast with a length of 73,705 m and a total water area of 4,643,877 m2. According to the Charter Croatia portal (Marines in Croatia, 2022), out of that number, there are 56 marinas with 16,000 berths in the sea and 8,500 dry berths and another 30,000 berths in ports and sports ports for commercial exploitation on the Adriatic coast. All Croatian marinas are present on the web through web pages where email addresses and contact persons with phone numbers are indicated. Interviews with contact persons were primarily carried out by telephone, where it was stated that it was student research to prepare a graduate thesis. A total of 42 persons in charge in Adriatic marinas (75%) were contacted, of which 26 or 62% responded to the questionnaire. Four responses were useless for processing, while the answers collected from 22 marinas were used for the analysis, which makes a relevant sample of 39% of all Adriatic marinas. The collected data were tabulated and processed using the MERA model (Valdor, 2019, pp. 1-9).

3.4.2. Data Collected

For data collection, a standardised questionnaire for marina directors was used to assess MERA. In addition to interviews with marina directors, several other resources were used, such as local public databases (e.g. management websites and websites associated with regional tourism and environmental groups). Where possible, the collected data were cross-checked using global (https://skipper.adac.de/) and local resources or separately sourced from each marina (e.g. the official website of each marina). Marina surfaces in the HTRS96 system[1] are shown in the table below, from which it can be read that the total land area is 381,283 m^2, the total water area is 917,396 m^2, and the total area is 1,298,679 m^2.

MARINA	AREA IN SQUARE METERS			PART OF THE AQUATORIUM AREA FOR BERTHS (BERTHS) M^2	CAPACITY M^2/DAY (M^2*365 DAYS)	USABILITY OF THE WATER AREA SURFACE M^2/DAY	USABILITY OF BERTHS (BERTHS) M/DAY
	Territory	Aquatorium	In total				
Umag	44,022	91.293	135.315	41,775	15,247,978	0.38	0.58
Rovinj	16.147	51,433	67,580	22.021	8,037,719	0.12	0.32
Pula	4,647	28,653	33,300	13,728	5,010,846	0.74	0.62
Pomer	9,283	40,912	50,195	18,939	6,912,700	0.52	0.82
Opatija	30,808	82,515	113.323	37,980	13,862,707	0.43	0.83
Cres	35,052	100,876	135,928	46,313	16,904,175	0.40	0.62
S. Draga	15.228	54,345	69,573	26,030	9,500,951	0.33	0.55
Rab	2.609	14,694	17.303	6,856	1,371,188	0.24	0.13
Šimuni	14.027	21.169	35.196	9,738	3,554,213	0.75	0.74
Žut	12,652	31,038	43,690	14,823	2,964,683	0.14	0.13
Piškera	15.222	21.052	36,274	9,680	1,936,026	0.16	0.10
Jezera	15,628	32,460	48,088	15,417	5,627,377	0.64	0.78
Vodice	19,557	53,488	73,045	24,752	9,034,419	0.66	0.89
Skradin	7,097	30,620	37,717	14,083	5,140,463	0.65	0.67
Trogir	8.341	18.159	26.500	8,734	3,187,822	1.25	0.84
Split	15,705	39,667	55,372	18,285	6,674,003	1.07	0.86
Milna	9.222	24.006	33,228	10,948	4.009.151	0.55	0.61
Vrboska	3,583	14.169	17,752	6,517	2,378,737	0.75	0.60
Palmižana	16.127	28,626	44,753	13,378	2,675,644	0.42	0.20
Korčula	7,705	22,365	30,070	10.256	3,743,399	0.36	0.31
Dubrovnik	52,395	71,510	123,905	24,610	8,982,826	1.08	0.70
Slano	7,830	58,449	66,279	27.101	9,892,025	0.36	0.69
In total	362,887	931.499	1,294,386	421,964	146.649.052	Aver. value 0.55	Aver. value 0.57

Table 2: General Data on the Observed Sample of Marinas
(Source: Compiled and processed by the authors based on the data from the survey questionnaire)

If the arrangement of the water area (aquatorium) according to the function is considered, i.e., 46% of the total area is used for berths (berths), the total capacity in the area is 422,002 m^2. The obtained area of the aquatorium is multiplied by the 365 days in the year when the specified area is available (except in the marinas of Rab, Žut, Piškera and Palmižana - seasonal marinas - availability of 200 days). It thus reaches the available capacity of areas/day for the analysed marinas, which is 146,649,053 m^2/d in total. The following graphic presentation presents the ratio between the total area of each LNT and its water surface (aquatorium) and the annual capacity of the vessel reception (secondary axis of the graph).

---

[1]The HTRS96/TM system, the projection coordinate system of the Republic of Croatia for the cadastre area and detailed state topographic cartography, the coordinate system of the transverse Mercator projection with the mean meridian 16°30' and the linear scale at the mean meridian 0.9999 defined based on HTRS96, has been in official use since 1 January 2010.

In addition to the above parameters, Croatian marinas use data on the daily utilisation of the area of the aquatorium (m²/day) and the daily utilisation of berths per day (m/day) in their business reports. These coefficients represent the quality of marina management in financial terms and the density of marina traffic, which can also be used in terms of nature preservation. To objectively interpret the data and tables 1 and 2, it should be noted that the averages listed were reduced to one day. LNT, however, also serve as wintering grounds for vessels in the off-season months, when all berths are mostly occupied, and the intensity of sailing is minimal so that in the high season, the intensity of manoeuvres would be maximum and the berths are mostly vacant because the vessels are at sea outside the marinas. Therefore, it is necessary to look at the data from the descriptive statistics as follows.

	N	Min.	Max.	Mean value.	Std. Dev.	Variance	Skewness	Kurtosis
Usability of water area m²/day	22	0.12	1.25	,5455	0.30803	0.095	0.737	0.081
Berth usability m/day	22	0.10	0.89	0.5723	0.25698	0.066	-0.735	-0.750
Manoeuvre intensity n/day	22	0.13	1.05	0.5609	0.26088	0.068	-0.078	-0.653

Table 3: Descriptive Table
(Source: Compiled and processed by the authors based on the data from the survey questionnaire using the SPSS 24 program)

The following table presents specific marina-related data that are important for calculating MERA.

MARINA	QUALITY OF THE WATER AREA (AQUATORIUM)		PROTECTED TERRITORY	THE STRUCTURE OF ST	PRESSURE			STATUS		
	Water	Seabed			NV	MA	EX	They are	EV	ON
Umag	Sea	0	0	Port	0.48	0	1	0	0	0.5
Rovinj	Sea	0	0	Port	0.22	1	1	0	0	0.5
Pula	Sea	0	0	Port	0.68	0	1	0	0	0.5
Pomer	Sea	0	0	Port	0.67	0	0	0	0	0.5
Opatija	Sea	0.3	0	Port	0.63	1	1	0	0	0.5
Cres	Sea	0	0	Port	0.51	0	1	0	0	0.5
S. Draga	Sea	0.3	0	Port	0.44	0	0	0	0	0.5
Rab	Sea	0	0	Port	0.19	0	1	0	0	0.5
Šimuni	Sea	0.3	0	Port	0.75	0	0	0	0	0.5
Žut	Sea	0	1	Port	0.14	0	0	0	1	0.5
Piškera	Sea	0	1	Port	0.13	0	0	0	1	0.5
Jezera	Sea	0	0	Port	0.71	0	0	0	0	0.5
Vodice	Sea	0	0	Port	0.78	0	0	0	0	0.5
Skradin	Freshwater	0.7	1	Port	0.66	0	0	0	1	0.5
Trogir	Sea	0	0	Port	1.05	0	1	0	0	0.5
Split	Sea	0.3	0	Port	0.97	1	1	0	0	0.5
Milna	Sea	0	0	Port	0.58	0	0	0	0	0.5
Vrboska	Sea	0	0	Port	0.68	0	0	0	0	0.5
Palmižana	Sea	0	0	Port	0.31	0	0	0	0	0.5
Korčula	Sea	0	0	Port	0.34	0	1	0	0	0.5
Dubrovnik	Brackish water	0.3	0	Port	0.89	1	1	0	0	0.5
Slano	Sea	0.3	0	Port	0.53	0	0	0	0	0.5

Table 4: Special Data on the Observed Sample of Marinas
(Source: Compiled and processed by the authors based on the data from the survey questionnaire)

According to the structure, all observed LNTs from the sample belong to the "port" category and, in the MERA calculation, have a value of 1. Other categories provided are docks, anchorages and open marinas. Furthermore, dredging works are not foreseen since LNTs are not located in estuaries with sand and silt (sludge) deposits. However, there is a difference in the seabed of the aquatorium, which is mainly rocks and has a score of zero (0), gravel (score of 0.3) and sand (score of 0.7). The type of water in the water area has an initial value of 0 since all respondents evaluated the quality of their water area as clean and clear. Therefore, in further consideration, this information was ignored in the calculation. LNTs located in a protected area or 1 km away from a protected area were given a score of one (1), and the rest were evaluated with zero (0). *Responses* represent acceptance of the climate crisis risk assessment. The more comprehensive the responses within the scope of LNT management, the more developed the awareness of the need to undertake measures and activities to protect the environment and prevent any pollution or decarbonisation within the scope of their capabilities and competencies. No matter how willing the management and staff of the marina are to actively participate in the *responses,* the responses cannot and must not be arbitrary and spontaneous but must be backed by the profession and science expressed through specific certificates. Once obtained, the certificate is subject to constant verification and evaluation in line with new scientific achievements. MERA evaluates the adopted measures (U.M.) and adopted instruments (U.I.) as presented in the following tables.

LNT	WASTE DISPOSAL	WASTE MANAGEMENT-SORTING	BILGE WATER MANAGEMENT	OIL MANAGEMENT	RATING OF ADOPTED MEASURES - U.M.*
Umag	Yes	Yes	Yes	Yes	0
Rovinj	Yes	Yes	Yes	Yes	0
Pula	Yes	Yes	Yes	Yes	0
Pomer	Yes	Yes	Yes	Yes	0
Opatija	Yes	Yes	Yes	Yes	0
Cres	Yes	Yes	Yes	Yes	0
S. Draga	Yes	Yes	No	No	2
Rab	Yes	Yes	No	No	2
Šimuni	Yes	Yes	Yes	No	1
Žut	Yes	Yes	No	No	2
Piškera	Yes	Yes	No	No	2
Jezera	Yes	Yes	Yes	Yes	0
Vodice	Yes	Yes	Yes	Yes	0
Skradin	Yes	Yes	No	No	2
Trogir	Yes	Yes	Yes	Yes	0
Split	Yes	Yes	Yes	Yes	0
Milna	Yes	Yes	Yes	No	1
Vrboska	Yes	Yes	No	No	2
Palmižana	Yes	Yes	Yes	Yes	0
Korčula	Yes	Yes	Yes	Yes	0
Dubrovnik	Yes	Yes	Yes	Yes	0
Slano	Yes	Yes	Yes	Yes	0

*Table 5: Response of Adopted U.M. Environmental Protection Measures According to LNT
(Source: Compiled and processed by the authors based on the data from the survey
questionnaire)
Scale: all measures adopted = 0; all measures not adopted = 4

The table shows that waste collection and management are organised in all analysed marinas, including separation (paper, glass, metal, textile, plastic and bio) and sorting of the collected waste. Appropriate equipment (pumps, hoses, neutralising agents) is needed to collect bilge liquids, which is not established in marinas away from the mainland.

The same goes for oil collection (from kitchens, engine rooms, and wellness centres...). Instruments are tools that individual marinas possess to symbolise their commitment to preserving the environment through proper action.

LNT	GREEN FLAG	BLUE FLAG	ISO 14001	EMAS	EVALUATION OF ADOPTED INSTRUMENTS - U.I.*
Umag	Yes	Yes	Yes	Yes	0
Rovinj	Yes	Yes	Yes	Yes	0
Pula	Yes	No	Yes	Yes	1
Pomer	Yes	Yes	Yes	Yes	0
Opatija	Yes	Yes	Yes	Yes	0
Cres	Yes	Yes	Yes	Yes	0
S. Draga	Yes	Yes	No	Yes	1
Rab	Yes	Yes	Yes	Yes	0
Šimuni	Yes	No	No	Yes	2
Žut	Yes	Yes	Yes	Yes	0
Piškera	Yes	Yes	Yes	Yes	0
Jezera	Yes	No	Yes	Yes	1
Vodice	Yes	Yes	Yes	Yes	0
Skradin	Yes	Yes	Yes	Yes	0
Trogir	Yes	Yes	Yes	Yes	0
Split	Yes	Yes	Yes	Yes	0
Milna	Yes	Yes	Yes	Yes	0
Vrboska	Yes	No	Yes	Yes	1
Palmižana	Yes	Yes	No	Yes	1
Korčula	Yes	Yes	Yes	Yes	0
Dubrovnik	Yes	Yes	Yes	Yes	0
Slano	Yes	Yes	Yes	Yes	0

Table 6: Response of the Adopted U.I. Environmental Protection Instruments According to LNT
(Source: Compiled and processed by the authors based on the data from the survey questionnaire)
*Scale: all instruments adopted = 0; all instruments not adopted = 4

From the presented table of answers on the instruments available to LNT management, it can be seen that all marinas carry the Green Flag certificate (100%), the Blue Flag is carried by 18 marinas (82%), ISO 1400 has been successfully implemented in 19 marinas (86%), and EMAS is owned by all surveyed marinas (100%).

3.4.3. Results and Discussion

The risk assessment of water quality in marina waters according to the MERA model is based on empirical research (Gómez, Valdor, & Ondiviela, 2019);(Valdor, 2019) based on which they formed a rating scale for quality factors (table 12) and a risk assessment scale. The percentile system makes it possible to identify risks beyond the average values. The following table presents the evaluation of quality factors.

Table following on the next page

FACTOR	CATEGORY	CRITERION	GLOBAL THRESHOLDS
Pressure	V.N. – very low (1)	Pri ≤ P25	Pri ≤ 1.5
	N- low (2)	P25 < Pri ≤ P50	1.5 < Pri ≤ 2.2
	S – medium (3)	P50 < Pri ≤ P75	2.2 < Pri ≤ 2.7
	V – high (4)	Pri > P75	Pri > 2.7
State	V.N. – very low (1)	Sti ≤ P25	Sti ≤ 0.5
	N- low (2)	P25 < Sti ≤ P50 P	0.5 < Sti ≤ 0.8
	S – medium (3)	50 < Sti ≤ P75	0.8 < Sti ≤ 1.2
	V – high (4)	Sti > P75	Sti > 1.2
Answer	Optimal (0)	Rsi ≥ P50	Rsi ≥ 0.75
	Insufficient (4)	Rsi < P50	Rsi < 0.75

Table 7: Rating Scale of Water Quality Factors in the Waters of Croatian Marinas
(Source: Valdor et al.: A global atlas of the environmental risk of marinas on water quality,
2019, p. 7)

The following table presents the results of water quality risk assessment in marinas according to the MERA model.

LNT	PRESSURE (P.R.) ST+NV+MA+EX	CONDITION (S.T.) SU+EV+NA	ANSWER (FROM) UM+UI	RISK (RI) PR · ST +OD
Umag	2.48	0.5	0	1.24
Rovinj	3.22	0.5	0	1.61
Pula	2.68	0.5	1	2.34
Pomer	1.67	0.5	0	0.835
Opatija	3.63	0.5	0	1,815
Cres	2.51	0.5	0	1,255
S. Draga	1.44	0.5	3	3.72
Rab	2,19	0.5	2	3,095
Šimuni	1.75	0.5	3	3,875
Žut	1.14	1.5	2	3.71
Piškera	1.13	1.5	2	3,695
Jezera	1.71	0.5	1	1,855
Vodice	1.78	0.5	0	0.89
Skradin	1.66	1.5	2	4.49
Trogir	3.05	0.5	0	1,525
Split	3.97	0.5	0	1,985
Milna	1.58	0.5	1	1.79
Vrboska	1.68	0.5	3	3.84
Palmižana	1.31	0.5	1	1,655
Korčula	2.34	0.5	0	1.17
Dubrovnik	3.89	0.5	0	1,945
Slano	1.53	0.5	0	0.765
Average	**2, 1973**	**0.6364**	**0.9545**	**2.2318**
Std. Dev.	0.87708	0.35125	1.13294	1.16547
Percentile P25	1.5675	0.5	0	1.2513
P50	1.7650	0.5	0.5	1,1835
P75	2.7725	0.5	2.0	3.6988

Table 8: Water Quality Risk Assessment in LNT Water Areas According to the MERA Model
(Source: Calculation by the authors based on survey questionnaire data)

According to the MERA model, the estimated water quality risks in the water areas of Croatian marinas range from 0.835 (negligible risk) to 4.49 (low risk). The average risk value is 2.23, which is evaluated as low risk. Similarly, the percentile distribution does not exceed the low-risk values. The radar chart in the following figure clearly shows the risk areas of water quality in the waters of the observed marinas from north to south in a clockwise direction. Croatian nautical tourism is seasonal tourism, which does not mean that marinas are empty or closed during the off-season. On the contrary, they serve as winter quarters with significant activities (repairs, renovations) and often serve as the residence for the owners, their friends and family.

However, the intensity of manoeuvring is minimal, and the risk of maritime accidents outside the high season is insignificant. This " rest " period is sufficient for the natural regeneration of damaged flora and fauna in the aquatorium, which, despite the wishes of the owners to extend the season, is highly favourable for the environment. Climate change, heralded by longer warm seasons that would benefit boaters and thus prolong the season, is likely to increase the pressure and worsen the situation, requiring additional responses.

4. CONCLUSIONS

Managing the climate crisis is a highly complex crisis management task in tourism due to many unknown parameters the profession and science still do not have harmonised attitudes on, like, e.g. numerous system factors and circumstances specific to individual areas, landscapes, climatic and geographical zones and spatial relief. Crisis management remains deprived of understanding the specific cause of the climate crisis, which significantly complicates the action process. Namely, although the cause is undoubtedly visible in the carbon footprint, its origin remains unclear. Because in addition to human activities that are inherently necessary for life, existence and comfort, there are also other causes, such as volcanic eruptions, fires caused by natural forces and the action of the sea or wind. Crisis management, therefore, occurs when the crisis is still in the foreshadowing or in the threat phase, giving it enough time to provide appropriate responses. Tourism has become the most propulsive industry of the 20th and 21st centuries, depended upon by millions of people who directly or indirectly participate in the tourism industry. Due to threats from the climate crisis, a decisive and unified approach of all stakeholders, i.e. all groups that see their interest in the tourism industry from economic, ecological, climatological or altruistic interests, while respecting the postulates of sustainable development, blue economy, low-carbon energy sources, is possible to adequately respond to threats, dangers and risks brought by the climate crisis. To properly direct, control and constantly evaluate these responses, they need to be managed by crisis management as a professional, multi-scientifically educated body that, in cooperation with destination management, the tourism community and line ministries, will manage crisis processes that include identification, risk assessment, responses and recovery. In considering the effects of climate change on Croatian tourism, in this paper, the emphasis is placed on coastal and marine tourism as the largest segment of importance for the economy, which is particularly exposed to the climate crisis due to the overload of the area and high tourist pressure in the seasonal months. It can be concluded that despite such exposure, the timely responses of the state, counties, local destinations, hoteliers and above all, tourism professionals, adequate responses, measures and instruments have been provided so far to preserve natural resources and thus contribute to the pervasive fight against the climate crisis. Climate change is a recognised risk for both Mediterranean tourism and Croatian tourism. The extent to which the climate crisis will stay under control depends on how and to what extent science, the profession and politics will be able and willing to manage this risk. In searching for an answer to how determined the Republic of Croatia is in the fight against climate change and thus searching for an answer to the climate crisis, the environmental findings and strategic documents of the Government of the Republic of Croatia were used. Empirical research conducted on a sample of 22 LNTs evenly distributed along the Adriatic coast proved that nautical tourism has a very low risk of water pollution in the nautical tourism ports' waters. During the period of transition from the planned to the market economy (1990-2000), the Republic of Croatia "got rid" of heavy industry (coke ovens, ironworks, refineries, shipbuilding, mechanical engineering...) and thus significantly protected its waters, sea and air. The economy has found a new niche in tourism, resulting in a large influx of people, vehicles and vessels focused on only three summer months, creating a vast potential for devastation and pollution of destinations.

Therefore, plans and strategies are moving towards a more even tourist pressure, i.e. its redirection towards the mainland and cities, and reinforced by rigid environmental regulations.

LITERATURE:
1. Bukša, J., Frančić, V., & Bukša , T. (2015). Technology-based risk calculation methodology in shipping. *Pomorstvo*
2. Dogan, K., & Mršić, T. (2013). Očuvanje prirodnih resursa nautičkog turizma u Republici Hrvatskoj. *Pomorski zbornik*, str. 73-85
3. Glaesser, D. (2006). *Crisis Management in the Tourism Industry.* Oxford: Elsevie
4. Gómez, A. G., Valdor, P. F., & Ondiviela, B. (2019). Mapping the environmental risk assessment of marinas on water quality: the Atlas of the Spanish coast. *Marine Pollution Bulletin, 139*, str. 355-365. doi:DOI:10.1016/j.marpolbul.2019.01.008
5. Gössling, S., & Scott, D. (2018). The decarbonisation impasse: global tourism leaders' views on climate change mitigation. *Journal of Sustainable Tourism 26(4):1-16, 26*(4), str. 1-16. doi:https://doi.org/10.1080/09669582.2018.1529770
6. HTZ. (2022). *Turizam u brojkama 2021.* Zagreb: Ministarstvo turizma Republike Hrvatske. Dohvaćeno iz https://www.htz.hr/hr-HR/informacije-o-trzistima/analize-s-podrucja-turiz ma/turizam-u-brojkama
7. International Energy Agency. (2020). *World Energy Outlook 2020, World Energy Model and Special Reports.* Paris: International Energy Agency. Dohvaćeno iz https://www.iea.org/reports/world-energy-outlook-2020#world-energy-model-and-speci al-reports
8. OECD. (2003). *Environmental Indicators. Development, Measurement and Use.* Paris: OECD Environment Directorate. Dohvaćeno iz https://www.oecd-ilibrary.org/environ ment/environment-at-a-glance_9789264012196-en
9. OECD. (2011). *Climate Change and Tourism Policy in OECD Countries.* Pariz: OECD. Dohvaćeno iz https://www.oecd.org/cfe/climate-change-and-tourism-policy-in-oecd-coun tries-9789264119598-en.htm
10. Osmanagić Bedenik, N. (2003). Kriza kao šansa. Zagreb: Školska knjiga
11. Padovan, A. V. (2013). Odgovornost luke nautičkog turizma iz ugovora o vezu i osiguranju. *Poredbeno pomorsko pravo, 52*(167), str. 1-35
12. Sučević, D. (2010). *Krizni menadžment : Vodič kroz planiranje, prevenciju i oporavak : s primjerima iz prakse.* Zagreb: Lider press.
13. Šverko Grdić, T., & Špoljarić:, T. (2018). Utjecaj klimatskih promjena na turističke tijekove - primjer Republike Hrvatske. *Zbornik Veleučilišta u Rijeci, 6*(1), str. 51-66. doi:https://doi.org/10.31784/zvr.6.1.1
14. UN. (2019). *World Urbanization Prospects: the 2018 Revision. Key facts.* New York: United Nations. Dohvaćeno iz https://www.un-ilibrary.org/content/books/9789210043144
15. UNWTO. (2020). *International Tourism Highlights .* Dohvaćeno iz International tourism trends: https://www.e-unwto.org/doi/epdf/10.18111/97892844224
16. Valdor, P. (2019). A global atlas of the environmental risk of marinas on water quality. *Marine Pollution Bulletin*, str. 1-9. doi:DOI:10.1016/j.marpolbul.2019.110661

GREEN ECONOMY AS A DRIVER OF SUSTAINABLE DEVELOPMENT

Goran Sabol
„*Međimurje University of Applied Sciences in Čakovec*", Croatia
goran.sabol@mev.hr

Magdalena Zeko
„*Međimurje University of Applied Sciences in Čakovec*", Croatia
mzeko@mev.hr

ABSTRACT
The broader vision of a successful global green economy implies the separation of economic activity from negative impacts on the environment. By realizing this vision, it is possible to set the global economy on a more sustainable path, which means preventing the very harmful effects of global warming not only on the environment, but also on economic prosperity. Preventing global warming implies a transition from the use of energy based on fossil fuels to renewable sources, which is why the stated challenge policy makers and investors often view the green transition only from a cost perspective, and not from an environmental perspective. However, the transition to a sustainable environment by 2050 also has the potential to create enormous opportunities in the global economy. The paper will explain the fundamental concepts related to the realization of the green economy, which are based on the achievement of the "Net Zero" goals by the year 2050. As entrepreneurship results in innovation and sustainable economic and social development, the emphasis will be on entrepreneurship, which provides the basis for starting and maintaining a green economy by providing green products and services, introducing more environmentally friendly production techniques, increasing the demand for green products and services, and creating green jobs. In this sense, the basics of the current legal framework for creating such a green economy will be presented.
Keywords: *development, entrepreneurship, green economy, legal framework, sustainable*

1. GREEN ECONOMY

In 1987, the United Nations World Commission on Environment and Development published a report entitled "Our Common Future", which defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on the Environment and Development, 1987). Twenty-five years after the aforementioned conference, the Rio+20 conference that took place in 2012 in Rio de Janeiro coined the concept of "green economy" (Barbier, 2012) which international organizations such as the World Bank and the United Nations (UNEP, 2011) accepted as a path to a sustainable future. In a certain way, the green economy is a means of improving the general quality of life and the environment in terms of climate and environment. The goal of this type of economy is the result of efforts to make the economy ecologically responsible and aimed at having a positive impact on the economy, society and the environment. Today, the leaders of the green economy are looking for ways to advance the development of the economy in an appropriate way and to respond to many challenges that have become common to all parts of the economy in recent years. During the formation of the green economy, many policies and processes are put in place that will help achieve goals and preserve sustainable development. The green economy is aimed at setting the guidelines for sustainable development, which in translation would mean reduction of the emission of harmful gases and finding ways for responsible management in economic entities.

In this type of economy, employment and income growth are driven by public and private investments in economic activities, infrastructure and assets that enable the reduction of carbon emissions and pollution, improved energy and resource efficiency, and prevention of loss of biodiversity and ecosystem services. Such investments should be enabled and supported through targeted public expenditure, policy reforms and changes in taxation and regulation. It is important to note that the term green economy does not replace sustainable development but creates a new focus on the economy, investments, capital, infrastructure, employment, skills, and positive social and environmental outcomes. The environmental program established by the United Nations represents the reduction of risks to the environment and the improvement of overall human well-being (UNEP, n.d.). The green economy has special values that need to be nurtured because care for the environment is an extremely important factor in further progress. Every state or city should take care of the green economy, i.e., care for ecosystems, at its own level. Accordingly, the green economy is an element that creates a fair distribution of funds and resources while at the same time ensuring equality in society. This kind of system has great possibilities in the post-industrial age because it precisely encompasses the reform of human resources and aims to improve production processes and consumer practices to reduce resource consumption, waste generation and emissions throughout the entire life cycle of processes and products.

2. BASICS OF THE LEGAL FRAMEWORK FOR ECONOMIC ACTIVITIES IN THE GREEN ECONOMY WITH SPECIAL REFERENCE TO GREEN JOBS

Today, 35 years later after the term green economy was introduced, it is no longer just a good idea but a necessary thing for continued economic development. In order to encourage its member states to facilitate and speed up the transformation of various economic entities, a certain legal framework was created in European Union – one that regulates incentives for environmentally sustainable economic activities and certain workplaces. Regulation (EU) 2020/852 on the establishment of a framework to facilitate sustainable investment[1] establishes the criteria for determining whether an economic activity qualifies as environmentally sustainable for the purposes of establishing the degree to which an investment is environmentally sustainable. Article 3 prescribes the criteria for environmentally sustainable economic activities. An economic activity shall qualify as environmentally sustainable where that economic activity contributes substantially to one or more of the environmental objectives: climate change mitigation; climate change adaptation; sustainable use and protection of water and marine resources; transition to a circular economy; pollution prevention; control, protection and restoration of biodiversity and ecosystems. Taking into account the life cycle of the products and services provided by an economic activity (including evidence from existing life-cycle assessments), the economic activity should not significantly harm: climate change mitigation (where that activity leads to significant greenhouse gas emissions); climate change adaptation (where that activity leads to an increased adverse impact of the current climate and the expected future climate), activity itself or people, nature and other assets. Also, it is of great importance that the economic activity has sustainable use and protection of water and marine resources, where that activity is detrimental to the good status or the good ecological potential of bodies of water, including surface water and groundwater or to the good environmental status of marine waters. It is also considered that economic activity significantly damages circular economy, including waste prevention and recycling, where that activity leads to significant inefficiencies in the use of materials or in the direct or indirect use of natural resources such as non-renewable energy sources, raw materials, water and land at one or more stages in the life cycle of products, including in terms of durability, reparability, upgradability, reusability or recyclability of products; that activity leads to a significant increase in the generation,

---

[1] https://eur-lex.europa.eu/legal-content/HR/TXT/PDF/?uri=CELEX:32020R0852&from=HR.

incineration or disposal of waste, with the exception of the incineration of non-recyclable hazardous waste; or the long-term disposal of waste may cause significant and long-term harm to the environment. In conclusion, it is also considered that economic activity significantly damages pollution prevention and control where that activity leads to a significant increase in the emissions of pollutants into air, water or land, in comparison to the situation before the activity started; or the protection and restoration of biodiversity and ecosystems. An economic activity shall qualify as environmentally sustainable when the economic activity is carried out in compliance with the minimum safeguards[2]. Environmentally sustainable economic activities must comply with the technical verification criteria established by the Commission in accordance with other provisions of the Regulation. Economic activities that are excluded from the grant of support based on the principle "Do not cause significant damage", and in accordance with the Notice of the Commission (2021/C 58/01) on technical guidelines on application of the principle of not causing significant damage within the framework of the Regulation on the Mechanism for Recovery and Resilience[3] are activities related to fossil fuels, including further use activities within the EU system emissions trading system (ETS) which achieve the predicted greenhouse emissions of gases that are not lower than relevant reference values; activities related to landfills waste, incinerators[4] and facilities for mechanical biological processing[5] and activities in which long-term waste disposal can cause damage to the environment.

3. GREEN JOBS IN A GREEN ECONOMY

A workplace can be considered a green workplace if the worker performs tasks in economic entities that result in products and services which are beneficial for the environment or that contribute to the preservation of natural resources, or if it collaborates with economic entities which contribute to the green transformation of business. Jobs in economic entities that result in products or services beneficial to the environment or that contribute to the conservation of natural resources are those jobs that are directly related to business processes that result in green products or green services which yield the economic project revenues. Additionally, there are workplaces that directly relate to the assessment of compliance with environmental standards and the implementation of environmental regulations and standards, ensure education and training which is related to green technologies and/or practices and which increase the general level of public awareness on environmental issues. Such jobs include the production of electricity and heat, or fuels from renewable energy sources (which are sources that are preserved in nature and renewed in whole or in part, for instance energy generated from water flow, wind, non-accumulated solar energy, biodiesel, biomass, biogas, geothermal energy, etc.). In addition, such jobs include products and services that improve energy efficiency or energy efficient equipment, appliances, buildings, and vehicles.

---

[2] Article 18 stipulates that the minimum safeguards shall be procedures implemented by an undertaking that is carrying out an economic activity to ensure the alignment with the OECD Guidelines for Multinational Enterprises and the UN Guiding Principles on Business and Human Rights, including the principles and rights set out in the eight fundamental conventions identified in the Declaration of the International Labour Organisation on Fundamental Principles and Rights at Work and the International Bill of Human Rights.

[3] https://eur-lex.europa.eu/legal-content/HR/TXT/PDF/?uri=CELEX:52021XC0218(01)&from=EN

[4] The exemption does not apply to activities in facilities that are exclusively intended for the processing of non-recyclable hazardous waste and to existing facilities, where actions within this measure are for the purpose of increasing energy efficiency, capturing exhaust gases for storage or use or recovery of materials from incineration ash, provided that such activities do not result in an increase in the capacity of waste processing facilities or by extending the lifetime of the plant, for which evidence is provided at the level of the plant.

[5] The exclusion does not apply to activities in existing facilities for mechanical biological treatment for the purpose of increasing energy efficiency or retrofitting separate waste recycling operations for biowaste composting and biowaste anaerobic digestion, provided that such activities do not result in an increase in the capacity of the waste processing plant or in extending the life of the plant, and for which evidence is provided at the level facility.

In addition to the above, green products and services include products or services that reduce or eliminate the creation or release of pollutants or toxics compounds; remove pollutants or hazardous environmental waste or reduce greenhouse gas emissions by methods other than the production of renewable energy. Regarding the waste materials, it is important to collect, reuse, restore, recycle or compost waste materials or waste water. Finally, this also includes products and services that preserve natural resources (products and services related to ecological agriculture and sustainable forestry, fisheries, land management, water resources management, biodiversity conservation) and products and services that enforce environmental regulations/standards; provide education and training related to green technologies and practices and those that increase the general level of public awareness of environmental issues. Examples of such green workplaces are workplaces in entities that deal with material recovery, workplaces with energy certification of real estate or workplaces of various experts who deal with energy from renewable energy sources. Green workplaces also include various jobs (farmers, breeders, workers) in ecological agriculture[6]. Jobs in the green processing industry are also a good example (jobs in the production of wood chips for biomass, jobs in the production of biofuels, in the production of various machines for the recovery of metal, plastic, rubber or vehicles for various types of waste, jobs in the provision of maintenance services, repair and installation ecological products). Jobs in economic entities which contribute to the green transformation of business' are directly related to creating or maintaining environmentally friendly production processes or reduced use of natural resources in the economy. Ecologically acceptable production processes and practices are those that reduce the negative impact on the environment or on natural resources that arise from the production of any good or services. These production processes and practices include production of green products and services for use within the economy, with the use of methods, procedures, practices, or technologies that have a positive impact on environmental or natural preservation resources. Jobs that are directly related to such processes and practices, the ones that do research, develop or use/maintain technologies and practices to reduce the impact of an economic entity on the environment, or the ones within whose responsibility is the training of other workers in those technologies and practices will be considered as green workplaces. Specific examples are various researchers, engineers, and other workers in the field. The management and administrative activities of a business, although related to the jobs and areas, will not be considered green workplaces. Likewise, workplaces where the worker only performs tasks related to the production of green products or green services for a small part of the working time, i.e., where the worker performs tasks related to the ecological creation/maintenance of acceptable production processes or reduced use of natural resources for a small part of working hours, will not be considered green jobs. In conclusion, jobs in economically active entities that contribute to one or more environmental goals, but which at the same time cause harm to other environmental goals cannot be considered green workplaces either.

## 4. CREATION OF NEW GREEN MARKETS

To quantify the size of the green economic opportunity, Oxford Economics in collaboration with Arup Singapore Pte Ltd., produced a report entitled "The Global Green Economy - Seizing the Opportunity" which relies on "Net Zero Emissions by 2050" (NZE2050) scenario made by International Energy Agency (IEA) which gives basic projections for the future (Arup, Oxford Economics, 2023). The NZE2050 scenario sets out a detailed plan of actions needed to limit global warming to 1.5 °C above pre-industrial levels by the year 2050.

---

[6] Ecological production implies compliance with the rules of organic farming that are subject to supervision national bodies. The mentioned regulations, which are regulated all areas of ecological production, are based, among others, on the following principles: the use of GMOs is not allowed, the application of ionizing radiation is not allowed, the use of artificial fertilizers is limited, herbicides and pesticides. The economic entity must be registered in the Register of ecological farms.

The report analyzed the changes that must occur in the global economy to facilitate this shift and identified the five largest categories of carbon-neutral goods and services that will emerge in the future. Each category represents a relatively niche product line today but is considered to have a large share of the future global economy under a net zero scenario. This assessed their direct contribution to future GDP, as well as the indirect contribution they make through their huge supply chains, and we call these opportunities new green markets.

4.1. Electric vehicle manufacturing

The global transportation sector was a major polluter and in 2020 which produced approximately 7.3 billion metric tons of carbon dioxide (CO_2) emissions. Passenger cars were the biggest source of emissions that year, accounting for 41 % of global transportation emissions (Statista, 2021). According to the "Net Zero 2050" scenario this should be reduced to 0.7 Gt by introducing modal changes, improving energy efficiency, and transitioning to electric vehicles, or introducing biofuels where possible. In order to reduce the impact of global traffic it is necessary to go "green" which is why it is necessary to develop the market for electric vehicles (Arup, Oxford Economics, 2023).
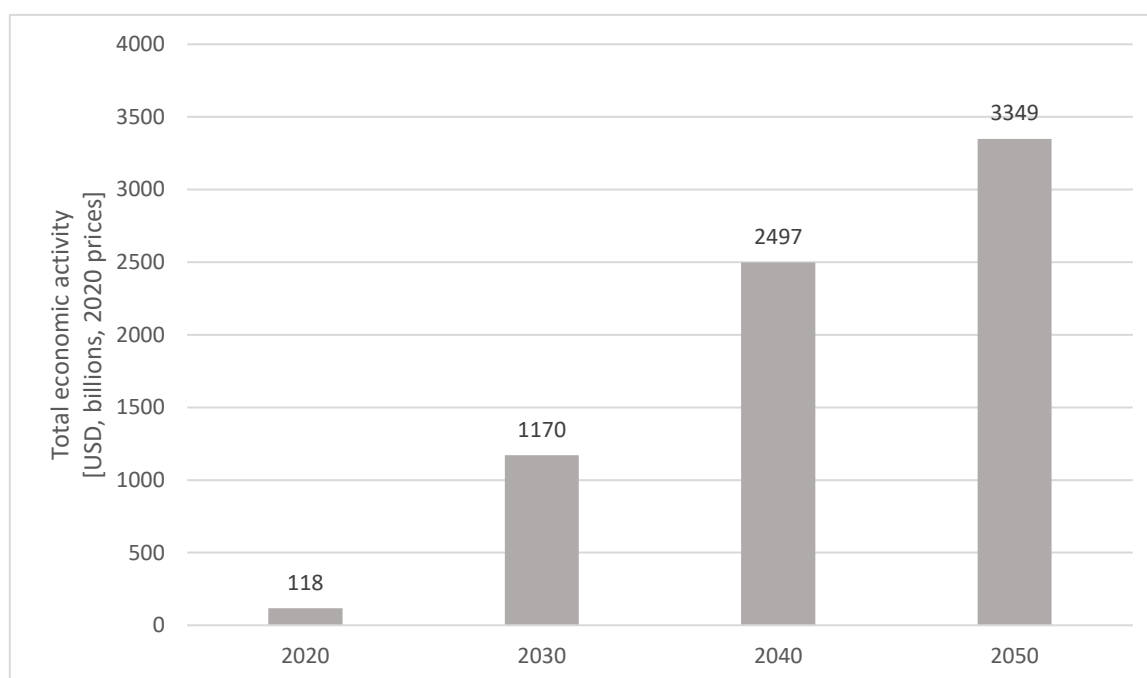
Figure 1: Global GVA from EV production, under NZE2050 scenario
(Source: Arup, Oxford Economics, 2023)

Electric vehicle (EV) sales doubled in 2021 compared to the 2020 to a new record of 6.6 million (for reference, only 120,000 electric cars were sold in the world in the whole 2012). In 2021, almost 10% of global car sales were electric which brings the total number of electric cars on the world's roads to around 16.5 million (a number which is triple the number that it was in 2018) (Arup, Oxford Economics, 2023). Global electric car sales continued to grow strongly in 2022, with 2 million sold in the first quarter of the year which is a 75 % increase compared to the same period in 2021. In order to meet the needs of the IEA's net zero scenario, the production of electric vehicles will have to increase rapidly. According to Oxford Economics, the electric share of light commercial vehicle sales will have to increase from around 4% of total vehicle sales in 2020 to more than 60 % in 2030 and close to 100 % in 2050. It is estimated that the production of electric motor vehicles (including motorcycles, light and heavy vehicles) and its parts, will directly contribute USD 777 billion to the global economy by 2030 and USD 1,471

billion by 2050. Also, the electric vehicle manufacturing sector will create indirect economic activity in its supply chain worth USD 993 billion by 2030, growing to USD 1,878 billion by 2050, making the total economic activity generated by this sector US 3.4 trillion dollars by that year (Arup, Oxford Economics, 2023).

4.2. Renewable electricity generation

Replacing fossil fuels with low-emission electricity is one of the most important drivers of emissions reduction when looking at the "Net Zero 2050" scenario, accounting for around 20 % of the total global emission reductions. Judging by Oxford Economics, the share of renewable energy in total global electricity production will increase from around 29 % in 2020, to 60 % by 2030 and almost 90 % by 2050. Most of this is expected to come from wind and solar energy (35 % and 33 % of total electricity generation in 2050 with hydrogen adding an additional USD 340 billion) (Arup, Oxford Economics, 2023).
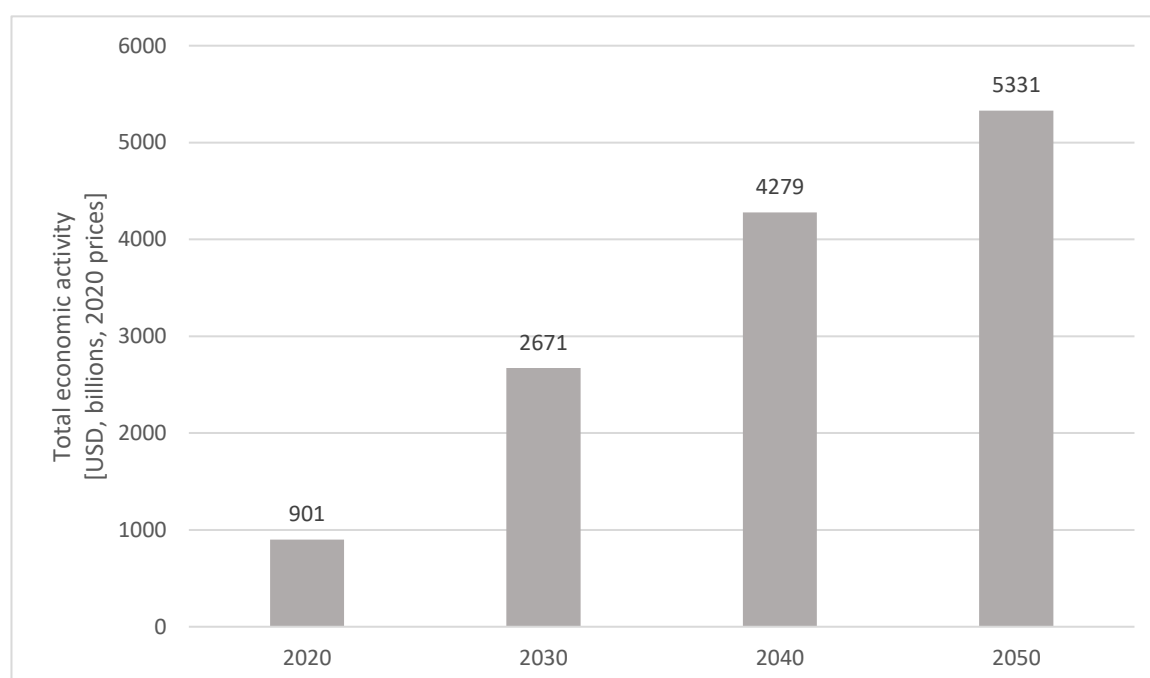
Figure 2: Global GVA from renewable electricity generation, under NZE2050 scenario
(Source: Arup, Oxford Economics, 2023)

It is also estimated that the green electricity generation and distribution sector will directly contribute USD 1.06 trillion to global GDP by 2030, rising to USD 2.03 trillion by 2050. This figure excludes electricity generation from nuclear power plants and carbon capture, utilisation and storage (CCUS)-enabled fossil fuel fired plants but includes the contribution of solar, wind, hydro, bioenergy, geothermal, and marine. Additionally, this renewable electricity generation is estimated to support indirect economic activity in global supply chains worth USD 1.6 trillion by 2030, rising to USD 3.3 trillion by the year 2050 (Arup, Oxford Economics, 2023).

4.3. Clean energy equipment

Achieving a steep "Net Zero 2050" reduction in fossil fuel emissions from electricity generation requires a dramatic expansion in the energy supply chain across a wide range of renewable energy sources, including solar, wind, heat pumps, hydro, geothermal, marine and battery power. Across this supply chain, it is the expansion in solar and wind power that are most critical. Today, these categories produce less than half of the electricity produced in coal, natural gas, and oil-fired power plants.

In order to reach the "Net Zero 2050" goals, these sectors must produce more than twice as much as fossil fuel power plants by 2030, and by 2050 renewable sources must account for 88 % of total global electricity production. In addition, a wide range of heat pumps will allow the world to heat its buildings in a low carbon way (Arup, Oxford Economics, 2023).
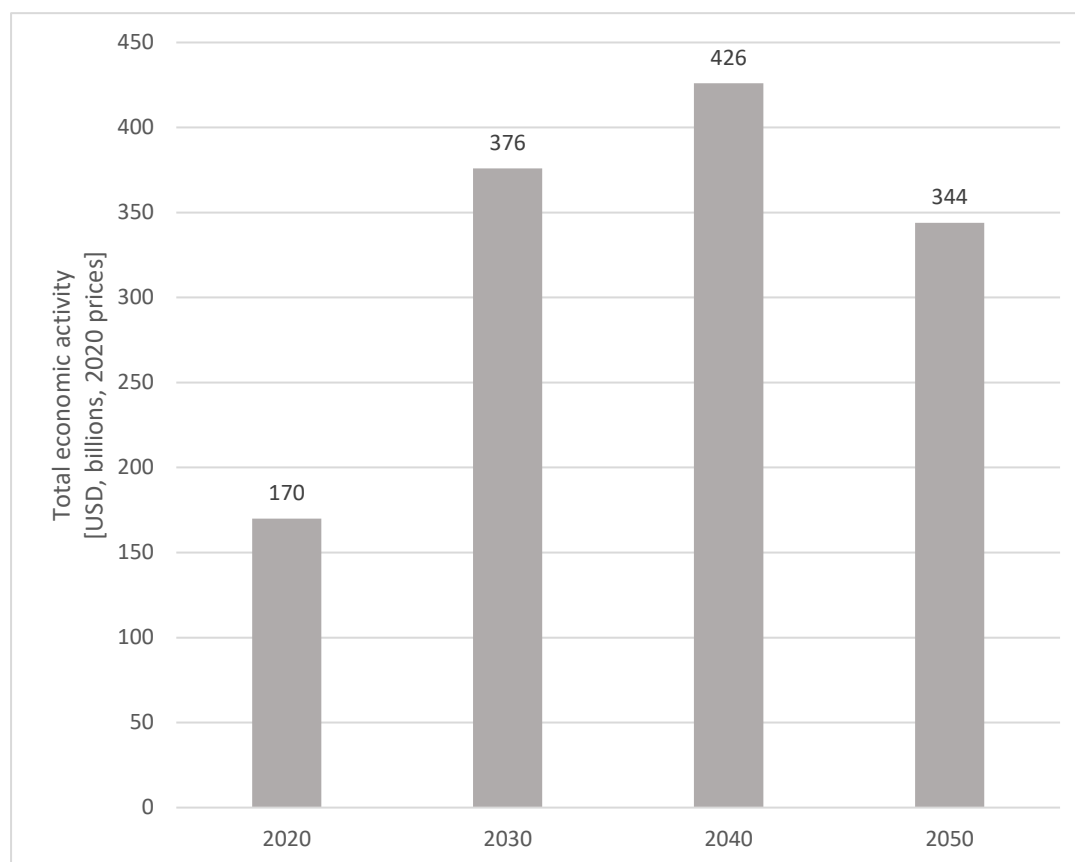
Figure 3: Global GVA from clean energy equipment, under NZE2050 scenario
(Source: Arup, Oxford Economics, 2023)

4.4. Renewable fuel production

Part of the solution to reducing carbon emissions in the transport sector and heavy industry comes from replacing fossil fuels with sustainable alternatives. Bioenergy plays an evolving role in the net zero transition over the next 30 years. One of its key advantages is that it can be used in existing infrastructure. Liquid biofuels will play a significant role in replacing fossil fuels in road transport between now and 2030, before electric vehicles become dominant. After that, liquid biofuels will become increasingly important in the aviation and marine fuel mix. As production increases so will the need for new infrastructure to produce, refine and ship sustainable raw materials. Renewable fuel production is estimated to directly contribute USD 135 billion to global GDP by 2030, rising to USD 295 billion by 2050. The above is based on IEA scenario projections for the use of hydrogen, biogas, ethanol, and other liquid biofuels (including biodiesel) and economic data from industrial forecasts by Oxford Economics. An analysis of the supply chain associated with the production of renewable fuels suggests that a significant indirect economic footprint will also be supported by the growth of this green market. It is estimated that an additional USD 495 billion of economic activity will take place in the renewable fuel production supply chain by 2030, rising to USD 837 billion by 2050. Therefore, the total economic activity generated by this sector by 2050 will be equal to 1 .1 trillion USD (Arup, Oxford Economics, 2023).
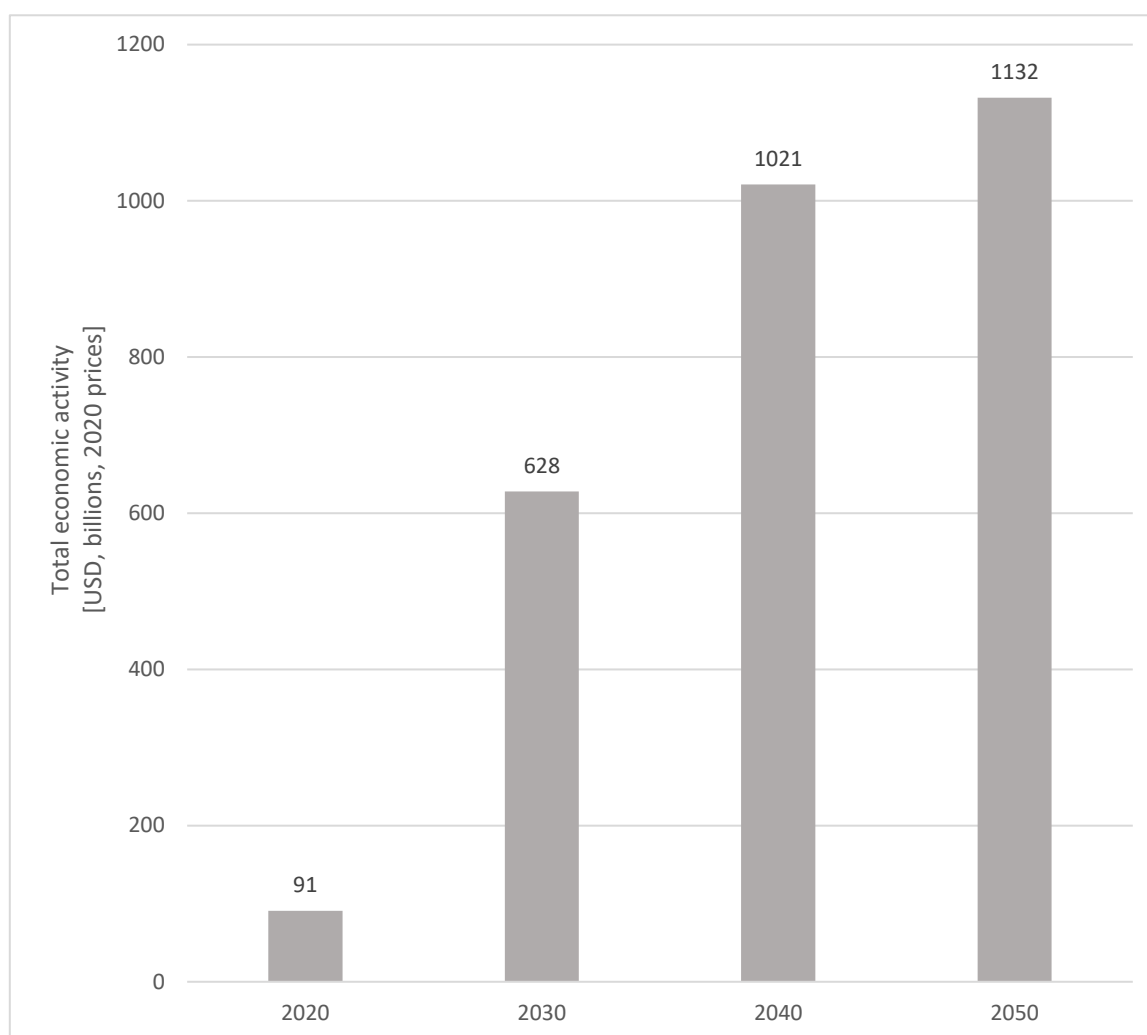
Figure 4: Global GVA from renewable fuel production, under NZE2050 scenario
(Source: Arup, Oxford Economics, 2023)

4.5. "Green" finance

Capital investment worth 1.5 % of global GDP is needed to finance the transition to Net Zero 2050, according to the Energy Transition Commission. A large new capital market must emerge, where investments to decarbonize the global energy system are fueled by the purchase and sale of equity and debt instruments. A new sector of green financial services is emerging with the aim of providing return on investment and environmentally positive outcomes. Financial tools, such as green bonds and carbon market instruments, encourage investments that reduce carbon and discourage those that harm the environment. They do the above by changing risk perception and internalizing some external environmental effects associated with harmful economic activities. The impact of green finance on the global economy is best judged by the results of the investments it enables. In terms of green opportunity, these results are already present in the various green markets we described earlier in this chapter—from clean energy equipment and infrastructure to fossil fuel substitutes. But the green finance sector will also make its direct contribution to GDP, which from an economic accounting perspective is equal to the profits and earnings associated with its issuance of green financial products. We estimate that the green finance industry will make a direct contribution to global GDP of USD 36 billion in 2030, rising to USD 61 billion by 2050. Additionally, a further USD 66 billion of economic activity will be supported in the supply chain sector in 2030 where the economy will grow to USD 90 billion by 2050 under this scenario (Arup, Oxford Economics, 2023).
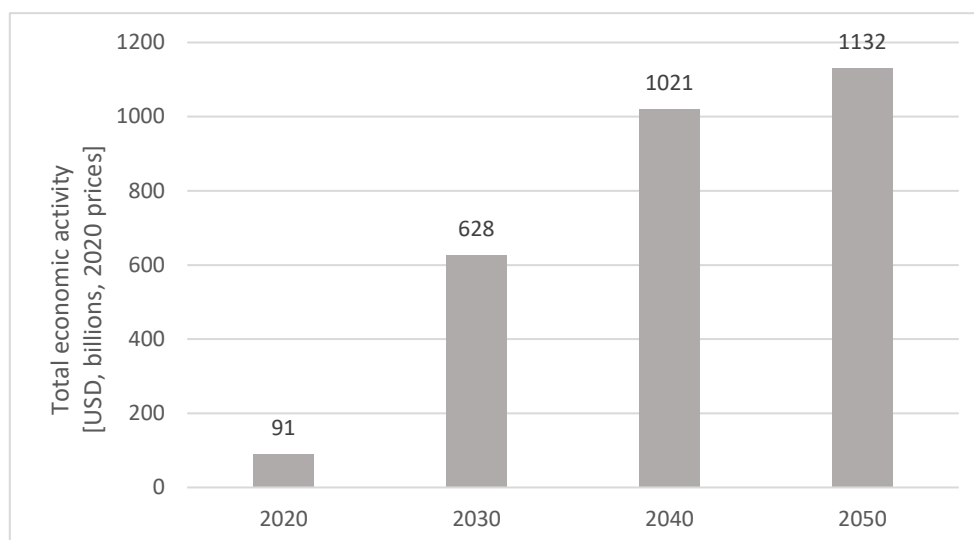
Figure 5: Global GVA from green financial services, under NZE2050 scenario
(Source: Arup, Oxford Economics, 2023)

5. CONCLUSION

Mitigation of climate change is expensive and implies, among other significant changes, a fundamental transition from the use of energy based on fossil fuels to those sources that are renewable. Because of this, most policymakers and investors too often understand the green transition from a cost perspective which very often gives unfavorable data. However, the transition to a sustainable environment by 2050 can also create huge opportunities in the global economy that can be very profitable. International Energy Agency formulated the "Net Zero by 2050" report, which is the world's first comprehensive study on how to transition to a net zero energy system by 2050 while ensuring a stable and affordable energy supply, providing universal access to energy, and enabling strong economic growth. In January 2023, Oxford Economics, in cooperation with Arup Singapore Pte Ltd. issued a report entitled "The Global Green Economy - Seizing the Opportunity" which relies on the "Net Zero by 2050" scenario made by the International Energy Agency (IEA). The "The Global Green Economy - Seizing the Opportunity" report identified five major new green markets for carbon-neutral goods and services to emerge. These markets are electric vehicle manufacturing, renewable electricity generation, clean energy equipment, renewable fuel production and "green" finance. It is estimated that the transition to a net-zero emissions environment by 2050 will create new industries worth USD 10.3 trillion for the global economy. This includes the direct GDP contribution to aforementioned markets; plus, activity supported in global supply chains. What is most important, therefore, is that setting the planet on this sustainable path will lead to significant productivity gains over a world where climate change is not controlled.

LITERATURE:

1. Arup, Oxford Economics (2023.): *The Global Green Economy: capturing the opportunity*, Arup Singapore Pte Ltd, Oxford Economics
2. Barbier, E., (2012.): *The Green Economy Post Rio+20.* Science (80-.). 338, 887–888.
3. Commission Notice, *Technical guidance on the application of 'do no significant harm' under the Recovery and Resilience Facility Regulation (2021/C 58/01).* Retrieved 21.02.2023. from https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021XC0218(01)&from=HR
4. International Energy Agency (IEA) (2021.): Retrieved 25.02.2023. from https://www.iea.org/news/pathway-to-critical-and-formidable-goal-of-net-zero-emissions-by-2050-is-narrow-but-brings-huge-benefits

5. International Energy Agency (IEA) (2022.), *Global EV Outlook 2022*, IEA, Paris; Retrieved 25.02.2023. from https://www.iea.org/reports/global-ev-outlook-2022/executive-summary
6. European Commission. *Regulation (EU) 2020/852 on the establishment of a framework to facilitate sustainable investment*. Retrieved 21.02.2023 from https://eur-lex.europa.eu/legal content/HR/TXT/PDF/?uri=CELEX:32020R0852&from=HR.
7. Statista Ltd. (2021).: Retrieved 24.02.2023. from https://www.statista.com/statistics/1185535/transport-carbon-dioxide-emissions-breakdown/
8. United Nations Environment Programmer (UNEP), (2011.): *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. doi:10.1063/1.3159605
9. United Nations Environment Programme (UNEP), (n.d.): Retrieved 22.02.2023. from https://www.unep.org/about-un-environment
10. World Commission on Environment and Development, (1987.): *Our common future*. Oxford.

MOBILE DEMINING MACHINE BASED ON THE ARDUINO PLATFORM

Ivan Kraljevic
Aspira, Split, Domovinskog rata 65, Croatia
ivan.kraljevic@aspira.hr

Jurica Trstenjak
Međimurje Polytechnic in Čakovec
Čakovec, Bana Josipa Jelačića 22A, Croatia
jtrstenjak@mev.hr

ABSTRACT
This paper presents in a concise way the use of the Arduino platform for the production of robotic carts that have the ability to detect metal, with the primary purpose of finding mines, but also other metal objects on the earth's surface. The robotic cart will be made of plastic, using a 3D printer. The robot will be controlled by an ESP32-CAM board which will, among other things, be in charge of transmitting the image in real time. A mini server will be set up on the board itself, which will be in charge of processing requests sent by the user from the smart device, such as the movement of the robot and the display of the image on the client side. The communication itself will take place via Wi-Fi technology, where the user will connect directly to the device and gain access to the robot control website. In order for the ESP32 to successfully power the engines and control direction and speed, an additional L298N module will be used. It is a dual H-bridge motor drive that allows control of the speed and direction of two DC motors simultaneously. The module can run DC motors that have voltages between 5 and 35V, with a maximum current of up to 2A. The EQKit MDS-60 will be used for metal detection. The sensor operates on a DC voltage between 3 and 5 V and with an operating current of 40mA. The sensor has the ability to detect metal at a distance between 60mm and 100mm. On the front there is a potentiometer with which the detection distance is adjusted. Eventually, an appropriate application was created with a user interface to manage the entire system.
***Keywords:*** *Arduino, ESP32-CAM, L298N, EQKit MDS-60*

1. INTRODUCTION
The development of technological processes, the discovery of new technologies and the pursuit of progress is the daily routine of today's society. In order to facilitate the daily processes, actions and jobs that people perform, a technology called IoT (Internet of Things) was developed. All previous achievements and discoveries in this sector provide great opportunities for the individual and society globally, to automate and facilitate processes that were previously performed manually. The remote control of devices, motors, etc. has thus gained a new dimension, and the possibilities that come with it are countless. With the development of wireless communication came the development of remote control of machines such as a mine detection machine, where in the past people had to manually operate such a machine. However, today this should not be the case.

2. INTERNET OF THINGS
The Internet of Things (IoT) is a system of interconnected computer devices, mechanical and digital machines, objects, animals or people that have unique identifiers and the ability to transfer data over the network without the need for interaction between people or between people and computers.

An IoT object can be a person with a heart monitor implant, a domestic animal with a biochip transponder, a car that has built-in sensors to warn the driver when the tire pressure is low, or any other natural or man-made product that can be assigned an Internet Protocol (IP) address and which can transmit data over the network.
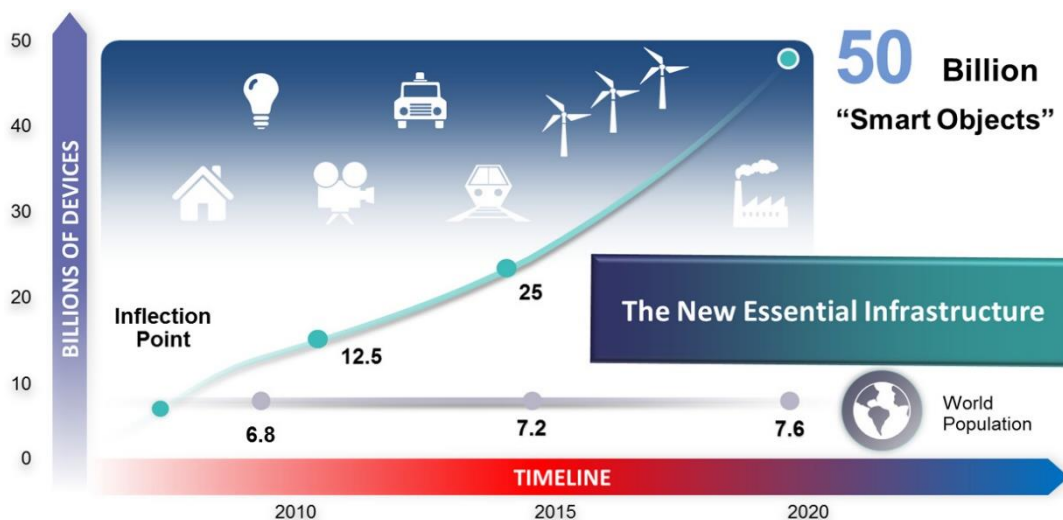
Figure 1: Number of IoT devices over the years
(Source: Cisco IBSG)

Building on a complex network that connects billions of devices and humans in a multi-technology, multi-protocol and multi-platform infrastructure, the main vision of the Internet of Things is to create an intelligent world where physical, digital and virtual concepts will unite to create smart environments that they give more intelligence to energy, health, traffic, cities, industry, buildings and many other areas of our daily life. It is expected to interconnect millions of „islands" of smart networks that allow access to information not only "anytime" and "anywhere" but also the use of "anything" and "anyone" via any "path", "network" and "any service ". This will be achieved if the objects that are manipulated every day are equipped with sensing, identification and positioning devices and have an IP address to become smart objects, able to communicate not only with other smart objects, but also with people with the expectation that areas could be reached which could never be reached without advances in recognition, identification and positioning technologies.

2.1. Functionality

The IoT ecosystem consists of Internet-enabled smart devices that use embedded systems, such as processors, sensors, and communication hardware, to collect, send, and act on data they receive from their environment. IoT devices share the sensor data collect by connecting to an IoT gateway or other end device where the data is sent to the cloud to be analyzed or analyzed locally. Devices communicate with other connected devices and act on the information they receive from each other. Devices do most of the work without human intervention, although people can interact with the devices—for example, set them up, give them instructions, or access data. IoT can also use artificial intelligence (AI) and machine learning to make the data collection process easier and more dynamic. The IoT consists of a collection of different, purpose-built networks. Today's cars, for example, have multiple networks for engine control, safety features, communication systems, etc. Commercial and residential buildings also have different systems for controlling heating, ventilation and air conditioning (HVAC), telephone services, security, and lighting.

As the IoT evolves, these networks, like many others, will be connected with additional security, analytics and management capabilities. This will allow IoT to become even more powerful.
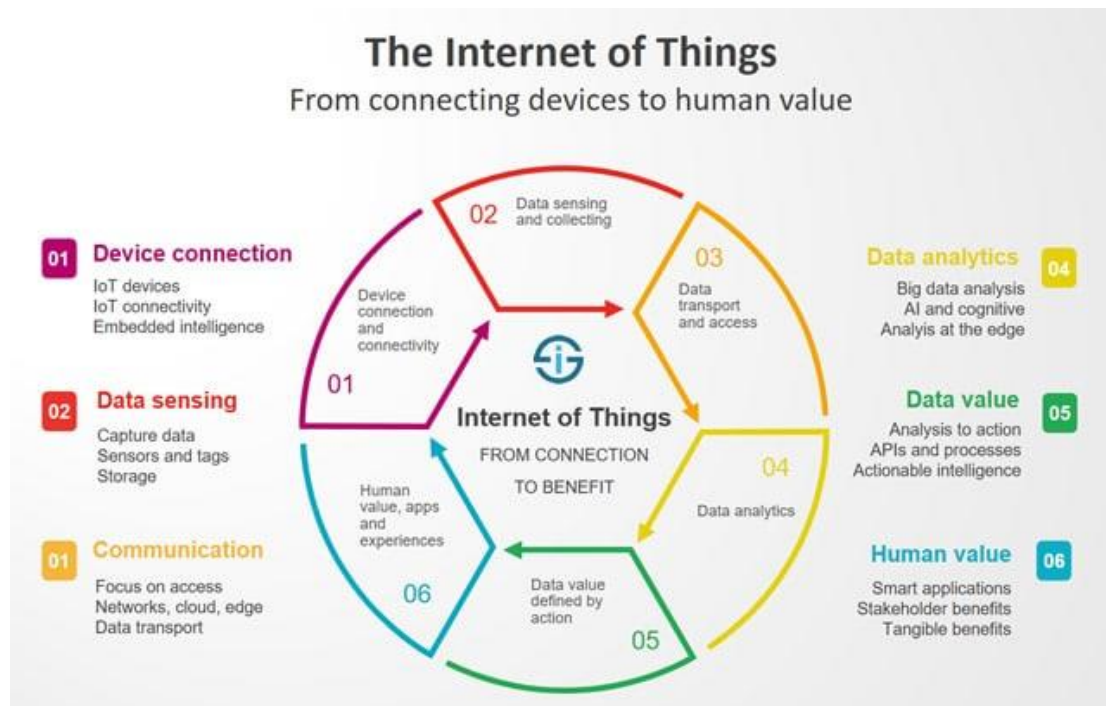

Figure 2: A simple example of an IoT system
(Source: https://www.i-scoop.eu/internet-of-things-iot/ (from: 25.08.2021.))

2.2. Architecture

The infrastructure is built around a multi-layered architecture where smart objects will be used to deliver different services through four main layers: the device layer, the network layer, the support layer and the application layer.
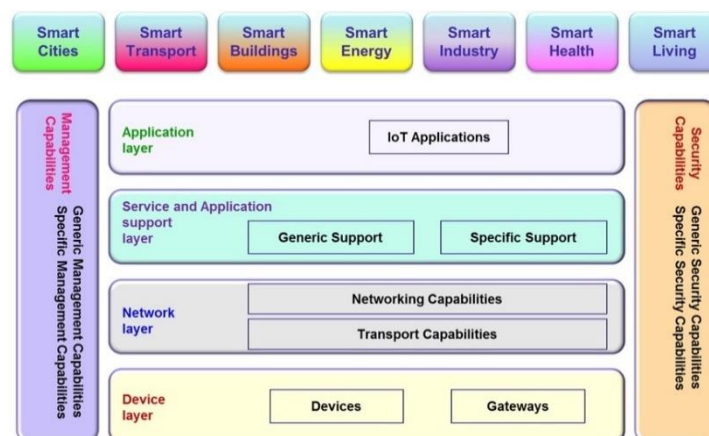

Figure 3: Layers of IoT architecture
(Source: ITU-T (from: 25.08.2021.))

The device layer houses various components (sensors, actuators, RFID devices) and gateways used to collect sensor readings for further processing, while the network layer provides the necessary transport and network capabilities to route IoT data to processing locations.

The support layer is a middleware layer that serves to hide the complexity of lower layers at the application layer and provide specific and general services, such as storage in various forms (database management systems and/or cloud computing systems), and many other services, such as translation. IoT can be perceived as an infrastructure that runs a number of application services enabled by a number of technologies. IoT application services are expanding into many areas such as smart cities, smart transportation, smart buildings, smart energy, smart industry and smart health, and are enabled by various technologies such as sensors, nanoelectronics, wireless sensor network (WSN), radio frequency identification (RFID), localization, storage and cloud. IoT systems and applications are designed to provide security, privacy, integrity, trust, reliability, transparency, anonymity and are bound by ethical constraints.
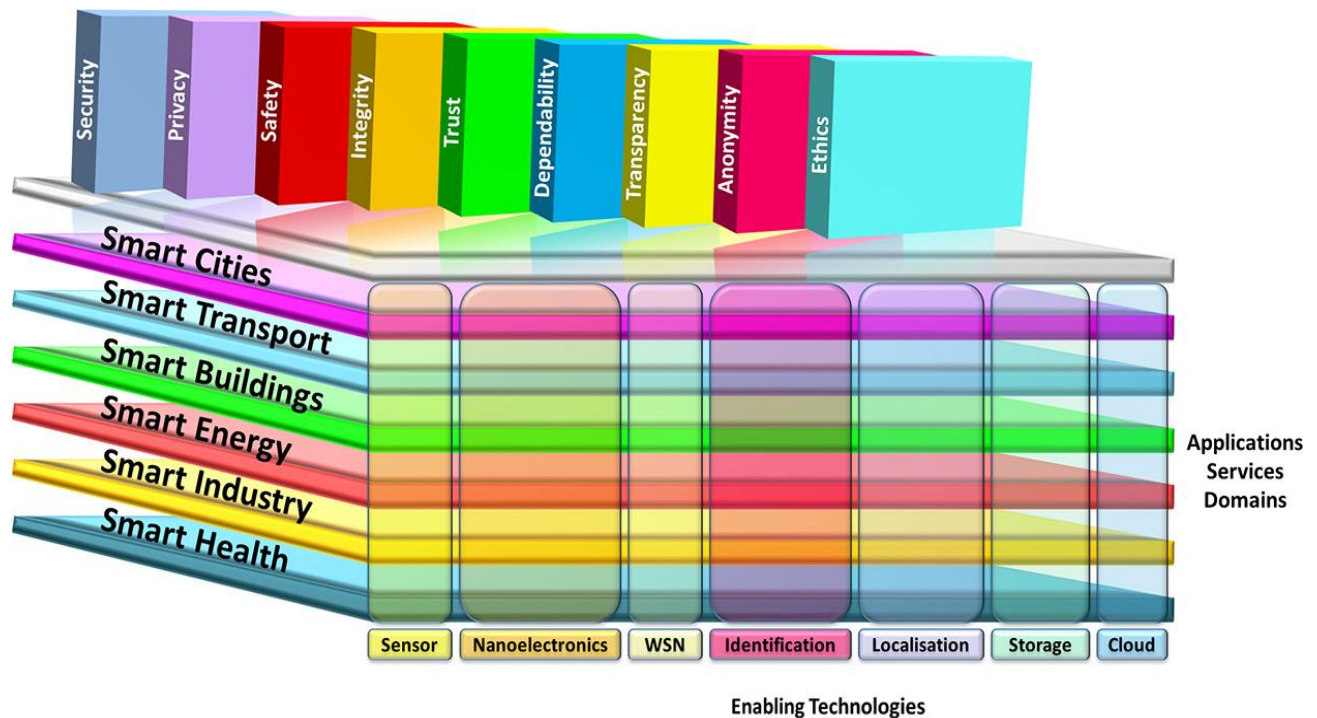

Figure 4: A three-dimensional view of the IoT
(Source: Liñán Colina i sur, 2016, xvii (from: 25.08.2021.))

3. COMPONENTS OF ROBOTS FOR MINE DETECTION
In this chapter, all the parts and electronic elements used in the construction of the practical work - a robot with metal detection option will be listed, as well as their brief specifications and advantages and disadvantages. Why exactly those components were used, what alternatives exist and their description.

3.1. ESP32-CAM – controlling unit
ESP32-CAM can be widely used in various IoT applications. It is suitable for home smart devices, industrial wireless control, wireless tracking, QR wireless identification, wireless positioning signals and other IoT applications. Due to its size and specifications, it is considered one of the ideal solutions for IoT applications. In this project, it was used precisely for reasons of practicality and simplicity. The module transmits the image in real time to the client side, where there are also buttons for controlling two electric motors, and it moves in 4 directions. There is also a sliding button for controlling the LED lighting. The response speed is very good, and the image transmission is not subject to interference as long as the signal is excellent.

Figure 5: ESP32-CAM AI-THINKER MODULE
(Source: authors)

It has a very competitive small-sized camera module that can work independently as a minimal system with a size of only 27*40.5*4.5mm and a idle current consumption of up to 6mA. One thing to note about this module is that it has components on both sides of the PCB. The "upper part" of the panel has a connection for the camera module, as well as a slot for microSD (sometimes called "TF") and an LED that is used to illuminate the objects that the camera captures. On the bottom side are the RESET button, the internal antenna and also the connection for the external antenna. The ESP32-CAM is based on the ESP32-S module, so it shares the same specifications and has the following features:
1) 802.11b/g/n Wi-Fi
2) Bluetooth 4.2 with BLE
3) UART, SPI, I2C and PWM interfaces
4) Working clock up to 160 MHz
5) Computing power up to 600 DMIPS
6) 520 KB of SRAM plus 4 MB of PSRAM
7) Supports image transfer via Wi-Fi connection
8) Multiple sleep modes
9) Possible upgrades of firmware over the air (FOTA)
10) 9 GPIO ports
11) Built-in LED flash

The ESP32-CAM includes an OV2640 camera module. The device also supports OV7670 cameras. The OV2640 has the following specifications:
1) 2 megapixel sensor
2) Output formats include YUV422, YUV420, RGB565, RGB555 and 8-bit compressed data
3) Image transfer speed from 15 to 60 frames per second

The ESP32-CAM board does not have a USB port, so it cannot simply be connected to a computer and start loading programs. An external FTDI adapter will have to be added instead.
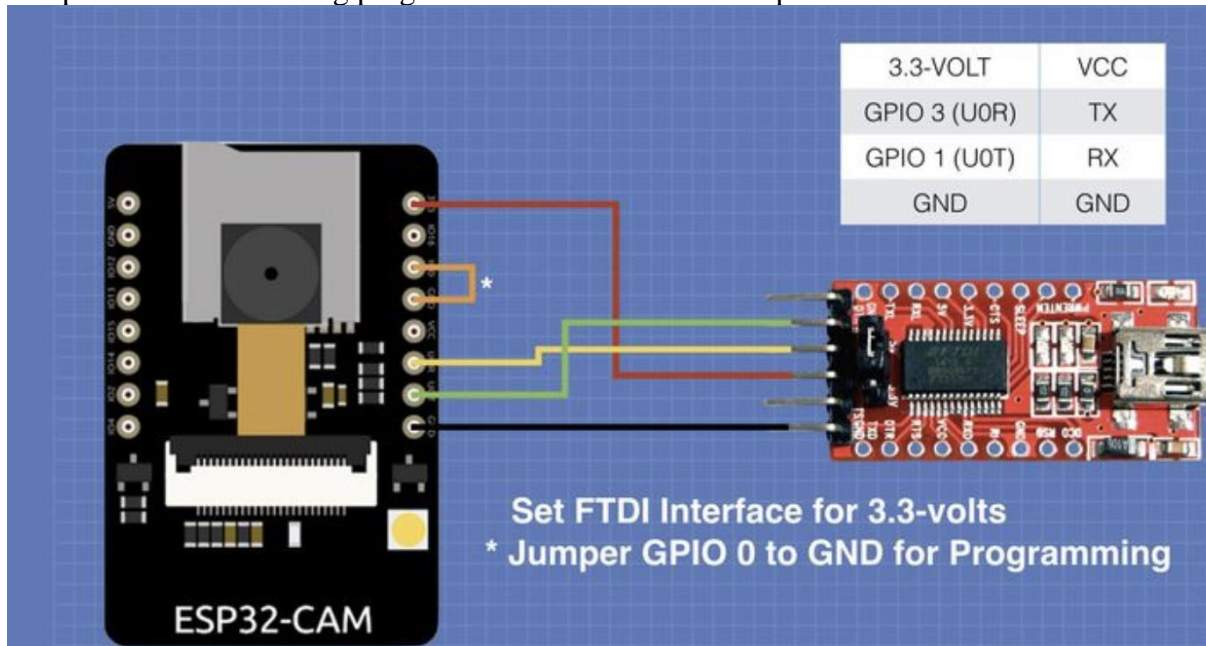

3.3-VOLT	VCC
GPIO 3 (U0R)	TX
GPIO 1 (U0T)	RX
GND	GND

Figure 6: FTDI adapter connection diagram
(Source: https://dronebotworkshop.com/esp32-cam-intro/ (from: 25.08.2021.))

3.2. L298N-motor driver

The L298N is a dual H-bridge motor drive that allows speed and direction control of two DC motors simultaneously. The module can drive DC motors that have voltages between 5 and 35V, with a maximum current of up to 2A. The module has two connectors for each of the motors (A and B), a set of 3 connectors for powering the motor, one of which is intended for negative battery pole, the other (VCC) for powering the motor between 5 and 35 volts and a 5 volt pin that can be positive pole input or output.
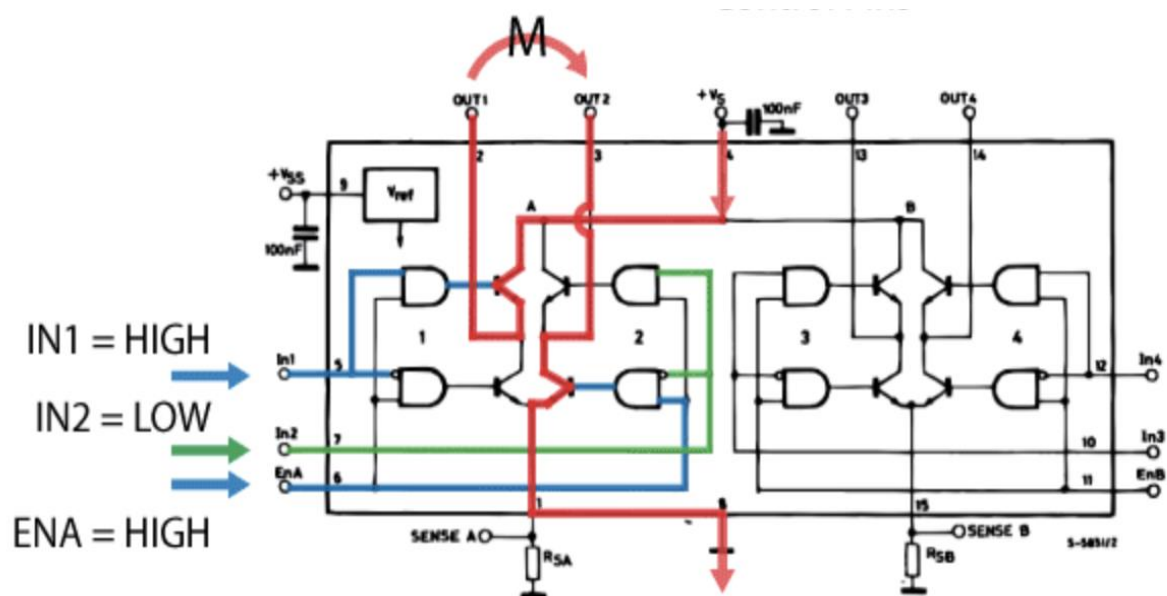

Figure 7: Diagram L298N
(Source: https://howtomechatronics.com/wp-content/uploads/2017/08/L298N-Block-Diagram-Current-Flow-How-It-Works.png (from: 28.08.2021.))
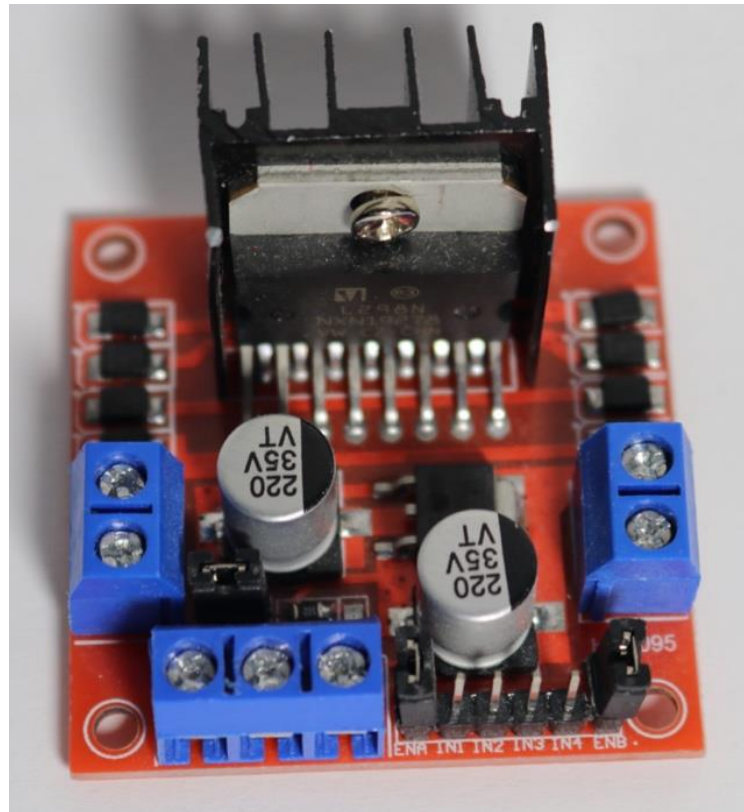
Figure 8: L298N
(Source: authors)

Following are the logic control inputs. The Enable A and Enable B pins are used to enable and control the motor speed. If there is a jumper on this pin, the motor will be enabled and run at maximum speed, and if we remove the jumper, we can connect the PWM (Pulse Width Modulation) input to this pin and thus control the speed of the motor. If this pin is connected to ground, the motor will be disabled. Then input 1 and input 2 pins are used to control the direction of rotation of motor A, and inputs 3 and 4 are used for motor B. These pins actually control the H-bridge switches inside the L298N IC. If input 1 is LOW and input 2 is HIGH, the motor will move forward, and vice versa, if input 1 is HIGH and input 2 is LOW, the motor will move backward. In case both inputs are the same, low or high the motor will stop. The same applies to inputs 3 and 4 of engine B.
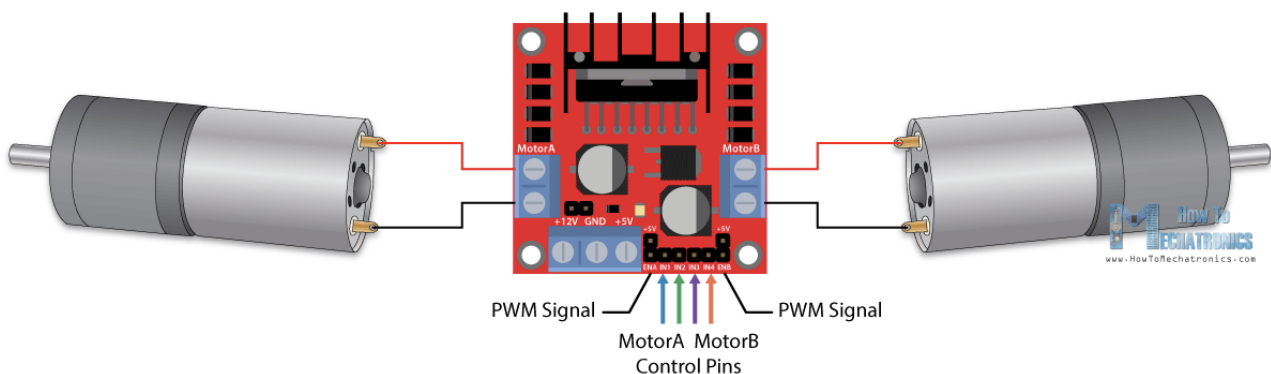

Figure 9: L298N - motor control inputs
(Source: https://howtomechatronics.com/wp-content/uploads/2017/08/L298N-Block-Diagram-Current-Flow-How-It-Works.png (from: 28.08.2021.))

3.3. EQKit MDS-60
The MDS-60 is a low-cost metal detector suitable for small projects such as this one. It consists of 16 elements connected to a PCB electronic board.

Figure 10: MDS-60
(Source: authors)

The detector is powered with direct current from 3V to 5V, has the ability to detect metal at a distance of up to 100mm, and activates a sound signal on each detection.

4. TESTING
After writing, the code is loaded onto the board, with the help of a library that can be installed directly in the IDE. When the loading is successfully completed, it is necessary to open a serial monitor in which the information specified in the code are displayed, and when starting the board itself, a message should be displayed with the corresponding IP address to which the client should connect in order to successfully drive the vehicle. After entering the address in the Internet browser, you should get a user interface with a real-time image and buttons that are used to control the vehicle itself. When a specific button is pressed, the command corresponding to the button pressed should be displayed in the serial monitor, and if the button is released, the STOP command should be automatically execute. Then it is checked whether everything works properly, and if the check passes without errors, the ESP should be assembled with motors and battery and the vehicle should be tested.
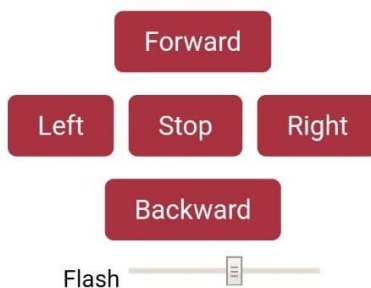
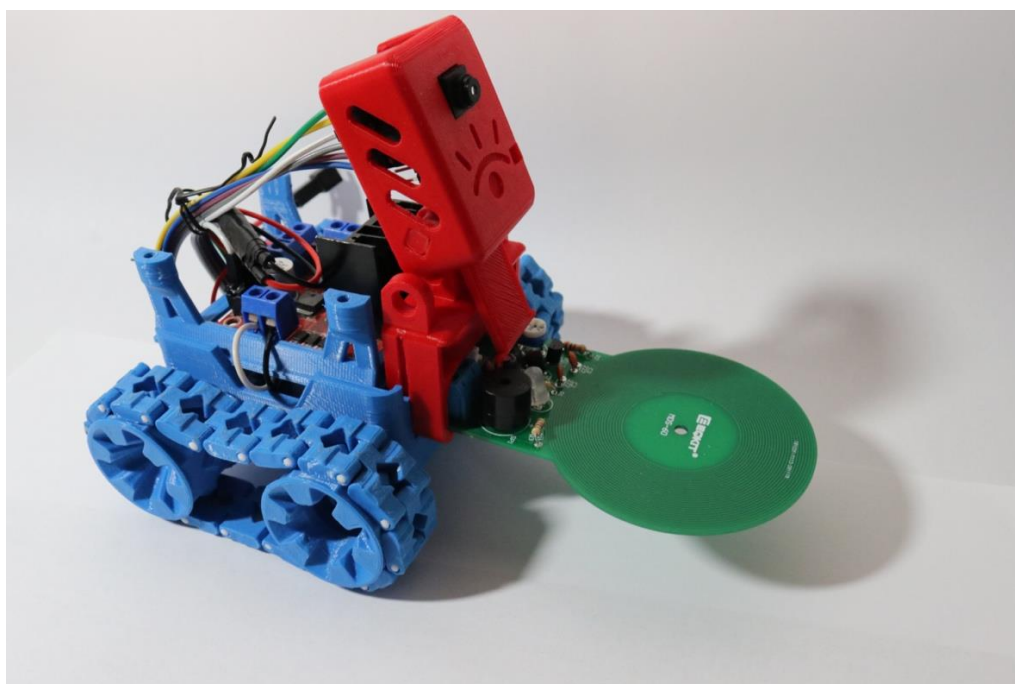*Figure following on the next page*

Figure 11: Robot control interface
(Source: authors)

Figure 12: Picture of the finished robot
(Source: authors)

5. CONCLUSION

In this paper, an attempt is made to present in a concise way the possibilities of automation of everyday processes that people encounter and reveals hints of the not so distant future towards which human civilization is moving. From living in a perfectly automated world where humans no longer have to perform risky tasks such as finding mines from past wars to monitoring human vitality and their values in real time in order to improve them. This paper presents the process of automation and all the advantages it brings. Some of the shortcomings and things that could be improved on this project are the distance at which this robot operates, the height at which it detects metal and the size of the robot itself. Cheap and easily available components were used for the project in order to demonstrate the very functionality of such a robot, but if a certain amount of money were invested, these defects would be easily repaired.

LITERATURE:
1. Antonio Linan Colina, Alvaro Vives, Marco Zennaro, Antoine Bagula, Ermanno Pietrosemoli (2016): 5 Days of IoT, Internet Archive.
2. Timothy Chou (2016): Precision: Principles, Practices and Solutions for the Internet of Things, Fayetteville, TX, U.S.A.: Lulu.com.
3. Dr Kamlesh Lakhwani, Dr Hemant Kumar Gianey (2020):Internet of Things (IoT): Principles, Paradigms and Applications of IoT, BPB Publications.
4. Internet of Things, Alexander S. Gilis, 2020. Retrieved 10.08.2021. from: https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT.
5. How The Next Evolution Of Internet Is Changing Everything (2020). Retrieved: 10.08.2021. from: https://www.cisco.com/c/dam/en_us/about/ac79/docs/innov/IoT_IB SG_0411FINAL.pdf.
6. Shenzhen Ai-Thinker Technology Co., technical specifications, Retrieved: 16.08.2021. from: https://raw.githubusercontent.com/SeeedDocument/Outsourcing/master/113990580 %20ESP32-CAM/113990580%20ESP32-CAM%20Product%20Specification.pdf.
7. 10 DIY Development boards, Retrived: 20.08.2021. from: https://thenewstack.io/10-diy-development-boards-iot-prototyping/.

HEAD OR HEART? DECISION-MAKING ON UNIVERSITY ENROLLMENT: CASE OF THE FIRST-YEAR STUDENTS AT POLYTECHNIC OF MEĐIMURJE IN CAKOVEC

Filip Zivaljic
Doktorska škola Sveučilišta Josipa Jurja Strossmayera u Osijeku
Trg Svetog Trojstva 3, Croatia
fzivaljic@gmail.com

Eva Trstenjak
Doktorska škola Sveučilišta Josipa Jurja Strossmayera u Osijeku
Trg Svetog Trojstva 3, Croatia
trstenjak.evaa@gmail.com

Mirjana Trstenjak
The Polytechnic of Međimurje in Čakovec
Ulica bana Josipa Jelačića 22a, 40 000 Čakovec, Croatia
mtrstenjak@mev.hr

ABSTRACT

A decision is a selection between alternative courses of action or alternatives. In the Republic of Croatia in 2021, graduates who passed their matriculation exams could choose from 119 institutions of higher education with the status of institutions for continuing education. 153 of them chose the Polytechnic of Međimurje in Čakovec. This paper provides an overview of the theory of decision-making, presents the enrollment trends at the Polytechnic of Međimurje in Čakovec according to the total enrollment quota, and investigates the enrollment decision-making process. The study measured the extent to which a first-year student believes he or she has made a decision based on an emotional or logical evaluation.
***Keywords:** The Polytechnic of Međimurje in Čakovec, Decision-making process, Higher Education*

1. INTRODUCTION

In Republic of Croatia there are 119 institutions of higher education. For graduates who have passed their matriculation exams, choosing the right institution for their higher education can be a challenging decision. With the growing competition among universities and other educational institutions there has been a vital need to learn and understand the nature of the student recruitment, eventually to impact the decision making behaviour of the prospective students and customers. (Paulsen, 1990) „When faced with any kind of buying decision, consumers take various steps in order to gather the right type of information, therefore universities need to market the proper channels of communication for the prospective consumer to learn more about the certain university and its programmes and services provided" (Momin and Sheik, 2018). Among the available options, 153 students chose the Polytechnic of Međimurje in Čakovec for their studies in 2021. In recent years, student enrollment has been at an all-time low. The purpose of this paper is to look into these students' decision-making processes and determine whether their enrollment decisions were based on emotional or logical considerations. This paper will also provide an overview of the the factors influencing decision-making process of students in recent research. This paper can be helpful to institutions of higher education in understanding students' decision-making processes and how they can develop marketing strategies to attract prospective students. By investigating the decision-making process of students who have enrolled in the Polytechnic of Međimurje in Čakovec, this paper

aims to contribute to the understanding of how students evaluate their options and make decisions regarding their higher education. Furthermore, the purpose of this paper is to provide practical recommendations for higher education institutions to improve their marketing strategies in order to better meet the needs of prospective students.

2. LITERATURE REVIEW

A literature review that is relevant to the context of this paper was conducted using the (Momin and Sheik, 2018) paper as the basis.

Matthews & Mabel Jones (1991) stated that since more students demonstrated that they had not much information about the quality indicators of the college they selected, it is very necessary for faculty to be aware of these students who are applying for their colleges without much awareness of quality. Every university must monitor student knowledge on key parameters. A higher indicator of unawareness has to be improved through effective communication tactics. A university's catalogue, brochures, and recruitment staff might objectively quantify "heavy use of computers in curriculum and good computer resources" and advertise it to high school seniors.

Kesić T, Previšić J (1997) In their research, they examined the motivations of Croatian students enrolling in economics and engineering programs. The results of the study validated the hypothesis that students of economics faculties are mostly motivated by utilitarian considerations, whereas students of electrical engineering faculties are primarily motivated by hedonic considerations. The data demonstrated that a greater proportion of electrical engineering students choose their college earlier than economics students. The portrayal of the influence of high school professors on future electrical engineering students revealed a considerable disparity. The research indicated that the motivations for enrollment and study at the Faculties of Economics and Electrical Engineering are distinct.

Mary C. Carlson (1999) shows that educational institutions need network strategies, target markets, and other marketing activities to better choose potential students. Most universities use university information to pick music department studios and faculties for student application aims.

According to Hossler (1999), today's competitive market with Internet use makes it difficult for educational institutions to recruit students. Since youths are more engaged on the Internet, they can find any information they need. These details assist students choose a university. Many institutions fear this process since they cannot affect pupils. Yet, the traditional print and direct mail used by prospective students has allowed them to influence them with their content.

Boyd Bradshaw, (2005) This study examined Southern Illinois University, Edwardsville freshman college choices. The study examines college choice for different demographics. The availability and brand image of academic courses and faculty instruction had a major impact on students' university enrollment decisions. Students joined the university for two key reasons: campus location and student scholarships.

Gonca Telli Yamamoto (2006) Educational institutions must engage in marketing due to rising market rivalry. Understanding student perspectives helps universities present their marketing image. In Turkey, university selection criteria include centralized testing, student selection, and placement options.

The study found that families influence university applications. The study also found that Turkish TV is the best medium for university awareness and education. Prospective students also notice the increased necessity for online website promotion.

According to W. Michael Hendricks (2006), prospective students must research schools and institutions extensively before choosing one. They search for colleges based on national rating, degree offerings, campus size, geography, and other factors. Online research is used to determine their college interests and needs.

According to Erik Nolen Allen (2007), students chose a college based on five main factors: interest in a major or degree program, location, cost, institutional prestige/reputation, and job placement. The individuals appeared to know what degree programs they wanted to pursue and what institutions offered. They also have enough knowledge that if their interest changes, they could easily switch programs within the same college, thus it may be a good idea to attend a college with a greater variety of degree programs.

Sandra J. Stack (2009) examines what motivates graduate students to apply to private MBA programs. Admissions and marketing don't know how to meet students' demands. This study's application decision was heavily influenced by work-school balance. Admissions meetings also influenced their choice. Universities must understand what drives its student segment.

Claire Brown (2009) Universities must use marketing techniques to showcase their programs and services to meet students' decision-making needs, such as seat availability. Program participants have diverse career goals and interests. Therein, it is almost evident that the key factor for selecting a university is its programs and that information search behavior varies by academic area. Universities use a "one-size-fits-all" marketing strategy to attract students, when a more targeted approach may work better. So, the study proposes that educational institutions focus their communication channels to specific student demographics and implement a sensitive marketing strategy in a market with increased competition.

Marwan M. Shammot (2011) This research paper demonstrates that word-of-mouth advertising is superior to print media marketing for colleges. In this study, financial cost had the most impact, whereas parental pressure had the least. Discounts for siblings can help private university applications.

Iqbal Muhammad Jawad (2012) This study examined how university brand image affects university choosing decisions. The study found that the university's image depends on prestige, quality of education and professors, scholarships, and admittance rate. The biggest factor was university education and instructor quality.

Noor Ismawati Mohd Jaafar (2013) The following research conducted from Malaysian universities indicates that employment or career alternatives and self-development are the most essential considerations for pursuing higher education, whereas employability, goodwill, and brand image are the most important factors for selecting an educational institution.

Jody Sue Sheppard (2013) says that brand image and goodwill of educational institutions take the top places in most studies, but this research demonstrates that the top priority while making a selection decision towards the university was the availability of the desired program or course by the student.

Studies also found that class flexibility and study time flexibility were important factors. Students attend university for personal development and job opportunities in their chosen course.

Katherine Culliver (2015) says that unconventional students have distinct motivations for applying to higher education than traditional-age students. To reach students nowadays, marketers must use electronic marketing. Traditional marketing strategies including billboards, flyers, and mailers were used by older nontraditional students, while the overall sample population used more modern methods (such as electronic media, e-mail, and social media).

Kobale, M (2016) According to the findings of this study, the authors came to the conclusion that dental students in Croatia are not significantly different from their counterparts in the majority of other countries in terms of their level of motivation and professional expectations. The majority of the students surveyed identified dental medicine as their primary area of professional interest. There were numerous compelling factors that led to the decision to pursue a profession in dentistry, including the opportunity for self-employment and maintaining a balanced lifestyle, including having sufficient time to spend with one's family. One of the reasons was that people have a widespread perception that it is simple to get work when they graduate.

Lorena Estefania Gutiérrez Florez (2018) Explains how word-of-mouth marketing channels spread information about a product or service. The surveyed portion of the population is open to the opinions of friends, acquaintances, and other customers when making a purchasing decision, therefore institutions can use social media to sell their services. Institutions need to put in more effort in order to grasp the customer buying behaviour and study the importance between the consumers and the certain brand image. The study recommends that universities provide transparent information and fully utilize the power of word of mouth communication among prospective students to influence target customers' buying behavior.

3. SURVEY
The study's goal was to discover whether students agreed more with statements about rational decisions or statements about emotional decisions about their choice to enroll to the Međimurje Polytechnic in Čakovec. A 7-point Likert scale was used for the study, with 9 rational and 9 emotional statements offered when making an enrollment decision. The research technique and scale were adapted from Novak and Hoffman (2009) study, that was conducted similarly. There has been a decrease in the number of students enrolled at the Međimurje Polytechnic in Čakovec in recent years. (See Graph 1)
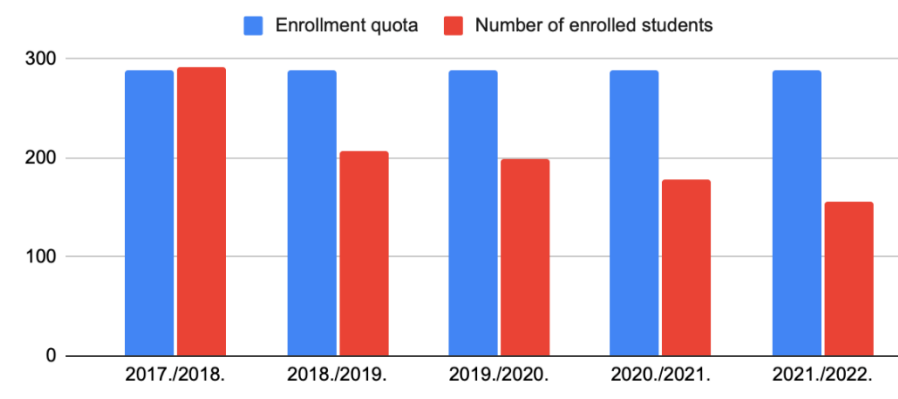
Graph 2: Enrollment quota and number of enrolled students

In the year that this research was carried out, 153 students were enrolled in undergraduate studies. The research was conducted in January, 2023. The study included 56 first-year undergraduate students from the Međimurje Polytechnic in Čakovec. With an average age of 20 years, 48.3% of the participants were female and 51.7% were male. (See Table 1)

N	Valid	56
	Missing	0
Median		2003.00

Table 1: The respondent's year of birth

The vast majority of respondents (80.4%) said that their standard of living is comparable to the national average. (See Table 2)

		Frequency	Valid Percent
Valid		3	5.4
	The standard is below the Croatian average	2	3.6
	The standard is above the Croatian average	6	10.7
	The standard is at the level of the Croatian average	45	80.4
	Total	56	100.0

Table 2: Standard of living

Respondents, who are now enrolled as first-year undergraduates at the Međimurje Polytechnic in Čakovec, chose rational statements with a greater level of agreement while making the decision to enroll at the Međimurje Polytechnic in Čakovec. (See Table 3) With the exception of question E2, which has the highest degree of agreement with the statement that measures emotional selection, the other statements with the highest score (5.68 and higher) pertain to rational choosing while enrolling in the first year. This is the case despite the fact that question E2 is the one that has the highest score.

|	N	Mean	Std. Deviation
E2_ I went by what felt good to me.	56	5.98	1.286
R7_ I was very aware of my thinking process.	56	5.96	1.279
R3_ I figured things out logically.	56	5.95	1.135
R2_ I tackled this task systematically.	56	5.88	1.207
R1_ I reasoned things out carefully	56	5.87	1.096
R9_ I used clear rules.	56	5.86	1.285
R8_ I arrived at my answers by carefully assessing the information in front of me.	56	5.68	1.390
R5	56	5.46	1.537
E3	56	5.36	1.623
R4	56	5.25	1.564
R6	56	5.21	1.786
E4	56	5.11	1.734
E6	56	4.93	1.757
E1	56	4.88	1.945
E5	56	4.30	1.858
E7	56	4.13	2.175
E9	56	3.79	1.904
E8	56	3.73	2.014
Valid N (listwise)	56		

Table 3: Type of choice

On the basis of their level of contentment with the course that they are currently enrolled in, 86% of students who are in their first year of undergraduate study would recommend their faculty. (See Table 4)

		Frequency	Percent	Valid Percent
Valid	Yes	44	78.6	86.3
	NO	7	12.5	13.7
	Total	51	91.1	100.0
Missing	0	5	8.9	
Total		56	100.0	

Table 4: Would you recommend your faculty to others?

When analyzing social networks, it stands out that respondents most often use two or more social networks. Facebook (80.4% of respondents use Facebook) and Instagram (78.6% of respondents use Instagram) stand out among them. (See Graph 2)
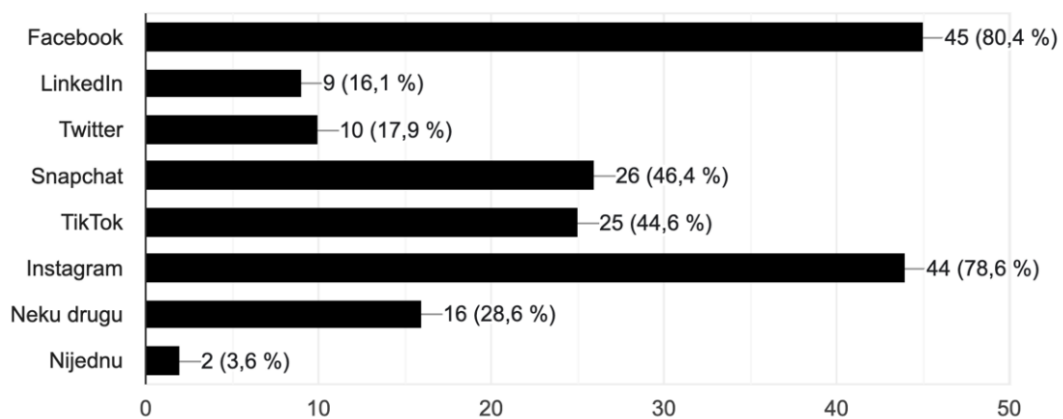
Graph 3: Social networks used by respondendts

4. CONCLUSION

According to the literature review, there are numerous factors that influence faculty selection. Many studies have been conducted on the factors influencing decision making in selecting a good university for admission. The common factors were the cost of the education program, the academic ranking of the university on a national level, followed by other important factors such as variations of programs offered by the university, as well as the size of the campus, location. This study suggests that before choosing an educational institution, one conducts extensive research on individual universities, and after extracting information on these institutions, students heavily rely on this information to choose their preferred universities. The information search process takes into account a variety of parameters, which vary from person to person as well as what they expect from their chosen universities. This research will help better understand these students' complex decision-making processes. Also, allowing institutions to develop newer marketing strategies for dynamic educational programs and changing trends in career options. The study done in January, 2023 with 56 first-year undergraduates from the Međimurje Polytechnic in Čakovec sheds light on the factors that influence students' decision to join in the first year and their satisfaction with their university experience. The data imply that rational reasons, rather than emotional ones, are the key determinants of university enrollment decisions among students.

In addition, the vast majority of students are pleased with their university experience and would recommend their faculty to others. Facebook and Instagram are the most often utilized social networking platforms among respondents. These findings provide information to university administrators and policymakers for improving marketing strategies in order to increase enrollment numbers.

LITERATURE:
1. Allen, E. N. (2007). An examination of the factors that influence students' choice of college.
2. Bradshaw, B. (2005).Factors influencing the college choice of first-time freshmen.
3. Brown, C., Varley, P., & Pal, J. (2009). University course selection and services marketing.Marketing Intelligence & Planning,27(3), 310-325.
4. Carlson, M. C. (1999). Undergraduate music student recruiting practices and strategies in public colleges and universities.
5. Culliver, K. (2015). Integrated marketing and nontraditional student enrollment decision making.
6. Flórez, L.,Estefania Guti, Escobar, M. I. C., Restrepo, A. H., Arango-Botero, D., & Valencia-Arias, A. (2018). Influence of social networks on the purchase decisions of university students.Cuadernos De Gestión,18(1), 61-83.
7. Gonca, T. Y. (2006). University evaluation-selection: A turkish case.The International Journal of Educational Management,20(7), 559-569.
8. Hendricks, W. M. (2006).The influence of the internet on the choice set of prospective college students during the search and choice stages of the college selection proces.
9. Hossler, D., Schmit, J., & Vesper, N. (1999). Going to College: How Social, Economic and Educational Factors Influence the Decisions Students Make. Baltimore, MD: John Hopkins University Press.
10. Iqbal, M. J., Rasli, A. B. M., & Hassan, I. (2012). University branding: A myth or a reality.Pakistan Journal of Commerce and Social Sciences,6(1), 168-184.
11. Kesić, T., Previ, J., Ekonomski, I.], n.d. MOTIVI UPISA I ZADOVOLJSTVO NASTAVNIM PROGRAMOM STUDENATA EKONOMSKIH I ELEKTROTEHNIČKIH FAKULTETA U HRVATSKOJ.
12. Kobale, M., Klaić, M., Bavrka, G., Vodanović, M., 2016. Motivacija za upis na studij i percepcija o karijeri medu studentima Stomatološkog fakulteta Sveučilišta u Zagrebu. Acta Stomatol Croat 50, 207–214. https://doi.org/10.15644/asc50/3/2
13. Matthews, M. J. (1991).The relationship between the perceived quality of selected state universities in ohio and students' application sets.
14. Momin, M.D., Sheik, M.M., 2018. The Factors Influencing Decision-Making Process of Students in Selecting Private Universities in India, International Journal of Management and Commerce Innovations.
15. Munisamy, S., Mohd Jaafar, N. I., & Nagaraj, S. (2014). Does reputation matter? case study of undergraduate choice at a premier university.The Asia -Pacific Education Researcher,23(3), 451-462.
16. Novak, T.P., Hoffman, D.L., 2009. The fit of thinking style and situation: New measures of situation-specific experiential and rational cognition. Journal of Consumer Research 36, 56–72.https://doi.org/10.1086/596026
17. Paulsen, M., &St. John, E. (2002). Social Class and College Costs: Examining the Financial Nexus between College Choice and Persistence.The Journal of Higher Education,73(2), 189-236.
18. Potočnik, D., 2008. Izbor studija: motivacijska struktura upisa i očekivani uspjeh u pronalasku željenoga posla.

19. Shammot, M. M. (2011). Factors affecting the jordanian students' selection decision among private universities.Journal of Business Studies Quarterly,2(3), 57-63.
20. Sheppard, J. S. (2013).Factors that influence college choice: Decisions of graduate students(Order No. 3606494).
21. Stack, S. J. (2009). Informing graduate enrollment management: Marketing and admissions through students' perspectives.