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MAS

ANALYSIS OF TOLERANCE IN SIX EUROPEAN MEDITERRANEAN COUNTRIES

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ABSTRACT

Tolerance is one of the ideals of a democratic and pluralistic society. It is a way of behaving which allows others the freedom to express opinions with which we do not agree, and the right of others to live according to their principles different from ours. Recently Europe is faced with political challenges caused by mass immigration to European countries. In such circumstances, dilemmas arise regarding the possibility of maintaining the ideals of freedom and equality in European countries, which have become a melting pot of people of different nationalities, races, cultures, religions, and lifestyles. In this article, we used the results of the tolerance research in six European Mediterranean countries, conducted in 2017 as part of the European Values Study project. The objectives were to determine for each of the mentioned countries the level of tolerance or intolerance towards social groups in general, towards individual social groups, and differences between different socio-demographic groups of respondents concerning their level of tolerance levels compared to the other countries. Also, members of the 'drug addicts' and the 'heavy drinkers' are considered the most problematic social groups in all six European Mediterranean countries. When it comes to gender, there is little difference in tolerance level. More educated and younger respondents have higher levels of tolerance.

KEY WORDS

tolerance, Mediterranean countries, European Values Study

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INTRODUCTION

It has been known since Aristotle that, in addition to being physical, human being is also a spiritual, rational, and social being; that is, a being of the community ('zoon politikon'). From his belonging to society comes his need for companionship and familiarity with others. For this familiarity to be without conflict and tension, in every society there is a certain organization of social life. Historically speaking, the aforementioned organization of social life differs greatly. Traditional societies were characterized by strong belonging to a particular community characterized by a relatively homogeneous culture, and the emphasized importance of traditional authorities such as family and church. On the other hand, modernity is characterized by belonging to a society characterized by cultural heterogeneity, the creation of impersonal and contractual ties, and authority based on law [1]. The characteristics of modern societies are the diversity of worldviews and value systems of individuals, the pluralism of political concepts and parties, the coexistence of diverse religious communities, and the multitude of opposing social, cultural, and economic interest groups [2]. In such circumstances, one cannot avoid discussing their interrelationships and the degree and peculiarities of tolerating the different.

Since tolerance is the central theme of this article, before the empirical analysis of tolerance in six European Mediterranean countries, the introductory part presents the definition, theoretical explanations, methods, and examples of tolerance research.

DEFINING TOLERANCE

Until the 16th century, the term tolerance mainly referred to the ability to endure physical discomfort [3]. It is only within the complex modern societies that the ideology of tolerance appears. Initial ideas were related to discussions about religious (Christian) tolerance [4, 5]. Newer discussions about tolerance discuss tolerance as a moral virtue of an individual, and a political virtue of a liberal state [3]. More space is left for discussions about freedom of conscience and opinion following the maxim about the equality of all people in rights and freedoms. However, religions still have an important role in encouraging tolerance [6].

The initial step of the scientific approach to tolerance is precisely defining the term, and bringing it into relation with other related terms. The word tolerance is derived from the Latin verb 'tolerare', which means to suffer or to bear. From a psychological point of view, tolerance means the ability to endure physical or mental pain, discomfort, stress, or negative environmental pressures and influences. In social psychology, social tolerance involves putting up with something or someone unpleasant, repulsive, different, or unacceptable. It is an attitude towards someone or something or a way of dealing with people, ideas, or things, which allows the equal existence of these people, ideas, or things. At the same time, tolerance towards people refers to tolerance for a number of their properties and characteristics - behaviour, habits, attitudes, beliefs, appearance, etc. [6]. In sociology, tolerance means the moral virtue of an individual and the political virtue of a liberal state. It is a way of behaving by which we allow others the freedom to express opinions with which we do not agree, and the right of others to live according to their principles, which are different from ours [3]. Tolerance is one of the ideals of a democratic and pluralistic society, but also a highly desirable virtue for every individual. Sociologists are particularly interested in the connection between globalization and tolerance. They believe that globalization encourages the need for more intense and extensive tolerance because it is based on the increased propagation of more intensive communication between people of different physical, psychological, and social characteristics [6].

When talking about tolerance, it is important to mention some related terms. First, these are the concepts of prejudice, stereotypes, and discrimination. Prejudice is a hostile or negative attitude towards members of a recognizable group of people, which is based solely on their membership

in that group. A stereotype is a generalization about a group of people, by which the same characteristics are attributed to almost all members of that group, regardless of the actual variations between members. Discrimination is unjustified negative and harmful behaviour towards members of a group, just because of their belonging to that group [7]. A term that can also be linked to tolerance is prosocial behaviour. It is any act committed with the aim of benefiting another person [7]. Some laws established for prosocial behaviour apply to tolerance. For example, the expression of such behaviour is influenced by the mood of individuals. Individuals in a good mood are more inclined to prosocial behaviour. Prosocial behaviour and tolerance are also affected by emotions such as fear, which most often reduce tolerant and increases intolerant behaviour [6]. Moreover, it is useful to mention the concept of social distance. It is the degree of social separation, diversity, and distance between individuals, groups, or layers of society. Social distance indicates the degree of closeness that individuals are willing to achieve with the average member of a certain social group. Expressing social distance is an indirect way of measuring prejudice against certain national, ethnic, racial, religious, and other groups, and is also a measure of tolerance [8]. The term opposite to tolerance is intolerance. It relates to attitudes and behaviours that do not show tolerance towards differences. It can be expressed as racism, sexism, ethnocentrism, anti-Semitism, chauvinism, xenophobia, and religious discrimination [6].

THEORETICAL EXPLANATIONS OF TOLERANCE

More precise theoretical explanations of tolerance were created at the end of the 20th and the beginning of the 21st century. The following is a presentation of several theories that enable a better understanding of the presence of tolerance in contemporary society.

According to the theory of social identity [9], social identity is as important to individuals as individual identity. An individual is naturally close, loyal, and generous towards the group to which he belongs in relation to groups to which he does not belong. Bias towards one's group refers to positive treatment and feelings towards that group, and negative treatment and feelings towards other outside groups. The explanation for this attitude towards other groups is in the process of competition. As soon as people are divided into groups, competition begins. Membership in one's group creates a desire to win in order to gain supremacy, and increase self-esteem. The maintenance of group boundaries is also influenced by certain social and cultural factors that can increase attachment to one's group and isolation from outside groups. With the increase in intragroup interdependence due to shared values and goals, the need to maintain clear boundaries towards other groups also increases [10]. For this research we put emphasis on the conflict theory presented by Hovland & Scars, which states that the reciprocal relationship between ingroup cohesion and outgroup hatred depends on the circumstances and most often takes place due to competition for physical resources and political power. A lack of resources in an inhabited area leads to conflict between two or more groups, which favours the creation of feelings of fear, insecurity, and threat, and, consequently, intolerance and hatred towards outside groups [7]. For example, when it comes to drug addiction the social conflict theory states that there are higher numbers of drug abusers in lower social classes and low-income families. Drug abusers tend to turn to crime, or are perceived as criminals, and this leads to conflict with other social groups, and intolerance of their lifestyle in the society [11]. Furthermore, according to the scapegoat theory [12], frustration caused by a real conflict results in aggression toward the so-called scapegoat. For example, an economic crisis and a sudden drop in standards in a country can bring about some unpopular groups being blamed. Thus, as a result of the economic crisis in Germany after the First World War, many turned against the Jews, and in the USA violence against Arabs increased after September 11 [7]. Blumer points out that in such cases, prejudices are the result of a change in collective perception, which is stimulated by the media, or the public characterization of some groups as negative [13].

In modern societies characterized by the existence of many different groups to which an individual can belong at the same time (e.g., one by ethnic origin, another by religion), there is a higher probability of creating a context in which loyalty and attachment to one's group are not necessarily connected with hatred of outside groups [14]. Today, mixed marriages due to religion, race, language, and nationality are common. Lipset states that the differentiation of roles and the crossing of groups to which we belong is an important prerequisite for the development of stable democracies, and thus more tolerant societies [15]. This thesis is related to the concept of social capital, and the theory of socio-cultural development. Putnam states that social capital refers to the characteristics of social organizations such as trust, norms, and networks [16]. Fukuyama believes that social capital is manifested through the ability of people to cooperate to fulfil common goals [17]. In both cases, a tolerant society encourages communication between different groups. A society with high social capital is a society of intertwined ties, in which individuals can rely on others from their networks. A fundamental prerequisite for the creation of such societies is the growth of trust in society and the formation of civil society. It consists of groups and organizations of a formal or informal type, that act independently of the state and the market, and promote diverse social interests [18]. Such organizations connect people through networks, horizontally and vertically. Inglehart states that at a high level of economic development in modern societies, certain intergenerational changes occur, and the importance of personal freedom increases [19]. Economic prosperity frees people from the pressure caused by material problems, and restrictive norms are slowly replaced by more liberal principles. People focus on post-materialist values, and personal choice and individualism come to the fore. Societies focused on personal choices are more sensitive to discrimination and violations of human rights, and are guided by ideas of tolerance towards diversity, gender equality, and alternative lifestyles [20].

RESEARCH ON TOLERANCE

Since tolerance is based on attitudes, its existence and strength within a population can be determined by measures of attitudes. To examine attitudes, researchers use specially created scales, which contain a series of questions aimed at a clearly defined object of attitude (e.g., attitude towards members of a certain nation). The answers to the questions determine the intensity of the attitude, which can vary from extremely negative to extremely positive. The scales can be used to examine ethnic prejudices; that is, the social distance that an individual wants to maintain in relations with members of another ethnic group. For example, people of one ethnic background can be asked about the degree of closeness they would be willing to have with members of another ethnic group (would they agree to live in the same country or neighbourhood, work in the same factory, be friends or marry, etc.). The assumption is that consent to greater closeness means greater acceptance of another ethnic group, or greater tolerance towards it, and vice versa [6]. Research on the levels of tolerance is mainly focused on specific countries due to their specific religious, political, and social context.

Loek Halman analysed variations in the level of tolerance in different European countries. His analysis was based on research conducted from 1988 onwards within the framework of the Eurobarometer and European Values Study project. The Eurobarometer survey [21] showed that the majority of Europeans approve of the ideals of human rights and fundamental freedoms, and recognize and accept human diversity while condemning racist attitudes. However, most Europeans also believe that there are too many people of different races and nationalities living in their countries. Regarding this question, Europe can be divided into three parts. The first part consists of intolerant countries, in which there is a widespread opinion that

there are too many people of different nationalities or races in their country (Belgium, Germany, France, and the UK). The second part are tolerant countries, which do not think that there are too many people of different nationalities and races in their countries (Ireland, Spain, and Portugal). The third part are the countries that are between these two extremes (Netherlands, Italy, and Denmark). Furthermore, the data of the research carried out in 1981 and 1990 within the European Values Study project, enables an answer to the question of whether intolerance is directed only at foreigners, or at other groups in society. When asked which groups they considered least desirable in the neighbourhood, Europeans cited those with problematic behaviours, such as alcoholics, drug addicts, and political extremists. Individuals with potentially problematic behaviours are less desirable in the neighbourhood than individuals who differ in terms of nationality, race, or religion. Also, regarding the tolerance towards strangers in the neighbourhood (e.g., people of different nationalities or races) the participants are intolerant if they believe that they disturb their lives [22]. However, since the end of the 1980s, certain social changes have taken place. Therefore, the stated results should be interpreted with some caution. Economic depression, and an additional influx of asylum seekers and economic immigrants, were recorded in European countries. Such circumstances potentially changed the degree of tolerance towards foreigners.

Recent studies of tolerance in Europe showed that the association between education and levels of trust and tolerance varies significantly across countries. A major source of this variation lies in the way in which individuals react to the level of diversity in the country where they live [23]. Kuyper showed that Europe is moving towards more tolerance and that the differences are related to other values, levels of income and income inequality, educational attainment, religious factors, degree of urbanization, EU membership, and political systems, etc. [24] Stoeckel & Ceka showed that far-right groups (i.e., fascists and neo-Nazis), and Muslims were the most disliked groups in Europe [25]. Also, conspiratorial thinking and cosmopolitanism emerge as the most important predictors of political tolerance. Recent research often states that education makes modern societies more tolerable [26, 27]. More specifically, it is important to teach children and young adults about social diversity, and conduct more research since the level of tolerance does not only relate to social context but also some individual differences [28, 29].

ANALYSIS OF TOLERANCE IN SIX EUROPEAN MEDITERRANEAN COUNTRIES

In this article, the results of the tolerance research obtained within the European Values Study project are used. It is a comparative international project in which the values of the inhabitants of European countries are examined. The data provide insight into the ideas, beliefs, preferences, attitudes, values, and opinions of citizens across Europe. It is a valuable source of data on how tolerant citizens in European countries are, or towards which social groups they show a greater or lower degree of tolerance. We focus on the analysis of tolerance in six European Mediterranean countries: Italy, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, and Albania. The data obtained from research conducted in 2017 are used. The objectives are to determine for each of the mentioned countries: (1) the level of tolerance towards individual social groups, and (3) the existence of statistically significant differences between different socio-demographic groups of respondents concerning their level of tolerance or intolerance.

METHODOLOGY

The European Values Study project began in 1981 and is repeated every nine years in a changing number of European countries. In this article, the results of the tolerance scale

obtained in 2017 on samples of citizens in Italy, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, and Albania were analysed. As for the type of samples by individual countries, they are different, but they share the characteristics of being probabilistic and multiphasic. In terms of sample size, 9 001 respondents were included in all six countries, and their structure by individual country is as follows: Albania (16,1 %), Bosnia and Herzegovina (19,2 %), Croatia (16,5 %), Italy (25,2 %), Montenegro (11,1 %), and Slovenia (11,9 %).

As a measure of tolerance, or intolerance, towards certain groups, the respondents' answers to the question of which of the nine social groups they would not like to have as neighbours were used. The question was in a dichotomous form in the questionnaire, where respondents could mark whether they wanted a certain social group for their neighbours. The responses of individual respondents were added together to create one quantitative variable that describes the tolerance of each respondent towards the idea of having certain social groups as their neighbours. The obtained variable was used for further statistical analyses that were made following the research objectives.

In the analysis, the Clopper-Pearson method was used to calculate the interval of proportions of citizens in certain countries concerning their desire not to have certain social groups as their neighbours. Mann-Whitney and Kruskal-Wallis tests were used to compare the socio-demographic groups (gender, age, and level of education) of respondents concerning the previously described quantitative variable. These tests were used because the Kolmogorov-Smirnov test indicated a non-normal distribution of the used quantitative variable (sig. = 0,000). The statistical program SPSS (v21) was used. The results were presented tabularly and graphically using box plots, and the option of obtaining a display in the form of folders was used in the Microsoft Office 365 program package. Conclusions about the results were made at a significance level of 5 %.

RESULTS AND DISCUSSION

Level of Tolerance towards Social Groups in General in Different Countries

The first research objective was to determine the level of tolerance or intolerance in six European Mediterranean countries. To answer this objective, a question about which social groups were not desirable as neighbours was used for the analysis. More specifically, the respondents in the EVS survey were asked to choose which of these social groups they do not want as their neighbours: people of different races, heavy drinkers, immigrants/foreign workers, drug addicts, homosexuals, Christians, Muslims, Jews, and gypsies. Since the question of interest was asked in a dichotomous form, for each respondent, the points he achieved were added up concerning the number of groups that were not desirable to him. If a respondent chose all nine social groups as undesirable, he received the maximum number of points. Based on the described procedure, a new quantitative variable was created, the results of which were used to obtain a box plot representation of the points achieved by respondents from all six observed countries.

The results of the analysis are shown in Figure 1. Croatia, Italy, and Slovenia are the countries with the highest tolerance levels compared to the other countries. Respondents from these countries achieved the fewest points, the median value for them is two, while for the other countries the median values range between three and four. The lower the median value, the fewer social groups were identified as undesirable neighbours by respondents in the survey. Furthermore, the analysis pointed to the fact that the most remarkable differences in answers between respondents were found in Bosnia and Herzegovina. This information can be seen in the elongated form of the box plot, which points to the fact that there is a considerable percentage of respondents who do not want a single social group as their neighbours, but also

a percentage of those who have no problems with any social group. In contrast, of all the six observed countries, Albania proved to be the most homogeneous, as the majority of respondents from that country do not want just two or three social groups as their neighbours.



Figure 1. Comparison of countries concerning the number of social groups that respondents do not want as neighbours.

Level of Tolerance towards Individual Social Groups in Different Countries

The second research objective was to determine the level of tolerance towards individual social groups in six European Mediterranean countries. The analysis showed which of the social groups are considered the most problematic in different countries. Using the Clopper-Pearson method, at a significance level of 5 %, we calculated the intervals of the proportions of respondents who chose certain social groups.

The results are shown in Figure 2. Members of the 'drug addicts' group are the most problematic - between 72,3 % and 74,1 % of all respondents in the survey do not want them as their neighbours. The social groups of the 'heavy drinkers' are also not desirable for approximately 60 % of all respondents. These two social groups can be considered as groups of people who are perceived as a threat to social and personal safety, due to their possible deviant and antisocial behaviour. This threat is often associated with the stigmatization of those groups in society. So, intolerance towards them in most cases exceeds the real threat they represent. Thus, the stigmatization of these groups, often due to a lack of knowledge and prejudices, results in their being perceived as a threat to social and personal security. Because of the threat to security, fear appears, which makes people less tolerant. They focus on their

security, so terms such as civil liberties and human rights are less accessible in their memory [30]. On the other hand, approximately 10 % to 18 % of all respondents do not want members of different religious groups (Christians, Muslims, and Jews) and people of different races as their neighbours, making them the least problematic. The mentioned social groups can be considered as groups of people of different racial and cultural heritage. Tolerance towards these groups is not related to a threat to personal security, but to a threat to cultural heritage, and the preservation of national identity and tradition. It is related to the concept of sociotropic threat, which is defined as generalized anxiety and a sense of threat to society, the state, or the region in which one lives [31]. According to the results, the perception of such a threat was not a problem in the analysed countries.



Figure 2. The intervals of the proportion of respondents who answered they do not want certain social groups as neighbours.

The results are also presented via the following Figures 3 to 11. They visually present which social groups are least desirable as neighbours in certain countries. People of different races are least desirable in Bosnia and Herzegovina, and Slovenia (over 23 % of respondents agree with this statement). Immigrants and foreign workers are least desirable in Montenegro (56.6 % of respondents agree with this statement). Italy leads all countries in terms of the lack of desire to have Gypsies in their neighbourhood (64,5 % of respondents agree with this statement). Heavy drinkers and drug addicts are the least desirable in Albania and Montenegro (over 80 % of respondents agree with these statements). Also, drug addicts are the most undesirable social group for neighbours in all observed countries. As for religious groups, Christians and Jews are the least desirable in Bosnia and Herzegovina (over 26 % of respondents agree with these statements). Similarly, Muslims are least desirable in Bosnia and Herzegovina, but also in Slovenia (over 27 % of respondents agree with this statement). For Christians, it should also be emphasized that, as a religious group, they are considered the least problematic group in one's neighbourhood in all observed countries. Finally, regarding social groups whose members identify as homosexuals, they are the least desirable in Montenegro and Albania (over 71 % of respondents agree with this statement).



Figure 3. Proportions of respondents by country who answered they do not want 'people of different race' as neighbours.



Figure 4. Proportions of respondents by country who answered they do not want 'immigrants/foreign workers' as neighbours.



Figure 5. Proportions of respondents by country who answered they do not want 'Gypsies' as neighbours.



Figure 6. Proportions of respondents by country who answered they do not want 'heavy drinkers' as neighbours.



Figure 7. Proportions of respondents by country who answered they do not want 'drug addicts' as neighbours.



Figure 8. Proportions of respondents by country who answered they do not want 'Christians' as neighbours.



Figure 9. Proportions of respondents by country who answered they do not want 'Jews' as neighbours.



Figure 10. Proportions of respondents by country who answered they do not want 'Muslims' as neighbours.



Figure 11. Proportions of respondents by country who answered they do not want 'homosexuals' as neighbours.

Level of Tolerance towards Certain Social Groups Concerning Socio-demographic Characteristics of Respondents

The third research objective was to determine the existence of statistically significant differences between different socio-demographic groups of respondents in different countries concerning their level of tolerance or intolerance. The following characteristics of the respondents were observed: gender, level of education, and age group. In general, women, younger people, and people with higher education express more negative attitudes or greater prejudices towards social groups and the behaviours of these groups that have more traditional or more conventional attitudes and behaviours [7].

The results for the gender groups of respondents are shown in Figure 12 and Table 1. The number of social groups that men and women do not want as their neighbours is equal (Me = 3 for both), with slightly greater heterogeneity of results found for men. Using the Mann-Whitney test, the existence of a statistically significant difference (alpha = 5 %) between men and women in each of the observed countries was not found.



Figure 12. The number of social groups that male and female respondents do not want as neighbours.

Table 1. Comparison of respondents by their gender concerning the number of social	groups
that they do not want as neighbours (Mann-Whitney test).	

		Mean Rank	Sum of Ranks	Mann- Whitney U	sig.	
Albonio	Male	725,3	505546	262202	0 472	
Albania	Female	740,0	568299	202293	0,472	
Bosnia and	Male	915,0	797868	417240	0.140	
Herzegovina	Female	951,6	947778	417240	0,140	
Croatia	Male	782,2	578061	286560	0.200	
	Female	758,7	606969	280309	0,290	
Itoly	Male	1228,8	1566706	752056	0.227	
пату	Female	1263,0	1534589	735230	0,227	
Montonogra	Male	575,3	328495	146577	0.090	
Montenegro	Female	542,0	295908	140377	0,080	
Classania	Male	598,9	339596	170127	0 467	
Sioveilla	Female	584,6	359557	1/015/	0,467	

The results for the level of education group of respondents are shown in Figure 13 and Table 2. Respondents with a tertiary level of education have the fewest problems with different social groups (Me = 2), opposite to respondents with a lower level of education (Me = 3). To observe whether there is a statistically significant difference between respondents concerning the observed variable, we used the Kruskal-Wallis test. The analysis showed that the difference between groups of respondents with different levels of education, at the significance level of 5 %, exists among respondents from Albania, Bosnia and Herzegovina, Italy, and Montenegro. More specifically, respondents with a tertiary level of education have lower mean rank values, which



implies that they have chosen a smaller number of social groups that they do not want as neighbours, compared to respondents with lower levels of education.

Figure 13. The number of social groups that respondents with different level of education do not want as neighbours.

Table 2.	Comparison	of respondents	s by their	level of	f education	concerning	the	number	of
social gro	oups that they	do not want as	s neighbo	urs (Krus	skal-Wallis	test).			

		Mean Rank	Kruskal-Wallis (chi-square)	sig.	
	Primary education	778,3			
Albania	Secondary education	697,9	26,6	0,000	
	Tertiary education	628,5			
De suite suit	Primary education	1003,7			
Bosnia and Herzegovina	Secondary education	915,7	33,9	0,000	
Therzegovina	Tertiary education	771,3			
Croatia	Primary education	755,6			
	Secondary education	760,3	1,5	0,479	
	Tertiary education	797,1			
	Primary education	1283,2		0,001	
Italy	Secondary education	1222,9	14,3		
	Tertiary education	1126,0			
	Primary education	535,1			
Montenegro	Secondary education	591,6	18,0	0,000	
	Tertiary education	492,9			
	Primary education	615,3			
Slovenia	Secondary education	597,2	5,7	0,059	
	Tertiary education	551,2]		

The results for the age group of respondents are shown in Figure 14 and Table 3. The younger respondents were more tolerant towards a larger number of social groups. Respondents between the ages of 15 and 29 mostly listed up to 2 social groups that they would not want as



Figure 14. The number of social groups that respondents of different age group do not want as neighbours.

Table 3.	Comparison	of respondents	by their	age group	concernin	g the number	r of social	groups
that they	do not want	as neighbours	(Kruska	l-Wallis te	est).			

		Mean Rank	Kruskal-Wallis (chi-square)	sig.	
	15-29 years	643,7			
Albania	30-49 years	717,8	35,8	0,000	
	50 and more years	796,9			
Description	15-29 years	884,7			
Bosnia and	30-49 years	898,4	5,4	0,068	
пегсеуотна	50 and more years	949,1			
	15-29 years	839,5		0,010	
Croatia	30-49 years	757,3	9,2		
	50 and more years	751,3			
	15-29 years	1123,6		0,002	
Italy	30-49 years	1278,4	12,5		
	50 and more years	1257,0			
	15-29 years	483,8			
Montenegro	30-49 years	556,4	15,3	0,000	
	50 and more years	586,1			
	15-29 years	610,7			
Slovenia	30-49 years	569,6	2,8	0,244	
	50 and more years	601,2]		

their neighbours, while older groups of respondents listed up to 3 social groups. Also, Figure 14 shows that there is greater heterogeneity in the views of respondents on this issue among the younger age group. Since three age groups were compared and the condition of normality of the dependent variable was not met, we used the Kruskal-Wallis test. At the significance level of 5 %, there is a statistically significant difference between age groups in the following countries: Albania, Croatia, Italy, and Montenegro. In all the listed countries, except Croatia, younger age groups have lower mean rank values, which means that compared to older age groups, they marked fewer social groups that they do not want as their neighbours. In Croatia, those aged 50 and more years have the lowest mean rank value, which means that they have relatively more tolerance towards certain social groups.

CONCLUSION

The purpose of this article is to present the level of tolerance or intolerance in six European Mediterranean countries. More specifically, using data from the European Values Study, we determined: (1) the level of tolerance or intolerance towards social groups in general, (2) the level of tolerance or intolerance towards individual social groups, and (3) the existence of statistically significant differences between different socio-demographic groups of respondents concerning their level of tolerance or intolerance. The results show that Croatia, Italy, and Slovenia are the countries with the highest tolerance levels compared to the other analysed countries. Also, members of the 'drug addicts' group, followed by the 'heavy drinkers', are considered the most problematic social groups in all six European Mediterranean countries. These results are in accordance with previous research, and also with the theoretical framework of social conflict theory presented by Hovland & Scars. 'Drug addicts' and 'heavy drinkers' are perceived as associated with crime and violence, and are as such not tolerated in the general population. When it comes to gender, there is little difference in tolerance level, while more educated, and younger respondents have higher levels of tolerance. It surely would be useful in future analysis to make a comparison of the level of tolerance in Central European countries and Mediterranean countries. Also, future analysis should include an investigation of more specific differences between respondents concerning their political orientations, and religiosity.

This article contributes to a better understanding of differences in tolerance levels in several European countries. In recent years, Europe is changing its social structure, so the examination of tolerance is important because intolerance increases conflict. It is also important to state that the increase in positive social relations is mainly influenced by social processes in which positive social behaviour towards stigmatized groups is promoted at all levels. This is particularly achieved through education, and media information [32]. It is necessary to systematically work on educating and informing citizens about the characteristics of different social groups, to reduce the perception that they are a threat, encourage citizens to be more tolerant towards them, and thereby build a more humane society.

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THE CAUSAL EFFECT OF MOUNTAIN PARTNERSHIP ON THE ENVIRONMENT

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ABSTRACT

In response to increasing ecosystems degradation, many mountain countries have recently implemented harm-reduction policy measures in order to sustain their future economic development, which is partially dependent on a strong tourism sector. The objective of this article is to evaluate the policies that stem from Metropolitan Public Gardens Association aims in order to ascertain whether they are associated with a reduction in greenhouse gasses. This cross-sectional study used greenhouse gasses emission data between 1995 and 2016 from 139 countries as an outcome. Difference-in-differences analysis using panel matching with economic, tourism, demographic and other control variables was conducted to evaluate the causal impact of Metropolitan Public Gardens Association policies on greenhouse gasses emissions before and after joining the Metropolitan Public Gardens Association. Our results show that the Metropolitan Public Gardens Association as a global trans-national alliance led effective policy in some cases but not in all. While managing or protecting the conservation, health, vitality and stewardship of mountain ecosystems by promoting a policy of sustainable mountain development, carbon footprints were reduced. We ascribe this impact to the Metropolitan Public Gardens Association committed environmental policy. Metropolitan Public Gardens Association succeeded in decreasing the emission of carbon dioxide per capita but the result for methane per capita is mixed. Surprisingly, evidence of increasing nitrous oxide per capita is found. More research needs to be done to assess the impact of the greenhouse gasses emission - Metropolitan Public Gardens Association intervention nexus before the Difference-in-differences analysis using panel matching technique becomes widespread.

KEY WORDS

mountain countries, tourism arrivals, difference-in-differences panel matching, greenhouse gasses, intervention

CLASSIFICATION

JEL: O13

INTRODUCTION

The mountain regions scattered across the Earth's crust are unique due to altitude and slope. Namely, the most common features in mountain areas are the steepness and ruggedness [1]. Throughout history, these features have significantly affected some countries (environmentally, socially and economically) [2]. Mountain areas occupy slightly less than one third of the global land area [3]; they provide essential ecosystem goods and services (EGS) for both mountain dwellers and people living outside these areas [4]. The decline of extractive industries such as mining, logging and farming and limited economic alternatives have prompted many such regions to redirect development towards tourism for diversification [2].

As one author remarked, greenhouse gasses (GHG) removal strategies go hand in hand with: afforestation, reforestation, and management changes [5]. Interventions to reduce GHG in mountain regions are predominantly needed having in mind that these regions are hotspots and cradles for biodiversity [3], serving as providers of myriad ecosystem services (ES) essential for humans including: carbon sequestration, air quality purification, water provisioning, food producing, tourism and recreation supply [6-8].

This article will deepen the research agenda on reducing GHG emissions, by examining the effect of Metropolitan Public Gardens Association (MPGA) legislative regulation to prevent environmental degradation with a specific focus on three environmental quality indicators: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). To slow the environmental devastation linked to global warming, MPGA countries implemented interventions to reduce GHG, with varying intensity. The praxis so far suggests that environmental policy conditions (e.g. public laws and regulations) can be counteracting forces in achieving operational integration goals which are directed at reducing GHG and making the mountain landscape more environmentally resilient. Special consideration is given to interventions related to agriculture, urbanisation and nature conservation. Environmental pollution is strongly controlled by specific legislation, which has led to prudent investments in environmental control.

The main research question addressed in this article is: have environmental regulations helped these countries to reduce their GHG footprint? Or, in other words, having in mind that information on legislation or contents at a micro-level is unavailable to us, have the countries that entered into the MPGA observed a reduction in the three aforementioned environmental quality indicators?

In addressing these issues, the objective was to assess whether the MPGA as an institution or distinct economic agent had any impact on GHG by implementing the environmental policy intervention to members. We also assumed that along with considering GHG emissions – important cofounders linked to features of those members, namely: the state of economics, tourism, population, commitment to act on global-warming, are intertwined with these questions.

In recent years, research on environmental degradation has grown, thanks to the climate change agenda, and has become extremely popular. Still, by tracking through the pages the available literature, we do not find any articles linked to the MPGA – GHG nexus. The novelty of our article lies in introducing this concept to that rich corpus of literature. While other papers that address various economic, social, political and institutional connoted questions and policies that refer to GHG emission are not lacking.

A paper written by [9] investigated the effect of trade liberalisation on carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) emissions. The paper adopted the difference-in-difference method and estimated the effect of accession to the World Trade Organization (WTO) on environmental quality. The study of [10] provides information on the

implications of policies such as social distancing, lockdown and curfews implemented by various national governments in recent times on food systems and greenhouse gas emissions.

One paper [11] try to identify the price impacts and transmission paths among different sectors of imposing CO₂, methane (CH₄) and nitrous oxide (N₂O) emission taxes in China using the Social Accounting Matrix (SAM) model, based on big data. By examining the environmental impact of foreign direct investment and industrialisation in 36 selected African countries, using data for the period 1980–2014, the authors conclude that FDI generally contributes negatively to the environment, whereas the effect of industrialisation on the environment is generally insignificant [12]. The damage from carbon emissions, methane (CH₄), nitrous oxide (N₂O) emissions and population density substantially decrease inbound tourism and international tourism receipts across countries [13].

This subject is also raised by [14] in their analysis of four tourism and hospitality (TH) subindustries' impacts on greenhouse gas (GHG) emissions and air pollutants in the US, finding that food and drink segment contribute higher to GHG (CO₂, CH₄, N₂O) emissions in the long-run than the rest of the subindustries, e.g. accommodation, entertainment, gambling, and recreation or performing arts and sports. Institutional performance is negatively correlated with carbon dioxide emissions, methane emissions, and ecological footprint while it is positively associated with nitrous oxide emissions [15]. Another study written by [16] links macroeconomic policies, economic growth, fossil fuel consumption and renewable energy consumption with environmental quality for selected developing countries from 1990 to 2017.

In this paper, we evaluate the effects of GHG interventions, which focused on improving environmental quality and optimal landscape health, using non-experimental or observational data, and the MPGA status of a particular country denotes the intervention. The MPGA countries were assessed before treatment and after multiple years of treatment. More generally we would research the causal inference on GHG footprint around the treatment group and compare MPGA countries vs. a control group when data were not generated by a randomised trial. As the panel matching method and a difference-in-differences (DiD-PM) estimator is particularly useful for researchers engaged in intervention research, we adopt this technique appropriate for a time-series and cross-sectional data to estimate the effect of in-country accessing to MPGA membership on the reported GHG emissions.

METHODOLOGY

In our study, we try to assess the causal effect of the MPGA on greenhouse gas emissions by using a matching analysis technique proposed by [17], which consists of a non-parametric generalisation of the difference-in-differences estimator. The details in form of shorter vignette of the method can be find in [18]. We designated from an appropriate tailored dataset accession to the MPGA during our period of analysis to be the treatment group.

The environmental intervention referring to greenhouse gas footprint is indicated by accession to the MPGA. The signed application at governmental level signals accession to the MPGA. The collective action, we presumed, would somehow affect all of the members of the organisation due to the requirement of strict adherence to the MPGA rules about environmental policy. These rules include conservation, maintaining the health, vitality and stewardship of mountain ecosystems, as well as taking care of economic sustainability, green development, etc. All these were navigated and enforced by domestic laws, in function of better environmental protection attitudes; with verification and balancing, and supervising critical points by various monitoring institutions.

These assumed measures are exogenous because they are instituted and imposed by the global strategy of MPGA, in order to provide long-run environmental sustainability among the members.

Because these countries' accessions to the MPGA were not randomly assigned, we generated a more accurate causal estimate through a matching technique across comparable country-level factors. Matching involves a systematic selection of similar cases (mapping similar countries) to approximate a counterfactual for each treated case. In other words, our analysis compares countries that have joined the MPGA that had potentially carried out some kind of environmental quality policy (treatment) to similar countries that did not institute the policy (the control group). Since panel data varies over time, matching allows control units to include both the time leading up to the "treatment" for a given country of interest as well as the period for similar observations of countries that were not treated.

We estimate the causal effects of MPGA country accession, which generates contingent policies included in the dataset using the *PanelMatch* package in R written by [18]. These authors proposed that innovation builds upon the synthetic control method (SCM) of [19] and the generalised SCM conceived by [20], allowing a simple understanding of how counterfactual outcomes are assessed; a particular advantage of this method that stands out is it does not require data on many pre-treatment time periods and is more flexible than the generalised SCM. Namely, the non-experimental data in social sciences often have a limited time span; our data are rather of this kind. The set of environmental quality policy effects (the particular details of which is unknown, but we assume some kind of policy intervention has been undertaken after joining the MPGA) had to be quantified through a nonparametric generalisation of difference-in-differences, with T-4 serving as the baseline. A country was considered to be a treated case if the environment policy was adopted at a specified time as a consequence of the country's accession to the MPGA; otherwise, it was considered to be an untreated case. Panel matching estimation would reduce bias compared to the standard twoway fixed effects (TWFE) regression commonly utilised in panel analysis, which was otherwise the second-choice methodology option.

The aim was to compare the outcomes of interest for a sample of countries under the new policy regime, in fact the trend in GHG emissions after transition. The policy conditioned some kind of restrictions on carbon footprint. It is a by-product of assumed MPGA accession at a specific time, and should negatively affect GHG, as predicted. However, using the matching technique, we searched for the differences between the outcomes under the old and new policy regime (in a country with a similar covariate history) but it does not have to have occurred at the same time. For the country-year covariates, we did not select a time period as they do not vary across years, while for our time-varying covariates, we specify the selection of the period of analysis (T-4:T+10). We then calculate and compare different refinement strategies to assess the best among the few, which would minimise covariate imbalance during the pre-analysis period (T-4:T0).

As the covariates on which refinement occurs, we specified a Kyoto Protocol dummy variable as well as an economic power variable (GDP per capita), tourism demand (international arrivals per capita) and demographic (population) control variables. Namely, we have a strong presumption that those variables had significant, relevant impact, considering their weight in the overall paper design, when it comes to air pollution or environmental degradation, as well as in processing our robust matching model. We assume that the Kyoto Protocol as a global voluntary instrument that regulates global environmental policy indicates a nation's positive attitude and commitment to mitigating global-warming. It is an efficient indicator for identifying which countries strategically wish to curb GHG emissions; as a covariate it would formally mitigate the confounding of our basic treatment effect estimates, whereas other included covariates would interfere, as such, in the opposite direction. After the refined matched sets of treated countries are obtained, we calculate the counterfactual outcome (with non-treated countries) using the weighted average of control countries. We made a weight for each control unit in $M_{i,t}$, e.g. in the refined matched set, where a higher weight had to be assigned to a more similar unit. In the next step, for each treated country, we estimated the counterfactual outcome in regard to GHG emissions using the weighted average of the control units in the refined matched set.

For K treated countries and T observation years, we followed the estimator proposed by the authors (17): average treatment effect (ATT) on the treated countries in changing GHG emissions expressed as follows:

$$\widehat{\text{ATT}}(F,L) = \frac{\sum_{i=1}^{K} \sum_{t=L+1}^{T-F} D_{it} \left\{ (Y_{i,t+F} - Y_{i,t+1}) - \frac{1}{|M_{it}^*|} \sum_{i' \in M_{it}^*} (Y_{i',t+F} - Y_{i',t+1}) \right\}}{\sum_{i=1}^{K} \sum_{t=L+1}^{T-F} D_{it}},$$
(1)

where outcome variable $Y_{i,t}$, is the change in GHG emission per capita in country *i* in year *t*, and $D_{it} = 1\{X_{it} = 1\} \times 1\{X_{i,t-1} = 0\} \times 1\{|M_{it}^*| > 0\},$ (2)

is an indicator for a treatment X_{it} set of countries with non-empty matching that includes countries which joined the MPGA in a certain year interval prior to time point 0. To compute the standard error of estimator ATT(F, L), and to derive significance out of the transiting direction in ATT, we used a block-bootstrap procedure designed for matching with time series cross sectional (TSCS) data on the weight [21]. The leads (*F*) and lags (*L*) next to ATT in parentheses at the left side of the equation denotes identical country history regarding cofounders from time t - L to t - 1 by which algorithm process outcome is measured at time t + F. The outcome of interest would be the change in new, reported GHG emission per capita from year t to year t + F, that has occurred in the interval from year 0 to 10. The number of bootstrap iterations is set to 10 000. With respect to timing, we consider that a country will have adjusted to a new environmental policy at least one year after accession to the MPGA.

How a country's regulatory policy in regard to GHG emissions actually impacts a treatment group, that is selected countries in the MPGA, explained above in the presented thesis, will be discussed in the subsequent sections.

DATA AND VARIABLE DESCRIPTION

The data consists of the large set of world countries, divided into two subsets, the first containing the MPGA members and the rest are non-member countries. In order to make more transparent, objective data processing, some countries were dropped out due to data being unavailable in some domains. Before running the panel matching analysis, after filtering the primary dataset from a larger set of 174, we were able to identify 24 countries representing the treatment group, while 115 non-members were assigned to the control group (or 139 countries in total).

Table 1 shows the variables used in the empirical analysis, while Table 2 shows the summary statistics of these variables.

About 17,4 % of countries have joined the MPGA, while about 61,2 % signed the Kyoto Protocol promising to reduce GHG emissions in the near future. With a mean emission of 4,70 kilotonnes, CO2_pc is the most emitted gas in volume among the chosen gasses, while CH4_pc is the least emitted. The wide range in other relevant variables (gdppc, arrp, pop) indicated by the minimum and maximum levels may suggest heterogeneity of observations (countries).

	mable description and data sources.
Variable	Data Source/ Description
	https://www.fao.org/mountain-partnership/members/en [22]
MOUNT	Dummy variable equal 1 for the countries that are MPGA members and 0 otherwise.
	https://ourworldindata.org[23]
CO2_pc	Total carbon dioxide emission per capita in levels, measured in kilotonnes.
CH4_pc	Total methane per capita emissions in levels (kilotonnes of CO_2 equivalent).
N2O_pc	Total nitrous oxide per capita emissions in levels (kilotonnes of CO ₂ equivalent).
gdppc	Total GDP per capita in levels (current USD).
arrp	International tourism arrival per capita in levels
рор	This is the total population of a country.
	https://www.chemeurope.com/en/encyclopedia/List_of_Kyoto_Protocol_signatories.html [24]
kyoto	Binary variable equal 1 for the countries that signed the Kyoto Protocol and 0 otherwise

Table 1. Variable description and data sources.

Table 2	2. Sum	mary st	atistics
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Variable	N	Mean	S.D.	Min.	Max.
MOUNT	2914	0,174	0,339	0,000	1,000
CH4_pc	2914	1,900	2,509	0,108	29,952
CO2_pc	2914	4,704	5,749	0,016	35,668
N2O_pc	2914	0,655	0,906	0,000	8,239
kyoto	2914	0,612	0,487	0,000	1,000
gdppc	2914	14310,777	15170,995	425,895	93712,141
рор	2914	45544,338	155954,570	42,000	1414049,000
arrp	2914	105773,698	215876,365	11,963	2043425,207
ID	2914	68,061	38,884	1,000	139,000

EMPIRICAL ANALYSIS

First, we drew the plot that shows the number of matched control units that share the same treatment history as a treated observation which originates from accession to the MPGA, assigned as a treated observation in the case of four year lag.

The plot given in Figure 1 shows the number of matched control units that share the same treatment history as a treated observation. We see that there are 14 treated observations for administered policy that have about 90 control units with the same treatment history when the number of lags is four. So, we have enough matched control units to test the MPGA transmitted policy along the GHG trajectories: most treated observations have more than enough matched control units.



Figure 1. Matched control units with the same treatment history.

In a next step, in order to refine the matched set further, and having in mind that one of the weighting techniques had to be chosen as the best (among Mahalanobis distance matching, propensity score matching, and propensity score weighting), we proceed. So, we compare the performance of each refinement method after it had generated a new matched set. Following a result assessment, we keep the propensity score weighting refinement results as it shows to be the optimal matched set. In this auxiliary part of our panel matching research, while searching for the optimal set, all of the previously mentioned time-varying covariates were implemented e.g. indicators for economic, tourism and demographic forces, as well as a binary type of variable for the Kyoto Protocol label.

The PSW refinement in our exercises essentially eliminates almost all imbalance, the standardised mean difference distance in all confounders of continuing type (yet the Kyoto covariate which is a binary type variable is somehow problematic) are minimised, e.g. has been kept to around 0. Although some degree of imbalance remains for this type of improved matching, the standardised mean difference for the lagged outcomes (CO₂, CH₄ and N₂O, all per capita) stay rather constant over time, this is a substantial difference as before, the entire pre-treatment period. This suggests that the assumption of a parallel trend for the proposed difference-in-difference estimator is valid. This encourages us to deliberately proceed with the analysis.

We now present the estimated ATTs based on the matching methods. Subsequent figures show the matching estimates of the effects of administering environmental policy which induce the act of accession to the MPGA, each for various GHG per capita types for the period of ten years after the transition point of accession to the MPGA, i.e., F = 0, 1, ..., 10.

Regarding the matching set obtained by the propensity score weighting (PSW) refinement method, and when the dependent variable of interest is set up to be CO2_pc, we assessed that the point estimates of the effects for accession to the MPGA are mostly close to zero in the year of accession (see Figure2). While moving forward on a year-by-year basis, the CO2_pc variable, as an outcome, transit more and more in the intuitively expected direction. We show that in the 2^{nd} year and future years the assumed treatment dynamics negatively impact on CO2 per capita emission. The ATT coefficient in the CO2_pc case becomes more significant and more prominently negative with the lapsing time. We report the same estimated treatment effects and confidence intervals in Table 3 (in the Appendix). It shows the estimated average treatment effect on the treated countries (ATT) when both the post-treatment (*F*) and pre-treatment period *L* are set to be 10 and 4 years, respectively, along with standard error (SE) and 97,5 % confidence interval. These results suggest that the effect on CO2_pc is significant;

namely, all point estimates certainly, with bootstrapped estimates, uncover negative values, after MPGA's policy intervention.

Starting from the first year, the constraints driven by policy directed to the MPGA members made substantial benefit in terms of CO2 _pc decreasing. After the turning point, which occurred in the 7th year of supposed treatment, when the average treatment effect estimate measured by CO₂ emission dropped the most –by as much as 1624 kilotonnes per capita – in future years this volume in the atmosphere above treated countries changed slightly yet its volume remained always in the negative zone of values, denoting a general fall, as we had predicted.



Figure2. Estimated average treatment effects in CO2_pc over time.

Note related to all figures 2,3 and 4: The average treatment effects are represented by point estimates over time (in years), with lines corresponding to standard errors obtained with 1000 bootstrap iterations. Here 2,5 % and 97,5 % are quantiles of the bootstrapped estimates reported. Propensity score weighting was used to create the matched sets.

The Figure 3 shows the level of CH4_pc movement in the MPGA group after acceptance of mandatory environmental policy. The methane emissions per capita (CH4_pc), at first paradoxically increased following the implementation of environment-led protection policy covered by appropriate laws, but the difference was insignificant. The results indicate an expected decrease of methane per capita, as expected after the adoption of environmental policy, in the years after the second year. Yet, the bootstrapped estimates yield both positive and negative values in the entire interval, suggesting little evidence of a non-zero effect. Summarising the case of the CH4_pc trajectory path on the change due to MPGA association, we show that the effect sizes had a strange trajectory path, zigzagging negatively but were insignificant. Furthermore, in the 5th year, beside others, we underline that the causal impact became borderline significant. The fall in the emission of CH4_pc in that year, we assess to be about 0,177 kilotonnes.



Figure 3. Estimated average treatment effects in CH4_pc over time.

According to Figure 4 we cannot find sufficient evidence for our hypothesis that MPGA induced environmental policy would reduce N2O_pc emission in the treatment group of countries. Some of the treatment effect estimates are positive, more precisely in the years: four, five and seven) indicating that an assumed environmental law regulation coming into force causally increases emission of N2O_pc. The weak magnitude in the second year brought in effect the significant impacts. We also noticed positive impacts paradoxically unevenly scattered which are not otherwise negligible in the other observed years. In some of them their confidence intervals were zero.



Figure 4. Estimated average treatment effects in N2O_pc over time.

CONCLUSION

This study was designed to determine whether the interventions to reduce GHG emissions under the MPGA significantly reduced the countries' carbon footprint, or whether they report more negative outcomes than the control group of countries. We can, without hesitation, report, and this is the most important conclusion, that: the mountainous countries, while taking care to environmental sustainability, given an incentive to invest in carbon abatement become lower emitters, on per capita basis, of carbon dioxide greenhouse gas after accession to the MPGA. Countries that made interventions to reduce GHG emissions after joining the MPGA were also found to have lower levels of small particles linked to methane per capita but only at borderline significance level. We also found counter-intuitive evidence that intervention based on a commitment to community efforts regarding environmental sustainability, recorded in the MPGA database, contributed to an increase in nitrous oxide emissions per capita in a few years following the intervention.

Results that link carbon dioxide and methane may enhance, we hope, the domestic-level policies introduced by governmental authorities in future. This will curb environmental vulnerability around a typical MPGA country more effectively. In response to the N_2O per capita environmental indicator spread, despite intervention, a mission to improve environmental care throughout the mountain world, will not suffice.

We recognise, as a self-criticism that our research objectives would not have been met if the panel matching estimation strategy suffered from bias of any sort, such as if the pivotal variable of instrument intervention is not fairly selected. We had focused on only one option of joining MPGA, at governmental level. Yet this kind of connections occasionally overlapped with different kinds of accessions to MPGA within the same time period, for example at intergovernmental or regional levels. Without more data, especially a richer specification of covariates, we also risk misspecification bias of some sort. We had unfortunately focused only on economic, touristic, demographic and institutional habitus of covariates that linked the commitment of nations to reduce GHG emissions, and which subsequently made the treatment subsample. Those inferences that had been extracted from the designed DiD-PM method, we hope modelled GHG complexities, giving the most plausible outputs.

Yet we believe the estimated null results, keeping those limitations in mind, are worth reporting given the widespread and long-term impact of MPGA policies on humanity. Especially, we may say concluding our narrative if the vicious cycle expressed in the growing population that transmits perpetual economic and tourism growth fosters the endless increase in carbon footprint. In spite of these limitations, we believe this estimation strategy of ours provides the most robust assessment of the effects of MPGA policies on environmental indicators spread to date, having in mind that we have long ago surpassed the peak of GHG saturation globally.

We hope others will be able to build upon our results to further assess the relevance, benefits and feasibility of various policy measures undertaken by MPGA regarding the global growth in the carbon footprint.

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APPENDIX

Table 3. Estimate of Average Treatment Effect of MPGA countries on the emission of CO2_pc over time.

Time, years	ATT estimate	Stand. value	2,5 %	97,5 %
<i>t</i> + 0	0,004	0,067	-0,146	0,128
<i>t</i> + 1	-0,111	0,130	-0,425	0,080
<i>t</i> + 2	-0,214	0,169	-0,608	0,045
<i>t</i> + 3	-0,206	0,215	-0,698	0,133
<i>t</i> + 4	-0,372	0,267	-1,034	0,016
<i>t</i> + 5	-0,449	0,281	-1,164	-0,056
<i>t</i> + 6	-0,464	0,287	-1,160	-0,020
<i>t</i> + 7	-0,516	0,315	-1,308	-0,020
<i>t</i> + 8	-0,580	0,358	-1,471	-0,050
<i>t</i> + 9	-0,708	0,443	-1,828	-0,065
<i>t</i> + 10	-0,831	0,530	-2,099	-0,065

*the average treatment effects on the treated (ATT), standard errors (SE) and 95 % confidence intervals are shown over the post-treatment period from t + 0 to t + 10 years

Table 4. Estimate	of Average Treatme	ent Effect of MPGA	countries on the en	mission of CH4_pc
over time.				
Time, years	ATT estimate	Stand. value	2,5 %	97,5 %

Time, years	ATT estimate	Stand. value	2,5 %	97,5 %
<i>t</i> + 0	-0,030	0,041	-0,119	0,041
<i>t</i> + 1	0,071	0,075	-0,057	0,240
<i>t</i> + 2	-0,028	0,069	-0,188	0,091
<i>t</i> + 3	-0,060	0,082	-0,223	0,094
<i>t</i> + 4	-0,114	0,112	-0,371	0,061
<i>t</i> + 5	-0,177	0,127	-0,468	0,020
<i>t</i> + 6	-0,193	0,147	-0,513	0,054
<i>t</i> + 7	-0,052	0,200	-0,448	0,330
<i>t</i> + 8	-0,146	0,164	-0,518	0,132
<i>t</i> + 9	-0,201	0,156	-0,564	0,056
<i>t</i> + 10	-0,200	0,150	-0,536	0,054

*the average treatment effects on the treated (ATT), standard errors (SE) and 95 % confidence intervals are shown over the post-treatment period from t + 0 to t + 10 years

Table 5. Estimate of Average Treatment Effect of MPGA countries on the emission of N₂O_pc over time (continued on p.692).

Time, years	ATT estimate	Stand. value	2,5 %	97,5 %
<i>t</i> + 0	-0,024	0,044	-0,158	0,014
<i>t</i> + 1	0,029	0,038	-0,012	0,129
<i>t</i> + 2	0,079	0,044	0,027	0,211
<i>t</i> + 3	0,048	0,033	-0,014	0,124
<i>t</i> + 4	0,175	0,229	0,020	0,961
<i>t</i> + 5	0,124	0,133	0,021	0,530
<i>t</i> + 6	0,045	0,034	-0,022	0,113
t + 7	0,103	0,085	0,023	0,359

over time (continuation from p.091).						
<i>t</i> + 8	0,023	0,055	-0,112	0,104		
<i>t</i> + 9	0,013	0,079	-0,181	0,117		
<i>t</i> + 10	-0,034	0,163	-0,496	0,121		

Table 5. Estimate of Average Treatment Effect of MPGA countries on the emission of N_2O_pc over time (continuation from p.691).

*the average treatment effects on the treated (ATT), standard errors (SE) and 95 % confidence intervals are shown over the post-treatment period from t + 0 to t + 10 years

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IMPACT OF REMITTANCE INFLOWS ON SELECTED SOUTH-EAST EUROPEAN ECONOMIES: A PANEL AUTO-REGRESSIVE DISTRIBUTED LAG APPROACH

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ABSTRACT

The impact of remittance inflows on economic development is contested in the existing literature. This article applies a panel auto regressive distributed lag to examine the impact of remittance inflows on economic growth and self-employment percentage in a panel of seven Southeast European countries between 1996 and 2020. The countries included in the panel are characterized by higher remittance inflows and include Albania, Bosnia and Hercegovina, Croatia, Kosovo, Montenegro, North Macedonia, and Serbia. The findings of the article indicate that there is no short-run relationship between remittance inflows and economic growth, but that remittance inflows are a significant contributor to economic growth in the long run. The article finds that in the short run, remittance inflows actually decrease the self-employment rate which can be attributed to the poverty alleviation impact of remittance flows, while there is no statistically significant relationship between remittance flows and the self-employment rate in the long-run. This indicates that there are opportunities to utilize the significant remittance inflows in more meaningful ways to stimulate investment opportunities.

KEY WORDS

remittance inflows, Southeast Europe, self-employment, GDP, panel ARDL

CLASSIFICATION

JEL: F22, O15
INTRODUCTION

Southeast Europe is an area where migrants have approached the increasingly open market of the European Union (hereafter: the EU) that is experiencing labour shortages in several key sectors. Such trends have caused many of the countries in the area to experience concerning demographic trends [1]. Croatia is one of the countries that is experiencing rapid demographic imbalances. The opening up of labour markets in the EU has triggered a new wave of migration that has exasperated demographic trends in the country. If the current scope of migration and low birth rates are to continue, the ratio of active workers supporting the economy compared to non-participating members of the economy is expected to become 1:3 in the not-too-distant future [2]. Such demographic trends are not sustainable. There is a clear need to establish a migration policy that will lead to the repatriation of some of these migrants, as well as an effort to prevent the "brain drain" phenomenon [3]. Even in the short-term, such a high number of migrants can lead to labour costs increasing, lesser government revenue through taxation and a decrease in the number of skilled workers necessary for essential jobs. The long-term consequences are increasingly dire with potential questions being raised as to the long-term feasibility of both the healthcare and the pension system [4].

While the migration wave has negatively impacted the state of the labour market and shortterm tax revenues have been hampered, there are also some other factors that need to be considered. World Bank data in 2022 indicates that remittances into Croatia now account for almost seven percent of GDP, compared to just 2,2 % in 1999. While this factor, at least, seems to be favourable for the Croatian economy as this additional revenue can be used both to finance everyday consumption and stimulate new spending, the actual academic discussion about the impact of remittances leads to the conclusion that their impact is contested in the existing literature [5-10]. It is far from clear how remittances impact the economy, particularly in an open economy highly dependent on external capital flows which are key characteristics of most economies in South-eastern Europe [11].

This article aims to fill the research void in examining the impact of remittance inflows on economic growth in South-eastern Europe. The section that follows will analyse the underlying differences in the existing literature and examine the causes for why there are so many dissenting opinions. The following section will examine the methodological approach and justify the selection of the relevant independent variables. The fourth section will present the results of the panel auto regressive distributed lags (ARDL) estimation and discuss how the findings of the article fit within the overall literature. The final section will provide relevant policy recommendations based on the findings and support the thesis that remittance inflows encourage economic growth in the long-term through poverty alleviation and the stimulation of private consumption.

LITERATURE REVIEW

There is no clear consensus between how remittance inflows impact economic growth and even the measurements of what the levels of remittance inflows are is contested as many of them arrive through informal flows [5]. The models that consider the impact of remittance inflows are differently specified with different broad base growth models that include [12] that have also been reconceptualized into additional contemporary models such as [13]. The different conceptualizations of base models of economic growth, as highlighted in [14] is an area of continued activity in the field of economics as there are minor modifications in the factors of production considered and the underlying variables necessary to properly account for their activity. There are different approaches such as those by [15] that have encouraged that these models need to also better account for human and knowledge capital as significant contributors to economic growth. Additionally, the impact of research and development given its significance to economic activity is insufficiently measured and considered in most econometric models [16]. The different base models, approaches to measuring remittance inflows and economic growth as well as different geographical regions around the globe are likely causes of why there are so many significant differences between how remittance inflows impact economic growth. Broadly, the literature examined can be subdivided into three separate categories:

- 1. the authors who believe that remittances inadvertently hamper economic growth [5, 6, 17, 18],
- 2. the authors who believe that remittances help promote economic growth and alleviate poverty [7, 19],
- 3. authors who find no statistically significant relationship between remittances and economic growth or find that the impact of remittance inflows may be different across different regions or countries [9, 20, 21].

Initially, there is a number of authors who believe that remittance inflows may inadvertently have an adverse impact on the aggregate economy including [6]. The authors argue that remittances do contribute to the consumption of non-tradable goods and that such an approach then causes the price of other goods in the economy to increase [6]. The authors believe that regardless of the well-meaning intentions of remittance providers that they actually contribute to the 'Dutch Disease' in small and open economies [6]. The authors further argue that as a result of having more disposable incomes, those receiving remittances then have less incentive to work which can lead to labour shortages and higher costs of goods and services [6]. A similar viewpoint is presented in [17]. In their study of a panel of Latin American and Caribbean countries, the authors employ a panel regression analysis and find that the impact of remittance inflows increases the real exchange rate [17]. As a result of these factors, the economic growth of the countries examined is hampered and prices increase for consumers [17]. The impact of remittances in Bangladesh between 1995 and 2006 was examined and a similar conclusion was reached by implementing regression analysis and finding that remittances adversely impact economic growth. The author also emphasized the need for country-specific countries and argued that some overly broad conclusions have been made based on panel data [18].

A slightly more nuanced viewpoint is presented in [5] where the authors emphasize that the formal remittance inflows probably account for between 35 % and 75 % of the actual volume of remittances. The authors find this problematic as they believe that many of the countries that have high inflows of remittances do not fully benefit from the possible government revenues that could be derived from remittances as they remain a part of the shadow economy [5]. As emphasized by [5], many countries including Ireland and Thailand are taking deliberate trends to attempt a reversal of migration trends and have attempted to ensure that qualified individuals return to their home countries. Overall, it is indicated that remittance inflows at best are not fully utilized as many of the informal channels through which these remittances flow do not have benefits for the aggregate economy. There are also similar articles that do not provide a clear response to how remittance inflows impact the aggregate economy or that the impact of remittance flows may be differ across countries.

An example of such a article is [8] as the authors argue that much of the existing literature has minor methodological concerns by utilizing approaches based on GMM or standard OLS regressions. The authors argue that such an approach is not methodologically valid given the fact that it does not fully account for the spatial interdependence of economic growth. Another methodological concern identified by the same authors is omitted variable bias as the authors believe that many studies combine remittance inflows with only some other foreign

capital flows or develop regression models that have a limited explanatory value. The authors believe that it is necessary to account for all of the possible foreign capital inflows including foreign aid, remittance flows, and FDI, and they have found that the impact of remittances is not consistent across the different areas they have observed and have found that remittance inflows do not have a statistically significant impact on economic growth in the African economies they observed. On the other hand, they have also found evidence of such a link in a panel of Latin American and Caribbean countries thus highlighting spatial differences in the impact of remittance inflows on economic growth [8].

Similarly, [9] has conducted an analysis of the 11 South-Mediterranean countries between 1984 and 2014 to examine whether there is a link between remittance inflows and economic growth. The author has established that remittance inflows do not directly positively impact economic growth based on a GMM approach. The author does find that in some cases institutional factors are a precondition for stability and that there is some correlation with ensuring higher levels of economic growth when countries that have functioning institutions also have higher levels of remittance inflows. The authors however do not establish that there is a direct link between remittance inflows and economic growth, but the author considers them to be complements that can enable the long-term foundations for economic growth.

The impact of remittances in Croatia was for example also examined [20]. It was concluded that remittance inflows had a favourable impact on the economy. The authors implemented a GMM panel approach that examined the MENA countries and concluded that, compared to other outside capital flows such as foreign aid, remittance inflows have a comparatively stronger impact on poverty alleviation in the MENA countries. The authors believe that the governments of these countries face significant problems in ensuring the prerequisites for economic growth given the failures of privatisation.

An analysis of remittance inflows on the economic growth of the MINT (Mexico, Indonesia, Nigeria, and Turkey) countries from 1980-2019 was also conducted [19]. The authors believe that omitted variable bias was one of the reasons why numerous models failed to fully capture the impact that remittance inflows can have on economic growth. The authors believe that the impact of the financial capital development variable is significant to the overall estimation of the model. The authors have employed a panel ARDL approach to consider the impact of the relevant variables. The authors have concluded that remittance inflows have a long-term positive impact on economic growth. As such, the authors believe that the facilitation of remittance inflows are significant, even though most of the spending supported by it is being spent on everyday consumption. This is comparable to the findings [7], where impact of remittance inflows in Bangladesh, India, Pakistan and Sri Lanka through a regression model reviewing data between 1976 and 2012 was examined. The author similarly found that remittance inflows could not only be used to stimulate consumption, but could also be used to stimulate entrepreneurial activities. The author includes relevant control variables including openness to trade, FDI as well as infrastructure to ensure that the regression findings are not spurious. This is also compatible with the findings in [10] where the importance of remittance inflows for investment activities and growth in the Philippines was studied. Examined were 1646 households that had at least one member of their family to migrate abroad and were receiving some form of remittance inflows. The author concluded that not only did remittance inflows support everyday consumption, but individuals who had consistent remittance support were more likely to engage in entrepreneurial activities and be self-employed. As a result, the author believes that remittance inflows are highly significant for the aggregate development of the Philippines and that they should be encouraged.

A panel of 25 sub-Saharan economies was examined [21] and complementary finding to those of [10] were found. The authors have emphasized that one of the problems in dealing with the study of remittance inflows is a lack of possible explanatory exogenous variables and also implemented a GMM approach. The authors believe that remittance inflows can have an effect in generating an alternative form of liquidity and, therefore, believe that remittance inflows should be encouraged as they have a positive impact on stimulating economic activity.

The findings are similarly varied when examining the impact of economic growth in the area of Southeast Europe. It should be noted that not all of the articles examined had the same sample of countries as those utilized in this article. A Delphi questionnaire approach that surveyed 10 experts and 20 remittance receivers per country was conducted by [22]. The authors concluded that most adverse demographic trends will be mitigated as persistent migration will no longer be as prominent in most countries, with the exception of Serbia. Furthermore, the authors concluded that, with the exception of North Macedonia, remittance inflows do fuel economic activity that is beneficial to the aggregate economy.

Other authors [23] examined the macroeconomic impact of remittance inflows in Southeast Europe and summarized key points from the existing literature. The authors found that generally, remittance inflows tended to have a positive impact on national incomes, but that there were concerns that remittance inflows tended to be associated with inflation. Further, authors focused their analysis exclusively on Romania and found that remittances have a significant impact on the aggregate economy. The authors further determined that after the first year, remittance inflows tend to decrease from migrants and that migrants tend to send back fewer resources during times of financial crisis [24].

A general impact of migration on Southeast Europe and conducted an extensive literature review of the topic was examined by [25]. The authors note that the entire area has a history of migration and that joining the EU has caused significant increases in the aggregate levels of remittances sent back, but highlight that the general impact of migration on development is contested. It can therefore be concluded that there is no consensus in the existing literature on how specifically remittances impact economic growth with numerous authors including [6] believing that remittance inflows can increase the costs of goods, decrease labour supply and cause the 'Dutch Disease'. On the other hand, authors such as [10] have highlighted those remittances have not only encouraged economic growth and stimulated consumption, but have also enabled individuals who receive remittances to invest in new businesses and thus stimulate additional levels of economic growth. It can be argued that part of the lacking consensus may stem from the fact that authors are examining different areas and economies and using entirely different models to examine the impact of remittances. The arguments specified by [8] concerning potential omitted variable bias may also be significant.

METHODOLOGY AND DATA

In order to examine the impact of remittance inflows on a panel of economies in Southeast Europe, data was downloaded from the World Bank. The article initially considered a general growth model as described in [26], represented by the following equation:

$$g_i = \gamma(z_i)' X_i + \epsilon_i, \tag{1}$$

where $\gamma(z_i)$ accounts for country-specific parameters and represents a broader approach to the Solow model, thus enabling for the inclusion of variables that best describe the economic growth of Southeast Europe. It also includes g as the aggregate level of economic growth, as measures by changes in GDP. The equation also includes an error term and considers the time period indicated by i. From this basic equation, the article developed an autoregressive distributed lag approach to fully capture the impact of the relevant variables on economic growth. The selection of the

ARDL panel model is mainly due to the fact that the method can be used both for short-term and long-term estimation of the coefficients [27]. Rather than using a GMM approach, the coefficients are estimated through a Pooled Mean Group (PMG) estimator developed by [28].

It can also be utilized even when the variables are either stationary or stationary in their first difference, which shall be empirically tested by utilizing the test developed by [29]. Stationarity is a term that indicates consistency in terms of the property of a time series not changing as a result of influencers such as trends or seasonality. This will also be supported by validating these results by using the panel unit root test proposed by [30]. The null hypothesis of the test proposed is that the variable is non-stationary, as is that of the test proposed by [29]. As emphasized by [31], an ARDL approach is not viable if a variable is I(2) or higher. ARDL models can include lags of both the dependent variable and the regressors and the number of lags will be determined automatically based on the Akaike information criterion.

Aside from estimating the model that will analyze the impact of remittances on economic growth, a second model will also be estimated that will examine the impact of remittances on the self-employment rate to test whether [10] research can also be applied to the area of Southeast Europe. Thus, the research is based on the following equations:

$$\Delta GDP_{i,t} = \varphi_i + \sum \gamma_1 \Delta GDP_{i,t-j} + \sum \gamma_2 \Delta FDI_{i,t} + \sum \gamma_3 \Delta GFCF_{i,t} + \sum \gamma_4 \Delta RI_{i,t} + \epsilon_{i,t}, \quad (2)$$

$$\Delta SE_{i,t} = \varphi_i + \sum \beta_1 \Delta SE_{i,t-j} + \sum \beta_2 \Delta FDI_{i,t} + \sum \beta_3 \Delta EE_{i,t} + \sum \beta_4 \Delta RI_{i,t} + \epsilon_{i,t}, \quad (3)$$

where we assume that GDP is impacted by an array of possible explanatory variables and the key factor of the article is determining how remittances as an independent variable impact economic growth. The full list of abbreviations for the variables is included in Table 1. N accounts for the cross-section units and t accounts for the examined time period. The second model uses the rate of self-employment as an imperfect proxy to measure investment activity and entrepreneurial methods, that [10] has shown to increase as a result of remittance inflows. All of the previously mentioned independent variables have been included as they are considered by some articles, including [10] to be strong determinants of GDP. Both models include a group-specific intercept (φ) and an error term (ε) as well as the relevant coefficients of both of the models ($\beta_{1...4}$ and $\gamma_{1...4}$).

Information concerning the data used in the variables as well as other technical information is provided in Table 1 below.

Variable	Variable abbreviation	Measurement	Relevance
Gross domestic product	GDP	Real \$2015	Dependent variable of first model
Remittance inflows	RI	Real \$2015	Independent variable of both models
Foreign domestic investments inflows	FDI	Real \$2015	Independent variable of both models
Education investment	EE	Real \$2015	Independent variable of second model
Gross fixed capital formation	GFCF	Real \$2015	Independent variable of first model
Self-employment rate	SE	Percentage of self- employed individuals compared to all individuals employed	Dependent variable of second model

Table 1. Key variables considered by panel ARDL models (World Bank 2022 data).

Based on evidence from the existing literature, it is possible to assume that FDI should be associated with an increase in economic growth as the increased economic activity caused by these investments should have a spill-over effect into other sectors as well. Such views are also present in other articles [7, 10]. As has been elaborated in greater depth in the literature review, the impact of remittance inflows is inconsistent across the examined literature including [5, 6, 17], so one of the primary goals of the article is to determine the relationship between remittance inflows and GDP. It is unclear whether additional remittance inflows adversely impact the economy as they may stimulate the 'Dutch Disease' or these inflows benefit the economy through additional resources that individuals receiving remittances may then spend and thus stimulate the economy.

While most of the existing literature including [1] assumes that additional spending in education results in better jobs thus leading to better wages and stronger economic growth, this is contingent on multiple factors. One area that may be unclear is whether higher wages can be achieved through educational spending as there are many other determinants to the level of wages. As such, despite the findings in [1], the final relationship between educational spending and GDP growth should also be verified.

Additionally, summary statistics of the data are shown in Table 2. A logarithmic transformation has been applied to all of the variables with the exception of the self-employment rate. The rationale for doing so is that this minimizes the values of skewness and kurtosis of the individual variables that could have resulted in a spurious regression. The use of inflation-corrected currencies will also ensure that time-specific effects do not have an impact on the final results of the models. The data considers the time period between 1996 and 2020 with some lacking data availability in the case of Kosovo.

	LGDP	LGFCF	LEE	LFDI	SE
Mean	25,7	24,21	20,17	20,08	31,59
Median	26,51	24,9	19,86	20,09	26,99
Maximum	29,23	27,88	21,78	22,38	66,51
Minimum	21,83	20,23	17,99	15,86	12
Standard deviation	2,29	2,26	1,07	1,22	15,08
Skewness	-0,38	-0,34	-0,05	-0,64	1,2
Kurtosis	1,93	1,87	1,76	3,98	3,07

Table 2. Summary statistics of variables.

It can be determined that, within the panel, the discrepancies are most significant in terms of the self-employment rate. While Albania has, on average, the highest self-employment rate, the value of this variable is comparatively low across the other observed Southeast European economies (data from World Bank).

RESULTS AND DISCUSSION

In order to ensure the statistical validity of the results, it was first necessary to conduct the panel unit root tests to ensure that all variables were either I(0) or I(1). This is verified and shown in Table 3.

	Levin, Lin and	Im, Pesaran and	Levin, Lin and	Im, Pesaran and	
	Chu t in <i>I</i> (0)	Shin W-stat in I(0)	Chu t in <i>I</i> (1)	Shin W-stat in I(1)	
	-4,31**	-0,87	-3,52**	-4,87**	
LGDF	(0,000)	(0,19)	(0,000)	(0,000)	
СE	-0,27	1,21	-5,67**	-6,48**	
3E	(0,39)	(0,89)	(0,000)	(0,000)	
	-3,41**	-4,27**	/	/	
LFDI	(0,003)	(0,000)	/	/	
	-9,25**	-4,51**	/	/	
LGFCF	(0,000)	(0,0000)	/	/	
	-0,79	0,76	-6,46**	-5,82**	
	(0,21)	(0,75)	(0,000)	(0,000)	
	-2,74**	-1,82*	/	/	
LRI	(0,003)	(0,034)	/	/	

 Table 3. Panel unit root test results.

*relevant at 0,05 level of statistical significance

**relevant at 0,01 levels of statistical significance

As can be seen from Table 3, all of the models are either I(0) or I(1). Unit root tests were not conducted for the I(1) forms of the variables in case the variables exhibited stationarity in their level forms based on the results of both of the relevant tests. It is clear from the conducted panel unit tests that both of the dependent variables of the ARDL models as well as LEE are I(1) while LFDI, LRI and LFGCF are I(0). This enables us to conduct the panel ARDL PMG estimation and the results of the first model are shown in Table 4.

Table 4.	Panel ARDL	model for	economic	growth.
	I unoi / INDL	model for	ceononne	SIOWIII.

	Coefficient	t-statistic			
Long-run equation					
	-0,018**	12.27			
	(0,0000)	-12,27			
LRI	1,02**	223.86			
	(0,0000)	223,80			
LOECE	1,27**	772 77			
EGICI	(0,000)	213,11			
	Short-run equation				
D(LGDP(-1))	-0,26	0.01			
	(0,23)	-0,91			
	-0,026	1.05			
	(0,36)	-1,05			
	-0,029	1.05			
D(LFDI(-1))	(0,297)	-1,05			
	0,004	0.16			
D(LKI)	(0,87)	0,10			
	0,083	1.54			
D(LRI(-1))	(0,12)	1,54			
D/I GECE)	0,19*	2.28			
D(LGFCF)	(0,019)	2,30			
	0,034	1.02			
	(0,31)	1,05			

*relevant at 0,05 level of statistical significance

**relevant at 0,01 levels of statistical significance

As can be seen from Table 4, remittance inflows do not have a statistically significant link in the short-term. On the other hand, in the long-term, remittance inflows are one of the key determinants to ensuring sustainable economic growth. These arguments are mostly consistent with several existing articles that have considered other areas around the globe including [7]. It can be argued, similarly to as was considered in [8], that accounting for different types of both domestic and foreign capital flows is essential to determining the statistical relationship between remittance inflows and economic growth. The only variable omitted from the article that was also considered in [8] were foreign aid inflows that are not as significant in Southeast Europe compared to the panel of countries the authors considered and there was limited data concerning total foreign aid inflows in the World Bank (2022) database. It can be argued that remittance inflows alleviate poverty and assist those individuals who receive remittances to stimulate private consumption. While this is a long-term process, this article does find evidence of a long-run positive relationship between remittance inflows and economic growth that is also consistent with the findings in [19]. The article also considers the impact of remittances on the self-employment rate as shown in Table 5.

	Coefficient	t-statistic			
Long-run equation					
	-8,44**	2.96			
LFDI	(0,0059)	-2,80			
1 66	-0,059	0.01			
	(0,991)	-0,01			
I BI	13,42	1.64			
LRI	(0,107)	1,04			
	Short-run equation				
D(I SE(-1))	0,03	0.23			
D(L3L(-1))	(0,11)	0,23			
	0,14	0.22			
D(LFDI)	(0,76)	0,55			
	-0,79*	2 12			
D(LRI)	(0,04)	-2,12			
D/I EE)	-0,78	0.77			
D(LEE)	(0,44)	-0,77			

Table 5. Panel ARDI	. model for	the self-em	ployment rate.
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*relevant at 0,05 level of statistical significance

**relevant at 0,01 levels of statistical significance

While [10] believed that remittance inflows significantly increase the self-employment rate, this is not a finding that this article could empirically verify. Rather, it seems that while remittance inflows do have an impact in stimulating long-term economic growth, remittance inflows actually have a short-term negative relationship with the self-employment rate. This finding can be explained when contextualized with other factors in the existing literature such as [6]. As explained in [6] it is often the case that remittance inflows can lead to labour shortages and for people needing to work less as a result of receiving remittance inflows and thus requiring less funds for personal consumption. It is similarly plausible that as a result of individuals receiving higher remittance inflows, they are no longer required to work as microbusinesses or engage in rural family farming. In the long-run the relationship between remittance inflows and the self-employment rate is statistically insignificant and this has not changed through multiple different estimates of the panel ARDL model. It is important to note that finding in [10] was based on surveys and that different datasets could lead to different findings. This is an area where further research is needed to resolve the

inconsistency in the existing literature with the different theoretical assumptions as proposed by [10] compared to [6] and [24].

The findings of the article are also consistent with [32] that also employed a panel data analysis approach to viewing the impact of R&D. In comparison to [32], this article also determines that the impact of foreign forms of capital and increased innovation are likely factors contributing to economic growth. The main findings are also consistent with [33] where the authors have utilized a panel approach to determine the impact of non-economic determinants of FDI, such as quality of institutions, in the example of Croatia. The arguments of the article are also consistent with the views of [34] about the unclear impact of neoclassical growth theory.

CONCLUSION

This article provides additional insight into the short-term and long-term impact of remittance inflows on a panel of Southeast European economies. The goal of the article was to establish how certain foreign capital inflows, primarily remittances, impacted the economic growth of the observed countries. The main reason for doing so was the inconsistency of the existing articles in establishing this relationship including [1, 5, 6, 15, 17]. In order to ensure the validity of the ARDL models that were the primary empirical method of establishing the relationship, a number of other independent variables that are determinants of GDP have also been included. The article also examined the impact that a set of selected independent variables had on the self-employment rate as some articles hypothesized that remittances led to higher rates of self-employment.

The article has determined that there is a long-run statistically significant relationship between remittance inflows and economic growth which is mainly consistent with the other findings [7, 19]. The article finds that as individuals receive additional inflows of capital through remittances, this has a poverty alleviating impact as individuals are then able to use more disposable income and thus encourage economic growth through personal consumption. While such findings are partially consistent with other articles such as [8] and [10], some of the findings of the article differ significantly from [10].

The second set of panel ARDL models established that there is no statistically relevant relationship between remittance inflows and the self-employment rate. In fact, due to the increase in disposable income, some are less stimulated to work due to having additional income as a result of remittances as explained in [6]. For this reason, remittance inflows in the short-term actually decrease the self-employment rate.

The article has also found that, in the observed dataset, FDI actually tends to increase the self-employment rate. This may be a cause of correlated events as the growth of FDI has tended to increase larger companies operating in SEE economies and thus has led to a lower need for people to operate microbusinesses. Regardless, it does indicate a valid managerial implication to all operating small or micro businesses that may find it difficult to stabilize their position on the market.

This article emphasizes that the fact that remittance inflows do not cause an increase in the self-employment rate does not mean that these inflows do not generate entrepreneurial activity. The article specifically examined the self-employment rate to complement the work [10] on an entirely different geographic area and using a different methodological approach, but the complex relationship between remittance inflows and investment is an area that warrants further research. It should also be noted that, as specified by [17], significant levels of remittance inflows are informal. These are some of the limitations of the article, but the very

inability to fully capture the remittance inflows is one of the main methodological shortcomings of the article. Another limitation may be the selected determinants of economic growth or the self-employment ratio. While these were based on previous articles, other viable indicators could also be utilized.

Future articles may also wish to analyse the impact on a micro, rather than on a macro level and gain access to empirical data through surveys. Monitoring and stimulating individuals to effectively utilize remittance inflows should be a priority for governments of Southeast Europe that have significant levels of remittance inflows. Educating individuals about financial opportunities and encouraging self-employment training could be beneficial to further boosting the impact of remittance inflows. As noted by [9], the quality of institutions and policy development is essential to maximizing the investment value of remittance flows.

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INVESTIGATION OF LEADERSHIP COMPETENCES OF PROJECT MANAGERS IN CONSTRUCTION INDUSTRY

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ABSTRACT

Leadership has been widely studied both in business schools and by scholars. However, little attention has been given to leadership specifics in project-based organizations, especially in the construction industry. Aiming to decrease the gap in aforementioned body of knowledge, this article intended to contribute by identifying competences that are crucial to the success of project management as well as by revealing their manifestation in future construction project engineers.

Therefore, theoretical framework of this article offers a literature review on variety of leadership theories. Building onto that, empirical part investigated importance of different leader competences, as perceived by future project managers, being graduate civil engineering students.

The use of the mixed method research has been chosen as the most appropriate for this study. It combined the use of qualitative methods with survey obtained data based on a Likert scale. In respect of that, theoretical framework was constructed relying on the research of secondary data sources, whilst empirical part data were processed using descriptive statistics and nonparametric tests.

Findings show that there are no significant differences in opinion among students in respect of their gender and almost none in respect of study course. The lowest rated competence concerns indecisiveness, suggesting high level of students' self-confidence and self-awareness. The highest rated competence indicates students' tendency to have things under control. Such reluctance toward risk taking has been found as potentially harmful for their personal and professional growth. Although their propensity to risk is expected to increase with experience, fostering emotional intelligence related competences has been advised as a tool of smarter risk perception.

KEY WORDS

leadership style, leader traits, leader competences, project management, civil engineering

CLASSIFICATION

JEL: D23, L74, M12

INTRODUCTION

Leadership is usually defined as the ability to influence people so that they willingly and enthusiastically perform a task, i.e. act towards accomplishment of organizational/project goals [1]. Its importance can be indicated by the stand of many scholars, that it is the only real function of management [2]. However, leaders are not necessarily managers [1]. The essence of leadership is not in the formal position of the leader but in the willingness of people to follow him [3]. Because of that there has been an enormous amount of studies trying to identify the key characteristics of a leader as well as to detect can one become a leader or the leaders are born as such.

Although leadership is obviously highly valued in general management literature, and it has been extensively studied for almost a century now, only recently have researchers been trying to investigate leadership style and competences within the field of project management, especially in construction industry [4]. Surprisingly, literature on project success factors ignored the project manager, his/her leadership style and competence [5]. Today, this knowledge gap is one of the most dynamic research topics. Building on different leadership schools which derived different leadership style typologies, key project manager's competences are being detected and considered the key to the success of project management [6]. Aiming to contribute to this discourse, research presented in this article intended to identify perception of relevant competences by future project managers in the construction industry. Such an aim is especially important at this moment of time, when investments in national infrastructure and other projects in all sectors of Croatian economy are fully certain [7], so the needs and interest in the profession of project management, especially in construction industry, are particularly emphasized. Fulfilment of so defined aim would enable both scholars and professionals to better direct their future efforts in developing successful project leaders as well as successful projects.

Based on the aforementioned, ensuing research question can be formulated: What is the self-evaluation of final year graduate students at the Faculty of Civil Engineering and Architecture Osijek, based on project managers' leadership competences advocated by various leadership schools?

Due to such research question, following hypotheses are defined:

- **H**₁: *Future project managers in construction industry, being final year graduate students at the Faculty of Civil Engineering and Architecture Osijek, perceive themselves to be competent in respect of both innate traits and competences that need to be learned.*
- H2: Future project managers in construction industry, being final year graduate students at the Faculty of Civil Engineering and Architecture Osijek, perceive themselves to have intellectual, managerial and emotional inteligence competences.
- **H**₃: *There are no statistically significant differences among respondents in respect of gender.*
- **H**₄: *There are no statistically significant differences among respondents in respect of study course.*

The structure of the article is as follows: section two reviews the main leadership schools, section three describes the chosen research methodology and applied methods. In section four the findings of the empirical part of the research are presented and commented. The article ends with concluding remarks and recommendations for future research.

LEADERSHIP STYLES AND COMPETENCES

As early as the beginning of the 20th century, Chester Barnard, an American business executive and the author of pioneering work in management theory, suggested that leaders should have

both managerial and emotional functions. Managerial functions he considered as cognitive functions, including directing, guiding and decision making, whilst he looked at emotional functions as at cathetic functions, comprised of motivational aspects of goal-setting, developing faith and commitment [8]. His book and opinion became a landmark at university courses in management and organization, so it is understandable that it more or less influenced all future schools of leadership theory. Due to the huge amount of leadership related research, specific approaches might be classified as presented in subsequent subsections.

THE TRAIT SCHOOL

The trait school has been one of the early theories of leadership, marked by the belief that leaders are born, not made. Consequently, representatives of this school advocated the idea that effective leaders have common traits. The traits encompass personal characteristics a leader should possess [9].

There has been even a psychological instrument developed aiming to explain individual's personality. It was created by Isabel Briggs Myers and her mother Katherine Cook Briggs, so it is called Myers Briggs Type Indicator (MBTI). It has been used around the world for 70 years to understand personality and interests. MBTI differentiates 16 personality types based on preferences being Extroversion/Introversion, Sensing/Intutive, Thinking/Feeling, Judging/Perceiving [9]. The idea is that leader needs to know himself as well as his subordinates, in order to be able to adapt his/her leadership style for getting the task done and keep the team motivated.

The trait school dominated up to the 1940s, although there are still authors supporting the idea, whose studies searched for such traits even much later [5]. For instance, Kirkpatrick and Locke [10] identified six key traits of effective leaders:

- drive (a broad term which includes achievements, motivation, ambition, energy, tenacity, and initiative),
- leadership motivation (the desire to lead but not to seek power as an end in itself),
- honesty and integrity,
- self-confidence (which is associated with emotional stability),
- cognitive ability (intelligence),
- and knowledge of the business (technical knowledge).

One of the most prominent representatives of the trait school, Levicki, commented such traits by claiming that they are all genetically determined [11].

Soon after that, Turner conducted a comprehensive study of project management aiming to improve the process of achiving strategic objectives. Among other things, he pointed out the leader traits important especially for project managers [12]:

- problem solving ability,
- results orientation,
- energy and initiative,
- self-confidence,
- perspective,
- communication,
- negotiation ability.

In comparison to previously listed general management traits, it seems the major difference is in emphasizing communication. Turner says: "One of the most important skills of a good leader is to be able to communicate the vision for the project, and the process of achieving that vision" [13; p.15]. Obviously, with project management being intensively people oriented, traits from the scope

of emotional intelligence become more important. This does not diminish the value of technical skills, but arguments the finding [14] that both task-oriented and relationship-oriented leadership behaviors are appropriate and needed in project management, they just take turns during the life cycle of a project, so successful leader should be able to demonstrate all of the above mentioned traits. Regarding that need for alternation of styles, IPMA Competence Baseline [15; p.86] states that "the project manager must know what leadership styles exist and decide which one is appropriate for the project, the team being managed and when dealing with senior management and interested parties, in all types of situations."

Critics regarding the trait theory are based mostly on the Great Men Theory, which would mean that experience and training have nothing to do with leaders development and success [16]. However, it seems that, although certain genetic predisposition for sure exists, innate traits for themselves are not sufficient for modern cognition of successful leadership in project management – some competences need to be learned to make the manager capable to apply all the necessary styles.

THE BEHAVIORAL OR STYLE SCHOOL

In the period from 1940s to the 1960s, leadership studies were influenced mostly by the behavioural or style school, which assumes that leadership can be learned, that effective leaders can be made and that they adopt behaviour they find adequate [5].

Representatives of this school equate leader behaviour with leadership styles. Goal of all the theories encompassed by the style school is to find patterns in the behaviour of successful leaders so that such behaviour could be learned by future leaders as well [17; p.234].

Within behavioural theories all researchers can be classified into two categories. The first category is consisted of those who focus their research on a leadership style that ranges from autocratic through democratic to laissez faire style. The second group of researchers are those who divide leadership styles based on whether they are people-oriented or task-oriented [2].

When narrowing the leadership studies from general management to specifics of project management, Turner [12] stated that leadership styles exhibited by project managers relate to the first mentioned category. He identified 3 key parameters founding those four leadership styles, as shown in Table 1.

parameter	autocratic	democratic	laissez-faire	bureaucratic
Team decision-making	low	high	high	low
Team decision-taking	low	low	high	low
Flexibility	high	high	high	low

Table 1. Leadership styles of project managers [12].

Such a differentiation literature recognizes as leadership styles based on authority. An autocratic style is one in which all authority is concentrated in one person, the leader, who has unlimited decision-making power and does not consult with associates. The leader expects to be obeyed and introduces penalties and rewards he finds appropriate. Therefore, autocratic style is characterized by mostly one-way communication [3; p.494]. The greatest advantage of this style is speed with which decisions can be made, due to which some authors believe that autocratic style increases labour productivity [18]. However, more recent studies point out that, in modern conditions, autocratic style can harm team's morale and lead to only minimum of work contribution put in by team members, so it is considered appropriate only in crisis situations [2].

As opposed to that, the basic characteristic of the democratic leadership style is involving subordinates in the decision-making process. Although a democratic leader will make the final decision, all team members are encouraged to take a more participative role in the decision-making process. Therefore, democratic leadership is considered a shared leadership, with two-way communication process applied. This not only increases job satisfaction by involving employees or team members in what is going on, but it also helps to develop people's skills. Consequently, team members feel in control of their own professional development and so are motivated to work hard by more than just a financial reward. Somewhat negative side of democratic leadership is that participation takes time. Because of that, democratic leadership is considered appropriate where teamwork is essential, and quality is more important than speed to market productivity [19].

The laissez-faire leadership style is more than an extreme version of democratic style: it involves non-interference policy, allows complete freedom to all workers and has no particular way of attaining goals. The concept is best described as "abdicating responsibilities and avoiding decisions" [20; p.475]. Leaders avoid making decision and do not involve in working units but they encourage the team members to do the work in their own way and to take the responsibility for their decision [21]. In real life, it is difficult to defend this leadership style unless the leader's subordinates are expert and well-motivated specialists, such as scientists [22; p.347].

And finally, bureaucratic leadership style is characterized by leaders who create, and rely on, the policy to meet organizational goals. Policies drive execution, strategy, objectives and outcomes. Bureaucratic leaders are usually strongly committed to procedures and processes. The danger here is that leadership's greatest benefits, motivating and developing people, are ignored by bureaucratic leaders [23]. This may be adequate in strict professions like military or banking, but in project management rarely.

In Croatia, a recent study [24] identified that democratic style is the most present, but in some groups of enterprises (tested after the size, growth phase and international orientation of the enterprise) autocratic, bureaucratic and laissez-faire styles are also present.

Although all of the aforementioned styles are generally all present and therefore their characteristics should be learned, every leadership situation is new, unique and unrepeatable, so moulding behaviour is simply not possible. Furthermore, although democratic leadership is endorsed by both the psychological literature and mainstream media, more recent studies [25] show that correlation of employee satisfaction with leadership style is a very complex phenomenon. Especially if appreciating the changes taking place in organizations, including more female employees and managers, increased informal team leadership, and more cross-cultural interactions, it can only be concluded that different leadership styles may be appropriate in different situations. Appreciating that, it can be concluded that behavioural school has made an important contribution to finding answers to the question of effective leadership and has been the base of schools developed afterwards, which shall be presented hereinafter.

THE CONTINGECY SCHOOL

The contingency school was popular in the 1960s and 1970s. By that time, illusions regarding the "big man" theory and the trait approach were definitely abandoned, and attention was focused on situation studies as well as the belief that leaders are the product of a given situation [3; p.503]. Rather than seeking universal theories of leadership that would apply in every situation, contingency theories suggest that what makes an effective leader would depend on the situation [5; p.51].

The claim that only the situation generates certain leaders would not be credible, because only some people, certain people, and not some others, became leaders in a given situation. Therefore, contingency theory emphasizes the importance of a specific situation, with respect to the importance of a person's characteristics [2]. In fact, due to the importance of the situation, leadership style is not dependent only of the leader, his characteristics and behaviour, but of

other stakeholders to the situation, too. Therefore, this theory assumes interaction among the leader and his associates (team members). Usually, the leader becomes the person who understands the aspirations of his associates and provides them with means for their accomplishment in a given situation [3; p.503].

There have been several schools of contingency theory that share such understanding of leadership, and one of the most notable is Fielder's theory. The most significant contribution of Fidler's studies is that he identified 3 key factors that determine leadership style and influence: leader-member relations, task structure and power position [5; p.51]:

- 1.)leader-member relation it implies the degree of trust that team members have in the leader and the loyalty they show. This relation shows whether the group accepts the leader and are the members willing to follow him. Fidler believes this factor is paramount to leadership success,
- 2.)task structure refers to whether the tasks are highly structured, clear and well defined. Task structure is the responsibility of the leader. When the structure is good, the business is more successful. Good structure is harder to achieve with non-routine tasks, which is often the case in project management,
- 3.)power position it differs depending on the position that the leader has in the organizational hierarchy. A leader who has a strong position of power will more easily gain followers.

Fidler's critics say that his theory is not universally acceptable [26], but he certainly initiated studies which do not believe in perfect characteristics or one and only acceptable style. However, project management authors have always appreciated his theory as well as his distinguishing between task-oriented and participative approaches to leadership. In order to maximize effectiveness, he used a least-preferred-coworker (LPC) score to assign team members to leaders depending on a situation [5].

Another contingency theory that has proven popular in both project management and general management is path-goal theory, by House [27]. The idea of this theory is that the manager should apply such leadership style and behaviour towards team members that would contribute to their satisfaction. In addition, the leader is expected to clarify goals to subordinates, to help them find the best path to the goal, and to help them remove obstacles that exist in the way of achieving the goal [3].

As such, this theory is a combination of contingency approach to leadership and motivational theories. It identifies four leadership behaviours [2]:

- 1.)directive leaders the leader tells the members what they need to do and how they should work,
- 2.) supportive leaders they act friendly toward subordinates, support them, and show interest in their needs and accomplishments,
- 3.) participative leaders take into account the proposals of subordinates and thus include them in the decision-making process,
- 4.) achievement-oriented leaders set ambitious goals and expect maximum engagement of subordinates to achieve them, because they believe that challenges and taking responsibility motivate people to achieve the goals.

In order to choose which of these 4 styles to apply in a given situation, the leader must take into account characteristics of the team members (knowledge, experience, self-confidence, ...) as well as environmental factors (task nature and structure, formal authority system, organizational factors...) [28].

THE VISIONARY OR CHARISMATIC SCHOOL

This school emerged in 1980s and dominated until late 1990s, although there are still many authors appreciating its thesis [5]. Charismatic leadership brings back the characteristics of the person to the centre of the theory and underlines the importance of charisma for effective leadership [28].

Yet Greek philosophers wrote about charisma, and more recently, in the context of modern management, Max Weber used the term charisma to explain influence that is not based on traditional or legitimate authority, but on the perception of followers that the leader is filled with the gift of divine inspiration [29].

People with charisma have something that cannot be learned or imitated, one has it or not. Charismatic leaders are people with a strong influence on their followers. And the followers not only follow them, but highly value and respect them and are willing to do anything for them. Respect and appreciation are in fact mutual, and as a result, charismatic leaders often achieve above-average success [2].

The theory of charismatic leadership was proposed by R. House in 1976, who pointed out that charismatic leaders rely on 4 personal characteristics: dominance, self-confidence, the need for influence, and the belief in moral correctness, in order to improve their effectiveness [28].

Later, in mid 1980s, transformational leadership theory emerged, and some authors equalize it with charismatic leadership because charisma is a key point of both theories. In general, it can be said that a charismatic leader is by nature a transformational leader, while not all transformational leaders are also charismatic leaders. The concept of transformational leadership was initially introduced by sociologist James V. Downton. It was subsequently expanded and popularized by scientist Bernard M. Bass, who developed what is today referred to as Bass' Transformational Leadership Theory [2].

Transformational Leadership Theory explains how the leader affects followers and in respect to that identifies two types of leadership [5; p.51]:

1.) Transactional leadership

- emphasizes contingent rewards, rewarding followers for meeting performance targets,
- manages by exception, taking action when tasks are not going as planned.
- 2.) Transformational leadership
 - exhibits charisma, develops vision, engendering pride, respect and trust,
 - provides inspiration, motivating by high expectations,
 - gives consideration to the individual, paying personal attention to followers,
 - provides intellectual stimulation.

One of the reasons for which Bass'es theory became popular has been his pragmatic approach. He developed the Multifactor Leadership Questionnaire (MLQ) as an assessment tool for differentiation among transformational, transactional and even non-transactional laissez-faire leaders [30]. The questionnaire is even today the most widely used leadership assessment tool, although in somewhat upgraded version by Dulewicz and Higgs [31]. They integrated contextual concepts into the original tool and named their version Leadership Dimensions Questionnaire (LDQ).

Studies regarding leadership in the area of project management reach consensus that project manager's style should be rather transformational than transactional in order to increase project performance [32-34]. Transformational leadership is all about empowerment, and empowerment climate has been proven to have a significant positive effect on concern for task, concern for people and customer service, being so a measure of effective project management [35].

THE COMPETENCY SCHOOL

This school has been popular since late 1990s, being founded on extensive range of research aiming to identify the competencies of effective leaders. Although it appears to be the same as the trait school, crucial difference is that competencies can be learned, so the leaders can be made, not born [5; p.53]. Competences encompass personal characteristics (traits, as understood by previous schools) but also knowledge (including intelligence) and skills [36]. Recent studies show that leadership is not only inborn but can be developed if one focuses on the inborn preferences [9].

Probably the most comprehensive overview of the research and authors belonging to the competency school has been acomplished by Dulewicz and Higgs [37]. They found out that majority of the comptence school authors differentiate up to four types of competence that determine leaders performance: cognitive, emotional, behavioral and motivational. Based on their own observations, they suggested to narrow these competence types into three categories:

- intellectual (IQ),
- managerial skills (MQ),
- emotional (EQ).

According to them, there are in total 15 competences reliable for leader's performance, among which IQ accounts for 27 % of leadership performance, MQ accounts for 16 % and EQ accounts for 36 %!

Finally, Dulewicz and Higgs [37] emphasize that different competence profiles determine different leadership styles. Both competences and styles are shown in Table 2.

It is not enough to possess one of these crucial traits. A combination is necessary to create balance and develop into a leader who can produce an efficient team and satisfactory end results [38].

category	competency	goal-oriented	involving	engaging
	Critical analysis and judgement	High	Medium	Medium
Intellectual (IQ)	Vision and imagination	High	High	Medium
	Strategic perspective	High	Medium	Medium
	Engaging communication	Medium	Medium	High
Managerial (MQ)	Managing resources	High	Medium	Low
	Empowering	Low	Medium	High
	Developing	Medium	Medium	High
	Achieving	High	Medium	Medium
	Self-awareness	Medium	High	High
	Emotional resilience	High	High	High
Emotional	Motivation	High	High	High
(EQ)	Sensitivity	Medium	Medium	High
	Influence	Medium	High	High
	Intuitiveness	Medium	Medium	High
	Conscientiousness	High	High	High

Table 2. (Competence	profiles and	on them de	pendent]	leadership s	styles [5;	p.55]).
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Furthermore, different leadership styles perform differently in different circumstances and project stages. In order to profile leaders according to the above listed competences and styles, Dulewicz and Higgs [37] have developed already mentioned assessment instrument, called Leadership Dimensions Questionnaire (LDQ), which is still one of the most appreciated assessment instruments in leadership theory and practice.

Modern leadership theories are continuously defining additional leadership styles, like authentic leadership, attributional leadership, lean leadership, e-leadership, cross-cultural leadership, interactive leadership and others. All of them reflect current context in leading human resources and market conditions in general, but time will be the judge of their merit and influence.

In the end, it is impossible to take a position on which of the presented theories of leadership is the best. In the spirit of scientific objectivity, it must be said that each of them has more or less elements that affect the success of the leader. As such, successful leadership is a combination of both personal characteristics, behaviour and situational factors. In addition, modern leadership styles have in common that they are increasingly participatory, in the sense that they tend to develop the independence and responsibility of their subordinates. This is especially important in project management and following chapters shall present is such trend evident among future leaders being student population.

METHODOLOGY

METHODS USED

The study presented in this article consists of a theoretical framework and an empirical research continuing on to it. Therefore, chosen methodology included both qualitative and quantitative scientific methods. The reason for such choice of research design is the fact that methodology of mixed method research provides a stronger understanding of the problem [39].

In order to create a relevant theoretical framework, the research of secondary data sources was conducted. The research combined the scientific method of analysis of the relevant literature, i.e. the method of synthesis for the purpose of the systematization of the analyzed data. In addition to that, scientific methods of inductive and deductive reasoning were used, in particular for the interpretation and comprehension of the collected data. Classification method was also used beneficial to presenting important typologies.

The main method applied during the empirical part of the study was a survey. The survey was conducted via a questionnaire as the principal research instrument. The questionnaire comprised of close-ended demographic questions as well as of 21 close-ended leadership related items with 5-point Likert-type response ordinal scales. Respondents rated each item with values ranging from 1 (strongly disagree) to 5 (strongly agree).

The responses obtained were processed using IBM SPSS 25 for Windows (Statistical Package for Social Sciences). Methods of descriptive statistics and non-parametric Kruskal-Wallis test were used in statistical data processing to identify statistical differences in the observed categories.

SAMPLING AND DATA COLLECTION

Empirical part of the research presented by this article aimed to investigate competences of a specific part of future project managers – chosen population have been final year graduate students of the Faculty of Civil Engineering and Architecture Osijek. During their education, these students acquire knowledge which is related to project management and is in accordance with Ordinance on the necessary knowledge in the field of project management [40]. Therefore, they are considered relevant respondents for this study and targeted as the study population.

The survey was conducted during January and February 2020. The survey questionnaire was created using Google Forms and as such was distributed using e-mails to all final year graduate students. Participation in the survey was anonymous and voluntary so the survey relied on random sampling. Students were allowed two weeks for the response.

Out of 101 students currently finishing their studies, 84 valid responds were collected. Renspose rate was 83,17 %. The sample has been consisted of 46,4 % female students and 56,3 % male students, which is consistent with overall gender structure of students at the Faculty. Respondents are among 21 and 26 years of age. Sample formation regarding course at which tested student are studying is shown in Figure 1. Detected portions reflect usual arrangement at the graduate university study.



Figure 1. Study course of the sample.

Questionnaire used is unique as it was formed by combining leadership competences suggested by different leadership schools. However, reliability of the research has been approved by calculating Cronbach's Alpha coefficient. Its value is 0,770 so authors conclude that created questionnaire as the survey instrument is appropriate and obtained results are reliable.

RESULTS AND DISCUSSION ON LEADERSHIP COMPETENCES AMONG CIVIL ENGINEERING STUDENTS

In order to describe the basic features of the data in the research, descriptive statistics for all Likert scale items are presented in Table 3.

Identified means suggest the lowest valued (2,48) competence by all questioned students is described by the statement People think you are indecisive. This can be interpreted as in compliance with relatively highly valued traits regarding self-confidence, and as such is a positive outcome. In relation to that, findings from the study identifying Croatian managers' perceptions of qualities and skills that make a good leader pinpointed self-confidence as the most valued quality of a leader, followed by excellence in technical skills and task orientation [41, 42]. It may be concluded that civil engineering graduates perceive themselves as incorporating all those qualities, which is promising considering these are young people on the threshold of their professional life.

The highest valued (4,26) competence is described by the statement You like to keep things under control. This is further verified by relatively lowly rated traits described as You are prone to risk and You always play it safe.

	/			
Competences related questions		Мах	Mean	Std. Deviation
You enjoyed being a leader as a child.	1	5	3,56	1,196
You like to keep things under control.	1	5	4,26	0,852
People think you are indecisive.	1	5	2,48	1,024
You know how to deal with difficulties and defeats.	1	5	3,87	0,915
You consider yourself a motivator.	1	5	3,62	0,968
You feel like you have confidence.	1	5	3,76	1,001
When you are sure you are right you urge on those who do not trust you.	1	5	3,86	0,984
You prefer to work alone than in a team.	1	5	3,08	1,204
You consider yourself an optimistic person.	1	5	3,99	0,912
You find yourself more practical than creative.	2	5	3,76	0,952
You always play it safe.	1	5	3,27	0,998
You consider yourself a passionate person.	1	5	3,74	0,880
You are prone to risk.	1	5	3,20	0,979
You consider yourself a good persuader.	1	5	3,61	0,850
You feel confident in yourself	1	5	3,74	0,907
You have a vision for the future (you know what you want to achieve in the long run).	1	5	4,11	0,850
You consider yourself a self-aware person (in the sense that you set ambitious goals but also accept objective limitations)	1	5	4,08	0,881
You consider yourself an authoritative person.	1	5	3,31	0,850
You consider yourself a cunning person.	1	5	3,18	1,043
You feel you are encouraging others on the team to be more productive.	1	5	3,71	0,858
You find yourself inspiring.	1	5	3,56	0,923

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Table 3. Descriptive statistics	tor all Liker	t scale items	(N = 84).

Additionally, as part of the quantitative data analysis, an analysis of all items was performed regarding to some demographic characteristics of the respondents – gender and graduate study course using the non-parametric Kruskal-Wallis rank test. The test was chosen for this part of analysis because it compares two or more independent samples of the same or different sample size. Since it is a nonparametric method, the Kruskal–Wallis test does not assume a normal distribution. Purpose of Kruskal–Wallis test is to decided whether the rank sums are so different that it is unlikely that they belong to samples selected from the same population [43]. The chosen level of significance was $\alpha = 0.05$, which means that in the case when the p-value is less than 0.05, the null hypothesis of equality in attitudes regarding gender or graduate study course was rejected.

The results of conducted analysis showed that the p values were larger than 0,05 for all items regarding gender, and therefore the null hypothesis was not rejected here. It was concluded that there is no statistically significant difference in the respondents' attitudes regarding gender.

Additionally, item "You are prone to risk" is the only trait expressing statistically significant differences among respondents regarding graduate study course. Mean ranks related to risk tendency of respondents, shown in Table 4, suggested that students studying hydraulic engineering could be the only among civil engineering graduates moderately prone to risk.

Competence	Graduate study course	Ν	Mean Rank
You are prone to risk	Hydraulic engineering	9	63,22
	Transportation Infrastructure	14	43,57
	Load Bearing Structures	24	46,02
	Construction, Management and Technology	37	34,77
	Total	84	

Table 4. Mean ranks	regarding	tendency	to risk.
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Such finding was further tested by Kruskal-Wallis test. Its results, shown in Table 5, confirmed that there is a statistically significant difference (p < 0.01) among tested graduate study courses regarding tendency to risk taking. Therefore, the null hypothesis of equality is rejected and it can be concluded that all students but those studying hydraulic engineering are not prone to risk.

Table 5. Kruskal-Wallis test regarding tendency to r	isk.
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Kruskal-Wallis H	11,747
df	3
Asymp. Sig.	,008

Such risk reluctance is not in compliance with results of the study conducted among Rochester Institute of Technology Croatia's undergraduate students, which detected those students are willing to take risks [44]. Such a difference in the attitude could be explained by the fact that risk itself is a broad category, which might also be perceived in different ways due to character and/or profession differences. Generally, risk is the exposure to the possibility of loss, related to doing something when things cannot be held under control and the outcome is not certain [45]. However, students' lack of tendency towards risk taking is somewhat concerning since, although there will be some anxiety involved with the uncertainty of success, risk-taking has been found to be helpful in solving differences in ideas, reaching consensus, and making informed decisions [46], which makes it very important for one's personal growth and elevating his/her potential for high achievement and strong leadership [45]. Authors find this a very good argument for which the rational risk appetite of future project managers should be encouraged during their education, in terms of highlighting differences and appropriate treatment of intellectual risk (engaging in adaptive learning behaviours), financial risk, technical risk and many other risk types.

An interesting recent research [47], conducted among project managers in construction industry, revealed that several factors influence on risk propensity and risk management: individual factors (experience, qualification, other leadership qualities, multitasking ability and risk management practices) and project factors (budget, scope, schedule, uniqueness, complexities). Out of those, experience and other leadership qualities are the most influential.

Based on experience remark and the fact that above presented results concern students, a rising trend of their risk propensity could be expected as they gain experience. And regarding other leadership qualities, such finding coincides with already mentioned statement by DuBois and coauthors [38] that balance among different competences is needed. Due to the also previously emphasized evidence that emotional category of leaders' competences (self-awareness, emotional resilience, motivation, sensitivity, intuitiveness, conscientiousness, influence)

account for more than a third of the success of a leader [37], authors advise to understand these other competences primarily as emotional intelligence competences and foster them in project management study programmes. Unfortunately, not just that current study programmes lack these skills, but findings show that Croatian professionals give preference only to technical skills and do not rate emotions and interpersonal skills highly, i.e. they have not even become aware of emotional intelligence importance [41, 42]. Elsewhere, beside enhancing risk propensity and accounting for leader's success, emotional intelligence of leaders in project management has been proven to significantly determines collaboration satisfaction outcomes perceived by other participants in a project team: performance contribution satisfaction, efficiency satisfaction, relationship satisfaction, and interests satisfaction [48].

CONCLUSION

The first part of this article offers an overview of leadership theories, including emphasis on their specifics in project management where applicable. As leadership has been widely studied for a long time, this theoretical framework turned to be an extensive guide from the early trait theories, over behavioural, contingency and charismatic schools to modern competency view. At the same time, it offered a fresh insight into characteristics of leadership in the field of project management, highlighting the fact that this overview has been created because being aware of different leadership styles is crucial for project managers, who should be able to adapt their style not only according to their personality but also according to the project type and phase as well as the project team attributes.

Empirical part of the research tested hypothesis. Results confirmed the first three hypothesis while the last one was partially confirmed:

- Future project managers in construction industry, being final year graduate students at the Faculty of Civil Engineering and Architecture Osijek, perceive themselves to be competent in respect of both innate traits and competences that need to be learned.
- Future project managers in construction industry, being final year graduate students at the Faculty of Civil Engineering and Architecture Osijek, perceive themselves to have intellectual, managerial and emotional intelligence competences.
- There are no statistically significant differences among respondents in respect of gender.
- There is statistically significant difference among respondents in respect of study course only concerning one tested item propensity to risk.

Findings demonstrated that future project managers involved in civil engineering definitely have the needed self-confidence to become true leaders. However, they should improve their emotional intelligence and especially change their perception of risk. From their perspective, the image of risk is always negative and their comfort zone is where they have everything under control, whereas they should embrace undertaking intellectual risk as a way of professional growth. The research results are somewhat encouraging as they indicate this could change as they gain experience. Nevertheless, taking an active role regarding risk and emotional intelligence training is advised.

The main limitation of this research is its focus on a particular population as well as choosing an appropriate sample, which do not allow generalization of conclusions. However, findings are reliable and considered indicative. As such, they could represent a valuable contribution to future larger scale research.

Authors find it useful to expand the research over different university studies within project management study programmes as well as among project management professionals, in order to enable comparison.

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AUGMENTED REALITY IN BUSINESS AND ECONOMICS: BIBLIOMETRIC AND TOPICS ANALYSIS

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ABSTRACT

Augmented reality enhances the sensory experience of the real world, often across multiple senses such as visual, hearing, tactile and sensorimotor, with technology using computer-generated sensory input. Current literature reviews of augmented reality mainly focus on its generic usage or specific topics, such as medicine or tourism. However, augmented reality has become one of the prevalent topics in business and economics since it is one of the main growth drivers of disruptive companies. Since many companies are considering its usage in their business models, there is a lack of literature review in business and economics. Therefore, this paper aims to present a literature review of the scientific research that investigates the broad range of usage of augmented reality in business and economics. Web of Knowledge has been searched with the keywords "augmented reality" within the research area of business and economics for 2017-2021. Bibliometric analysis has been conducted to investigate the main journals, conferences, authors and countries. Finally, text mining with VosViewer has been conducted to extract the main topics, which are: (i): Technologies; Education; (ii) e-Commerce; Retailing; (iii) Tourism; User Experience; (iv) Consumers; Purchase. The results indicate that the research of augmented reality in business and economics for usage and economics for usage and economics for usage and economics for usage and economics for usage.

KEY WORDS

augmented reality, bibliometric analysis, VosViewer, keyword analysis, text mining, topic mining, education

CLASSIFICATION

JEL: M21, O3

INTRODUCTION

The transformation of virtually all industries and business models has been made possible by several separately developed but concurrently deployed digital technologies [1]. Information technology, computer science, communication, and networking technologies are all combined in digital technologies [2].

Digital technologies can be categorised into infrastructure (primary), mature (secondary), and emerging (tertiary) technologies. Furthermore, mature technologies are present as they are "old enough" to understand their benefits and drawbacks, although they might not be widespread globally. Telephone and farming are among them [3], [4]. Mobile and communication technologies, social networks, cloud computing, sensors, and the Internet of Things (IoT) are considered infrastructure technologies because every industry will inevitably employ them. For instance, practically all businesses rent and pay for cloud computing services to store content, eliminating the need for capital expenditure on their servers.

A mature technology has been in use for a sufficient time for most of its initial flaws and inherent difficulties to be eliminated or mitigated. In some instances, it may also apply to technologies whose scientific basis is well-understood but has not yet achieved general use [5]. Mature digital technologies include the omnipresent applications in society and business, such as enterprise resource planning (ERP), databases, and data warehouses [6].

Emerging digital technologies may not yet have reached their full potential and typically contain the following items: robotics (e.g. robot process automation), 3D printers, blockchain, drones, advanced and virtual reality, etc. Businesses may be aware of the benefits of applying emerging digital technologies but do not fully deploy them in their day-to-day business [7]. The simultaneous and integrated application of emerging digital technologies allows for disruptive innovations and reinvention of the overall business model [8]. An example of such a model could be extracting the information from physical devices (data on sensors and IoT devices), disseminating it via mobile technologies like 5G, storing it in the cloud, and performing real-time analysis using big data and advanced data analytics.

Augmented reality (AR) refers to technologies that allow a real-time connection between the virtual and physical worlds [9]. In AR applications, a real-world environment is brought to life by computer-generated perceptual information, sometimes across many sensory modalities, including visual, aural, haptic, somatosensory, and olfactory [10]. Hence, AR alters how one perceives the physical environment. Unlike virtual reality (VR), which captivates the user completely in a virtual world, AR enables the person to interact with virtual elements seamlessly using real-world objects [11]. Both technologies have a significant role in the development of Web 3.0.

The first AR interface was developed in the 1960s [12]. Since then, AR has experienced relatively slow growth, until the development of smartphones, due to which AR technologies have a strong potential to be omnipresent. A typical smartphone has standard hardware, a 4G/5G high-speed network, a built-in camera, and a relatively large screen [13], [14], which is sufficient for running most AR applications. Because of affordable technologies that allow its widespread usage, the AR market forecasted growth is from \$6,27 billion in 2021 to \$10,37 billion in 2022 and has a strong potential for even considerable progress [15].

Due to its strong potential to impact various aspects of science, business and education, AR literature reviews are relevant for academics and practitioners. Literature reviews about AR technologies and applications range from the general ones that cover the broad area of AR deployment (e.g. [16]-[18]) to those focusing on either AR relevant technologies or AR specific applications. In addition, taxonomy, methods and patterns of various AR techniques are

developed to provide a common vocabulary for AR researchers and practitioners [19]. A brief overview of examples of specific applications using AR technologies is as follows. Most of the applications focus on medical displays [20], educational environment [21], [22], tourism [23], and manufacturing applications [24], [25].

There is still a lack of bibliometric analyses of AR in business and economics; when they do exist, they tend to be less informative and capture only a segment of business and economics, such as manufacturing or tourism. Considering that AR has a significant role in disruptive technologies that drive most business growth, this paper aims to develop a literature review of AR covering the broader area of business and economics. Web of Knowledge has been searched to discover AR research in business and economics. The research goals were to: (i) detect the most prominent authors, institutions, journals, conferences, and most cited papers and (ii) detect the main topics of the research and research groups based on countries. For that purpose, bibliometric analysis and text mining has been used. This article aims to provide a broad literature review of AR usage in business and economics.

The outline of the article is as follows. After the introduction, the methodology is presented. The third part discloses the article's findings while the conclusion and future implications are discussed lastly.

METHODOLOGY

Specific methods are used to provide a broad literature review of AR usage in business and economics. Furthermore, the paper comprehends the main research topics and groups using the linkages between keywords and countries of author origin [26]. This part of the research paper consists of Data representation followed by the Analysis methods used. The Data part consists of the Web of knowledge search strategy explanation. Searched keywords, filtered fields and indices are shown. Analysis methods used part briefly explains the two methods used in this research paper, bibliometric analysis and text mining analysis.

DATA

The Web of Knowledge (WoK) database has been used for AR scientific papers. The following search strategy has been applied (Table 1). Firstly, the primary search was conducted in WoK, using the keywords "augmented reality" as the research topic, which resulted in many research papers, including the period from 1982 to 2021. Secondly, the search was refined by the WoK Research area of Business Economics and focused on 2017-2021, which resulted in 488 papers. Additionally, the research is focused only on English-language peer-reviewed literature. Science Citation Index Expanded (SCI-EXPAND), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), and Emerging Sources Citation Index (ESCI) are WoK indices included in the search strategy, Table 1.

Search strategy	Research papers	Period	Indices	
"augmented reality" (Topic)	23 152	1982- 2021	A&HCI, BKCI-SSH, BKCI-S, CCR-EXPANDED, ESCI, IC, CPCI-SSH, CPCI-S, SCI- EXPANDED, SSCI	
Refined by: Business Economics (Research Areas)	488	2017- 2021	SCI-EXPANDED, SSCI, A&HCI, ESCI	

Table 1. Web of the knowledge search strategy.

The following subsection displays the analysis methods of this research. To represent the researched topic, bibliometric and text-mining analyses are used.

ANALYSIS METHODS

The analysis is conducted in two phases.

Firstly, bibliometric analysis has been conducted using the WoK interface, focusing on the research area, document type, type of open access, journal and conferences of the paper publication. Furthermore, the most frequent countries, funding agencies, authors and institutions are also examined.

Secondly, full data about each paper has been extracted from WoK, including the bibliometric data, abstract, keywords, and references for each paper. This data has been used as input for the text mining analysis using the VOSviewer tool [27]. Two advanced functions of VOSviewer are used.

First, VOSviewer's text mining functionality for constructing co-occurrence networks of terms extracted from English-language textual data, for instance, from keywords (both authors and assigned), is deployed. This process utilises the Apache OpenNLP library, an open-source Java library for processing Natural Language text [28]. Tokenisation, sentence segmentation, part-of-speech tagging, named entity extraction, chunking, parsing, and co-reference resolution are some of the services provided by OpenNLP.

VOSviewer envisions bibliometric linkage using a distance-based principle, with the ability to visualise various types of items in a network, e.g. those based on the keywords, authors or countries. Firstly, items are grouped in nodes, and secondly, the distance between nodes is normalised [29]. Thirdly, nodes are located in a two-dimensional space following the principle that strongly related nodes are located close to each other, using the VOS mapping technique. Finally, nodes are allocated to clusters using the smart local moving algorithm [30], [31].

This approach allows the co-occurrence analysis to discover the most researched topics and research groups of AR in business and economics. The focus is on the keywords and countries' co-occurrence for that purpose, using the full-counting extraction algorithm.

A total of 2295 keywords were assigned to papers in WoK (both Author Keywords and Keywords Plus). In addition, the threshold of 10 keywords occurrence was used for the analysis, indicating that only those keywords that occur in a minimum of 10 papers are retained in the analysis. This approach resulted in the 55 keywords used in text mining analysis.

The total number of countries of authors in the analysed papers was 72. The threshold of 5 countries was used for the analysis, indicating that only those countries that occur in a minimum of 5 papers are retained. This approach resulted in the 32 countries used in the co-occurrence analysis.

BIBLIOMETRIC ANALYSIS

Table 2 presents the allocation of papers according to research areas since the search strategy was oriented mainly to indicate that researchers from the 488 publications that were extracted concentrate their work primarily on business and economics (100 %). Papers are, in some cases, assigned to more than one research area. Most of the papers that are assigned to another research area besides business and economics are allocated to Social Science Other topics (12,3 %) and Computer science (8,2 %), followed by Engineering (5,3 %), Public Administration (4,9 %), Communication (3,5 %) along with the rest. Other areas include Telecommunications, Agriculture, Geography, International Relations, Forestry, and Medical Informatics.

Table 3 presents the distribution of papers according to the document type, journals and conferences. Most of the research has been published as research articles (352 papers, 72,1%), followed by papers published in conference proceedings (105 papers, 21,5%) and book chapters (31 papers, 6,4%).

Research Area	No. of papers	percentage of 488	
Business Economics	488	100,0	
Social Sciences Other Topics	60	12,3	
Computer Science	40	8,2	
Engineering	26	5,3	
Public Administration	24	4,9	
Communication	17	3,5	
Operations Research Management Science	17	3,5	
Information Science Library Science	14	2,9	
Environmental Sciences Ecology	12	2,5	
Psychology	12	2,5	
Education Educational Research	11	2,3	
Other areas	43	8,8	

Table 2. Distribution of papers according to the research areas. Note that the sum of the research papers differs from the number of papers (488) since the paper can be assigned to more than one research area.

Journals and conferences that publish AR papers are highly diversified. Some of the top-performing article titles are Journal of retailing and consumer services (30 articles), AR and VR empowering human place and business (22 articles), Journal of business research (22 articles), Progress in IS (22 articles), Technological forecasting and social change (19 articles), International journal of retail distribution management (13 articles) and Psychology marketing (10 articles). Other papers (214) are published in other articles, indicating the field's heterogeneity. Some of these journals are Harvard business review (6 articles), Tourism Management (6

Document Type	No. of papers	Journal title	No. of papers	Conference title	No. of papers
Article	352 (72,1 %)	Journal of retailing and consumer services	30	International conference on augmented reality and virtual reality	25
Proceeding. Paper	105 (21,5 %)	Augmented reality and virtual reality empower human place and business	22	Conference of the international business information management association	10
Book Chapters	31 (6,4 %)	Journal of business research	22	Other	70
Total	488 (100 %)	Progress in IS	22	Total	105
		Technological forecasting and social change	19		
		International journal of retail distribution management	13		
		Psychology marketing	10		
		Other	214		
		Total	352		

Table 3. Distribution of papers according to the document type, journals and conferences.

articles), Journal of the academy of marketing science (5 articles), International journal of advertising (4 articles) and International journal of consumer studies (4 articles). The selection of the journals that publish the AR papers indicates that the focus is growing on marketing, tourism and consumer studies. This shows that AR is a technology that will be involved in many fields, as it is useful for both the consumer and producer.

Among the conferences, the most papers are published in the International Conference on AR and VR (25 papers), followed by the conference of the international business information management association IBIMA (10 papers). Most of the papers (70 papers) are published at other conferences. However, these are only two conferences that publish more than 10 papers on AR, indicating that currently, no conference focuses solely on the AR domain.

Table 4. presents the distribution of papers according to country. The majority of papers are published in the USA (93 papers), England (81 papers), Germany (44 papers), Australia (35 papers) and the People's Republic of China (33 papers).

The leading funding agency in the area of AR research is the European Commission (25 papers), followed by the Ministry of Science and Technology Taiwan (9 papers), the National Natural Science Foundation of China (7 papers), the Ministry of Science and Higher Education Poland (3 papers and lastly UK Research Innovation Programme (3 papers). The results indicate that more developed countries are funding more research in the AR field.

Country	No. of papers	Funding Agency	No. of papers
USA	93	European Commission	25
England	81	Ministry of Science and Technology Taiwan	9
Germany	44	National Natural Science Foundation of China	7
Australia	35	Ministry of the Education Republic & National Research Foundation of Korea	6
People's Republic of China	33	Ministry of Science and Higher Education Poland	3
France	29	UK Research Innovation Programme	3
India	24		
Netherlands	24		
Italy	23		
Russia	20		

Table 4. Countries of the authors (with 20 or more papers) and funding agencies (with 3 or papers). The sum should not be 488 since the focus is here only on countries which occur in more than 20 papers and on funding agencies which occur in more than 3 papers.

Table 5 presents the most frequent authors and institutions of AR papers. The top three affiliations/institutions are the University of London (18 papers), Manchester Metropolitan University (14 papers) and the University of New South Wales Sydney (13 papers), indicating that most research is based in the United Kingdom and Australia. The most frequent authors are also listed in the table, indicating that 12 published more than 5 AR papers indexed in WoK.

Figure 1 shows the citations of the papers investigating the AR topic in 2017-2021. A total of 488 papers generated 6 180 citations, indicating an average number of citations is 12,1 per paper. The number of publications has been steadily growing, from 55 publications in 2017 to 156 in 2021. The number of citations increased even further, from 17 in 2017 to 3 537 in 2021, indicating the strong impact of AR papers resulting more from their practical implications than from their theoretical implications.

Affiliations	No. of	Author	No. of
	papers		papers
University of London	18	De Ruyter, K.	12
Manchester Metropolitan University	14	Keeling, D.I.	12
University of New South Wales Sydney	13	Chylinski, M.	11
King's College London	12	Mahr, D.	10
Maastricht University	11	Heller, J.	9
State University System of Florida	11	Hilken, T.	9
University of Sussex	11	Dieck, M.C.T.	8
University of Texas System	9	Huang, T.L.	8
Bucharest University of Economic Studies	7	Rauschnabel, P.A.	8
Yuan Ze University	7	Jung, T.	6
California State University System	6	Hassan, A.	5
Indian Institute of Management	6		
University of Central Florida	6		
University of Texas Rio Grande Valley	6		
Griffith University	5		
Hong Kong Polytechnic University	5		
King Abdulaziz University	5		
Tallinn University	5		
University of Bristol	5		
University of Michigan	5		

Table 5. Most frequent authors and institutions (with 5 or more papers). This table presents only those affiliations and authors which occur in more than 5 papers.



Figure 1. Number of publications and citations of papers about AR (2017-2021).

Appendix 1 presents the 10 papers investigating AR in business and economics that generated the highest number of citations from 2017 to 2021. The two most cited publications investigate AR applications in retailing [32] and manufacturing [33] as one of the most important

technologies relevant for their future development in digital transformation. Other papers investigate more specific topics, such as customer experience [34], e-commerce [35], shopping apps [36], tourism and hospitality [37], online service experience [38], construction [39], marketing [40], and retail [41]. The scope of the most cited papers indicates the most significant areas of AR applications in business and economics, which will be investigated in the next chapter of this article.

TEXT MINING

In this part, keywords and country co-occurrence with citation analysis are described.

Keywords co-occurrence analysis

The software VOSviewer analysed 488 articles to extract the most researched AR-related topics. The most frequent keywords are AR, technology, VR, AI and e-commerce. All keywords with at least 15 occurrences are categorised into four logical groups (Figure 2). The node's size indicates the keywords' frequency: the larger the node, the more frequent the keywords. The proximity of the links between the two phrases affects the line's thickness [42]. The study discovered 1858 links for 55 items, giving the co-occurrence an average link strength of 33,8 (across all keywords).



Figure 2. VosViewer cluster analysis (keywords with 10 or more documents).

Figure 3. presents the keywords heat map. The brightness around the most frequent keywords indicates their high occurrence (e.g. AR, VR, technology, experiences and impact).

Table 6 presents the clusters extracted by VosViewer. Cluster keywords are presented in the second column, and the third column defines the cluster topic and example papers that represent the specific cluster most.

Further cluster systematising and explanation are denoted in this research following part. As shown in Table 6, there are four Clusters on which this research will focus.
		context				
	re	tail sati	sfaction		simulation	
	online purchase intention	information	framework			
consumer responses	perceived value	act behavior	technology		performance design	
	customer experience ^{nsumers}	vii experiences	rtual reality	artificial intelligence	systems	
telepresence	responses e-commerce moderati	a	ugmented reality	inter	net ed management industry 4.0	lucation
	customer satisfaction	destination	tourism	innovation	big data	
produ	uct decision-making	enga determinants	egement		knowledge	
	user acceptance retai	adoption	mixed reality	gamification		
	technology acceptance model		co-creat			
	information-t	echnology user ex	social media e	digital transformation		

Figure 3. VosViewer keywords heatmap (keywords with 10 or more documents).

Clustor	Cluster Cluster keywords		
Cluster	Cluster Reywords	Example papers	
	artificial intelligence; AR; big data; co-creation;	Technologies;	
	design; digital transformation; education; future;	Education	
Cluster 1	gamification; industry 4.0; innovation; internet;	[43], [44], [45], [46],	
	simulation: social modio: systems	[47], [48], 0, [51],	
	simulation, social media, systems.	[52], [53], [54], [55],	
		[56], [57], [58], [59]	
	behavior; consumers; context; customer	e-Commerce;	
Cluster 2	experience; decision-making; e-commerce;	Retailing	
	experiences; framework; impact; information; online; responses; retail; retailing; satisfaction;	[60], [61], [62], [63], [64]	
	technology;	— • • •	
Cluster 2	adoption; destination; determinants; engagement; information-technology; mixed reality; model;	Experience	
Cluster 5	technology acceptance model; tourism; user acceptance; user experience;	[65], [66], [67], [68]	
	consumer responses; customer satisfaction;	Consumers; Purchase	
Cluster 4	environments; interactivity; moderating role; perceived value; product; purchase intention;	[69], [70], 0	
	telepresence; VR		

Table 6. Cluster keywords and cluster topics (keywords with 10 or more documents).

Cluster 1 – Technologies; Education includes artificial intelligence (AI), AR, big data, co-creation, design, digital transformation, education, future, gamification, industry 4.0, innovation, knowledge, management, performance, simulation, social media and systems. Due to the scope of the papers, the topic of this cluster was called Technologies, Education. The research presented in this cluster indicates that AR could strongly support improvement in business and education, often complemented by AI.

[43] discusses that AR is one of those innovations that can help companies in their digitalisation, enabling them to position their products innovatively, create value for the customer and potentially increase sales. The authors conducted a survey where they presented AR apps to the graduate students for their opinion. The findings indicated that the most important factors in developing such an app are the explicit purpose of the application, ease of use and learning, smooth operation, imaginative information presentation, and interactivity.

[44] stresses that AR and VR technologies are needed in training, such as nursing training. They point out that this should be compulsory for any nursing education. Furthermore, they are promoting their application with arguments that it can reduce inexperienced nursing students' anxiety and make them more familiar with the ward environment and fundamental nursing skills, which can minimise medical errors in their real practicum.

[45] indicates that location-based AR navigation systems are becoming available; therefore, proper optimisation of consumer satisfaction and purchase intention is needed. Their findings show that consumers' intentions to purchase location-based AR navigation systems were found to be significantly influenced by three user perceptions of AR (AR): spatial ability (sensory domain), sense of presence (feeling domain), and conceptual understanding (cognitive domain). Furthermore, experiences mediated these consumer intentions in education, entertainment, aesthetics, and escape, such as make-up AR app [46].

Other papers in this cluster complement the role of AR in education. They are presented further in the text.

[47] researched how school classrooms could be shaped and equipped with innovative technologies such as AR, AI and smart material for a futuristic classroom open shape. They called them vignettes in their research. After experimenting with the Six Pillar method, the researchers concluded that it has the potential to prepare teaching staff for this new environment which could become a much better connection between school, further education or practical environment.

[48] uses the Unified Theory of Acceptance and Technology 2 (UTATU2) model to predict the consumers' behavioural intention toward AR adoption among companies in the Middle East based on education and gender. They confirm that all the UTATU2 model variables correlate statistically to AR adoption, especially in more educated users.

0 research imagines the usage of AR in an innovative higher education institution (HEI). The classroom of the future, as they call it, is a design thinking lab, which consists of AR technology with interactive detachable workstations, shareable smartboards and interactive video display walls. The AI complements AR with additional functionalities. Future graduates of such HEIs will have a smooth transit from education to a desired job or entrepreneurship practice due to the enhanced real-life experience, which is more relevant to business practice than classical education.

[50] focuses on attaining students' feedback on AR implementation in HEI in the Russian Federation, finding out that students were particularly interested in reviving textbooks with illustrative material based on AR to make them more appealing to the reader. [51] shows that AR with AI can help show practical and real-life examples in higher education during serious crises and pandemics such as COVID-19, enabling a more community-orientated approach to the study and practice of entrepreneurship.

The potential of "visual thinking", a concept that is underdeveloped in many HEIs' curricula but is essential to the design thinking process, is tapped into by AR's capacity to generate a visually rich environment [52]. Empathy and feelings of surprise and delight are frequently experienced during in-person design work, and they are often key to immersion and

engagement, which also consider our nonverbal senses [53]. In addition to generally promoting visual thinking, AR can assist students in practising the kind of covert observation frequently essential to the empathising and testing phases of the design thinking process [54]. Such observation is unquestionably an important aspect of fieldwork. However, if such possibilities are not offered, AR can offer an alternative that goes beyond a purely cognitive comprehension of the usefulness of this technique.

AR implementation in the study curriculum depends on the subject itself. Numerical and natural science subjects have seen the most AR usage in the classroom. They are mainly accessed through a handheld display. Furthermore, the study shows the benefits of AR usage in Science, Technology, Engineering and Mathematics (STEM) education. Student benefits are evident and recorded. Lecturers are surprisingly getting well with new technology as well. Although the general outcome is positive, specific study outcomes may vary depending on learner type, subject, learning environment or style, duration of the intervention, and student's computer attitude [55]. [56] showed that lecturers perform well with the Photomath AR application regardless of their teaching or teaching experience stage. The research recommends that lecturers prepare their curricula in the AR way from the basic to secondary difficulty level.

[57] research showed that with AR implementation in HEIs, students engage and perform better, have a positive attitude toward learning and increase their independence. On the other hand, AR implementation might be expensive, some software might be of poor quality due to a lack of experience in development, and sometimes the user interface is not convenient.

An important aspect of this cluster is also gamification. Since our psychological emotions occasionally influence our decisions, gaming has always been at the forefront of technological advancement. The game industry was one of the first to use AR technologies, one of the first examples being "Pokemon Go" [43], [58] which indicated that the AR technology's momentum had started. As a result, adding the mobile gaming software "Pokemon Go" made "the game" more emotional and nostalgic [59]. The game offered something unique compared to other games available, such as the ability to play the game indoors or outside utilising a phone and camera. The audience had never previously before "Pokemon Go" experienced walking on the ground while inside a virtual world through your camera's lens. AR technology spread quickly when combined with nostalgia for the "Pokemon" series [60].

Cluster 2 – e-Commerce; Retailing contains the following keywords: behaviour, consumers, context, customer experience, decision-making, e-commerce, experiences, framework, impact, information, online, responses, retail, retailing, and satisfaction. Due to the scope of this research, it was called e-Commerce; Retailing.

[61] presents the typology of new technologies powered by AI and show a new framework for better customer journey understanding. Authors conclude that the internet of things, AR, VR, virtual assistants, chatbots, etc., will hugely impact consumer experience and decrease the time between purchase and delivery. However, they also denote that a potential downside of these technologies' usage is loss of control, privacy concerns and danger of overreliance on them.

[62] researches the eye tracking method for consumer visual attention in their shopping process. They argue that mobile eye tracking has several limitations in the sense of a heavy data coding process and limited control of some important variables. VR might help consumer eye tracking while AR can be of a hand to the consumer in their shopping process.

[63] theoretically reviews the AR contribution to the retail customer experience transformation. After a review of 141 articles, they found that nine digital value propositions, such as vividness, mobility, peer communication, personalisation, interactivity, connectivity, value co-creation, telepresence, and information availability, are the main mediators in this consumer experience transformation understanding.

[64] compares AR and web-based product presentations using the IKEA website and Place app research. The findings show that AR generates better immersion and enjoyment in the shopping process. Furthermore, reuse and purchase intention are influenced by enjoyment, immersion and media usefulness. Therefore, retailers should impose AR apps as they are more than certain to increase revenue and overtake the competition by offering something new and unique.

Cluster 3 – Tourism; User Experience contains keywords adoption, destination, determinants, engagement, information-technology, mixed reality, model, technology acceptance model, tourism, user acceptance and user experience. Due to the scope of the papers, this cluster's topic was Tourism; User Experience.

[65] investigates the application of AR in tourism. The findings show that tourists might be interested in AR apps with intuitive interface design and qualitative content. This topic is broadened by Loureiro et al. (2020) [66], who investigated the improvement of AR apps over the last few decades in a comprehensive study. The research used a full-text analysis of 56 journals and 325 conference proceedings for virtual and AR apps in tourism-related studies. Their findings indicate that AR and VR apps have a wide area of improvement for a better touristic experience. Some of the improvements are in the atmospheric design, cultural heritage and smart cities content, location-based information, experiential, telepresence and case study applications, among others mentioned. They also recommend further improvements in the field of physical and sensory simulations, enhanced longitudinal virtual experiences, well-being development and the use of AI.

[67] explores AR's perceived value in the tourism industry from the tourism development perspective. Research findings indicate AR app implementation use in tourism strategy development, AR implementation and tourist experience design.

[68] investigates the possibility of attracting tourists, especially millennials, with innovative technologies to complement the scattered hotel accommodation option. Through their case study, they tried to develop a combination between scattered hotel accommodation options and technological advances in Istria, Croatia. The findings indicate that infrastructure needs to be properly developed for other advancements. Most accommodation providers are not using applications for destination experience, a target market for AR apps. The research presented in this cluster denotes that AR apps are more than welcome in the tourism sector with few additions. Those additions are quality content, great and easy user interface and an overall quality app that can be a great asset to a particular destination's visiting tourists.

Cluster 4 – Consumers; Purchase consists of the following keywords: consumer responses, customer satisfaction, environments, interactivity, moderating role, perceived value, product, purchase intention, telepresence, and VR. Due to the scope of the papers, the topic of this cluster was called Consumers, Purchase.

[69] investigates a "try before you buy" online shopping experience. They focus on AR apps where consumers try products on their faces or surroundings. AR apps compared with other non-AR product presentations, this research results show greater customer perceived informativeness and enjoyment of their shopping experience with AR apps. Furthermore, when a consumer has increased perceived informativeness, this transforms into purchase intention, increasing brand recognition and potential revenue.

[70]describes that there have been obstacles between consumers and online products. Therefore, the authors mention that these obstacles can be overborne by AR app usage. Furthermore, their research shows that AR implementation reduces product quality and fit uncertainty, and reducing product uncertainty leads to a positive product attitude.

0 denotes that new technologies such as augmented and VR will significantly impact the future of e-retailing. Using the stimulus-organism-response (S-O-R) model, the study examines the AR consumer intention in e-retail. The study found that most of the sample University students have technophilia or a strong enthusiasm for nw technology usage and purchase intention.

Countries co-occurrence

Figure 4 represents the countries' co-occurrence analysis for at least 10 documents per country. The total number of countries detected is 32, with 244 linkages. Five clusters were discovered, among which the United States of America and England are represented with the highest number of papers.



Figure 4. VosViewer cluster analysis (countries with 10 or more documents).

Figure 5 contains the country's heat map. It can be seen that the middle part of the map has the brightest yellow colour. This shows that the United States of America and England, with border countries such as Australia and New Zealand, indicate keywords with 10 or more documents per country.

Table 7 presents the cluster of the countries where the author's institution is situated. Cluster 1 contains mainly European countries except for Taiwan and New Zealand. Cluster 2 denotes a more diverse mix of European (Poland, Portugal and Wales), South Asia (India, Malaysia), South America (Brazil) and the Middle East (Saudi Arabia). Cluster 3 is formed mainly of European countries, except for Canada and Iran. Cluster 4 contains Northern European countries, except for Australia. Finally, Cluster 5 contains a mixture of regions such as North America (USA), South Asia (Singapore), Europe (Turkey) and the Far East (People's Republic of China and South Korea). As can be seen, most countries with a minimum of 10 documents per country are mainly from Europe. However, the cluster composition indicates strong international cooperation between authors from various countries.

		denmark			
romania	germany	netherlands			
	greece spain				
	sweden finla	and	stralia		south korea peoples r china ^{turkey}
			usa		
1	canada taly	england	new zealand		
russia	^a portugal france brazil			taiwan	
	malaysia	scotland			
	saudi arabia				
		wales			
		india			
		poland			

Figure 5. VosViewer countries heatmap (keywords with 10 or more documents).

Cluster	Cluster countries
Cluster 1	Estonia; France; Italy; New Zealand; Norway; Russia; Scotland; Taiwan;
Cluster 2	Brazil; India; Malaysia; Poland; Portugal; Saudi Arabia; Wales
Cluster 3	Canada; Finland; Greece; Iran; Romania; Spain; Sweden;
Cluster 4	Australia; Denmark; England; Germany; Netherlands;
Cluster 5	People's Republic of China; Singapore; South Korea; Turkey; USA

The following section consists of a discussion and conclusion. In that section comparison of these research findings with another peer, literature will be discussed. Furthermore, the research paper authors will conclude their final thoughts.

DISCUSSION AND CONCLUSION

SUMMARY OF THE RESEARCH

Technological innovations have become ubiquitous, and their omnipresence will increase even more. Therefore, companies must adapt to the constant market demands, which require constant technological innovation, with AR as one of the most prominent.

The purpose of this work was to provide a literature assessment of AR in business and economics research from 2017 to 2021. The research time frame for this study, which uses the Web of Knowledge database, spans from 2017 to 2021.

THEORETICAL IMPLICATIONS

The article aimed to conduct a literature review of AR in business and economics research in 2017-2021, thus complementing the more general literature reviews of AR research, e.g. [16], [17]-[19]. However, more importantly, this literature review focuses on the applications of AR in business and management, which is relevant, taking into account that previous research focused on specific applications using AR technologies, e.g. [20]-[25].

The first part of the research presents the bibliometric analysis to detect the most significant journals, conferences and countries. It is explained below.

Most of the research has been published as research articles, followed by papers published in conference proceedings. The AR topic is highly diversified based on the various journal areas that publish AR research, ranging from the Journal of retailing and consumer service to various journals in business research, retail distribution management, psychology, marketing science and tourism management, and others. Conferences are also diversified, with the only exception being International Conference on AR and VR is the most fruitful one. Yet, no single journal or conference is solely devoted to the publication of AR research.

Most of the papers were published in the USA, followed by England and Germany, indicating that most AR research has been conducted in developed countries. The same conclusion stems from the analysis of the funding agencies.

Citation analysis has, on the other hand, indicated a constant rise in publications and citations from 2017 to 2021. The number of citations grew much larger than the number of publications, indicating the demand for AR high-quality publications.

The second part of the research presents the text mining analysis using VOSviewer software, intending to conduct the keyword and country co-occurrence. The co-occurring keywords are structured in 4 clusters with main topics of technology & education (cluster 1), e-commerce & retail (cluster 2), tourism & consumer experience (cluster 3) and consumer & purchase (cluster 4). Most publications are interconnected with imposing AR app benefits and their impact on future business, e.g. consumer purchase intention, e-commerce, tourism and education.

The co-occurrence by countries has shown five clusters from which most publications are from the United States of America and England. Therefore, confirming the results of the bibliometric analysis also pointed out these two countries as the leading ones in the area of AR research.

PRACTICAL IMPLICATIONS

To provide clients with unique solutions, practitioners of AR will find this study helpful. Indepth analyses of current AR trends and prospective future uses for the improved experience in business, and economics are shown in this study.

Several concepts are constructed with AR technology for it to be more efficient in providing solutions. Visual thinking or AR's capacity to generate a visually rich environment with the ability to understand changes in personal behaviour is crucial for detecting nonverbal senses detection [52], [53]. The practical implication of such AR's ability could be in the fieldwork/practical application of various disciplines. Education, retail and gaming are the industries where AR technology might see the biggest impact.

The ARs in classroom usage help students, especially in STEM education, better understand numerical, visual or graphical equations and solving processes, for example [55], [56]. This kind of lecture innovation would not only be practical but would decrease the amount a student needs to spend understanding how to solve an exercise. Furthermore, it would deduct the time a lecturer must spend explaining tasks and could focus on other aspects.

Another industry where AR is already gaining full usage is the gaming industry. The innovation of an old game, such as "Pokemon", with new technologies, such as AR, can substantially increase the number of game users due to the combination of the new technology and nostalgia and user emotions [58]. Therefore, a game that uses AR technology might become more interesting to the user due to the higher level of engagement, as it involves a real-life environment through the mobile phone camera lens.

Another distinction is that this study provides a detailed explanation of each cluster's mapping results. This means the subjects that have received the most attention and use in AR research for the corresponding field can be identified.

Cluster 1 focuses on technology & education the most. Therefore, the papers in this cluster show innovations in these areas as the examinee's opinion of the research experiment. AR innovations are positively referenced by students, which included that the explicit purpose of the application, ease of use and learning, smooth operation, imaginative information presentation, and interactivity are the most important aspects of AR app development [43]. Furthermore, any education with a practical application should have AR technology as compulsory. It can reduce inexperienced students' anxiety and make them more familiar with the practical application environment and fundamental specific job skills, which can minimise errors in their real practicum [45].

Cluster 2 focuses on e-commerce and retailing. In this field, AR is just one of the few technologies, such as AI & VR, that are "working" together to create a more efficient consumer buying process [61]. Another great innovation in this area is the eye tracking method which could be tracked through the laptop/computer video camera or by using VR glasses, where the tracking would be easier. The AR, in this case, would only be used in the consumer part of the purchase process [62].

Cluster 3 is focused on tourism & user experience. This cluster is focused on one industry where AR implementation is of great importance due to its nature. AR technology might change the way tourists experience cities, same as with the retail purchasing process; tourism city exploration might change as well with new sightseeing AR apps [65][67], [68]. Those apps are already used in some Croatian touristic cities such as Split.

Cluster 4 is focused on consumers & purchases. This cluster can be slightly related to cluster 2, where AR is used in online purchasing to make purchasing for the consumer easier. The option of showing products in their environment makes a purchasing intention difference [69] 0.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Based on corresponding research, it can be said that, while being initiated early, the study of AR in business and economics is still in its infancy. Future investigation in this area will need to focus on expanding AR usage in particular industries and the consumer experience. Although these technologies can simplify for consumers to obtain their activities and potentially raise the calibre of doing traditional business, many industries still have not embraced them.

Article limitations stand from the focus on only one scientific research source indexed in WoK. Although this approach assures the inclusion of peer-review research, it also misses the emerging research, which is especially relevant for advanced technologies, such as AR. Therefore, future research directions for reviewing AR in business and economics are to increase the coverage of the research papers to white papers and case studies and include complementary technologies, such as VR. Furthermore, a combination of professional research papers and two or three additional research paper databases would contribute to a better and more concise AR in business and economics presentations.

APPENDIX

Table 8	Ten	most cited	augmented	reality	nublications	(2017 - 2021))
Table 0.	run	most cheu	augmenteu	reality	publications	(2017-2021	<i>ب</i> ر

Title	Authors	Journal	Average per year	Total
The Future of Retailing	Grewal, D.; Roggeveen, A.L. and Nordfalt, J.	Journal of Retailing 93 (1), 1-6, 2017	68,33	410
The future of manufacturing industry: a strategic roadmap toward Industry 4.0	Ghobakhloo, M.	Journal of Manufacturing Technology Management 29 (6), 910-936, 2018	77	385
The impact of virtual augmented and mixed reality technologies on the customer experience	Flavián, C.; Ibáñez-Sánchez, S. and Orús, C.	Journal of Business Research 100 , 547-560, 2019	57,75	231
Is Augmented Reality Technolog y an Effective Tool for E- commerce? An Interactivity and Vividness Perspective	Yim, M.Y.C.; Chu, S.C. and Sauer, P.L.	Journal of Interactive Marketing 39 , 89-103, 2017	33,83	203
Enabling smart retail settings via mobile augmented reality shopping apps	Dacko, S.G.	Technological Forecasting and Social Change 124 , 243-256, 2017	27,33	164
Technological disruptions in services: lessons from tourism and hospitality	Buhalis, D.; Harwood, T.; Bogicevic, V.; Viglia, G.; Beldona, S. and Hofacker, C.	Journal of Service Management 30 (4), 484-506, 2019	38,5	154
Augmenting the eye of the beholder: exploring the strategic potential of augmented reality to enhance online service experiences	Hilken, T.; de Ruyter, K.; Chylinski, M.; Mahr, D. and Keeling, D.I.	Journal of the Academy of Marketing Science 45 (6), 884-905, 2017	25,67	154
Collaboration in BIM-based construction networks: A bibliometric-qualitative literature review	Oraee, M.; Hosseini, M.R.; Papadonikolaki, E.; Palliyaguru, R. and Arashpour, M.	International Journal of Project Management 35 (7), 1288-1301, 2017	25,17	151
Augmented reality marketing: How mobile AR apps can improve brands through inspiration	Rauschnabel, P.A.; Felix, R. and Hinsch, C.	Journal of Retailing and Consumer Services 49, 43-53, 2019	35,25	141
Discernible impact of augmented reality on retail customer's experience, satisfaction and willingness to buy	Poushneh, A. and Vasquez-Parraga, A.Z.	Journal of Retailing and Consumer Services 34 , 229-234, 2017	22,33	134

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EVALUATING RESTAURANTS' PROFITABILITY OF A DAILY DEAL PROMOTION

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ABSTRACT

Although group buying daily deal sites are widely popular among consumers, it is unclear if deal promotions are profitable for merchants, especially for restaurants. The goal of this study is: (1) to investigate if restaurants make profit from a group buying deal, break even or make significant investment and (2) to find out what factors affect deal profitability. A model for calculating the short-term profitability of restaurant's deal promotions is developed, and ten variables are identified and tested using linear regression analysis to find the once affecting deal profitability measured by return on investment. The research was conducted on the case of Grouper.mk, the leading deal platform in Macedonia. Findings show that deal promotions are profitable and effective tool for restaurants. Deal promotions that provide takeout are less profitable for restaurants, while those that offer additional discount on extra purchases are more profitability varies across restaurants category, from least profitable for fast food restaurants to most profitable for fine dining restaurants. Based on the findings of this research, recommendations for maximizing the deal profitability are provided.

KEY WORDS

online group buying, eDeal group buying, e-commerce, return on investment, restaurants

CLASSIFICATION

JEL: L66, L81, M30

INTRODUCTION

Online group buying for daily deals is a new e-commerce business model that acts as an intermediary between the end customers and merchants. The business model was introduced by the Chicago based company Groupon (Groupon.com) in 2008 and very soon it became the fastest growing online company ever, reaching \$1 billion in revenue faster than any other online company in history [1]. The model was so successful, enjoyed massive growth in 2010, and continued growing rapidly in emerging economies [2]. As an online promotion form, the groupbuying model has low barriers to entry therefore it can be quickly launched, but evidence shows that it can be as quickly closed due to fierce competition [3]. It caught the attention of many ecommerce experts and authors because of the innovative element it introduced - a solid connection between the local brick-and-mortar retailers and online customers. Before the advent of Groupon, services like dining, spa treatments and other experiences were not involved in online retailing and were not considered suitable for online selling. The main category of the deal industry, in the beginning, was the services but soon the goods became very popular as well as the travel deals, imposing the categorization of the deals into 3 main categories: services, goods, and travel. Group buying platforms untapped a new segment and influenced the e-commerce industry as a whole.

As a result of this phenomenon, an increased number of group buying websites emerged while the size of the group buying population and the dollar amount spent has significantly risen [4]. Hundreds of local merchants from the service industry rushed to make deal promotions reach new customers and exploit the benefits offered by this new promotional tool. It offers various deals on deep discounts that enable end customers to make substantial savings and try new things at low risk, such as newly opened restaurants, spas, and beauty salons. The four types of motivations for online group-buying for end customers are profit, value, emotion, and achievement [5]. Consumers' reactions towards online popularity information for online service deals do differ across cultures [6]. The deals are negotiated with the merchants and group buying site gets a commission fee for each coupon sold. Wu et al. [7] investigate the coordination of traditional and online group-buying channels considering website promotion and found that the total profit of the whole system could be hurt when the agreed price or revenue-sharing contracts were adopted by the firms. From a marketing standpoint, the model offers measurable promotion that has not been offered by any online promotional channel so far – paying only per customer brought, instead of paying per impression (CPI – Cost per Impression) or clicks (CPC – Cost per Click).

Despite the success of the model, a contrarian view of the success of daily deal sites for merchants has emerged [8]. The criticism lies in the skepticism of the value and returns on investments (ROI) from the deals offered by merchants. Discussions emerged between experts and scientists if the deals are effective for merchants, putting in danger the sustainability of the model of group buying due to the assumption that the deals are not profitable for merchants and they will stop using the promotional tool eventually [9-12].

Kumar and Rajan [13] undertake a broader research of coupons as marketing strategy and measure profitability of three different businesses (restaurant, car wash service and beauty and spa) that completed deal promotions and construct a model for projecting when and how the merchant will recover the shortfall in profits from the coupon launch. Some studies, [8, 14] found that restaurants have a negative ROI rate for running deal promotions, and 42 % of the restaurants reported unprofitable Groupon promotions.

The literature that investigated the deal effectiveness and profitability for merchants is scarce and most of the studies focus on the long-term ROI of the promotion. However, merchants are

often more interested in the direct cost of the promotion and if they will break even, spend money or make a profit from running a deal.

To our knowledge there is no study investigating the merchants' one-time profitability of a daily deal and the ROI rate of one deal promotion. For that reason, this study focuses on the evaluation of the key factor – one-time profit earned from the deal promoted by restaurants or ROI on short-term. The research was conducted on the case of Grouper (Grouper.mk), the Macedonian pioneer and leading online group buying site.

Restaurants particularly were chosen because they are a representative category to measure short-term profitability. In addition, they were running promotions since the appearance of the deal sites, they represent the most sold category [8, 14, 15], and they are more likely to make upsell during the first customer visit. However according to the findings of [8] not only that restaurants don't break-even but they represent the third category with negative ROI rate, after perishables and apparel. Dholakia [14] also found that 42 % of the restaurants reported unprofitable Groupon promotions. Accordingly, the research questions of this study is 'Do restaurants make a profit from a group buying deal, break even or make a significant investment?' and 'Which factors affect deal profitability?'. A model for evaluating the short-term profitability of a restaurant's deal promotion was developed to measure its ROI rate per restaurant category. Then, upon calculating the short-term ROI rate, different variables related to the deal promotion, the restaurant and its employees, as well the previous experience with deal promotion is investigated, to find out the once contributing to increased deal profitability for restaurants. Informed by the results of our empirical study recommendations for more profitable deals for restaurants are provided.

In addressing this challenge, this study has a significant contribution from an academic and practice point of view. It is innovative research that will enrich the literature about the groupbuying short-term profitability for the providers, in this case restaurants and fill the existing gap in this important issue. Developing the model for calculating the short-term profitability of restaurant deal promotions and identifying the factors affecting deal profitability will help merchants better understand the profitability of these promotions and restaurants' owners and managers to make more profitable deals. The findings are expected to add value to group buying sites and help sales representatives to advise the restaurants for better deals in order to have a repeat and satisfied clients. The remainder of the article is organized as follows. Section 2 describes the model of online group buying for daily deals model and evolution. Section 3 discusses the literature on the profitability and effectiveness of deal promotion.. Section 4 describes dataset and the methodology. Section 5 presents the empirical findings and Section 6 evaluates whether the results warrant any change in the to hitherto conventional conclusion and provides managerial implications and recommendations.

ONLINE GROUP BUYING FOR DAILY DEALS MODEL AND EVOLUTION

The base of the business of group buying via daily deals itself was not new, for instance in the core of the model are the well-known coupons that date from the 19th century. Asa Candler, one of the partners of Coca-Cola, was the first to introduce and practice this revolutionary promotional tool in 1887 when he decided to dispense coupons that entitled customers to one free glass of his drink [16]. Coupons represent a promotional tool in marketing theory and have been heavily used for years in almost every industry. However, the coupon evolved over time and the new technologies brought online coupons that replaced the coupon clipping in newspapers and other printed forms. The innovation of Groupon's business model consists of the ideal combination of promotional coupons for discounts and the power of the group using

advances in technology. Group buying also traces back to the 19th century when it was practiced in different forms. Buying clubs represent the oldest form of group buying when people groups in order to get discounts [17]. The Internet-based group-buying was first introduced in the late 90s [18] and is being widely used for both business-to-business (B2B) and business-to-consumer (B2C) transactions. Groupon's business model is the brokerage between the merchants and the end customers. It offers various benefits for both sellers and buyers. Benefits for the consumer include low prices and very high discounts that allow remarkable savings. The benefits for the merchants include an effective promotion, advertising and selling of the agreed product or service. The online group buying (OGB) site receives a commission from the merchant for each coupon sold i.e. for each customer brought to the merchant. The OGB site promotes the deal in front of thousands of potential customers; interested customers buy the online coupons and redeem them at the merchant to get the prepaid service or product. OGB site receives the payment from the consumers and then transfers it to the business, deducting a certain fee, which is agreed upon in the contract with the merchant. The merchant's fee charged from each coupon sold represents the OGB company's revenue. So, the model offers win-win outcome. Figure 1 depicts the business model and process flows that occur between the three parties involved.



Figure 1. Processes in the business model of group buying daily deal sites.

However, the new business model of so-called group buying via daily deals evolved over the past few years. Firstly, the name 'deal of the day' and 'daily deal' was used because the deals lasted for 24 hours in the beginning creating a feeling of urgency and stimulating impulse buying, but this changed over the years and now every site publishes lots of new deals each day that last for a longer period, from few days up to one month, depending on the category and nature of the deal. Secondly, the name 'group buying' was used to emphasize that each

deal had to reach a certain minimum predefined number of buyers in order to get 'tipped' i.e. to be successful. This was used to guarantee the merchants a certain number of buyers in order to get group discounts while it incentivized the buyers to share the deal with their friends in order to get the discount, which included a social momentum of sharing. The deal sites became very popular and each deal had lots of coupons sold that often passed the maximal capacity of the merchant to serve so many customers, so this moment of the minimum threshold to be reached for each deal disappeared over time and nowadays many daily deal sites removed this graphical element of their sites and don't require a predefined minimum number of buyers for each deal. And third, in the beginning, the daily deals were used and targeted at the service industry such as restaurants, beauty salons, spas etc. The main goal being the high promotion and attraction of new customers the deals were considered to be most suitable for the local businesses in the service industry, having in mind the high margins and the constant need for new buyers. After a certain time, the deal sites enriched their portfolio by adding travel deals and products. The merchants selling products could use the new tool either for promoting their brand or new products and bringing new customers but as well to sell piled-up inventories.

Having in mind the evolution and changes of the business model we propose a new short name – *'eDeal group buying'* instead of 'online group buying for daily deals'. The letter 'e' that stands for 'electronic' is widely used in any field to emphasize the electronic and online momentum. On the other hand, the 'daily' part can be removed because the deals last more than one day. The part 'group buying' is left because of the recognition of the model so far and still brings a group of people to one place and because of possible misinterpretation of the term 'eDeals' if it stands alone because there are eDeal services that offer Software as a Service (SaaS) possibilities and Customer Relation Management (CRM) eDeals for companies. Further in this study the term eDeal group buying will be used and the abbreviation *eDGB*.

LITERATURE REVIEW

Despite the popularity of the model, which can be a fruitful field for investigation and research, the literature is still scarce. Lui and Sutanto [19] investigated the group-buying literature including journal articles and articles published in conference proceedings and emphasized that online-group buying studies require further development due to the limited number of existing studies and inadequate topics explored. They found that modeling analysis was used in more than half of the studies, thus lacking empirical evidence considering them theoretical in nature. Bralić et al. [20] investigate online group buying websites in Croatia that changed marketing strategies to identify critical factors that affect the intention to purchase from the group-buying sites. Luo et al. [21] develop a framework predicting that (1) deal popularity increases consumers' purchase likelihood and decreases redemption time, conditional on purchase, and (2) the social influence-related factors of referral intensity and group consumption amplify these effects.In line with this, Kao et al.[6] found that deal popularity does influence purchase intention. Groupbuying platforms may promise substantial savings for consumers and create opportunities for businesses to gain exposure to new customers and in addition to offering consumers discounts, such platforms also serve to inform consumers about the existence and nature of businesses [22]. Wan et al.[23], design a GB coupon with two factors: the degree of consumer perceived ease of use and the discount price rate with a detailed analysis, they recommend the optimal groupbuying mechanism and provide the corresponding conditions by comparing the profitability of single-time and double-time mechanisms.

Only a few studies investigated the deal effectiveness and profitability for merchants. These studies focus on the long-term return-on-investment (ROI) of the promotion including determinants that are not always easy to quantify and measure with empirical studies. Dholakia [14] investigated the performance of daily deal promotions for merchants and identified 3 main

factors: new customer acquisition efficacy (1), spending beyond the coupon value, often called 'upselling'; (2) and repeat full-price purchase (3)[24]. Surprisingly, he found out that the spending beyond Groupon's value is not a significant predictor of the deal profitability, while the other two (1 and 3) positively affect the profitability of the promotion. To understand the real potential associated with daily deal promotions Dholakia and Tsabar [25] conduct an indepth descriptive analysis of the experience of Gourmet Prep running a Groupon promotion. The results provide evidence of significant exposure value, defined as the increase in sales because of exposure received by the business to the Groupon customer base. Dholakia and Tsabar [25], concluded that deal promotions are beneficial to merchants in multiple ways, and daily deal promotions can be an effective marketitoolsool for retail startup businesses in local markets for achieving exposure and stimulation sales.

Gupta et al. [8] measure long-term profitability and return on investment including similar key determinants and adding new determinant called cannibalization, which occurs when a customer opportunistically uses a voucher for purchases that would otherwise have paid full price. Their model for measuring profitability takes in consideration: voucher purchase and redemption (1), cannibalization from prior customers (2) and future profit from new customers (3). They found out that in the short-term merchants suffer losses, which are offset in the long run by upside revenue from newly acquired customers. Eventhogh Gupta et al. [8] conclude that daily deals can be cautionary tale for merchants: a substantial percentage are unlikely to benefit, and might well lose money, they suggested that a careful analysis of the right data provides clear indicators of both: what types of merchants are likeliest to benefit, and which factors that influence profits should receive the most management attention. He concludes that for merchants that meet the criteria for promising outcomes, define a clear objective for their promotion, and manage it around the particular factors critical to its success, daily deals can be a very effective marketing tool. Shivendu and Zhang [26] develop a two-period game-theoretic model to analyze the strategic interaction between heterogeneous merchants and consumers and found that merchants that are new in the market place or less wellknown gain more from offering a deal on the daily deal website. Farahat et al. [27] observed the relationship between business survival and daily deal adoption for restaurants and spas and found that restaurants that are more likely to offer a daily deal are on the edge of business survival, whereas the correlation is weaker for spas. As Edelman et al. [28] point out, discount coupons are likely to be profitable if they predominantly attract new consumers who regularly return with full-price payment on future visits; however, coupons could also sharply reduce profit for firms when offered to a large number of long-time consumers. Hence, when designing discount coupons, firms would like to pick up the targeted consumers and discourage the untargeted consumers from using the discount coupons. Cheung et al. [29], point that retailers need to recognize the role of group buying and whether this strategy is beneficial or detrimental. Using survey data they revealed that group buying agent is beneficial to retailers. They supported the hypotheses that group buying is an effective promotion tool for retailers in expanding their customer base. Their research also showed that customer satisfaction positively influences repeated purchases through group buying agents and future purchases with retailers at regular price. Wan et al.[23], design a GB coupon with two factors: the degree of consumer perceived ease of use and the discount price rate and with the detailed analysis, they recommend the optimal group buying mechanism and provide the corresponding conditions by comparing the profitability of singletime and double-time mechanisms.

Reiner and Skiera [30] found that all merchants achieved a positive profit. However, this finding is driven mainly by long-term profits; short-term profits were only slightly positive. Daily deals were found to add value to the businesses of affiliated merchants and facilitate revenue management [31]. Online reputation is positively associated with the sales of vouchers [32].

For instance, deal sites act as a reminder for the existing customers of their favorite places, so they are reminded and incentivized to visit the place, which otherwise they might have chosen differently. Heo [22] investigated the impact of different deal features on the generation of business and revenue on group-buying platforms and found that discounted price has no impact on business generation and revenue on the group-buying platform. In contrast, the minimum number of buyers was the most significant factor contributing to the number of successful restaurant deals and the second most important influence on total revenue. Recently Angelovska et.al. [3] via empirical study found that merchants' intention to repeat offers depends on profitability of the deals output, spending beyond the coupon, new customers brought by the deal, and there is diverse across different categories of businesses. It is important to note that profitability varies across industries and should be approached in different manner for different industries. For example, restaurants are representative group to measure shortterm profitability of a deal because they have the highest opportunity to upsell as coupon users come for a meal and are likely to buy drinks and deserts; they can also bring friends with them who have not purchased coupons. On the other hand, services like a monthly subscriptions for sports do not have the opportunity to upsell, so more adequate measurement for those industries will be needed to measure the return rate and recommendation rate to friends and family. Events (ex. concerts, shows, etc.) or certain activities (ex. horse riding, paragliding, etc.) represent another category that deserves a different model for measurement. These types of industries do not have the opportunity to upsell, and thus don't have extra amount spent by customers beyond the coupon. Additionally, it is not likely that the same coupon user will return to the same activity or event. One person who did paragliding is not likely to do that in near future again so we should take in consideration neither the upsell amount nor the repetition rate. The benefits for these companies are often filling the capacities (ex. event venues), attracting new customers, and building awareness. These companies often use promotions to make a profit that otherwise would not occur. For example, a paragliding club has the capacity to make 20 flights a day but he makes on average 5 in a certain period. It can be assumed that his goal is to use the capacities while making a profit with the lower margin than the regular one.

Based on the literature review determinants that affect the deal success can be divided in two groups based on the timing when they appear. The first one being direct benefits from the deal include: New customers acquired – the primary purpose of a promotion is to attract new customers; Increased awareness – the deal is promoted to various channels that the site uses to advertise: newsletter campaigns, social media channels and affiliate partnerships with other sites thus enabling high deal visibility; Possibility for price discrimination – merchants can offer coupon promotion via the eDGB channel not affecting their regular prices and customers and Profit earned from the deal – the short-term profit that the merchant makes from running a particular deal. The second group of determinants that arise after the deal, and which depend solely on the merchant itself and how he served the customers with coupons during the deal, include: Increased number of repeat customers – satisfied customers are likely to come back to the merchant and become repeat ones; Increased profit – the increase in repeat customers means increased profit for the merchant in long run; and Increased awareness and WOM – awareness reached due to Word-of-Mouth of satisfied customers.

RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

The research was conducted on the leading eDGB site in the Republic of Macedonia, Grouper. Macedonia is a small emerging market and Grouper was the first eDGB site on the market. It was launched in January 2011 when the e-commerce level of adoption was very low [33] and shortly it revolutionized online buying in the country giving incentive to the population to buy online. Online group-buying quickly became a bright spot in the mainland of the e-commerce

market. It nurtured a group of online shoppers and speeded up the development of the ecommerce market in Macedonia. Grouper is not just the first online group-buying site on the Macedonian market but is the leader in the e-commerce industry holding 40 % of the market share in the Republic of Macedonia in 2012 and 2013 [15, 34].

By this time, a significant number of local businesses have tried running deal promotions with Grouper, and over 80 % have run multiple ones. It has featured over 10.000 deals in cooperation with over 1600 companies to more than 95.000 users [15].

The share of restaurants in the total number of Grouper merchants is 17 %. From the 272 restaurants in Grouper's merchant's ,portfolio 22 closed their business so the number of active restaurants is 250 [15]. The restaurants portfolio of the eDGB according the years of operation consists of recently opened restaurants, restaurants with few years of operation and restaurants with tradition. According the style of the restaurant all types of restaurants are involved, from fast food restaurants, small local restaurants to big fine-dining restaurants. The period of investigation was set to 3 months from August to November 2014 and all restaurants that had scheduled deals or launched a deal between August 2014 and November 2015 were included in our analysis or a total number of 32 restaurants. The research was conducted in period of 12 months, from August 2014 to August 2015.

The data collection and analysis can be divided in 7 phases:

Phase 1: Providing selected restaurants a document to evidence the upsell amount from coupon customers

Before the start of the deal each restaurant was given an excel spreadsheet with two columns, the first one consisting the coupon code and the second one empty column in which the restaurants were asked to fill in the amount that every coupon customer spent beyond the coupon while redeeming it.

Phase 2: Mystery shopping to rate employees' ability to upsell

Mystery shopper visited each restaurant 3 times during the redemption period with purchased coupon to evaluate restaurant's employees capability to upsell. The frequency of the visits was calculated in a meaningful way to include different shifts and hours. The mystery shopper rated the employee's upsell inclanation with 'Yes' or 'No' and considering the 3 visits value of 'Yes' or 'No' was applied to this tested variable.

Phase 3: Gathering information for upsell amount and collecting additional information during interviews

Upon the redemption period of the deal, the sheet was collected from each restaurant and empirical observation was conducted followed with an interview with the general manager of the restaurant to collect additional data about variables that might affect the profitability of the deal: years of operation (1), type of restaurant (2) and number of employees (3). Additionally, data needed to calculate the profit was collected such as average profit margins of restaurant (4) and the cost to serve each coupon customer (5).

Phase 4: Gathering information from the deals database of Grouper for the selected deals and restaurants

Data for each deal analyzed was collected: face value (1), discount (2), deal price (3), is the deal package for 2 or more persons (4), does the deal include drinks (5), is takeout allowed (6), are there restrictions in the usage conditions (7), was additional discount offered with the coupon (8), number of coupons sold (9) and number of coupons redeemed (10). In addition, data was collected for the restaurant's number of deals featured before the deal analyzed (11).

Phase 5: Analysis of the deals profitability

The following model was designed and used to calculate the deal profit for each deal (Fig. 2).

$$\begin{array}{l} Deal \ Net \\ Profit \end{array} = \begin{pmatrix} Profit \ per \\ Coupon \ Customer \\ \end{array} \times \begin{pmatrix} Number \ of \\ Redeemed \ Coupons \end{pmatrix} + \begin{pmatrix} Net \ Amount \\ Received \ per \ Coupon \\ Coupons \\ \end{pmatrix} \\ \begin{array}{l} Number \ of \\ Unredeemed \\ Coupons \\ \end{pmatrix}$$

Where:

 $\begin{array}{l} Profit \ per \\ Coupon \ Customer \end{array} = \begin{pmatrix} Cost \ per \\ Redeemed \ Coupon \end{pmatrix} + \begin{pmatrix} Profit \ from \\ Upsell \ amount \ per \ coupon \end{pmatrix} \\ \begin{array}{l} Cost \ per \\ Redeemed \ Coupon \end{array} = \begin{pmatrix} Net \ Amount \\ Received \ per \ Coupon \end{pmatrix} - \begin{pmatrix} Net \ Cost \ to \\ Provide \ the \ Service \end{pmatrix} \\ \begin{array}{l} Net \ Amount \\ Received \ per \ Coupon \end{array} = \begin{pmatrix} Coupon \\ Price \end{pmatrix} - \begin{pmatrix} Deal \ site \\ Commission \end{pmatrix} \\ \begin{array}{l} Profit \ from \\ Upsell \ Amount \ per \ coupon \end{array} = \begin{pmatrix} Revenue \ from \\ Upsell \ amount \ per \ coupon \end{pmatrix} x \begin{pmatrix} Average \ Profit \\ Margin \end{pmatrix} \end{array}$

Figure 2. A Model for Calculating one-time deal profitability.

Because in our case Grouper pays the company for each coupon sold, regardless it was redeemed or not to calculate the total deal profit we multiply the profit per customer with the number of redeemed coupons and add the amount restaurant received for the unredeemed coupons.

After calculating the net deal profit per deal in absolute amount we want to express it in relative amount in order to make comparison between restaurants. For that purpose, the ROI of each deal was calculated. The total deal profit with already extracted costs for the promotion is expressed, and the ROI rate is calculated by dividing the net deal profit with the cost of the investment i.e. total expenses of the deal (Fig. 3).

 $Return on investment = \frac{(Gain from Investment - Cost of Investment)}{Cost of Investment}$

Modifying for our purposes we calculate the ROI rate of a deal:

Deal Net Profit = (Total Revenue from Deal – Total Expenses of the deal)

$$Deal \ ROI \ rate = \frac{Deal \ Net \ Profit}{Total \ Expenses \ of \ the \ deal} x \ 100 \ \%$$

Where:

 $Total \ Deal \ Expenses = \frac{Number \ of}{Redeemed \ Coupons} \times \begin{pmatrix} Cost \ to \ serve \\ Coupon \ Customer + \end{pmatrix} \\ \frac{Cost \ of \ Upsell \ Amount \ to}{Coupon \ Customer} + \\ \frac{Cost \ of \ Upsell \ Amount \ to}{Coupon \ Customer} \end{pmatrix} \\ \frac{Cost \ of \ Upsell \ Amount \ to}{Coupon \ Customer} = \begin{pmatrix} Upsell \ Amount \ Coupon \ Customer - \\ Spent \ per \ Coupon \ Customer - \\ Upsell \ Amount \ per \ Coupon \end{pmatrix}$

Figure 3. Modified equations for calculating short term ROI rate from a deal.

To analyze the collected data quantitative research methods are applied. Descriptive statistics is used to describe and compare the data. To determine the impact of deals details and restorant's characteristics regression analysis is employed and to estimate the factors that will impact calculated ROI rate. As the goals in this research are focused answering two questions: 'Do restaurants make profit from a group buying deal, break even or make significant investment?' and 'How the short-term ROI rate, is affected by: the deal details (1), restaurant (2), restaurants' employees (3), and restaurant's previous experience with running deals (4)?'. The hypothesis for each group of factors are set.

It is assumed that the deal details taken in consideration in the first five hypotheses will affect deal profitability. Restaurants run different deals aiming to attract different targets of consumers.

The deal can offer main dish for one person or it can be a package for two or more persons. Deals can offer food and drinks or only food, so that restaurant is able to make upsell on drinks to the deal customers. Further, some restaurants pose time restrictions in usage to fill in empty tables during off-peak periods and not affect the regular hours when they are full with regular customers. One example is excluding weekends of the deal usage period or certain hours during the weekdays. Some restaurants give the option for takeout to the deal customers, while others prefer to keep that option out assuming that deal customers will make additional purchases while dining in the restaurant. Additional discount on certain products can be made to induce cross-selling of certain products that the restaurant wants to push, for example a coupon for main dish of choice may entitle users to extra 20 % off on a bottle of wine during the redemption of the coupon. Following the developed model for calculating short-term profitability and previous literature review, we adress the identified research gap and the hypothesis to be tested are:

H1: Offering package deal for 2 or more persons negatively affects deal profitability.

H2: Inclusion of drinks in the deal negatively affects deal profitability.

H3: Time restrictions in the deal usage conditions negatively affect deal profitability.

H4: Providing takeout in the deal negatively affects deal profitability.

H5: Offering additional discount with the deal positively affects deal profitability.

H6: Restaurant's years of operation affects deal profitability.

The size of the restaurant, measured by the number of employees and the experience of the restaurant by the years of operation is investigated. Further restaurants were divided into 5 categories: fine dining, casual dining, fast casual, fast food and ethnic [35]. We examine if the restaurant category will affect profitability to find out if there is significant difference between ROI rates of different restaurant categories. The hypothesis to be tested are:

H7: Restaurant's number of employees positively affects deal profitability.

H8: Restaurant's category affects deal profitability.

During redemption of coupons deal users can make additional purchases and orders, which represent the upsell amount per coupon user and directly affects the deal profitability. With this hypothesis, we want to test if restaurant's employees' effort to upsell will affect users to make more purchases thus affecting deal profitability. If a restaurant offered several deals, we assume that lessons learned will be applied to future deals to achieve better results. The hypothesis to be tested are:

H9: Restaurant's employees' effort to upsell positively affects deal profitability.H10: Restaurant's previous experience with running deal positively affects deal profitability.

Phase 6: Testing ROI rate dependency on selected variables

After calculating each deal's ROI rate, regression analysis is applied to test the dependency of the ten variables set in the hypothesis, in order to make significant conclusions. The baseline empirical model is the following:

$$ROI = \beta_0 + \beta_1 P + \beta_2 D + \beta_3 R + \beta_4 T + \beta_5 AD + \beta_6 YO + \beta_7 E + \beta_8 C + \varepsilon_{it}$$
(1)

where:

ROI is the return on investment calculated in Fase 5,

P is the deal package for 2 or more?,

D denotes does the deal include drinks?,

R denotes restirctions in the deal conditions for usage?,

T denotes was takeout allowed?,

AD denotes was additional discount offered?,
YO denotes years of operation,
E denotes no of employees,
C denotes restaurant category.

Pearson's correlation coefficient (r) is a measure of the strength of the association between the two variables. Pearson's correlation to test the relationship between ROI rate is used and variables connected to the deal details, restaurant's employees and restaurant's previous experience in running deals. ANOVA (Analysis of variance) is used to analyze the differences among group means of more than two groups. The differences in ROI rates across five restaurant categories using ANOVA test is used. The restaurants in three categories according the years of existence and three groups according the number of employees are formed.

Phase 7: Creating a model for recommendations for more profitable deals for restaurants

Finally the , inductive method and descriptive analysis is used to provide recommendations for the restaurants for more profitable deals.

EMPIRICAL ANALYSIS AND RESULTS CALCULATION OF THE NET PROFIT AND ROI RATE FOR EACH DEAL

The research was done on 32 restaurants running deals with Grouper, and 6 restaurants of them were in the category of fine dining, 4 in fast food, 6 in fast casual, 10 in Ethnic, and 6 In Casual dining. Only 15,6 % of the restaurants were employing below 5 employees, 43,8 % were employing from 5 to 10, and the rest above 10 employees. 50 % of the restaurants were operating less than a year, and this fact is confirmation that the group-buying model is used frequently as a promotion tool.

The deal profitability using the values previously collected in Phase 3 and 4 using the equations from Phase 5 is examined. Table 1 shows the input variables used for calculation and each variable' minimum, maximum and average value.

Measure	Average Value	Min	Мах	Source	
Coupon Price	€ 2,14	€ 0,98	€ 5,67	Deala	
Commission	34,3 %	20 %	50 %	Deals Database of	
Net amount received per coupon	€ 1,40	€ 0,63	€ 3,40	Grouper	
Coupons Sold	441,8	55	2014	(Phase 4)	
Redeemed Coupons	397,8	48	1866		
Net cost to provide the service	€ 1,74	€ 0,65	€ 4,39	Intomiou	
Cost per redeemed coupon	-€ 0,34	-€ 3,37	€ 0,99	with restaurants (Phase 3)	
Upsell amount per coupon customer	€ 1,76	€ 0,00	€ 6,50		
Restaurant's Average Profit Margin	60 %	35 %	75 %		
Profit from upsell amount per coupon customer	€ 1,15	€ 0,00	€ 4,23		
Net Profit per coupon customer	€ 0,81	€ 1,48	€ 3,39	Calculated	
Total Expenses for the deal	€ 929,35	€ 70,65	€ 4891,33		
Deal Profit	€ 522,60	-€ 168,88	€ 5636,83		

Table 1. Input variables for calculation of ROI - Profit Analysis.

Having calculated the profit for each deal analyzed, the ROI rate is calculated to make comparisons using the modified equations for ROI calculation from Phase 6. The ROI rate varies across companies between -36 % and 120 % (Fig. 4).



Figure 4. ROI rate across merchants' analyzed deals.

Three out of thirty-two merchants or 9 % reported negative rate of ROI, which indicates that they did not break-even with the deal promotion. *The average ROI rate amounts 41 %*. The restaurant with worst ROI rate is a fast food restaurant (Traditional food), newly opened with 6 employees offering a deal for takeout food of choice. The restaurant with the greatest ROI rate is a casual dining restaurant (Chinese food), newly opened with 6 employees that offered a main dish of choice for the deal users.

QUANTITATIVE ANALYSIS OF THE FACTORS THAT AFFECT ROI RATE

Drawing on regression analysis the findings present impact of deals details and restaurants characteristics on ROI rate. The results of the regression analysis are presented in Table 2. Before the interpretation of empirical results, a brief discussion regarding diagnostic tests. According to the R2 (0,56) measure of the overall fit, and the Anova F (2,5) of significance of the parameters the model estimations perform well. The Durbin-Watson statistic is 1.93 indicating there is no autocorrelation detected in the sample.

The results showed that offering a package for 2 or more persons in the deal (H1), deals including drinks (H2) and deals adding time restrictions in deal conditions (H3) are not statistically significant (at 5 % significance level) predictors of ROI rate. The deals offering take out and deals offering additional discount are found to statistically significant (at 5 % significance level) impact ROI rate. Deals that provide option for takeout (H4) impact negatively and are less profitable and deals that offer additional discount on other purchases during redemption (H5) impact positively and are more profitable for restaurants. The average upsell amount per deal user amounts 3,38 EUR for deals that offered additional discount, versus 1,46 EUR for deals that did not, which indicates that the additional discount encouraged more than double spending by deal customers that were entitled to additional discount on another product or service.

Furthermore, the impact of years of operation (H6), number of employees (H7) are not statistically significant predictors of restaurants profitability. Restaurant category (H8) is found to be statistically significant impact on ROI rate of each deal.

Variables	Beta	Std.error	t	Sig.
(Constant)	1,65	0,671	2,46	P<0,05
Is the deal package for 2 or more? Yes/No	-0,355	0,176	-1,012	p>0,05
Does the deal include drinks? Yes/No	0,093	0,162	0,573	p>0,05
Restirctions in the deal conditions for usage? No/Yes	0,007	0,146	0,049	p>0,05
Was takeout allowed? Yes/No	-0,279	0,234	-2,692	P<0,05
Was additional discount offered? Yes/No	0,137	0,19	3,72	P<0,05
Years of operation	-0,116	0,098	-1,182	P>0,05
No of employees	-0,101	0,145	-0,694	P>0,05
Restaurant category	-0,125	0,181	-2,532	P<0,05

 Table 2. Regression results: dependent variable ROI rate

Based on the results that restaurant category impact profitability ROI rate across categories are analyzed (Table 3).Fine dining and casual dining restaurants show highest rates of ROI, 62 % and 58 % respectively; consequently, they offered the most profitable deals. Fast casual and ethnic restaurants showed ROI rate between 35 % and 40 %, which indicates that they offered profitable deals as well. Fast food restaurants are the once with the lowest deal profitability - close to zero (0.50 %), indicating that deals are not profitable for this restaurant category. The lower profitability is expected taking in consideration that fast food restaurants are characterized with fast turnover of people, where people don't go to enjoy dinner or launch but grab a quick meal or takeout.

Restaurant Category	Freq. of each category	Mean (Years of operation)	Mean (#of employee)	Mean (ROI rate %)	Source
Fine Dining (N=6)	18,75	6,12	19,33	62,17	
Fast food (N=4)	12,50	2,86	5,00	0,50	Interview
Fast casual (N=6)	18,75	0,73	5,33	40,17	with restaurants
Ethnic (N=10)	31,25	4,68	10,40	34,80	(Phase 3)
Casual dining (N=6)	18,75	2,78	11,83	57,50	

Table 3. Average ROI rate across restaurant categories.

Table 4 consists the average values of the variables used to calculate deal profitability: cost per coupon, upsell amount and average profit margin across restaurant categories. Fast food restaurants have the highest cost per coupon, the lowest upsell amount and the lowest profit margin, which indicates that lowest profitability can be logically expected. Fast casual restaurants had low upsell amount per coupon as well, but the lower cost per coupon and the higher profit margin compensated for the low upsell amount and enabled higher profitability. For casual dining restaurants the cost per coupon is close to zero as the amount received per redeemed coupon is almost the same as the cost to provide the service offered with the coupon. The upsell amount is included when calculating deal profitability and directly affects the deal profitability positively.

Restaurant Category	Cost per coupon (EUR)	Upsell amount per coupon (EUR)	Average profit margin %
Fine Dining	-0,49	3,41	68
Fast food	-0,53	0,50	45
Fast casual	-0,13	0,70	60
Ethnic	-0,52	1,86	58
Casual dining	0,02	1,84	65

Table 4. Average values of variables used to calculate deal profitability across restaurant categories.

Whether or not the employees will affect the profitability depends if they will induce more sales from deal users during redemption. Employees directly affect customer's experience and satisfaction from a certain restaurant. Mystery shopping showed that 56 % of the restaurant's employees were not keen to upsell and did not make efforts to recommend something or induce additional purchases. Pearson's correlation analysis showed statistically significant difference between ROI rates of deals where employee's where keen to make upsells. Restaurants whose employees make effort to upsell enjoy higher profitability (H9). Half of the restaurants whose deals were analyzed had previously offered a deal and for half of them the analyzed deal was the first one they offered. Whether or not the analyzed deal was the first one offered by the restaurant, Pearson's correlation coefficient did not show statistically significant difference (H10) (Table 5).

Table 5. Hypothesis connected to restaurant's employees and restaurant's previous experience with running deals.

	No	Yes	Impact on profitability (Pearson coefficient r)	Significance
H9: Restaurant's employees' effort to upsell affects deal profitability.	56 %	56 %	Positive (0,431)	Significant p<0,05
H10: Restaurant's previous experience with running deal affects deal profitability-	56 %	56 %	Negative (-0,240)	Not Significant p>0,05

The research shows that the deal promotion was profitable for 91 % of the restaurants. Fast food restaurants reported negative rates of ROI, indicating that the group buying deal is not profitable for them, but they can reach great awareness and acquire new customers.

On the other hand, restaurants that offered takeout option have lower profitability, which can be also connected to the deal category because fast food restaurants are most likely to offer takeout. Restaurants that offered additional discount with the coupon had higher deal profitability and encouraged more than double spending by deal customers while coupon redemption. Finally, employee's ability for upsell affected profitability positively.

CONCLUSION, PRACTICAL IMPLICATION, LIMITATION AND FUTURE RESEARCH

CONCLUSION

The findings of the researchers dealing with profitability of group buying deals are ambiguous. Gupta et al. [8] found out that on short-term merchants suffer losses, which are offset in the long run by upside revenue from newly acquired customers. The other group of researchers found that deal promotions are beneficial to merchants in multiple ways, and daily deal promotions can be effective marketing tool for retail startup businesses in local markets for achieving exposure and stimulation sales, especially for new merchants [25, 28, 29]. This research is focused on one-time (short-term) profitability of deal promotions offered by 32 restaurants that ran and completed promotional deals between August 2014 and August 2015 in this study is examined. Internal data from Grouper's deal database, mystery shopping and input from restaurant owners and managers is used. The results of this research are in line with second group of researchers and the deals are found to be profitable for 91 % of the restaurants, while 9 % did not break-even with the deal promotion. The average ROI rate amounts 41 %. The profitability highly varies across restaurant categories; fine-dining restaurants have the highest ROI rate (62 %), while fast-food restaurants have the lowest (0,5 %). Furthermore, factors that affect deal profitability connected to the deal promotion itself are takeout option (1) and additional discount provided (2). Deals that allow takeout are less profitable, and deals that offer additional discount on selected products during redemption are more profitable. Although, restaurant's years of operation and number of employees don't affect deal profitability, restaurants that employ friendly staff that are willing to make recommendations and are trained to upsell experience higher deal profitability. Spending beyond the coupon value, often called 'upselling' [24] is found as not significant predictor for the deal profitability in Dholakia [14]. Altogether, the results find deals profitable and effective promotional tool for restaurants.

MANAGERIAL IMPLICATIONS AND RECOMMENDATIONS

Our recommendations can be used by eDGB sites to improve restaurant's satisfaction while maximizing profitability and by restaurants themselves to help them in the choice and decision-making process when composing a deal.

Taking in consideration the results some specific recommendations can be drawn to help restaurant owners when running a deal with an eDGB site. There is no doubt that all restaurants benefit from the deal in terms of advertising, increasing awareness and acquiring new customers but when it comes to profitability restaurants have to carefully decide what they will offer in order to maximize their deal profitability. We address the concerns raised from the analysis and offer recommendations that can be used as a guide to help the decision making in choosing the best deal.

Fast food restaurants concern - Fast food restaurants should minimize the cost per coupon by offering products that have highest margin in order to break-even with the deal. When composing a deal, they should assume that deal customers won't make additional purchases and form a deal price which when deducted the deal site commission will cover their cost to serve the coupon customer. That way they will ensure not having additional costs for running the deal; meanwhile they will get promotion, increase awareness and attract new customers. On the other hand, if they have a pre-defined budget they are willing to spend on the deal they can limit the number of coupons sold. They can calculate the number of coupons they should offer by diving the total sum of the pre-defined deal budget with the cost to serve the coupon customer.

Deal specific recommendations – The ideal deal for any restaurant category would be a deal that offers main dish per person excluding drinks; one that provides additional discount to selected products with higher margin that the restaurants prefer to cross sell; and require redemption in the restaurant, excluding take out. Additionally, restaurants can apply time restrictions to maximize capacities utilization during off-peak hours. However, they should be careful when applying time restrictions in order to maximize sales and deal profitability as well.

Employees training for upsell – Restaurant employees should be well trained to encourage upspend by making recommendations to coupon customers. Employees directly affect the customer's satisfaction of the restaurant and should provide excellent service to coupon customers to make a good first impression to new acquired customers. Daily deals can be a very

effective and profitable marketing tool for restaurants that have clear objective for their promotion and manage it around the particular recommendations critical to its success.

LIMITATION AND FUTURE RESEARCH

Several limitations of this study that may restrict the generalizability of the findings need to be emphasized. The findings of this research are based on sales data from only one group-buying platform, Grouper dealing in Macedonia. Future studies may expand this focus to include several other group buying websites in other countries. This may allow researchers to identify similarities and differences among them. Other such websites may include different deal features and it may be interesting to examine the effects of other deal features such as urgency, exclusivity, and social sharing functions. The survey is conducted within a small population which severely impairs the validity of the data. On the other hand, the characteristics of the restaurants fit the profile of the case company, which increases the reliability of the research. Also, the study is cross-sectional, further studies can be conducted to examine the impacts of these same factors over time. A longitudinal study with measures at different times will be helpful to answer these questions.

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GENUINE FORGERY SIGNATURE DETECTION USING RADON TRANSFORM AND K-NEAREST NEIGHBOUR

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ABSTRACT

Authentication is very much essential in managing security. In modern times, it is one in all priorities. With the advent of technology, dialogue with machines becomes automatic. As a result, the need for authentication for a variety of security purposes is rapidly increasing. For this reason, biometrics-based certification is gaining dramatic momentum. The proposed method describes an off-line Genuine/ Forgery signature classification system using radon transform and K-Nearest Neighbour classifier. Every signature features are extracted by radon transform and they are aligned to get the statistic information of his signature. To align the two signatures, the algorithm used is Extreme Points Warping. Many forged and genuine signatures are selected in K-Nearest Neighbour classifier training. By aligning the test signature with each and every reference signatures of the user, verification of test signature is done. Then the signature can be found whether it is genuine or forgery. A K-Nearest Neighbour is used for classification for the different datasets. The result determines how the proposed procedure is exceeds the current state-of-the-art technology. Approximately, the proposed system's performance is 90 % in signature verification system.

KEY WORDS

signature, recognition, k-nearest neighbour, radon transform

CLASSIFICATION

JEL: C88

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INTRODUCTION

Authenticating with signatures individually can be considered as major attributes of a person. Like other authentication methods such as smart cards, fingerprints, PINs and passwords, signatures cannot be forgotten, lost or stolen. That is why the there is a huge demand for signature verification. The major challenge is to come up with more accurate automated signature verification systems. This handwritten signature verification can be done online and offline automatically. In online signature verification system many electronic devices like digital pens, digitizers and tablets are used. You need a still image to see your signature offline. Verification of the signatures in offline is the method used most commonly as it requires no additional equipment to record the signature which can be done even without a signer. If a person tries to copy the other person's signature done by a forger. Forger creates its own dash pattern because it has information about the signer's name when it doesn't know the exact signature. It is an example for a simple forgery. Suppose counterfeiter attempts to counterfeit without knowing the name or signature, this is a random counterfeit.

Over the last two decades, the field of signature verification has created many innovations on behalf of many other researchers. In the local histogram feature approach [1-7], polar and Cartesian coordinates are used to separate the signature into different zones. In each zone, Histogram features like Directional Gradient (HOG) Histogram and Local Binary Pattern (LBP) Histogram has to be calculated. In LBP, there is variant called Block wise Binary Pattern (BBP) [8] which is generally used to separate a signature into many 3×3 blocks. Another method, known as writer independent [9] values properties such as shape and texture of a signature. This method extracts black and candidate pixels. The distance moment [10] based on the structural information and point-to-point temporal records of envelope by finding out the point-to-point distance. A novel autonomous system for signature detection depending on architecture of neural network has been proposed by Shikha et al. [11]. Self Organizing Map (SOM) is the learning algorithm used, which classifies patterns based on a Multilayer Perceptron (MLP). Shekaret et al. [12] proposed a morphologically structured spectrum constructed in the form of a lattice. The signature is equally divided into 8 grids of same size using this method. A different method was proposed by Bhattacharya et al. [13] called as Pixel Matching Technology (PMT). The reference signature is mapped with each pixel in the template of a signature in this approach. SVM based verification is done in a system which verifies the offline signature proposed by Sheth and Kruty [14]. Yasmine et. al [15] proposed a new one class SVM based system which verifies the signature online. The template of an original signature done by a signer is used in this method.

RELATED WORKS AND MOTIVATION

Signatures are the most socially and legally recognized means of personal authentication and, therefore, a modality that faces high levels of attack. Signature verification plays an important role in identifying forged signatures. Biometric application. Biometrics measures an individual's unique physical or behavioral characteristics with the goal of recognizing or authenticating an identity. This motivates to develop an high accurancy based offline signature recognition system.

The performance of a validation model depends on the set of features used in the model. Much work has been done in connection with offline signature verification, which uses different types of feature sets to work with the model. In most works, the features are topology, geometric information, gradients, structural information, and concave base [16, 17]. Ferrer et al. [18] proposed a method using the set of geometric features given in the description of the signature envelope and stroke distribution. After that, hidden Markov models, support vector machines

and Euclido removal classifiers were used for review processes. Zulnarnain et al. In recent works, a signature inspection method was introduced based on geometric features such as triangular pages, angles and ranges derived after triangulation of the signature image. For classification, they used Euclidean classifier and voting based classifiers. Some plants are reported for gray value distribution [20, 21], pixel orientation [22-24], pixel environment [25] and curvature functions [26]. Graph metric functions are also available in the literature [27]. In [28], the authors proposed a form function called a string torque and analyzed the upper and lower signatures. Support vector machine (SVM) was used with code characteristics for signature confirmation. One model has been used in combination with several features to improve the classification accuracy of the model. For example, in [29] with directional characteristics, exercise information and gray value distribution were used. The authors used 16 serious features obtained from the distribution of pixels in the diluted Signature valley. Combinations of different types of characteristics express feature extraction unit. Of course, to use a model for 16 time applications, momentary information calculations are mathematically considered with 16 timing functions. In the recent work [30] proposed by Serdouk et al., Directional distribution is not the only feature extraction policy. Here, combining the longest barrel function in the direction combined with the gradient of the local binary pattern (GLBP), and the longest run strengthens the horizontal, vertical direction, and two main diagonal directions considered Combined to do. So you used a combination of topology and color history features. As a phase feature, the longest pixel is used. Gradation information is extracted with neighboring local binary patterns (GLBP). GLBP calculations on each pixel of the signature image can cost cost. Serdouk et al. We proposed a verification system based on the artificial immune recognition system. A template-based validation scheme is also presented [31]. The method they provide is based on using a grid template to encode the geometry of the signature. Also note that many prior art works use an ensemble of multiple classifiers to achieve the best results. Oi et al. [32] Recent studies have presented a framework based on discrete Radon transforms (DRTs), principal component analysis (PCA), and stochastic neural networks (PNNs) to identify counterfeiting from actual signatures. rice field. However, in an application, the designed hardware device needs to run fast for classification and decision making. Table 1 outlines the existing methods and their classification methods. Zois Elias et al. [33] addresses a feature extraction scheme based on the detection of first-order transitions between asymmetric lattice arrangements of simple pixel structures. Experiments were conducted with a group of decisions, accompanied by a selection of reinforcement features, using only unlinked or blinded training and test datasets, all derived from four widely used signature database. Sharif et al. [34] used the geometric features and the features generated from the study of the local pixel distribution. They used genetic algorithm-based feature selection and eventually SVM for the classification work. Batool et al. [35] presented a way to generate features by determining the pixel distribution in the signature area. I used SVM for classification. The ratio of training and test variables is shown in the experiment as 70:30. Ajij et al. [36] introduces a new feature set based on the quasi-straightness of boundary pixel execution for signature verification. The basic combination of direction codes extracts the quasi-segments from the signature boundary pixels and retrieves the feature sets from the various quasi-line classes.

Several methods or detection models have been developed, but the results of existing methods confirm that there is still room for improvement in terms of accuracy and robustness. In addition, you have the opportunity to propose a powerful feature set that works in conjunction with less complex classifiers for better performance. It would be even more beneficial if the feature set could be easily extracted from the signature image. In this article, we have proposed a new feature set from the Extreme Points Warping that defines the signature stroke. The following sections detail the proposed methods and test results. The contributions of this article are described further in the text.

- This method introduces a new way to select features from signatures. This combination of forms a new signing feature.
- In our approach, the average of the extracted features passes through a classifier for verification.
- However, by demonstrating the experiment based on the actual data set, the robustness and efficiency of the proposed method.

Method	Features	Classifiers
[16]	Uniform Local Binary Patterns (ULBP)	Nearest Neighbor
[33]	Long range correlation (LRC)	SVM
[34]	Local pixel distribution	GA, SVM
[35]	GLCM, geometric features	SVM
[36]	Quasi-straight line segments	SVM

Table 1. Type of the classifiers used existing methods.

PROPOSED TECHNIQUE

The block diagram of proposed forgery signature recognition system is shown in Figure 1. System consists of different blocks which will explain below.

The system that we have introduced is divided into three phases: (a) Enrolment of signatures (Creating model) (ii) Training the signatures (iii) Signature Verification. The given system's block diagram is described in Figure 1.



Figure 1. K-Nearest Neighbour (K-NN) based signature classification system.

In the first phase, to find the parameters which characterize the variance of the signatures which are used as a reference, we use a set of signatures for reference. The extracted parameters along with the set of reference signatures are stored in the system database with unique user identification.

During training phase we select few signatures which are genuine and forged to train K-NN classifier. Further in third phase, the claimed person's signatures which are used for references are compared with the test signature. If the similarity measure is greater than or equal to the threshold value given in classifier, then the authentication of person is done and it will be denied otherwise.

DRT & EXTRACTING THE FEATURE

Discrete Radon Transform is a representation of a shadow or a projection at an angle of original image in each column of a matrix. It is expressed as follows:
$$R_{j} = \sum_{i=1}^{\Psi} w_{ij} I_{i, j} = 1, 2, ..., N_{\varphi} \cdot N_{\theta}.$$
 (1)

where R_j is jth beam pixels overall intensity, Ψ denotes overall image pixels, w_{ij} is the donation of ith pixel to jth beam sum. Furthermore, I_i is ith Pixel's intensity, N_{ϕ} is Beams/angle which are non-overlapping and N_{θ} is total number of angles.

The pen-strokes and background of a signature image has to be mapped to one and zero respectively to extract the global features. Then the speckle noise is removed using median filtering. Finally the signature image's DRT is found.

ALIGNMENT OF SIGNATURE

To compare the signatures of different lengths Extreme Points Warping Algorithm is used. Rather than warping the whole signal, only few selected (Peaks & Valleys) important points will be warped in Extreme Points Warping (EPW) algorithm. The minimum total distance between the two vectors will be found to get the best straight alignment between the two vectors. We need to align the observation sequence to make sure that every observation sequence is a signature image's rotation invariant representation. Two observation sequences optimal alignment is obtained in linear way. Then the observation sequences are shifted iteratively with respect to one another. Calculation of the distances between corresponding observations is done in any iteration. When the average distance is minimum between the consecutive observations, then the alignment will be optimal. The average distance between the optimally aligned vectors can be found to get the distance between two signatures.

ENROLLMENT

Five signatures are used for each user in our system during enrolment to this system. The distance between each of the pair is found by pair-wise aligning these signatures, with the help of EPW algorithm.

We calculated the following reference set statistics using the alignment scores obtained:

- a. Average distance to the farthest signature, (d_{max})
- b. Average distance to the nearest signature, $\left(d_{\text{min}}\right)$

TRAINING

In training data set we have two: five- signatures, where one of them is genuine signatures and remaining is forgery. These signatures will be used to get the threshold value which helps us to separate the genuine and forgery classes. The reference signatures are different from these signatures.

Initially we need to compare each training signature with signatures in the reference set which is claimed to belong. We use EPW algorithm for that which gives a 2-D feature vector (p_{min}, p_{max}) . These values are normalized by taking the averages of the corresponding reference set (d_{min}, d_{max}) the feature set distribution is found by using equation (2) and (3).

$$N_{\rm max} = d_{\rm max}/p_{\rm max},\tag{2}$$

$$N_{\min} = d_{\min}/p_{\min}.$$
 (3)

With the normalized features, forgery and genuine samples in the training set are separated well due to the distribution of these normalized data. We can see that the distance measured of the vectors is normalized by the averages of corresponding reference set. By this we can remove the user dependent thresholds need which is generally used while deciding whether the given signature is similar enough to that of the reference set.

CLASSIFICATION

The Trained classifier is tested using the data set which consists of five genuine and five forgery signatures. The signatures used during the enrolment and training phases are different from these signatures. To find whether the test signature is forgery or genuine, first we need to compare the signature with all the reference signatures which belongs to the ID claimed using EPW algorithm. The distance values (p_{min} , p_{max}) which are normalized by the averages of reference set who claimed it (d_{min} , d_{max}), Finally trained classifier is used to classify whether the signature is forgery or genuine by using the normalized values.

EXPERIMENTAL RESULTS

Proposed system uses 30 genuine signature patterns and 20 Skill forged signature patterns for each user. In addition, we've added five real-world signature samples from a random user to avoid getting fake signatures from the skill. Similarly, in the testing phase, another 10 original signature samples from the same user, 5 skill counterfeit signature samples from that user, and 5 original signature samples from user are combined and tested.

The signature verification efficiency is evaluated by two parameters: (i) false acceptance rate (FAR) and (ii) false rejection rate (FRR). Recognition rate is one more parameter to consider when assessing classifier performance. Details and examples are given in Figures 2-7.

Type I error or False Rejection Rate (F R R)

$$FRR = \frac{No.of genuine signatures identified as forged}{No.of genuine signature samples} \times 100 \%.$$
 (4)

Type II error or False Acceptance Rate (F A R):

$$FAR = \frac{\text{No.of forged signatures identified as genuine}}{\text{No of forged signature samples}} \times 100 \%.$$
(5)

Recognition rate: The classifier accuracy is identified by this parameter, which is given by:

$$Recognition rate = \frac{No.of correctly indentified signature samples}{No.of signature samples} \times 100 \%.$$
(6)

Genuine/ Forgery signature detection using Radon Transform and KNN

Add data base and Feature Extraction

Extract Features: Input Image

Read Signature Image

Genuine/Forgery detection using KNN Search

Figure 2. GUI for Genuine/Forgery signature detection system.

Genuine/ Forgery signature detection using Radon Transform and KNN



Input Image

Figure 3: Reading the input forgery/genuine signature.

Genuine/ Forgery signature detection using Radon Transform and KNN

Add data base and Feature Extraction	Lottes	Extract Features: Input Image
Read Signature Image	A ACARTA	Genuine/Forgery detection using KNN Search
	Or	

Features of Input Image extracted



Genuine/ Forgery signature detection using Radon Transform and KNN



Feature Extraction of Data Base is Completed

Figure 5. Feature extraction of database signatures.

Genuine/ Forgery signature detection using Radon Transform and KNN



Fake signature





Figure 7. Group-wise error rates FRR and FAR are plotted with respect out datasets. **Table 2.** Results of proposed KNN based signature verification system

Users	No. of signature	FRR	FAR	Accuracy
User1	50	5/50 = 10 %	3/50 = 6 %	45/50 = 90 %
User 2	50	3/50 = 6 %	4/50 = 8 %	47/50 = 94 %
User 3	50	4/50 = 8 %	2/50 = 4 %	46/50 = 92 %

Methods	FRR (%)	FAR (%)
[16]	14,21	10,48
[22]	09,64	13,16
[34]	13,16	11,38
[18]	15,50	16,39
[21]	14,66	10,01
[36]	15,04	7,85
Proposed Work	8	6

Table 3. Comparison of proposed method with existing methods

Good results obtained for many individuals (50 signers), but poor results for some one reduces the overall average accuracy. We have showed the error rate for each group of our data set in Figure 6. In which each group has 50 signers.

In this study, we measured the performance of the proposed system with characteristics of each signature after the KNN was implemented in the signature to represent it in the validation system as shown in Table 2. In addition, the study estimated 93,1 % recognition accuracy using 100 users with 5 000 signature samples. It is also clear that a small number of signature features during the training phase will result in less valid results, higher FARs and FRRs, and less accuracy. It is also noted that the work has achieved a comparable and sometimes better performance than other systems as shown in table 3. From Figure 8 it is clearly indicated that proposed method having less error rate (FAR, FRR) compare to various existing methods.



Figure 8. Graphical view of comparative analysis with existing works.

In addition, the results obtained in this experiment show that not only the components (as a function) obtained from the KNN analysis widely adopted in previous studies, but also other items can be used for online and offline signature verification.

CONCLUSION

In this offline signature classification, two class pattern recognition is used to approach the problem which uses the K-NN classifier. The robust and stable method, DRT is used to extract the global features of the signature. DRT establishes simulated evolution of time evolution from one vector feature with the next and using EPW it helps us to develop a signature model. The validation results confirm the better effectiveness of the proposed method, as it achieved an accuracy of 93,1 % with 100 users and 5 000 signatures consists of real and artificial signatures.

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THE 2022 RANKING LIST OF CITATION ANALYSIS RESEARCHERS USING H-INDEX

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ABSTRACT

The impact factor of scientific journals and the h-index depend on the citations. Therefore, the citation analysis is a very important part of scientometrics. The paper presents the 2022 ranking list of citation analysis researchers. The ranking is presented primarily according to the h-index of researchers. The advantage the h-index is that it combines both the quantity – number of articles and quality – citations to these articles. A researcher cannot have a high h-index without publishing a considerable number of articles. The h-index favors researchers that publish a continuous stream of articles. Researchers with the same h-index are ranked by the number of citations. The minimum h-index of the 10 ranked researchers is 26. h-index can be determined from the following online databases: Web of Science, Scopus, Google Scholar and the Publish or Perish program. The ranking is edited using the Google Scholar database.

KEY WORDS

impact factor, h-index, number of citations, citation analysis researchers, Google Scholar

CLASSIFICATION

JEL: Z19 PACS: 01.40.gf

INTRODUCTION

The impact factor of scientific journals and the h-index depend on the citations. Therefore, the citation analysis is a very important part of scientometrics. The paper presents the 2022 ranking list of citation analysis researchers. The ranking is presented primarily according to the h-index of researchers.

Researchers with the same h-index are ranked by the number of citations. The minimum h-index of the 10 ranked researchers is 26.

h-index can be determined from the following online databases: Web of Science, Scopus, Google Scholar and the Publish or Perish program. The ranking is edited using the Google Scholar database.

The h-index, as a particularly simple and useful way to characterize the scientific output of a researcher, was introduced by Jorge E. Hirsch in 2005 [1], and it is defined as follows: "A scientist has index h if h of his/her Np papers have at least h citations each, and the other Np - h papers have no more than h citations each".

The h-index was applied to compare scientists, scientific journals, research teams, research institutions and countries.

The advantage the h-index is that it combines both the quantity – number of articles and quality – citations to these articles [2-6]. A researcher cannot have a high h-index without publishing a considerable number of articles. The h-index favors researches that publish a continuous stream of articles.

The article is organized as follows: in Section 1 the Introduction is given, in Section 2 the 2022 ranking list of citation analysis researchers is presented. Conclusions are given in Section 3.

THE 2022 RANKING LIST OF CITATION ANALYSIS RESEARCHERS USING h-INDEX

The 2022 ranking of citation analysis researchers is presented primarily according to the researchers' h-index. The ranking has been constructed using the Google Scholar [7-11] database. Researchers with matching h-index are ranked by the number of citations.

Ten researchers are included in the ranked list. The minimum h-index of the ranked researchers is 26.

Here is the 2022 ranking list:

1. Eugen Garfield

h-index = 70

citations: 36 743



Founder of the Institute for Scientific Information No verified email - <u>Homepage</u> Scientometrics Bibliometrics Citation analysis Citation indexing

Eugene Garfield (1925-2017)

Follow Cited by

	All
Citations	36743
i-index	70
10-index	329

2. Gyula Mester

h-index = 47

citations: 3 746



Gyula Mester (Orcid: 0000-0001-7796-2820) / FOLLOWING Professor, University Óbuda, Institute of NextTechnologies, Hungary, University of Novi Sad, Serbia Verified email at bgk.uni-obuda.hu - Homepage Unmanned Autonomous Sy... Robotics and Intelligent Sy... Flying Cars Self-Driving Cars Citation Analysis

Cited by All Citations 3746 h-index 47 91 i10-index

3. Paul Wouters

h-index = 42

citations: 9 959

(Sea)	Paul Wouters	FOLLOW	Cited by	
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	citation analysis bibliometrics scientometrics virtual knowledge e-science		Citations h-index i10-index	9959 42 94

4. Howard D. White

h-index = 35

citations: 9 664

Howard D. White	Follow	Cited by	
College of Computing and Informatics, <u>Drexel University</u> Verified email at drexel.edu - <u>Homepage</u>			All
Citation analysis bibliometrics collection evaluation library and information scie relevance theory		Citations h-index i10-index	9664 35 67

5. Mohsen Nouri

h-index = 33

citations: 3 671



6. John S. Liu

h-index = 29

citations: 3 984

	John S. Liu	FOLLOW	Cited by	
	<u>National Taiwan University of Science and Technology</u> Verified email at mail.ntust.edu.tw			All
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			h-index	29
			i10-index	43
7. Kailash	Garg			

h-index = 29

citations: 2 315



Dr. Kailash Garg

Ex-Chief Scientist, CSIR-NISTADS, New Delhi, India No verified email Scientometrics Bibliometrics Citation analysis

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8. B.S. Kademani

h-index = 29

citations: 2 288



Dr. B. S.Kademani Scientific Officer-G Scientific Information Resource Division, Bhabha Atomic Research Centre, Trombay, Mumbai-400 085 No verified email Scientometrics Bibliometrics Citation Analysis

9. Jasar Tonta

h-index = 28

citations: 3 126

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citatio	ons: 2 731		
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TT I	Leipzig University of Applied Sciences Verified email at htwk-leipzig.de - Homepage		All
	Data Integration Entity Matching E-Assessment Citation Analysis	Citations h-index	2731 26

CONCLUSIONS

In this article the 2022 ranking list of citation analysis researchers is presented. The ranking is presented primarily according to the h-index of researchers. Researchers with the same h-index are ranked by the number of citations. The minimum h-index of the 10 ranked researchers is 26. The h-index can be determined from the following online databases: Web of Science, Scopus, Google Scholar and the Publish or Perish program. The ranking is edited using the Google Scholar database.

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